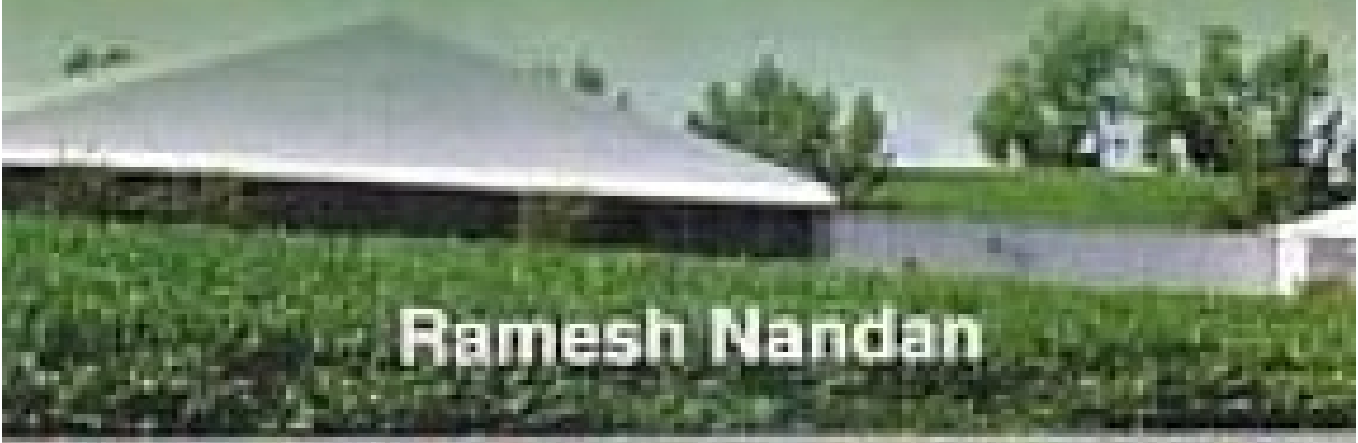
Livestock and Poultry Production

Management and Planning



Ramesh Nandan

LIVESTOCK AND POULTRY PRODUCTION
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Contents

Preface

1. The Sustainability of Livestock Production Systems
2. Preparedness for Upkeep of Livestock during Calamity
3. Economic Importance of Livestock in Vulnerable Zones
4. Issues and Perspectives in Livestock Production
5. Management of Livestock Production
6. Practical Technologies and Options for the Genetic Improvement of Livestock
7. Food Safety and Quality as Affected by Animal Feedstuff
8. Feedstuffs in Livestock
9. Animal Husbandry Development Programmes
0. Poultry Production Techniques
1. Alternative Poultry Production Systems and Outdoor Access
2. Poultry Farming
3. Live Bird Marketing

Bibliography

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Preface

Livestock have an image problem in the developed world. They are blamed for everything from global warming to increasing heart disease. Britain's 'mad cow disease' - or bovine spongiform encephalopathy - hasn't helped. Livestock are seen as wasteful, growing fat on grain that people could eat and polluting the environment with their faeces and urine and the gases they give off. But these charges are not true of livestock in the developing world. True, ruminants produce methane gas, one of the 'greenhouse gases' - but methane from ruminants accounts for only some 2.5 percent of the total greenhouse gases. Pastures grown to feed livestock take carbon dioxide out of the atmosphere, tying it up in plant material above and below the ground, just as forests do. True, eating too many animal products may increase the risk of heart disease - but this is a problem of the developed world, not the developing world. People in developing countries generally eat much less meat than those in the developed world, and the meat they eat is less fatty. Indeed, recent studies from Kenya, Egypt and Mexico show that children who do not get enough meat and milk in their diets may grow up physically and mentally compromised.

Livestock play a vital role in the agricultural and rural economies of the developing world. Not only do they produce food directly, they also provide key inputs to crop agriculture. Most farms in the developing world are too small to justify owning or using a tractor, and the alternatives are animal power or human labour. The livestock sector provides us with meat, dairy and eggs, as well as wool and leather. The global livestock sector is rapidly changing in response to globalization and growing demand for animal-source foods, driven by population growth and increasing wealth in much of the developing world. The rapid rate of urbanization seen in many countries is not only linked to growing affluence but also gives rise to changes in people's food preferences; usually tending towards greater convenience and higher standards of safety. As well as the many benefits and opportunities associated with rapid sector transformation and growth, they are also associated with social, environmental and public health risks. Poultry are kept in most areas of the world and provide an acceptable form of animal protein to most people throughout the world. During the last decade, many developing countries have adopted intensive poultry production in order to meet the demand for this form of animal protein. Intensively kept poultry is seen as a way of rapidly increasing animal protein supplies for rapidly increasing urban populations. Poultry are able to adapt to most areas of the world, are relatively low priced, reproduce rapidly, and have a high rate of productivity. Poultry in the industrial system are housed in confinement with the aim of creating optimal conditions of temperature and lighting, and in order to manipulate day-length to maximise production. The term broiler is applied to chicks that have especially been bred for rapid growth. Broiler strains are based on hybrid crosses between Cornish White, New Hampshire and White Plymouth Rock. Layers are efficient egg producers, breeds used for egg production in the industrial production system are almost entirely based on the White Leghorn and Rhode Island Red.

This comprehensive text covers all types of farm animals and provides detailed information on each species.

—Author

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Chapter 1 : The Sustainability of Livestock Production Systems

Livestock are usually helpful in sustaining agricultural production. However, there are cases where livestock development has had disastrous environmental consequences. For example, clearing of the tropical forests in Central America and the Amazon during the last two decades, these developments has been sharply criticized for their ecological and sociological damage.

Most criticism has focused on

a) the destruction of irreplaceable genetic materials,
b) tendency for pasture to rapidly diminish in productivity because of loss of soil fertility, leaving the fragile soils vulnerable to compaction and erosion,
c) the displacement of indigenous peoples and small farmers by land speculators who have used cattle ranching as a mechanism for obtaining and controlling large tracts of land, and
d) the threat to the environment from destruction of oxygen producing trees.

Livestock development, *per se,* in most of the Amazon basin is not very profitable at current prices. Nonetheless, government incentives in Brazil have affected livestock development and, more dramatically, Amazon settlement and deforestation (Binswanger). Income tax credits and subsidised interest rates on loans for livestock development, along with grants of land on favourable terms to individuals engaged in livestock development, have given substantial private incentives for livestock development in rainforest areas.

This is one of the most dramatic examples of a case where government policy is the primary cause of an unsustainable agricultural system. Although some rainforest destruction would remain even if government policies were fully neutral, due to the pressure of spontaneous colonisation by poor farmers but the areas affected would be much smaller. The damage caused by such settlements is a more difficult problem. Achieving a sustainable system in such situations will require development of either improved technologies or, more likely, the exclusion of settlers.

Developed countries contribute to environmental degradation to a far greater extent than does either Brazil or other developing countries. However, that others have and are destroying irreplaceable assets is poor justification for continuing with equally bad policies in the developing countries. The intent should be to make the best use possible of the available resources, in all regions.

Overgrazing on semi-arid and arid lands, leading to range degradation, is another case of an unsustainable livestock system. Pastoralism is a practice that utilises extensive rangelands where rainfall is low and highly variable, making settled agriculture and/ or livestock production extremely risky. The principal production risk for a specific area is that no rain will fall. However, cattle can be herded to areas in which rain has fallen and pastures are available.

The need to access a large area of land in order to ensure sufficient pasture is an

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created as common lands are converted into lands with an increasing degree of private control. However real, important and difficult these issues are, it is not an adequate justification for retaining the current system.

Historically, pastoralist groups have fought for specific areas, thus deciding "property rights." In recent years, the increased value of livestock output has led to the gradual emergence of more private land rights in countries as diverse as Somalia and Botswana. Kenya has successfully privatized its land with beneficial results. Clarification of such land rights is the primary factor needed to reduce overgrazing. However, that will not in itself reduce the increasing pressures on land which are stemming from higher population and which lead to deforestation and cultivation of marginal land. Again, the best solution seems to require the development of improved technologies which are more productive and sustainable combined with the education of producers to use them.

Feed availability, disease, climate, social and political forces, as well as economic incentives all influence the pattern of livestock use which emerge in developing countries. Thus, one of the main responsibilities of policy makers is to ensure that economic markets work well so that livestock producers receive appropriate signals regarding resource allocation. Similarly, the sensitivity of the mix of outputs to economic and technical factors indicates that, when formulating livestock development strategies, it is important to have a clear understanding both of the various production constraints and also of the demand the for different products. There are cases where government intervention in markets is justified i.e. the protection of domestic producers from international dumping or to initiate long term industry development. Unfortunately, development often does not always occur even when the government has intervened to obtain higher livestock prices.

Sometimes this is due to the intervention appears short term and the resulting uncertainty mitigates against development which were in fact sought. More generally, the government does not make the concerted effort through related research to develop the technologies required to increase productivity, or the requisite political stability or land rights are not present. As a general, though not precise, rule of thumb, livestock development in most countries will make the greatest contribution to domestic welfare if the government establishes free markets for livestock products and inputs and strives to develop complementary research, infrastructure and animal health programs. Research, education, and non-distorted market signals seem generally to be the best guarantee of achieving sustainable livestock production.

Investment for Sustainable Livestock Development in Developing Countries

Bank livestock lending peaked in the 6 year period 1974-79 when an annual average of seven free standing livestock projects and 19 projects with a livestock component were approved; costs including the cost of livestock components amounted to US$9.47 billion (1989 US dollars) and 5.15 billion (U.S.$ current). Livestock lending declined in the period 1980-85 to a yearly average of about two free-standing projects and 17 component projects; costs amounted to 5.77 billion (1989 US dollars). Over the five year period 1986-90 the aggregate cost of Bank-assisted livestock projects and components amounted to US$3.54 billion (1989 US dollars). Average annual lending declined in real terms from US$1,578

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important reason for the evolution of "common" range systems. In such systems, a group of pastoralists share land, with all being able to move about with their herds in search of the best forage. If the system is to work well, pastoralists must have a well defined membership group with clear (albeit sometimes complex) rules of access to pasture and water. If group membership and/or the rules of access become unclear or ineffective, particularly as when population or economic pressures encourage greater use of the range, the system may tend toward an "open" access system in which no limits are placed on the number of herders (and animals) using the land. In this case, the economic value of pasture is likely to be severely diminished or lost altogether (Jarvis 1984).

In most areas, pastoralism is probably more productive in terms of the value of total output of beef and milk per hectare of land than is cattle ranching. The pastoralists utilise much more labour and extract a larger number of joint products for direct use, especially milk. Beef is produced from cull animals, both steers and cows, but accounts for a relatively small proportion of output. Pastoralists often barter milk and beef with agriculturalists for grain, which is a cheaper source of energy. Manure is used for fuel, and is also left on the fields of agriculturalists during seasonal migrations into settled areas. Agriculturalists sometimes pay herders to graze their animals overnight on their fields.

In systems in which land is communally owned, livestock ownership provides usufruct rights to land which are otherwise lost. Mechanisms are needed in such systems to ensure that all individuals having grazing access also have livestock. In pastoralists systems, livestock ownership traditionally belonged to kinship groups which used force to maintain their hegemony over a particular region. Complex societal rules and livestock exchanges existed within such groups to ensure that individuals who lost their animals to disaster, such as drought or disease, could reconstitute their herd. Such mechanisms have been breaking down in recent years, largely because pastoralist populations have gradually expanded while rangelands have been lost to the spread of sedentary agriculture. Under these conditions, the average herd has been shrinking whilst the aggregate number of animals grazed has been growing.

Traditional mechanisms have proved insufficient to reconstitute the herds of many individuals following disaster. Wealthy individuals, frequently located in urban areas and able to better diversify risks through other economic activities, are accumulating animals and hiring others to herd them. Gradually, as a higher proportion of total herds are owned by such individuals who seek a more marketable output, greater emphasis is being placed on beef production. Under such pressure, there is fear that overgrazing is increasing. It appears, nonetheless, that the main effect of overgrazing has been an increase in the periodic herd losses suffered from drought, rather than a decrease in range quality.

The range generally seems to have substantial resiliency, recovering more rapidly than the herd. However, such a system is truly sustainable, except perhaps at a low average and highly variable yield. A greater problem is the lack of incentives created by the common range system for the development of any productivity increasing technologies. Such technologies would be privately unprofitable within a situation where animal nutrition is not under the herder's control. Without a shift toward greater control of land, there is little possibility of increasing ruminant livestock output in this area.

The primary problem faced by common ranges is the inequities which are likely to be

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billion for period 74–79 to US$962 million for period 1980 to 85 and US$708 million for period 1986–90. This means that average lending for the last two periods was only 61% and 45% of the earlier period (1974–79) in real terms.

For the first time no free standing livestock project was approved in FY90 but 11 projects were approved with a livestock component. The absence of a free standing project in FY90 is considered as a one-year anomaly and it is expected that the number of livestock projects per year will stabilise at about 2 free-standing and 12–15 component projects. The reduction in livestock lending as a proportion of the total lending for agriculture parallels, albeit to a greater extent, agriculture's decline as a percentage of the Bank's lending operations; from 30.1% in 1980 to 16.3% in 1989 and 17.3% in 1990. The character of lending operations changed substantially over the last decade with greater emphasis being placed on lending instruments other than specific investment loans. IBRD and IDA lending by loan category is given below for FY90.

Table 1: *Lending FY90*

Loan Category	*US$Million*	*%*
Specific investment	19,179.9	49.15
Sector investment	3,957.2	19.11
Financial intermediary	879.0	4.24
Sector adjustment	2,543.6	12.28
Program lending and Structural adjustment	1,434.0	6.92
Debt reduction	1,460.0	7.05
Technical assistance	203.0	0.98
Emergency reconstruction	54.0	0.26
	20,710.7	100.00

A decade ago Bank lending was dominated by specific investment loans but the picture has changed drastically with the increased emphasis on other types of loans, especially sector investment loans, sector adjustment loans, program lending and structural adjustment loans.

Review of Bank Experience with Livestock Lending

The reduction in Bank lending for livestock was caused by the relatively poor performance of livestock projects as indicated by a number of reports and papers which reviewed lending for livestock development. The most important and comprehensive of these reviews-"The Smallholder Dimension of Livestock (1985)" - was undertaken by the Bank's Operations Evaluation Department (OED) which is entrusted, by the Bank's Board of Directors, with authority and responsibility to undertake an independent review and report on the performance of all Bank lending operations.

In addition to the OED report the Bank's experience with Dairy Development was reviewed in 1982 (AGR Technical Note No. 6). The Bank's experience in Dry Tropical Africa was reviewed in 1981 by Mr. Stephen Sandford (Consultant) who produced a report for internal use. These three reports provide a good independent assessment of livestock lending including problems and issues and suggested lessons. Four World Bank reports which dealt with special aspect of livestock, e.g., veterinary, dairying and integrated crop- livestock are not dealt with in this paper although they provide valuable insights on livestock lending

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and the sustainability of development efforts. Salient points from these papers are, however, discussed later in this paper.

OED Report

The OED report was based on a review of 124 audited projects and 206 ongoing projects which comprised the Bank's livestock portfolio at the end of 1983. Of the 330 total, 91 were livestock projects and 239 livestock component projects. Of the 124 audited projects, 52 were livestock projects and 76 were component projects.

From modest beginnings in 1959 in Uruguay, through late 1983 early 1984 when the OED study commenced, the Bank provided some US$11.7 billion (in constant 1983 dollars) for livestock development of which almost US$6.1 billion (52%) was targeted to smallholders. The livestock sub-sector was thus significant in the Bank's lending portfolio and smallholder livestock lending was an important part.

The rate of livestock lending increased through the 60's and 70's to peak in 1979 and thereafter to decline. Smallholder lending followed a similar pattern but the percentage of total livestock investments for smallholder development showed a steady increase from the late 60's to the present and over the 70's accounted for roughly two-thirds of all Bank livestock lending. This was in response to Bank management's increasing sensitivity in that period to equity considerations which affected all agricultural sub-sectors.

There were according to the OED report regional differences in project components and their design, in species/product emphasis and in target group, depending on ecological, socioeconomic, cultural and traditional factors. Credit and livestock purchase were major project components in most regions. Nearly two-thirds of all audited projects included such components. About half of all projects included components for development of on-farm infrastructure, pasture improvement, and fodder development. Projects frequently included the above activities as multiple components. About 40% included a technical assistance and/or farmer training component. Other components occurred less frequently. In general, the design of smallholder projects was similar to that found for the whole set of livestock-related projects. The ongoing projects also had larger scope than the audited projects and nearly all of the components appeared with greater frequency suggesting that each project, on average, included a larger number of livestock-related components.

In terms of species emphasis, the OED report found that investments in cattle development (beef, dairy, and dairy-beef, in that order) accounted for about two-thirds of component activity in audited projects and an even higher proportion of total funds. Substantially less attention was paid to other species, viz. sheep, poultry, and swine, each about 10%; goats, about 5%; and miscellaneous species (cameloids, rabbits, bees, etc.), about 2%.

Cattle development was also emphasized in ongoing projects, but its relative importance decreased to less than one-half of the total number of interventions. Thus, while cattle development continues to be important in ongoing projects, other species are now increasingly emphasized. This emphasis on other species reflects increased efforts to support and improve existing smallholder farming systems. In such systems there is also growing emphasis on integrating livestock with agriculture, to their mutual benefit.

All regions participated in the Bank's livestock development efforts according to the OED report. The number of livestock-related projects (audited and ongoing) at that time was

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spread fairly evenly by region, but the bulk (three fourths) of all livestock investments were in Europe, Middle East and North Africa Region (EMENA) and Latin America and the Caribbean Region (LAC). Smallholders received the highest proportion of livestock investments in Western Africa Region (WA), South Asia Region (SA), EMENA, and East Asia and Pacific Region (EAP) in audited projects, and in Eastern and Southern Africa Region (ESA), EAP, SA, and WA in ongoing projects.

Project Performance

The average ERR of all audited livestock activities Bank-wide was 11% (OED report). The average ERR of 46 livestock projects was 7.2% and that of 58 component projects, 14%. The lower average figure for livestock projects appeared to be due to the low returns from smallholder livestock projects (average ERR -0.3%) and large holder livestock projects (average ERR 6.2%), as mixed smallholder/ largeholder livestock projects performed satisfactorily on average (ERR 11.6%). Smallholder component projects (average ERR 10.7%), largeholder component projects (average ERR 18.9%) also performed generally satisfactorily.

While the results suggested that livestock investments made as a component of a diversified project were most successful than as a part of a straight livestock project, there was insufficient data to support such a conclusion statistically because separate ERRs were rarely available for individual components of multi-component projects, particularly if the individual components were relatively small, as they often were for livestock investments. It was stated that additional information was needed on the performance of livestock investments within livestock component projects, particularly as such investments comprised an increasing proportion of the total ongoing livestock portfolio at the time of the OED Study.

By region the OED Report showed that, EMENA, LAC and Southeast Asia had the highest number of total projects with ERRs exceeding 10% (77%, 68% and 67%, respectively) and ESA, EAP and WA had the highest number below 10% (74%, 56% and 50%, respectively). Some 14 of 22 projects (64%) with negative ERRs were in ESA and WA.

By project type, livestock projects performed particularly poorly on average in both African regions and, to a lesser extent, in East Asia and the Pacific Region (EAP). Component projects also performed unsatisfactorily on average in Eastern and Southern Africa (ESA), but performed satisfactorily overall in all other regions, particularly in EAP which had the highest average ERR (33.7%) Bank-wide.

Ex-ante appraisal projections were observed to be much more optimistic than *ex-port* ERRs. *Ex-ante* ERRs on 46 livestock projects were some 200% higher than ex-post ERRs and on 58 component projects they were some 70% higher. Only one in six of all projects has ERRs at completion equal to or greater than appraisal ERRs.

Two conclusions emerged from the OED Study. First, a large number of livestock investments were successful, particularly in the regions where lending was highest, and their success should not be obscured by the existence of problem projects, particularly those in ESA and WA. Second, the substantial variation in project performance suggested a need for improved appraisal methods, especially greater attention to the production coefficients adopted, the benefit stream projected, the project time frame and risk analysis.

The principal factors affecting project outcome identified in the OED study were the

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availability or lack of:

- technological packages adequately adapted to existing farming systems;
- an economic context providing attractive producer incentives;
- the institutional capability for implementing the proposed project;
- qualified technical personnel;
- a government commitment to livestock development and/or smallholders;
- political and economic stability;
- clear property rights for lands to be developed;
- functioning producer organisations - particularly where group action is needed;
- a project design which realistically takes into account country strengths and weaknesses; and
- firm, consistent, but flexible supervision of implementation.

The OED report stressed that these factors were similar to those which cause problems in projects in other agricultural sub-sectors. An effort was made to identify factors specific to livestock. The risk in livestock projects appeared most closely linked to the inadequacy of applied livestock-related research in most countries, the lack of technical personnel, the weakness of livestock-related institutions and their lack of integration with agricultural institutions, the greater importance of land tenure issues, and the failure of some projects to recognise fully the inadequacy of the "base" on which projects had to build. The tendency to proceed too rapidly in terms of physical implementation, without sufficient technological, institutional and staff development, stood out.

The study also pointed out that the performance of livestock projects must also be measured in dimensions other than the simple ERRs. Many livestock projects were pioneering efforts, involving new relatively untested technologies, requiring institutional strengthening, staff development, and livestock policy formulation. Benefits achieved through improved institutions, staff development, and "learning by doing" were not revealed in the ERRs. Nonetheless, there was a strong correlation between the project ERRs and the audit reports assessments of achievements in these other areas - poor economic performance has often been accompanied by poor institutional development and the like rather than offset by improvements therein. Indeed, poor performance in these areas was a major cause of low ERRs.

The smallholder livestock and component projects examined by the OED Study fared worse than livestock projects (taken as a group). Their average *ex-ante* appraisal ERR was equally as high as other livestock projects, but their *ex-post* ERR was even lower.

The OED study concluded that the widely-held perception that the Bank's livestock development efforts have been unsatisfactory accounted, in part, for the steep decline in livestock lending since 1980.

The study found that the performance of Bank livestock was highly variable, ranging from very satisfactory to very unsatisfactory, but was satisfactory more frequently than not. It also appeared that considerable learning had taken place regarding the design and implementation of livestock projects, and it was concluded that future projects should perform better.

Nonetheless, it also concluded that the evidence suggested that livestock projects overall

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may be more difficult than other agricultural sub-sector projects, and that livestock assistance, especially to smallholders, would probably require greater design, implementation, and supervision inputs than they had received up to that time. The study also concluded that the Bank should continue and probably increase its support for livestock development, especially to smallholders, given the high potential for raising their incomes and living standards.

It pointed out that livestock were a key element in raising farm productivity and it was difficult to conceive of sustained increases especially in smallholder agriculture in most areas in the world without attention to livestock development; demand for livestock products was increasing rapidly in most developing regions, and livestock investments were expected to be increasingly economically attractive. The study highlighted the point that livestock project design initially placed heavy emphasis on meat and milk and largely ignored other outputs such as traction and manure. This approach was strongly influenced by livestock systems in developed countries, and by an emphasis on larger commercial producers.

The move toward smallholder livestock development had encouraged a shift toward more diversified use of livestock and the integration of livestock and agricultural production activities. It emphasized the need for this shift to be more fully reflected in project design, e.g., greater cognizance should be taken of joint livestock outputs when assessing the demand for and the benefits of livestock production, and greater effort should be made to coordinate the efforts of livestock and agricultural development agencies.

Milk was considered to merit greater emphasis relative to meat production. The primary need was seen as the organisation of marketing, processing and distribution facilities, especially in regions where milk production was dominated by smallholders. Small-scale dairying was seen as undoubtedly one of the most promising avenues for future Bank lending.

It concluded that livestock development efforts suffered from a “cattle bias”. Additional emphasis should be placed on swine and poultry, small ruminants and other animals, especially through research, technical services, and market development.

The study made special mention of livestock-related projects in the African regions because of the difficulties which were experienced there. It pointed out that many of the countries in ESA and WA were newly independent with ill-defined policies and priorities, limited infrastructure, weak skilled manpower and material resources, widespread poverty, and a high prevalence of drought and pestilence. Many governments were overly centralised and urban oriented.

Not only livestock investments fared poorly in such countries, but indeed all agricultural-related activities. Nevertheless, in several countries, livestock development appeared crucial to overall economic development and, in others, it would have a high positive impact. It emphasized that a substantial amount had been learned regarding livestock development, and there was evidence that where such lessons had been applied in ongoing projects the situation was improving.

Finally, it was evident from the study that smallholder livestock projects performed unsatisfactorily overall. The review indicates that efforts were often made to develop individual projects which were innovative, but these were also often ambitious in scope and size, were generally weak technically, and were implemented in a largely unfavourable economic climate in countries where government sometimes showed limited sensitivity to

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smallholder development potential and needs.

Target groups sometimes failed to involve themselves in project design and implementation out of misunderstandings or from distrust of government intentions, and were other times excluded either for paternalistic or political reasons. The Bank may have been too ready to finance such ambitious projects, particularly where institutional support was weak, where land tenure problems were apparent, and where government commitment was questionable. In a number of instances, an exploratory pilot phase would have been more appropriate instead of a large, demanding and high-risk effort. The study mentioned that a number of operational staff hold the view that pressures of the lending program were a contributing factor in this context.

Review of Bank-financed Dairy Projects

In 1982 the Bank prepared a comprehensive review of Bank/IDA-financed Dairy Projects (AGR Technical Note No. 6). The paper lists and reviews 75 projects which were either exclusively for dairying or had a dairy component. The total cost of these projects amounted to US$6,533 millions, the dairy components amounted to US$1,034 million and the loan/credit amounted to US$1,999 million.

Latin America (LAC) Dairy Projects

The study concluded from a review of 30 dairy programs in LAC that the projects "successfully attained production targets, improved the institutional support structure and contributed towards the establishment of effective livestock credit systems".

A feature of the region was the traditional preference for raw milk (which is boiled before use) and this enabled smaller producers to dispose of surplus milk directly to consumers without concern for an accessible processing facility. Low priced imports were a constant threat but it is concluded that "the livestock industry throughout the area had adjusted to the low price import option by developing a dual purpose production system, by utilising natural pastures, by upgrading cattle and by increasing the carrying capacity of the land". Project officers considered that marketing patterns did not need changing and processing facilities, especially for pasteurised milk, were adequate although increased investments would be required as dairying expanded. The report draws attention to the deleterious effect of low cost imported milk products on investment and production in many LAC countries but concludes "in the LAC area it is doubtful that there is a country or group of countries which could be described as marginal for dairy production in terms of the possible financial advantages of imported milk projects".

Europe, Middle East and North African (EMENA) Dairy Projects

Fifteen dairy or projects with dairy components were assisted in six countries (Morocco, Turkey, Yugoslavia, Ireland, Spain and Romania). Total project costs were US$2.47 billion and dairy development components amounted to US$778.01 million and Bank loans amounted to US$597 million. Projects are judged to have performed satisfactorily in all cases with the exception of large public sector farms in Yugoslavia. They encountered serious management, overstaffing and price problems. Yugoslavia changed its policies as a result of this negative experience and subsequent projects supported smallholders only.

Dairy programs in virtually all countries emphasized pasture, forage and feed

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production. Successful dairy cattle importations were a feature in the case of Turkey and Morocco (Friesian and Brown Swiss). Another feature of these latter countries is the prevalence of raw milk consumption which enables producers to sell directly to consumers and traders without incurring processing costs. The Rumanian projects main objective was to improve yields and labour productivity by modernising existing large public sector units (involving feeding, housing and milking). With the exception of Ireland, which exported most of its milk as manufactured products under EEC arrangements, production in the EMENA projects was almost entirely for home consumption to meet increasing consumer demand.

The report concludes: "Assessment of overall performance of EMENA dairy development projects provides evidence among most projects of measurable success in achieving project goals and governments' major objectives. The diversity of project design grew out of the need to develop approaches best suited for particular social, economic, and ecological conditions country by country. Successive programs in Turkey, Morocco and Yugoslavia built on earlier experiences, revising where necessary, and in the case of Yugoslavia, making a major shift from large social sector production units to emphasis on smallholder production. This shift of emphasis had also occurred in Turkey and Morocco and represented a welcome development which appeared to be the trend in all regions. The Rumanian experience represented an isolated set of conditions and as noted above was probably limited to one country".

Eastern Africa Region (EA) Dairy Projects

Bank-assisted dairy development in EA, six projects in four countries (Ethiopia, Kenya, Tanzania and Zambia) and a modest component in a Malawi rural development project, was small. Total project costs amounted to US$88.5 million, total dairy components amounted to US$65.4 and IDA credits amounted to US$56.6 million. The Ethiopian project was greatly affected by major political changes and was generally unsuccessful although the country has a good potential for dairying. The dairy components of three Kenya smallholder credit projects were highly successful.

The extent of success is indicated by a consumption level of 75 litres/capita, by smallholders supplying 75% of the total market supply. The Tanzania project supported large units (350 cow units) under parastatal management and since 13 out of the proposed 17 units established did not cover operating costs, because costs were high and production coefficients were much lower than appraised estimates, the project was a failure. Although a smallholder component was included in the Tanzania project, it was seriously constrained by a shortage of grade cows. The Zambia project was drastically revised downwards after a review and the revised project involving 150 smallholders instead of the original 1,800 performed satisfactorily.

South Asia (AS) Dairy Projects

Total investment in dairy development has amounted to US$547 million, total project costs amounted to US$556 million and loans and credits amounted to US$250. Four dairy projects in India and one in Sri Lanka were supported. In addition two livestock projects in Burma and Pakistan had dairy components.

The Indian dairy projects have been singularly successful. Dairying in India is characterised by the development of well-managed cooperatives which handle collection, processing and marketing, and provide support services efficiently to existing small dairy

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farmers, who typically own one or two milking buffalo. Although production conditions in Pakistan are similar but generally superior to those in India and although the project aimed at replicating the Indian Amul model as far as possible, its performance has fallen far short because the project was not as well managed and was not as successful at institution building, at commanding government support or at defining and implementing appropriate pricing and marketing policies.

The Sri Lanka project was drastically revised after initial disappointing experience to replicate the Indian/Amul model as far as possible. After revision, the performance was fairly satisfactory. A project feature was the poor performance and high mortality of heifers imported from Australia. The Burma project had limited success because the Socialist government showed little interest in supporting and developing the smallholder dairy sector despite its considerable potential.

East Asia Pacific Region (AE) Dairy Projects

The regions total investment in dairy production was US$50.3 million, total project costs were US$122.6 million land Bank loans amounted to US$62 million.

Two dairy projects were assisted in Korea. A smallholder coconut development in Malaysia had a fairly substantial dairy component costing US$13 million and under the Philippines Second Livestock Project a small pilot dairy component costing US$0.225 million was supported. The Korean projects were highly successful in financial terms and production coefficients in most cases reached or exceeded appraisal expectations. However, they were judged to have negative economic rates of return by the Bank when opportunity costs of imported products were taken into consideration.

Under the dairy component of the Malaysian project the importation of 6,600 heifers for Government raising centres was envisaged. Serious problems were encountered with imported heifers, pasture development was much slower than expected and government tended to support large scale public and private enterprises over smallholders. A Bank supervision mission recalculated the ERR and showed that it was negative.

It was shown that milk, reconstituted from imported ingredients, cost US$0.22/litre compared with US$0.24/lither for local milk delivered to the processing plant. On the basis of this analysis, government was advised to slow dairy development and most of the available funds were not used. Malaysia has an extremely humid tropical climate and Bank staff consider that the potential for dairy development is extremely limited. The Philippines pilot dairy component had limited success. Although the Philippines has some potential for dairy development despite the humid tropical climate, Bank staff are of the opinion that dairy development there will be slow.

Review of World Bank Livestock Activities in Dry Tropical Africa

The 1981 “Review of World Bank Livestock Activities in Dry Tropical Africa” covered 34 livestock and 37 mixed livestock/crop projects in 26 Sub-Saharan countries. It was undertaken by Mr. Stephen Sandford who had considerable experience of livestock development in Africa. The review dealt primarily with 30 “livestock only” projects (in 22 different countries) and only cursory reference was made to 37 mixed projects. Although the review was based on information in Bank Documents, the author drew heavily on his

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independent knowledge and broad experience of livestock production and pastoralist in arid and semi-arid regions.

The report concluded that "ranching" projects or ranching components failed dismally. It also concluded that components to improve marketing and livestock movement, slaughtering and processing "have an abysmal record" and that veterinary components and off-range fattening by smallholders have a "generally good record". Sandford was unable to show any statistical relationship between failure and the size and complexity of projects, but nevertheless concluded" it is my belief that projects are too big, too complex and excessively dependent on expatriates". He further concluded " that the increasing size of projects during the 1970's was more related to the Bank's own desire to spend more on agricultural sectors than on a realistic assessment of the absorptive capacity of the livestock subsector". He also argued that the Bank emphasizes what happens at the top on the performance of the bureaucracy and underemphasizes what happens at the bottom actual performance at the field level.

Role of the Bank

In Sandford's view, the Bank, apart from providing capital, provides three other important elements: (a) pressure on governments not to neglect their livestock sectors; (b) specific pressure in favour of particular policies, programs and components; and (c) technical advice on particular points. Overall he felt that little of the increased meat and milk production during the previous 20 years could be attributed to Bank projects or government programs if rinderpest measures and water development were excluded.

He considered that what development there was came from a growth in livestock populations, required and made possible from growth in the human population and some expansion in livestock forage (crop residues). Despite this, he cautioned that livestock production and the welfare of livestock owners will decline further "… unless more effective and more wide-scale government sponsored programs are undertaken" because of the decreased availability of land for extensive production systems and the encroachment of cultivators on grazing land.

Despite his criticisms, he believed that the effect of the Bank's involvement on livestock development had "been beneficial" although over-influenced by "fashions" such as ranching in the '60s, fattening in the early '70's and group formation more recently. He concluded "… Bank-financed projects are usually better oriented, as well as better financed, than other livestock programs implemented by governments, and the visits of Bank appraisal and sub-sector review missions are often the occasion on which government think most deeply about their livestock policies and programs".

Although he concluded that "… Bank expenditures (US$750 million) on livestock development will not be justified by production increases in the short term, important lessons can be learned from the experience" and management cadres in African countries are being slowly build up". Livestock programs in Africa should be less capital-intensive, smaller amounts should be spent more slowly and much greater flexibility should be permitted. From the viewpoint of African welfare and economic growth he felt that it would be a pity "… if the Bank were to conclude that if it cannot spend very large sums fast, then it has no proper role in the future in African livestock development".

Rangelands

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Sandford feels that there is little reliable evidence "…indicating either that widespread degradation is going on in African rangelands or that, if it is, it is due to livestock development programs". However, he felt that continued caution over the development of water supplies was warranted, but as much for social as for environmental reasons. He considered the Bank's increased willingness to finance veterinary components favourably because of the positive effects on the welfare of poor and rich stock owners and because he does not accept the environmental danger argument. He condemns "ranching" as opposed to pastoralist systems on many grounds including:

- ranches are less equitable because they increasingly favour the rich and powerful;
- they are often a reason for expropriating land which is already being fully or partially used;
- at least, under African conditions, ranches have no advantage in terms of increased food production over pastoralist systems or smallholder herds;
- at least in terms of production coefficients there is no reason to favour one type of ranch (pastoral, cooperative, company group or private) over any other commercial arrangement by pastoralist; and
- there is little evidence that animal numbers (stocking rate) can be controlled better on ranches, including private ranches than under pastoralist systems.

Sandford does not agree despite many claims to the contrary "that the know-how already exists to improve range and pasture productivity in African arid regions (less than 600 mm)". Although he appears to agree that technology exists to improve rangelands and productivity in the higher rainfall areas (over 600 mm) major questions remain to be resolved, e.g., is technology cost effective and how can the management capability needed to successfully implement it be developed? (In view of the Bank's experience with ranches, and its justifiable reluctance to support them, the question is probably moot at this stage except for smallholders).

Sandford placed considerable emphasis on the need for increased support for livestock research and attention was drawn to the smallness of research components in Bank projects (about 1.4% of total project costs). A recommendation was made "that the Bank should allocate a substantially higher proportion of its livestock programs for research" and it should adopt a more active policy of assisting research units in major livestock countries.

In view of the Bank's negative experience with livestock marketing and processing components Sandford recommended a special study on these. Much more attention should, in his view, be given to ranch records and information on ranch performance, in the Bank's records, is judged to be grossly inadequate. Emphasis was placed on the need to make greater use of "competent anthropologists" in project preparation and implementation.

Although he refers to the use of anthropologists in 30% of livestock projects, there appears to have been no measurable difference between projects whether or not anthropologists were used. Sandford considered that veterinary components of livestock projects were successful although the extent to which costs were recovered was not clear. Producers put high priority on animal health inputs and the evidence available showed that they were prepared to pay for drugs, vaccines and medicines if given the chance to do so. He recommended that considerably more support should be given to veterinary research to fill the gap in coverage between the research programs of ILCA and ILRAD, to provide

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guidelines on how veterinary services should be improved and how field delivery systems should be organised and developed.

Pastoral Associations

Although the recent emphasis on pastoral associations (Sandford includes group ranches in this category) was considered "a move in the right direction", he cautions against seeking some "universal model".

Since he was sceptical about the value of grazing management or controls on animal numbers, except to the extent that pastoralist may themselves handle these matters, he was against their use as vehicles for implementing government controls on grazing or stocking rates. Association's main functions, in his view, embraced land tenure, resource management, provision of services, communication of information, external relations and the building and maintenance of community cohesion and morale. He made the point that associations have land tenure and land reform implications and they should be treated like land reform projects.

General Problems

Staff-related problems, such as the inability to recruit suitably qualified staff occurred in 90% of the projects analysed (by Sandford) and political policy-related problems in about 70%. In Eastern and Southern Africa, government policies were one of the most frequently cited problems. Formal project coordination committees worked badly, especially if established at a senior level. Project management costs, although difficult to estimate, appear to have been excessively high in some cases.

The Sandford review takes issue with the project approach towards livestock development in Africa and argues for a program approach. It also argues for flexibility in design and implementation of projects in dry regions to enable management to deal with unforeseen circumstances such as droughts. Sandford believes that the Bank becomes over-involved in detail and that Bank project appraisal methodology "has more to do with Bank ritual than with the effective design of projects".

Investment in Livestock in Developing Countries

Present Status of Livestock Projects

The performance of livestock projects is still a cause for concern. On the Bank's internal rating system, mandated for all projects under supervision, the performance of 40% of livestock projects in 1989 was unsatisfactory. Only Fisheries projects have a worse performance record and even area development projects, although bad, are rated somewhat better than livestock.

This rating refers to free standing livestock projects and must be interpreted with some caution because one cannot infer from it that livestock components in broader based agriculture projects are performing less satisfactorily than other components. Since the rating system applies to the overall project we must assume (unless otherwise stated) that the performance of the livestock component is fairly represented by the overall rating. It is important to keep this in mind when one realises that most of the lending for livestock is now made under component projects. The findings of the three studies which I referred to are still valid and describe the main problems which underlie poor project performance. Overall performance is heavily biased downwards by poor performance, especially for Africa and to

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a lesser extent the East Asia and Pacific Region. It is important to note that the performance of Livestock projects in all other regions was similar to Agriculture projects in general.

The bias is considerable because the volume of lending and the size of projects are relatively small in these regions. In response to past deficiencies the lending program is now paying more attention to supporting smallholders, improving technical support services (i.e., extension, research, veterinary) institution building, cost recovery and privatization. Considerable emphasis is being placed on strengthening and restructuring veterinary services, on extension and research and encouraging the formation of Pastoral Association (for veterinary and resource management) in the Sub-Saharan Africa. Dairying is receiving renewed emphasis; dairy projects are under consideration, for example, in Sudan, Kenya, Madagascar, Uganda and Zambia. Furthermore, livestock have an important role in the "Bank's Areas of Special Emphasis", namely: poverty alleviation, food security, protecting the environment, private sector development/ public sector reform and women in development. There are, for example 26 Sub-Saharan African countries with extension and 17 with research projects, although the primary focus in these projects is on agriculture and not livestock. Much more needs to be done to strengthen livestock extension and research.

In addition to new initiatives in project design more efficient economic policies are being emphasized in structural and sectoral adjustment lending. These include more realistic exchange rates, free market policies, privatization and cost recovery.

Important Factors and Examples

Profitability

It is important that long-term markets are available (and verified) to ensure profitability. Financial projections and rate of return calculations should be conducted with care. Although the World Bank places great emphasis on project analysis it is surprising how often projects fail because of inadequate profitability. Since livestock development is a long term activity, inflation and as a consequence high interest rates cause serious cash flow problems during the earlier project years. In addition to problems with prices and markets (which should be verified with care) technical and production coefficients are often over-optimistic.

Unless judgements are made by experienced operators they are inclined to reflect what is technically feasible, or what is feasible in the developed world, without due allowance been made for differences in management capabilities, technical services or the availability, cost and quality of input supplies. For example, in African ranching or dairy projects it was assumed by all donors in earlier years that parastatals could achieve production coefficients similar to those obtained on good commercial (settler) farms. With hindsight we know this was not the case — parastatal coefficients were similar to those achieved in the traditional sector and in addition parastatals suffered from political interference, overstaffing and price regulation as well as poor management (including financial management).

Profitability is also determined by the level of capital investment. Smallholders have a substantial advantage in most cases over large commercial farms. Combined with low opportunity cost labour (family) this can give smallholders a distinct advantage over large farms and parastatals. Consequently their financial viability is considerably less threatened by low production coefficients, prices or management skills.

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Economic Justifications

Even if an enterprise is financially attractive this may not mean that it is economically attractive as measured by the economic rate of return (ERR). The ERR omits subsidies and taxes. Border prices (free world market prices) are used to value inputs and outputs. Consequently, a satisfactory ERR is a much better indicator of long-term sustainability than the FRR. The ERR is particularly important in countries where free markets are not permitted to operate and where the exchange rate and prices are seriously distorted.

Government Economic Policies

An overvalued currency is without doubt the most serious constraint on orderly sustainable livestock development in many countries. It is particularly serious for countries with an export surplus or the potential to develop exports. There is for example, an excellent market in the Middle East for live animals (especially sheep and goats) but Somalia, Sudan and Ethiopia have not been able to exploit this market, except to a limited extent, because exchange rates have been grossly overvalued. Conversion of earnings at the official exchange rates can be equivalent to a tax of 100% – 300% on livestock exports.

When one considers the stimulus that a 100% real increase in livestock prices would have on producers willingness to use new techniques and increase production, one begins to appreciate the magnitude of the overvalued foreign exchange problem. Governments are reluctant to move to a more realistic exchange rate because this would affect local consumer prices, especially for city consumers who wield a disproportionate political influence. If the exchange rate is grossly overvalued the conditions are automatically created for a flourishing smuggling trade. Large numbers of animals (especially sheep and goats) are presently smuggled live to the Middle East from East African countries and large numbers of cattle are smuggled (walked) into Kenya from adjacent countries. If these conditions are not corrected, projects, which are aimed at improving livestock and meat marketing are doomed from the outset. This is usually true even if the actual marketing operation is in the hands of private traders with the public sector role confined to the provision of marketing and processing facilities on a fee for services rendered basis. Although, it can be argued that smuggling has positive economic features it is a costly and inefficient way to conduct business. Government is denied access to revenue and foreign exchange which could have been generated by official exports.

A grossly overvalued exchange rate has an additional negative effect in that the real costs of inputs that require foreign exchange are not reflected in the price paid by farmers and are therefore, not recovered even if a full cost recovery policy (local currency) is in place. This is an important issue and common difficulty with revolving funds for veterinary drugs and medicines in donor supported projects.

The adoption of a realistic exchange rate appears to be the solution to this problem. The Bank is addressing the exchange rate issue through its structural adjustment program, albeit with mixed results. Sustainable livestock development will, in many countries, depend on the success of these efforts especially if success is directly related to the availability of foreign exchange as would, for example, be the case for a veterinary project importing drugs and medicines. There will always be a problem of this nature unless a country's currency is freely convertible at realistic exchange rates. Government price controls are a major cause of failure for projects which rely on Government or parastatal production, processing and marketing; they can also affect the private sector if rigorously implemented.

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Overall effects can even transcend national boundaries. Livestock projects in East Africa were negatively affected, to a major extent, by government price control policies — even private sector ranches as well as parastatals. Livestock specialists and planners should not feel too guilty about parastatal failures because these policies had their origins in economic management theories and embraced all sectors (e.g., coal mining, car manufacture, and transport (in European countries) in those heady economic planning days.

Technology

Sustainable technology must take the realities of the country in question into consideration. Too often attempts are made to transfer technology from developed countries without realising that they are unsustainable because labour/capital ratios are completely different and support services less developed; not only technical ones but also electrical, mechanical, manufacturing, communications and transport.

Investment in large commercial state or parastatal dairy production and processing in Africa and elsewhere is a good example of inappropriate technology. Smallholder dairying requires very little capital investment and, in addition, can usually utilise low opportunity cost labour. Consumers in many countries are not prepared to pay the extra costs of heat treating, packaging and distributing milk. Systems which are based on the sale of unprocessed milk (either fresh or sour), distributed from door to door by farmers or local vendors, are much more robust from an economic standpoint. Consequently dairy projects based on pasteurisation and sale of milk in bottles or packages can only be justified if the milk shed is located at a considerable distance (at least 50 km) from the city market. Even where pasteurisation is justified by transport distances considerable savings can be made by selling bulk milk to local vendors; as an alternative to a marketing system which may be doomed from the outset by heavy packaging and distribution costs.

The key mistake in attempting to transfer modern dairying practices to the developing world, arises from a lack of appreciation of relative costs of labour and size of incomes which by comparison with the developed world are usually 50 to 100 times smaller. The relative cost of labour must also be kept in mind when designing appropriate Artificial Insemination and other technical and input supply services.

When one considers that the average workers daily wage is only equal to about 2-3 litres of milk, it is clear that every effort must be made to utilise cheap labour and economise on fixed capital (buildings, machinery and vehicles) as well as economising on foreign exchange expenditures. These issues are discussed in more detail in a World Bank report entitled “Dairy Development in Sub-Saharan Africa” which will be published shortly in the World Bank’s Technical Paper series.

The importance of grading-up, by crossbreeding, to achieve good dairy merit, must be emphasized. Crossbreeding is the cheapest and least risky approach. It avoids problems associated with acclimatisation and minimises the disease risk.

The record shows that mortality rates are unacceptably high for European breeds imported to tropical/sub-tropical regions and the number of animals imported should not exceed what is needed to establish an efficient crossbreeding program. Processing technology, for milk and dairy products, should concentrate on simple manual system or ones with minimal mechanisation — for milk separation, butter churning and small scale village cheese manufacture. Butter and cheese manufacturing is particularly important in areas which

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have a pronounced seasonal milk surplus and that are located far from liquid milk markets. Milk powder manufacturing plants can rarely, if ever, be justified because of their high capital and operating costs and the availability of subsidised milk powder on world markets.

Large processing plants for meat and poultry are also difficult to justify. Small abattoirs that provide slaughtering facilities for a fee are the best solution if the number of animals involved can justify moving beyond the private butcher. Housewives would usually prefer to use their own labour to dress fowl rather than pay high processing charges. Furthermore, live chickens are much easier to store and can be killed when needed. It is interesting to note that this system is still operating in Taiwan where per capita incomes are several times higher than in most developing countries. In my experience we should look to Asia for appropriate models for processing and marketing livestock. Furthermore, there is now ample evidence to support the proposition that responsibility for marketing live animals and livestock products should be delegated to the private sector. If the public sector has any role it should be confined to the provision of infrastructure (markets, railway stockyards and lairage at ports) and, in addition, help to facilitate these activities by reducing red tape, improving telephone and telex services, abolishing taxes, and facilitating veterinary certifications for exports. The working capital that is needed in the livestock and meat trade is extremely large and Governments must ensure that adequate amounts are available through the banking system.

Feed Supplies

The sustainability of smallholder livestock depends, in large measure, on feed supplies. Virtually, all smallholders produce forage and crop by-products and therefore dairying and cattle/sheep fattening enterprises can be undertaken by virtually all farmers. Furthermore, even if the quantity of feed is small it usually has little if any cash value (except when sold or bartered to nomads). Since home produced feed costs little, if anything, smallholder livestock farming is unburdened of one major risk-that associated with large fluctuations in feed prices and reliance on purchased feeds.

Likewise smallholder pig and poultry systems flourish on farms producing grains (e.g., maize, rice) and crops and cereal by-products (e.g., rice bran). Robust smallholder pig production was a feature of Danish agriculture until very recently (a flourishing pig production industry based on home grown barley) and robust smallholder pig production still flourishes in Poland (based on home grown potatoes and cereals) and in Yugoslavia (based on home grown maize and wheat pollard from home grown wheat). Likewise smallholder pig and poultry production flourishes in Asia because all smallholders have access to cheap rice bran. Rice milling is usually dispersed through numerous small villages and farmers receive or buy back most of the rice bran from their own crop; rice bran stores badly because its oil content is high and it is therefore unattractive to feed compounders. It must be fed fresh and since rice milling is a continuous process rice bran is constantly available to smallholders.

These traditional smallholder livestock systems are virtually risk free and will survive (as they did in Western Europe) until wage levels are such that their contribution to family income becomes insignificant or when they are incapable of providing an economic labour wage. For example, in Asian rice systems, a man can manage a flock of about 150 ducks grazing on rice paddies.

This system persists when the cost of feed saved, by scavenging, is sufficient to justify a man's wage but the practice has collapsed in countries where wages have surpassed this

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level. These examples are given in order to stress the point that one needs to be vigilant and fully understand the implications of the underlying economic realities as well as their influence on switching points in farming systems (e.g., from manual to machine milking).

Smallholders are economically more robust than large commercial producers because they are much less subject to feed and product prices. They should be encouraged to the fullest whenever possible and will persist until gradually surpassed by economic development. Feed is normally the binding constraint on smallholder production and projects designed to assist this sector should always incorporate a well thought-out feed and/or forage component.

Commercial sustainable pig and poultry industries can be developed on imported feeds in countries with a deficit in these products (e.g., Taiwan, the Philippines and Korea). This is possible because it is much cheaper to transport feed grains than meat and poultry products. However, if the industry is to survive in the deficit country production standards and efficiency must be comparable with those found in developed countries. Developing countries usually has a substantial advantage in labour and construction costs and, in addition, the fertilizer value of waste products is usually much higher and as a consequence the waste disposal problem is minimised.

Although somewhat surprising, it is worth noting that few countries have a well thought out strategy for meeting their short, medium and long term feed supplies (energy and protein feeds). One needs only to look to the continuing chronic feed protein deficit in Eastern European and Asian countries to realise the full magnitude of the problem. Perhaps FAO and the World Bank could play a more substantial role in rectifying this situation. The gains that can be achieved, if enlightened policies are put in place, are phenomenal and clearly evident from the expansion of pig and poultry production, on imported feeds in many developed and developing countries.

Sustainable Support Services

Sustainable smallholder development depends on sustainable technical and other services. Sustainability of services is largely a function of cost recovery. Even where the principles of cost recovery and privatization are accepted the task of developing sustainable institutions to deliver these services is a formidable one. Considerable investment will be needed in institution building, technical assistance, management training and staff training at all levels. Grass-root farmer organisations (i.e., pastoral association and cooperatives) need in most cases to be established and farmers trained to own, operate and manage them. This is a task that goes much beyond the life-span of the typical livestock project. One should look to Operation Flood in India and village agriculture/livestock cooperatives in Taiwan to see what can be achieved in the mature stage, and to initiatives for restructuring veterinary services and establishing pastoral associations in Sub-Saharan Africa to see what can be achieved at the earlier development stages.

In recent years the Bank has placed much more emphasis on institution building and the provision of services (e.g., extension, research and veterinary), in full cognizance of the importance of these to sustainable development. Although this is not the place to discus these important services, it is pertinent to point out, that in most developing countries livestock services are either non-existent, weak, non-effective or absent. The design of efficient affordable services is a difficult task which calls for innovation, the rejection of old nostrums

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and careful cost/benefit analysis to establish affordability, a prerequisite for sustainability. While donor agencies can assist this process, governments must ensure that coherent policies and strategies are implemented to avoid confusion and to save time and resources. Donors must ensure that their activities and projects are consistent with the policies and strategies which have been set by Government.

Animal Health Services are of paramount importance to the sustainability of smallholder system but especially to dairy farmers using disease susceptible crossbreds. Although good progress has been made on conceptualising restructuring and cost recovery most livestock farmers in Sub-Saharan Africa have still to 'make do' with, at best, a rudimentary and, at worst, a totally ineffective service. In Ethiopia, for example, the expenditure on veterinary drugs and medicines is only about 5% of the amount veterinarians estimate would be economically justified on the basis of epidemiological studies. It will be extremely difficult to rectify this situation even though the principles of restructuring and privatization are fully accepted. A major effort is needed to train veterinary field assistants that will be employed by service cooperatives, the front line institutions. Systems of bookkeeping and cost recovery must be developed and demonstrated which require time and a massive training program. A mechanism is needed to enable payments in local currency to be converted to foreign exchange to replenish imported veterinary stocks. In addition procurement and distribution must be streamlined. Although one must assume that these problems can eventually be resolved one should question if the contribution or the role of farmers in administering drugs and medicines is adequately taken into account in present Sub-Saharan Africa models where veterinary assistants, selected from and paid by the traditional village community or pastoral association, are responsible for administering drugs, medicines and vaccines to livestock.

When one considers that probably 90% of the veterinary drugs and medicines are administered by farmers in developed countries (as represented by farmer's expenditure), albeit in most cases under the veterinarian's instructions one begins to realise the importance of training the African farmer to play a much greater role in the administration of veterinary products. It would take an enormous increase in manpower, travel time and cost to replace the farmer's legitimate function in, for example, 'drenching' for stomach worms and liver fluke. Study and analysis is needed to sharpen the focus on these matters - perhaps FAO could help by establishing badly needed guidelines.

Environmental Sustainability

Despite some common misconception livestock projects normally make a substantial beneficial contribution to sustainable agriculture. In arid areas there is now ample evidence that irreversible degradation is not taking place on a large scale as a consequence of over-grazing. Rangelands generally recover when droughts give way to a wetter cycle of annual precipitation. The public clamour and fear of irreversible degradation appears to follow a similar cyclic pattern. The real environmental problem in arid areas is caused by erosion brought about by increased and continuous cropping as well as bush cutting (for fuel) which is, in turn, a consequence of population pressure. Overgrazing does exist and can cause erosion on slopes, but these effects are minor compared to those caused by human population pressure. Furthermore, grasses, forage, legumes and legume trees, introduced to provide livestock feed, are important builders of soil fertility and, in addition, provide ground cover which prevents or lessens wind and water erosion in susceptible areas (e.g., Ethiopian highlands).

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Chapter 2 : Preparedness for Upkeep of Livestock during Calamity

Following a natural disaster or a crisis, due to conflict the safety, security and wellbeing of livestock is often a primary, if not the main concern of affected owners. Patterns of movement for livestock-owning human populations following a disaster can be heavily influenced by the needs of their animals. Furthermore, livestock shelter and settlement infrastructure can play a key role in influencing the human shelter and settlement decisions taken by affected communities. In some emergencies, livestock that were not previously sheltered may develop the need for protection and shelter –for example in severe weather conditions or extreme insecurity.

Assessments should analyse the trade-offs between the protection risks and the potential livelihoods benefits of greater livestock ownership or access to livestock products. In some cases, traditional livestock management practice may be modified to enhance protection. Particularly vulnerable groups should be targeted in this assessment process in order to ensure that their protection needs are identified.

The role of women, children, older persons and persons with a disability needs to be understood. The relevance of livestock interventions needs to be understood in the context of human rights and protection. Hence lives tock aid workers need to be fully aware of rights-based approaches to humanitarian intervention, and humanitarian principles.

In addition, workers also need to be familiar with livelihoods-based programming.

In insecure environments, livestock can easily be regarded as a valuable and desirable item by armed militia, police, security forces or criminals. Armed groups and governments will sometimes use livestock raiding as a specific strategic tactic for terrorizing communities and asset stripping. Consequently, in some situations the provision of livestock can place vulnerable communities at increased risk of violence.

The provision of large numbers of livestock where resources are scarce may also be a potential source of conflict between farmers and livestock owners, or between livestock-owning groups. Agencies working in conflict areas may also need to ensure that animals for sale have not been stolen. Agencies responding to emergencies have the responsibility to ensure that their interventions at the least do not increase risk to beneficiaries (do no harm), and where possible aim to reduce risk and increase protection.

Emergency situations may be plagued by lawlessness and civil strife, even when they have not arisen directly as a result of conflict. Protection of the poorest livestock keepers who may not be equipped to deal with theft of their stock should be considered. Programmes should consider carefully how continuing protection of the animals involved can be ensured. Where such protection cannot be reasonably guaranteed, options such as destocking may be more appropriate.

Successful livestock feeding programmes should result in livestock that regain or increase their original value and that may therefore be more attractive for looting. Feed camps involving the concentration of large numbers of livestock may attract thieves,

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particularly in insecure areas. Where large numbers of people have been displaced and moved with their livestock into camps, grazing may be available outside the camp but at the risk of violence or personal insecurity, in which case the provision of feed to the camp or nearby area may be appropriate.

The risks to the personal safety of beneficiaries and staff in transporting feeds for use in emergency programmes should always be of paramount importance. The disruption caused by emergencies is very often associated with a degree of lawlessness and the cargo and trucks used by distribution networks can offer a tempting target for robbery. Most international relief agencies have well-established security guidelines that account for this and are generally able to implement these effectively, often in collaboration with local or other security agencies. However, it may be difficult for small-scale local initiatives with limited resources to achieve a similar level of protection.

Establishing a safe distribution network to ensure the safety and security of beneficiaries travelling to and from and at distribution points should be a priority. Water Users Protection of water users should be taken into account. For example people watering animals at water points may be vulnerable to livestock rustling, robbery or attack, in particular women.

Water point management must be addressed prior to rehabilitation or establishment in order to avoid potential ownership conflicts as well as to ensure equitable access and sustainable systems for the future. Issues of water management are particularly important to ensure the protection of water users around refugee or Internally Displaced People's camps – for example when the camp residents need access to water points outside the camp for their livestock and may come into conflict with the host populations. Negotiation with all stakeholders beforehand can help to minimize potential conflicts.

Emergency Management

Disaster management (or emergency management) is the term used to designate the efforts of communities or businesses to plan for and coordinate all personnel and materials required to either mitigate the effects of, or recover from, natural or man-made disasters, or acts of terrorism. Disaster management does not avert or eliminate the threats, although their study is an important part of the field. Events covered by disaster management include acts of terrorism, industrial sabotage, fire, natural disasters (such as earthquakes, hurricanes, etc.), public disorder, industrial accidents, and communication failures.

Emergency Planning Ideals

If possible, emergency planning should aim to prevent emergencies from occurring, and failing that, should develop a good action plan to mitigate the results and effects of any emergencies. As time goes on, and more data becomes available, usually through the study of emergencies as they occur, a plan should evolve. The development of emergency plans is a cyclical process, common to many risk management disciplines, such as Business Continuity and Security Risk Management, as set out below:

- Recognition or identification of risks
- Ranking or evaluation of risks
  - Responding to significant risks
  - Tolerate

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    - Treat
    - Transfer
    - Terminate
- Resourcing controls
- Reaction Planning
- Reporting & monitoring risk performance
- Reviewing the Risk Management framework

There are a number of guidelines and publications regarding Emergency Planning, published by various professional organisations such as ASIS, FEMA and the Emergency Planning College. There are very few Emergency Management specific standards, and emergency management as a discipline tends to fall under business resilience standards.

In order to avoid, or reduce significant losses to a business, emergency managers should work to identify and anticipate potential risks, hopefully to reduce their probability of occurring. In the event that an emergency does occur, managers should have a plan prepared to mitigate the effects of that emergency, as well as to ensure Business Continuity of critical operations post-incident. It is essential for an organisation to include procedures for determining whether an emergency situation has occurred and at what point an emergency management plan should be activated.

Implementation Ideals

An emergency plan must be regularly maintained, in a structured and methodical manner, ensure it is up-to-date in the event of an emergency. Emergency managers generally follow a common process to anticipate, assess, prevent, prepare, respond and recover from an incident.

Pre-Incident Training and Testing

Emergency management plans and procedures should include the identification of appropriately trained staff members responsible for decision-making when an emergency occurs. Training plans should include internal people, contractors and civil protection partners, and should state the nature and frequency of training and testing.

Testing of a plan's effectiveness should be carried out regularly. In instances where several business or organisations occupy the same space, joint emergency plans, formally agreed to by all parties, should be put into place.

Communicating and Assessing Incidents

Communication is one of the key issues during any emergency, pre-planning of communications is critical. Miscommunication can easily result in events escalating unnecessarily. Once an emergency has been identified a comprehensive assessment evaluating the level of impact and its financial implications should be undertaken. Following assessment, the appropriate plan or response to be activated will depend on a specific pre-set criteria within the emergency plan. The steps necessary should be prioritised to ensure critical functions are operational as soon as possible.

Phases and Personal Activities

Emergency management consists of five phases: prevention, mitigation, preparedness, response and recovery.

Prevention

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Prevention was recently added to the phases of emergency management. It focuses on preventing the human hazard, primarily from potential natural disasters or terrorist attacks. Preventive measures are taken on both the domestic and international levels, designed to provide permanent protection from disasters. Not all disasters, particularly natural disasters, can be prevented, but the risk of loss of life and injury can be mitigated with good evacuation plans, environmental planning and design standards. In January 2005, 168 Governments adopted a 10-year global plan for natural disaster risk reduction called the Hyogo Framework.

Mitigation

Personal mitigation is a key to national preparedness. Individuals and families train to avoid unnecessary risks. This includes an assessment of possible risks to personal/family health and to personal property, and steps taken to minimize the effects of a disaster, or take procure insurance to protect them against effects of a disaster.

Preventive or mitigation measures take different forms for different types of disasters. In earthquake prone areas, these preventive measures might include structural changes such as the installation of an Earthquake Valve to instantly shut off the natural gas supply, seismic retrofits of property, and the securing of items inside a building. The latter may include the mounting of furniture, refrigerators, water heaters and breakables to the walls, and the addition of cabinet latches. In flood prone areas, houses can be built on poles/stilts. In areas prone to prolonged electricity black-outs installation of a generator. The construction of storm cellars and fallout shelters are further examples of personal mitigative actions.

On a national level, governments might implement large scale mitigation measures. After the monsoon floods of 2010, the Punjab government subsequently constructed 22 ‘disaster-resilient’ model villages, comprising 1885 single-storey homes, together with schools and health centres.

Preparedness

Preparedness focuses on preparing equipment and procedures for use *when* a disaster occurs. Preparedness measures can take many forms including the construction of shelters, implementation of an emergency communication system, installation of warning devices, creation of back-up life-line services (e.g., power, water, sewage), and rehearsing evacuation plans. Planning for all different types of events, and all magnitudes is of utmost importance, so that when a disaster does occur responders know exactly what their assignments are.

For evacuation, a disaster supplies kit may be prepared and for sheltering purposes a stockpile of supplies may be created. The preparation of a survival kit such as a “72-hour kit”, is often advocated by authorities. These kits may include food, medicine, flashlights, candles and money. Also, putting valuable items in safe area is also recommended.

Response

The response phase of an emergency may commence with Search and Rescue but in all cases the focus will quickly turn to fulfilling the basic humanitarian needs of the affected population. This assistance may be provided by national or international agencies and organisations. Effective coordination of disaster assistance is often crucial, particularly when many organisations respond and local emergency management agency (LEMA) capacity has been exceeded by the demand or diminished by the disaster itself. The National Response Framework is a United States government publication that explains responsibilities and

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expectations of government officials at the local, state, federal, and tribal levels. It provides guidance on Emergency Support Functions which may be integrated in whole or parts to aid in the response and recovery process.

On a personal level the response can take the shape either of a *shelter in place* or an *evacuation*. In a shelter-in-place scenario, a family would be prepared to fend for themselves in their home for many days without any form of outside support. In an *evacuation*, a family leaves the area by automobile or other mode of transportation, taking with them the maximum amount of supplies they can carry, possibly including a tent for shelter. If mechanical transportation is not available, evacuation on foot would ideally include carrying at least three days of supplies and rain-tight bedding, a tarpaulin and a bedroll of blankets.

Donations are often sought during this period, especially for large disasters that overwhelm local capacity. Due to efficiencies of scale, money is often the most cost-effective donation if fraud is avoided. Money is also the most flexible, and if goods are sourced locally then transportation is minimized and the local economy is boosted. Some donors prefer to send gifts in kind, however these items can end up creating issues, rather than helping. One innovation by Occupy Sandy volunteers is to use a donation registry, where families and businesses impacted by the disaster can make specific requests, which remote donors can purchase directly via a web site.

Medical considerations will vary greatly based on the type of disaster and secondary effects. Survivors may sustain a multitude of injuries to include lacerations, burns, near drowning, or crush syndrome.

Recovery

The recovery phase starts after the immediate threat to human life has subsided. The immediate goal of the recovery phase is to bring the affected area back to normalcy as quickly as possible. During reconstruction it is recommended to consider the location or construction material of the property.

The most extreme home confinement scenarios include war, famine and severe epidemics and may last a year or more. Then recovery will take place inside the home. Planners for these events usually buy bulk foods and appropriate storage and preparation equipment, and eat the food as part of normal life. A simple balanced diet can be constructed from vitamin pills, whole-meal wheat, beans, dried milk, corn, and cooking oil. One should add vegetables, fruits, spices and meats, both prepared and fresh-gardened, when possible.

Disaster Management of Poultry in Flood

Poultry, pronounced (pôl2 trç), is a name given to domesticated birds kept by humans for the eggs they produce, their meat or feathers. These birds are most typically members of the superorder Galloanserae (fowl), especially the order Galliformes (which includes chickens, Guinea fowl, quails and turkeys) and the family Anatidae, in order Anseriformes, commonly known as "waterfowl" and including domestic ducks and domestic geese. Poultry also includes other birds which are killed for their meat, such as the young of pigeons (known as squabs) but does not include similar wild birds hunted for sport or food and known as game. The word "poultry" comes from the French/Norman word *poule*, itself derived from the Latin word *pullus*, which means small animal.

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The domestication of poultry took place several thousand years ago. This may have originally been as a result of people hatching and rearing young birds from eggs collected from the wild, but later involved keeping the birds permanently in captivity. Domesticated chickens may have been used for cockfighting at first and quail kept for their songs, but soon it was realised how useful it was having a captive-bred source of food. Selective breeding for fast growth, egg-laying ability, conformation, plumage and docility took place over the centuries, and modern breeds often look very different from their wild ancestors. Although some birds are still kept in small flocks in extensive systems, most birds available in the market today are reared in intensive commercial enterprises. Poultry is the second most widely eaten type of meat globally and, along with eggs, provides nutritionally beneficial food containing high-quality protein accompanied by a low proportion of fat. All poultry meat should be properly handled and sufficiently cooked in order to reduce the risk of food poisoning. There is some concern that poultry farmers who come in intimate contact with their birds could be exposed to avian influenza, and that new strains of the disease, transmissible man to man, may develop and could pose risks of a pandemic.

Chickens Feed

Chickens are medium-sized, chunky birds with an upright stance and are characterised by fleshy red combs and wattles on their heads. Males, known as cocks, are usually larger, more boldly coloured and have more exaggerated plumage than females (hens). Chickens are gregarious, omnivorous, ground-dwelling birds that in their natural surroundings search among the leaf litter for seeds, invertebrates and other small animals. They seldom fly except as a result of perceived danger, preferring to run into the undergrowth if approached. Today's domestic chicken (*Gallus gallus domesticus*) is mainly descended from the wild Red Junglefowl of Asia, with some additional input from the Grey Junglefowl. Domestication is believed to have taken place between 7,000 and 10,000 years ago and what are thought to be fossilized chicken bones have been found in northeastern China and dated to around 5,400 B.C.

Archaeologists believe that domestication was originally for the purpose of cockfighting, the male bird being a doughty fighter. By 4,000 years ago, chickens seem to have reached the Indus Valley and 250 years later, they arrived in Egypt. They were still used for fighting and were regarded as symbols of fertility. The Romans used them in divination, and the Egyptians made a breakthrough when they learned the difficult technique of artificial incubation. Since then, the keeping of chickens has spread around the world for the production of food with the domestic fowl being a valuable source of both eggs and meat.

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Figure: *Cock with comb and wattles*

Since their domestication, a large number of breeds of chicken have been established but, with the exception of the white Leghorn, most commercial birds are of hybrid origin. In about 1800, chickens began to be kept on a larger scale, and modern high output poultry farms were present in the United Kingdom from around 1920 and became established in the United States soon after the Second World War. By the mid-20th century, the poultry meat producing industry was of greater importance than the egg-laying industry. Poultry breeding has produced breeds and strains to fulfil different needs; light-framed, egg-laying birds that can produce 300 eggs a year; fast-growing, fleshy birds destined for consumption at a young age, and utility birds which produce both an acceptable number of eggs and a well-fleshed carcase. Male birds are unwanted in the egg-laying industry and can often be identified as soon as they are hatch for subsequent culling. In meat breeds, these birds are usually castrated (often chemically) to prevent aggression.

A bantam is a small variety of domestic chicken, either a miniature version of a member of a standard breed, or a "true bantam" with no larger counterpart. The name derives from the town of Bantam in Java where European sailors bought the local small chickens for their shipboard supplies. Bantams may be a quarter to a third of the size of standard birds and lay similarly small eggs. They are kept by smallholders and hobbyists for egg production, for use as broody hens, for ornamental purposes and showing.

Ducks

Ducks are medium-sized aquatic birds with broad bills, eyes on the side of the head, fairly long necks, short legs set far back on the body and webbed feet. Males, known as drakes, are often larger than females (simply known as ducks) and are differently coloured in some breeds. Domestic ducks are omnivores eating a variety of animal and plant materials such as aquatic insects, molluscs, worms, small amphibians, waterweed and grasses. They feed in shallow water by dabbling, with their heads underwater and their tails upended. Most domestic ducks are too heavy to fly, and they are social birds, preferring to live and move around together in groups. They keep their plumage waterproof by preening, a process that spreads the secretions of the preen gland over their feathers.

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Figure: *Pekin ducks*

Clay models of ducks found in China dating back to 4000 BC may indicate that the domestication of ducks took place there during the Yangshao culture. Even if this is not the case, domestication of the duck took place in the Far East at least 1500 years earlier than in the West. Lucius Columella, writing in the first century BC, advised those who sought to rear ducks to collect wildfowl eggs and put them under a broody hen, because when raised in this way, the ducks "lay aside their wild nature and without hesitation breed when shut up in the bird pen". Despite this, ducks did not appear in agricultural texts in Western Europe until about 810 AD when they begin to be mentioned alongside geese, chickens and peafowl as being used for rental payments made by tenants to landowners.

It is widely agreed that the Mallard (*Anas platyrhynchos*) is the ancestor of all breeds of domestic duck (with the exception of the Muscovy Duck (*Cairina moschata*), which is not closely related to other ducks). Ducks are farmed mainly for their meat, eggs and down. As is the case with chickens, various breeds have been developed, selected for egg-laying ability, fast growth and a well-covered carcase. The most common commercial breed in the United Kingdom and the United States is the Pekin duck, which can lay two hundred eggs a year and can reach a weight of 3.5 kg (7.7 lb) in forty-four days. In the Western world, ducks are not as popular as chickens, because the latter produce larger quantities of white, lean meat and are easier to keep intensively, making the price of chicken meat lower than that of duck meat. While popular in *haute cuisine*, duck appears less frequently in the mass-market food industry. However, things are different in the East. Ducks are more popular there than chickens and are mostly still herded in the traditional way and selected for their ability to find sufficient food in harvested rice fields and other wet environments.

Geese

Figure: *An Emden goose, a descendent of the wild Greylag Goose*

The Greylag Goose (*Anser anser*) was domesticated by the Egyptians at least three

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thousand years ago and a different wild species, the Swan Goose (*Anser cygnoides*), was domesticated in Siberia about a thousand years later and is known as a Chinese goose. The two hybridise with each other and the large knob at the base of the beak, a noticeable feature of the Chinese goose, is present to a varying extent in these hybrids. The hybrids are fertile and have resulted in several of the modern breeds. Despite their early domestication, geese have never gained the commercial importance of chickens and ducks.

Domestic geese are much larger than their wild counterparts and tend to have thick necks, an upright posture and large bodies with broad rear ends. The Greylag-derived birds are large and fleshy and used for meat while the Chinese geese have smaller frames and are mainly used for egg production. The fine down of both is valued for use in pillows and padded garments. They forage on grass and weeds, supplementing this with small invertebrates, and one of the attractions of rearing geese is their ability to grow and thrive on a grass-based system. They are very gregarious and have good memories and can be allowed to roam widely in the knowledge that they will return home by dusk.

The Chinese goose is more aggressive and noisy than other geese and can be used as a guard animal to warn of intruders. The flesh of meat geese is dark-coloured and high in protein but the skin has a high fat content, although this contains mostly monounsaturated fatty acids. The birds are killed at either around ten weeks or about twenty-four weeks. Between these ages there are problems with dressing the carcase because of the presence of developing pin feathers.

In some countries, geese and ducks are force-fed to produce livers with an exceptionally high fat content for the production of foie gras. Over 75% of world production of this product occurs in France, with lesser industries in Hungary and Bulgaria and a growing production in China. Foie gras is considered a luxury in many parts of the world, however the process of feeding the birds in this way is banned in many countries on animal welfare grounds.

Turkeys

Turkeys are large birds, their nearest relatives being the pheasant and the guineafowl. Males are larger than females and have spreading, fan-shaped tails and a distinctive fleshy wattle, called a snood, that hangs from the top of the beak and is used in courtship display. Wild turkeys can fly but seldom do so, preferring to run with a long, straddling gait. They roost in trees and forage on the ground, feeding on seeds, nuts, berries, grass, foliage, invertebrates, lizards and small snakes.

The modern domesticated turkey is descended from one of six subspecies of Wild Turkey (*Meleagris gallopavo*) found in the present Mexican states of Jalisco, Guerrero and Veracruz. Pre-Aztec tribes in south-central Mexico first domesticated the bird around 800 BC, and Pueblo Indians inhabiting the Colorado Plateau in the United States did likewise around 200 BC. They used the feathers for robes, blankets and ceremonial purposes. It was more than 1,000 years later before they became an important food source. The first Europeans to encounter the bird misidentified it as a guineafowl, a bird that was known as a “turkey fowl” at that time because it had been introduced into Europe via Turkey.

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Figure: *Male domesticated turkey sexually displaying by showing the snood hanging over the beak, the caruncles hanging from the throat, and the 'beard' of small, black, stiff feathers on the chest*

Commercial turkeys are usually reared indoors under controlled conditions. These are often large buildings, purpose-built to provide ventilation and low light intensities (this reduces the birds' activity and thereby increases the rate of weight gain). The lights can be switched on for 24-hrs/day, or a range of step-wise light regimens to encourage the birds to feed often and therefore grow rapidly. Females achieve slaughter-weight at about 15 weeks of age and males at about 19. Mature commercial birds may be twice as heavy as their wild counterparts.

Many different breeds have been developed but the majority of commercial birds are white as this improves the appearance of the dressed carcass, the pin feathers being less visible. Turkeys were at one time mainly consumed on special occasions such as Christmas (10 million birds in the United Kingdom) or Thanksgiving (60 million birds in the United States). However, they are increasingly becoming part of the everyday diet in many parts of the world.

Quail

The quail is a small to medium-sized cryptically coloured bird. In its natural environment it is found in bushy places, in rough grassland, among agricultural crops and in other places with dense cover. It feeds on seeds, insects and other small invertebrates. Being a largely ground-dwelling, gregarious bird, domestication of the quail was not difficult, although many of its wild instincts are retained in captivity. It was known to the Egyptians long before the arrival of chickens and was depicted in hieroglyphs from 2575 BC. It migrated across Egypt in vast flocks and the birds could sometimes be picked up off the ground by hand. These were the Common Quail (*Coturnix coturnix*), but modern domesticated flocks are mostly of Japanese Quail (*Coturnix japonica*) which was probably domesticated as early as the 11th century AD in Japan. They were originally kept as songbirds, and it is thought that they were regularly used in song contests.

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Figure: *Japanese quail*

In the early twentieth century, Japanese breeders began to selectively breed for increased egg production. By 1940, the quail egg industry was flourishing but the events of World War II led to the complete loss of quail lines bred for their song type, as well as almost all of those bred for egg production. After the war, the few surviving domesticated quail were used to rebuild the industry, and all current commercial and laboratory lines are considered to have originated from this population. Modern birds can lay upward of three hundred eggs a year and countries such as Japan, India, China, Italy, Russia and the United States have established commercial Japanese quail farming industries. Japanese quails are also used in bio-medical research in fields such as genetics, embryology, nutrition, physiology, pathology and toxicity studies. These quails are closely related to the common quail (*Coturnix coturnix*) and many young hybrid birds are released into the wild each year to replenish dwindling wild populations.

Other Poultry

Guinea fowl originate in Africa and the species most often kept as poultry is the helmeted guinea fowl (*Numinidae meleagris*). It is a medium size grey or speckled bird with a small naked head with colourful wattles and a knob on top and was domesticated by the time of the ancient Greeks and Romans. Guinea fowl are hardy, sociable birds that subsist mainly on insects but also consume grasses and seeds. They will keep a vegetable garden clear of pests and will eat the ticks that carry lyme disease. They happily roost in trees and give a loud vocal warning of the approach of predators. Their flesh and eggs can be eaten in the same way as chickens, young birds being ready for the table at the age of about four months.

A squab is the name given to the young of domestic pigeons that are destined for the table. Like other domesticated pigeons, birds used for this purpose are descended from the rock pigeon (*Columba livia*). Special utility breeds with desirable characteristics are used. Two eggs are laid and incubated for about seventeen days. When they hatch, the squabs are fed by both parents on "pigeon's milk", a thick secretion high in protein produced by the crop. Squabs grow rapidly but are slow to fledge and are ready to leave the nest at 26 to 30 days weighing about 500 g (18 oz). By this time, the adult pigeons will have laid and be incubating another pair of eggs and a prolific pair should produce two squabs every four weeks during a breeding season lasting several months.

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Disasters such as hurricanes, tornadoes, floods, earthquakes, severe winter weather, hazardous material spills, or nuclear power plant accidents can occur any time. The event may occur suddenly or be anticipated for several days, such as an approaching hurricane or flood. The time to prepare for these events is long before they occur. Even at the farm level, procedures should be written. They should be kept in a safe, fireproof, quickly accessible place with other important documents. (These and any other important documents should be taken along if it becomes necessary to evacuate the farm.) Each member of the farm family and herd personnel should know of, and practice the plan so that action may be taken even in the absence of key management personnel.

The first step in planning for a disaster is to determine what type of disaster could occur on the farm and how often. It would be useless to spend time and money, for example, to plan for severe winter weather if the farm is located in a tropical environment.

If the premises are near a nuclear power plant, even though the risk of an accident occurring is slim, the owners would want to consider how to protect their animals from radioactive fallout. If the farm is near a major highway, one might want to consider a hazardous material spill from a road accident in their planning. Living next to a river or stream would put planning for flooding or a barge accident in the forefront.

Only after each individual farm owner has considered their risks can they decide what priority of planning, money, and resources they wish to allocate to each. An all hazards plan is most desirable, however, plans should also be customized for specific situations. Once the risks are known, decisions can be made about what actions can be done in advance, and what actions would be required when the disaster occurs. Generally avoiding the disaster, mitigating its effect if it cannot be avoided, and sheltering the animals lessens the effects of a disaster on livestock. The approach taken would depend upon the type of disaster anticipated. Sometimes only one approach may be appropriate such as sheltering. In some instances combined approaches such as mitigation and sheltering may be required. In other events such as floods or firestorms sheltering may be the wrong thing to do. Mitigation Hazard mitigation is defined as any action taken to eliminate or reduce the long-term risk to life and property from natural or technological hazards. Some examples of hazard mitigation might be hurricane seeding to reduce the intensity of a storm, tying down homes or barns with ground anchors to withstand wind damage, redirecting the impact away from a vulnerable location by the digging of water channels or planting vegetation to absorb water, the establishment of setback regulations so building is not allowed close to the water’s edge, and the construction of levees or permanent barriers to control flooding.

The farm and farm buildings should be surveyed to figure out what mitigation procedures should be followed based on the hazard risk. Barns and buildings can be built or repaired so they exceed building codes. Construction or moving of the buildings to higher ground could be done. Glass windows and doors could be replaced or boarded with sturdier material. Drainage furrows could be kept sodded. Trash piles and burial sites could be cleaned and moved.

(Many farms contain burial sites contaminated with lead based paints, machinery grease, motor oil, lead lined tanks, batteries, roofing nails, asphalt, shingles, caulking compounds, linoleum, and plumbing lead. During flooding this material may leech into the crops or feed supply or be moved to a more accessible area where animals could consume them.) Toxic

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chemicals, pesticides, herbicides, and rodenticides could be moved or stored in secured areas to prevent their washing onto pastures where animals may be exposed. Loose items could be secured. Ponds that could cause flooding could be drained or have levees constructed around their perimeter.

Preparing the Farm and Farm Animals for Disasters

A list of resources and people should be developed by the farmer and kept with important papers. This list should contain emergency phone numbers, suppliers, truckers, and people that can help with the animals especially if normal working conditions are disrupted.

Suppliers that may be needed during or after the disaster should be obtained. Many of these items may not be obtainable after the disaster. Also, by obtaining them in advance more reasonable prices will be paid. Unfortunately disasters attract individuals who gouge and prey on the misfortunes of victims.

Items that could be obtained are portable radios and TV's, extra batteries, flashlights, candles, portable generators, salt, gravel, litter, fuel, antifreeze, stored feed such as hay (The amount to store would depend on the hazard. After the Washington state flood most producers vowed never to inventory large amounts of hay due to excessive flood damage and spoilage.), ropes, halters, animal restraint equipment, and medical supplies. Once obtained, they should be stored in such a manner so that they will be usable after the disaster. While in storage they should be checked at regular intervals – i.e.: Once a week to assure that they do not spoil and that electrical or mechanical appliances are still working. They should also be rechecked and evaluated after the event to assure they are still usable. A log should be kept to remember when and how often the items were monitored. Animals should be kept current on all appropriate vaccinations and booster shots before the disaster. Keep a written record of the products given and the

date of injection. The stress of the event and the disruption of the environment could cause an increase in infectious disease spread. Proper vaccination could protect the animals. Representation to Governmental Agency Managing the Disaster Response

As the disaster approaches or after it arrives the most important thing the farmer needs are truthful, accurate, and current information. A county, state, or federal emergency management agency coordinates government's response to most disasters. Representation to this agency for the farmer is critical. In most instances, a member of the division's Department of Agriculture competently does this. It is strongly suggested that farm organisations lobby for veterinary representation either through the Department of

Agriculture or separately to this agency. Often, the needs of animals during disasters are given low priority. Veterinarians, who are aware of these needs and can also verify the validity of requests for help, are most suited to bring animal problems to the fore front. Often actions required protecting animals such as sheltering or evacuation must be done before a similar action is taken for people. (To move animals to shelter from pasture or evacuate them to other locations takes considerable time and many workers.)

Governmental agencies will not issue such directives for animals before similar instructions are issued for people. They fear that a panic situation would occur and people might be critical about why the animals are being protected before them. (Animals can always be released from the shelter or returned from their point of evacuation if the disaster does not materialize.) What they do not consider is that it must be done while it is still safe for people

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to do the task since animals cannot shelter or evacuate themselves. After the disaster, government usually limits access to the disaster area. Animals will have to be fed, watered, and milked. Who is better suited to do this than the owner? Designation of farmers as emergency workers by government solves the problem of who will be responsible for this task. A veterinarian located in the emergency operating centre can get these messages across.

Evacuation

If evacuation of the animals is being considered (which may not be practical) to avoid the hazard then evacuation procedures, places, and routes should be planned. Since all animals may not be able to be evacuated, owners should decide ahead of times which are the most important ones to save. Various decision criteria can be used such as sale value, breeding quality, stage of pregnancy, stage of production, or simply sentimental preference. These animals should be identified ahead of time and a written list kept. If the owner were not home when the disaster threatens, others would then know which animals to save. Routes must not interfere with human evacuation routes. Alternate routes should be found in case the planned route is not accessible. Places where animals are to be taken should be decided in advance and arrangements made with the owners of these places to accept the animals. Trucks, trailers, and other vehicles should be obtained in advance. Acclimate the animals to them so they will not be frightened when they have to be used. Restraint equipment, food and water supplies should be available to use and move with the animals. Sufficient people should be on hand to help move the animals. The animals should be photographed and permanently identified by metal ear tag, tattoo, brand, registration papers, or microchip. A permanent record of the identification must be kept. This information will be useful to resolve arguments of ownership in case the animal gets loose. Papers documenting the identification should be kept with other important papers. Ultimately the decision to evacuate will depend on the distance to be traveled, the amount of time available before the disaster is due to impact on the farm, and whether there is any advantage to moving the animals to the place selected. Sometimes, evacuation may be done after the disaster providing the roads are passable, and the equipment needed for travel usable. If this is the case, the accepting location must be contacted to find out its condition.

Sheltering

Whether to move farm animals to shelter or leave them outside will depend on the integrity and location of the shelter being used and the type of disaster. During Hurricane Andrew, some horses left outside suffered less injury then those placed in shelters. This was because some shelters selected did not withstand the high winds. Horses were injured by collapsing structures and flying objects that may have been avoided on the outside. Another reason for possibly leaving animals unsheltered is because floodwaters that inundate around a barn could trap animals inside causing their drowning. During severe winter weather shelter animals from icy wind, rain, and snow. Generally, if the structure is sound, the animal should be placed indoors. Once they are inside, secure all openings to the outside. As mentioned previously, the sheltering should be ordered and completed before similar action is taken for humans.

Farm cats and dogs should either be placed in a disaster proof place or turned loose, as they generally will stay close to their home in the immediate period following a disaster. If they are loose, however, attempts must be made to immediately catch them again after the threat is over, to prevent these animals from becoming feral and a public health hazard. Some

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farm dogs are dangerously aggressive, and under normal circumstances should be kept chained. These dogs cannot be kept chained or turned loose during a disaster. If an inside shelter cannot be found then the only safe and humane thing to do is to euthanize these dogs as a last measure before evacuation.

Human Evacuation

What can be done with the animals if there is a need to evacuate the premises, and the animals have to be left unattended? There is always the risk that animals left unattended for extended periods could die or suffer injury. Sometimes, this may be the only option to protect human life. Protecting human life should always take priority in planning. Regardless, after the animals are secured in appropriate shelters food and water should be left for them, which they can obtain on their own. The amount necessary for survival is considerably less than for other purposes. If the animals survive, then the decision can be made after the disaster whether it is worth the time and expense to bring them back to their previous condition.

Every practical effort should be made to leave animals with sufficient food and water for their survival.

Enough for 48 hours should be left.

Usually within that time the initial effects of the disaster will be over.

During the recovery phase the decision can then be made as to the best way to mount a rescue effort.

Special Considerations

Some practices that may be followed in planning for disasters especially during the winter require a special alert. During winter weather it is common to use portable heaters, gritty substances on the floor to prevent slipping, and antifreeze. When using these heaters, be sure they are working properly in an area where there is adequate ventilation. Heaters not working correctly could be a source of carbon monoxide, a deadly odorless colourless poison. Antifreeze used in vehicles is a deadly poison. Animals seem attracted to it and will readily consume it because of its sweet taste. Take care to properly label all containers. Do not use containers previously filled with antifreeze for other purposes especially feed and water. Promptly clean up all leaks and spills. Water supplies should be checked for freezing. Many animals have died of thirst during the winter even with abundant water sources, because they could not drink the water as it was frozen solid. If gritty material is spread on floors to prevent slipping, use only approved non-toxic materials. Recently a farmer mistakenly used Furadan, a fungicide for this purpose by mistake. Several cows that had licked it off the floor died.

Farms can be insured against catastrophic events. Insurance policies are available for replacement of materials damaged, repair work for recovery, boarding of occupants and animals if evacuated, lost production, and relocation. These should be investigated and purchased before the disaster threatens. For a farmer to claim compensation for lost production, which in many cases is the largest economic cost during a disaster, the farmer must have substantial records that document the level of production his/her herd has achieved in previous years. This is generally only successful in herds with recognised herd monitoring programs, such as Dairy Herd Improvement or other programs that are available for various species. To verify the validity of these records a herd health program should be in place, which is based on a valid veterinarian-client-animal relationship. A copy of all production

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records should be kept in a secure place that the details are not lost during the disaster. Many veterinarians are willing to keep copies of their clients' production records, if these are computerized and space efficient.

Fodder Crops

FODDER CROPS are crops that are cultivated primarily for animal feed. By extension, natural grasslands and pastures are included whether they are cultivated or not.

Fodder crops may be classified as either temporary or permanent crops. The former are cultivated and harvested like any other crop. Permanent fodder crops relate to land used permanently (for five years or more) for herbaceous forage crops, either cultivated or growing wild (i.e. wild prairie or grazing land), and may include some parts of forest land if it is used for grazing.

Temporary crops that are grown intensively with multiple cuttings per year include three major groups of fodder: grasses, including cereals that are harvested green; legumes, including pulses that are harvested green; and root crops that are cultivated for fodder. All three types are fed to animals, either as green feed, as hay, i.e. crops harvested dry or dried after harvesting, or as silage products. Silage, or ensilage, refers to green fodder preserved without drying by fermentation that retards spoiling. Some fodder crops are components of compound feeds.

Grasses contain crude fibres, crude protein and some minerals. Legumes are particularly rich in proteins and minerals. Root crops are high in starch and sugar and low in fibre, making them easy to digest. The fibre content of most fodder crops consists of cellulose, a complex carbohydrate polysaccharide that is indigestible for humans, but which is a good source of energy for animals, and particularly ruminants.

For reporting purposes, the aggregation of various fodder crops into "feed units" is expressed in different ways in different countries. For example, aggregations are reported in terms of metabolizable energy, digestible nutrients, starch equivalent, protein equivalent, or grain equivalent. The FAO list includes 17 primary crops. The code and name of each crop appears in the list that follows, along with its botanical name, or names, and a brief remark where necessary.

PRODUCTS USED FOR ANIMAL FEED include: processed products from fodder crops; waste and residue; manufactured compound feeds, consisting of various mixed feeds of vegetal and animal origin to which minerals and vitamins have been added; and chemical preparations, such as vitamins and minerals and various additives.

Maize for Forage

Maize is a domesticated form of a wild grass, first cultivated over 5,000 years ago in tropical Mexico that produces an adaptable and productive grain. It has been inextricably linked with the rise of the South American civilizations and following their conquest by the Spanish, it was exported around the world. It was introduced to the UK in the early part of the twentieth century.

Today the bulk of maize production occurs in the US, China and Brazil. In the more

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northerly climates like that of the UK where there is insufficient summer warmth to ripen the crop, maize is grown largely for forage. Here it has become an important crop being the most important forage after grass with around 100,000 hectares grown annually, mainly in the south of the country. Nearly all is ensiled to produce a quality, high-energy silage that complements grass silage for the winter feeding of livestock.

Maize is a plant of sub-tropical origin that requires warm soil temperatures and photosynthesises in a different way to other UK crops. Known as the C4 pathway, the trait provides useful diversity for the farmer; maize responds to warm dry conditions, whereas grass does not. Forage maize is relatively easy to grow and being drought tolerant is a consistent provider of high yields with minimum input from the farmer. From a practical point of view, forage maize also spreads the silage making season – maize is ensiled in September or October, long after most grass silage making has finished.

As a crop, forage maize has further advantages on the farm. Its late drilling date in early May provides the farmer with an area onto which he can spread the accumulated manure of the winter without damage. However, forage maize is not completely without its difficulties being low in both protein and minerals and as a crop sometimes difficult to fit into the cropping rotation.

Although a good cleaning crop once it is established, maize is not very tolerant of weed competition during early growth and so a herbicide programme is important. The residual herbicide atrazine has been a mainstay of maize weed control for some time however, this has now been superceded and a range of maize herbicides are now available to cover the spectrum of broadleaved weed attack. Most current varieties require established populations of around 100,000 plants per hectare, usually being precision drilled in rows 75cm apart. Drilling depth is just as important as timing and ideally should be between 3 and 6cm, reserving shallower depth for heavier soils.

The harvesting window for maize is wider than for grass silage as maize holds its digestibility as a forage for longer. A good crop will typically yield between 30 and 50 tonnes of fresh matter per hectare (between 9 tand 15 tonnes of dry matter at 30% moisture content). Maize produces palatable silage that livestock like but which also produces much less effluent than grass. For farmers near watercourses this significantly reduces the environmental risks of effluent pollution.

Forage Sorghum

Animal feeding is one of the most important markets for sorghum production. Sorghum is utilised in the nutrition of dairy and beef cattle as well as swine and poultry. The grain, stalks and leaves are all animal feeding products.

Sorghum is a genus of grasses with about 30 species, one of which is raised for grain and many of which are used as fodder plants, either cultivated or as part of pasture. The plants are cultivated in warm climates worldwide. They are native to the tropics and subtropics of the Old World and one species is endemic to Mexico, a number have been introduced into other parts of the world. *Sorghum* is in the subfamily Panicoideae and the tribe of Andropogoneae.

One species, *Sorghum bicolour*, native to Africa with many cultivated forms now, is an

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important crop worldwide, used for food (as grain and in sorghum syrup or "sorghum molasses"), fodder, the production of alcoholic beverages, and biofuels. Most varieties are drought- and heat-tolerant, and are especially important in arid regions, where the grain is one of the staples for poor and rural people. These varieties form important components of pastures in many tropical regions. *Sorghum bicolour* is an important food crop in Africa, Central America, and South Asia and is the "fifth most important cereal crop grown in the world".

Some species of sorghum can contain levels of hydrogen cyanide, hordenine and nitrates lethal to grazing animals in the early stages of the plant's growth. When stressed by drought or heat, plants can also contain toxic levels of cyanide and/or nitrates at later stages in growth.

Sorghum vulgare var. *technicum* is commonly called broomcorn. An annual grass like other Sorghums, it grows 6 to 15 feet tall, although dwarf varieties are only 3 to 7 feet in height. The upper peduncle is normally 8 to 18 in long, topped by a branched inflorescence or panicle which originate the seed-bearing fibres. The fibres are usually 12 to 24 inches long but can be up to 36 inches long; they are branched toward the tip where the flowers and seed grow. The seeds weigh about 30,000/pound, with feed value similar to oats. A ton of the fibrous panicle makes 900 to 1200 brooms.

Livestock aren't the only animals benefiting from sorghum. The pet food industry is utilising sorghum in their products, too. Although this niche market is relatively small compared to the larger livestock markets, sorghum does provide a cost competitive and nutritious feed ingredient for pet food companies, who are using the grain for carbohydrate blends in dog and cat foods.

Sorghum is also used in bird seed. The large red or white grain provides a high quality ingredient for bird seed companies.

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Chapter 3 : Economic Importance of Livestock in Vulnerable Zones

Livestock have an image problem in the developed world. They are blamed for everything from global warming to increasing heart disease. Britain's 'mad cow disease' - or bovine spongiform encephalopathy - hasn't helped. Livestock are seen as wasteful, growing fat on grain that people could eat and polluting the environment with their faeces and urine and the gases they give off. But these charges are not true of livestock in the developing world. True, ruminants produce methane gas, one of the 'greenhouse gases' - but methane from ruminants accounts for only some 2.5 percent of the total greenhouse gases. Pastures grown to feed livestock take carbon dioxide out of the atmosphere, tying it up in plant material above and below the ground, just as forests do.

True, eating too many animal products may increase the risk of heart disease - but this is a problem of the developed world, not the developing world. People in developing countries generally eat much less meat than those in the developed world, and the meat they eat is less fatty. Indeed, recent studies from Kenya, Egypt and Mexico show that children who do not get enough meat and milk in their diets may grow up physically and mentally compromised.

Livestock play a vital role in the agricultural and rural economies of the developing world. Not only do they produce food directly, they also provide key inputs to crop agriculture. Most farms in the developing world are too small to justify owning or using a tractor, and the alternatives are animal power or human labour.

For many smallholder farmers, livestock are the only ready source of cash to buy inputs for crop production - seeds, fertilizers and pesticides. Livestock income also goes towards buying things the farmers cannot make for themselves. And that includes paying for school fees, medicine and taxes. Income from cropping is highly seasonal. In contrast, small stock, with their high rates of reproduction and growth, can provide a regular source of income from sales. So can milk and milk products like butter and cheese. Larger animals such as cattle are a capital reserve, built up in good times to be used when crops are poor or when the family is facing large expenses such as the cost of a wedding or a hospital bill.

In the past, farmers could restore the fertility of their land by letting it lie fallow for several years or longer. But as population pressure increases, fallow periods decline or even disappear and different ways of maintaining food production are needed: enter the animal.

Animals are a crucial link in nutrient cycles, returning nutrients to the soil in forms that plants can readily use. They can bring nutrients from pasture and rangeland and concentrate them on crop land through their manure and urine. The animal manure and urine that people in the developed world see as pollutants are vital fertilizers in the developing world. Few smallholders can afford enough mineral fertilizers. Animals give farmers a reason to plant legumes as pastures and cover crops that protect the soil and restore its structure and fertility. According to a Winrock report in 1992, 'The greatest threat to [the African rangelands] comes from human populations and expansion of cultivation. There is no solid evidence linking livestock to this process [desertification].'

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Increasing the productivity of livestock systems and mixed crop-livestock systems motivates farmers to protect their rangelands and use them sustainably for raising livestock rather than putting them to the plough.

Productive livestock can add value to 'idle' land. Already, in many parts of the world mixed crop-livestock systems are the norm, but the importance of the livestock component has been overlooked. Even the language we use tends to reinforce this. When we talk about the non-grain parts of cereal crops, we tend to use terms like 'crop residues' or 'by-products'. Yet in many farming systems, such as the barley-sheep system of the drier parts of West Asia and North Africa and the tef-based system in the Ethiopian highlands, the farmers value these 'by-products' as much as, if not more, than the grain. 'Improved' varieties or production packages that overlook the feeding value of these 'residues' will find little favour with the majority of farmers.

Intensive animal production in the developed world uses resources that could serve direct human uses - grain that could be eaten by people, land that could produce food crops, electricity that could illuminate and heat people's homes. But in the developing world livestock add value to resources that would otherwise go to waste. Marginal land that cannot — and indeed should not — be ploughed; straw, stovers, groundnut haulm, household wastes, all go to feeding livestock in smallholder systems. Cassava peel, for example, feeds goats in humid West Africa. In Syria farmers allow weeds to grow in their cereal fields and then 'rogue' them to feed to their sheep. The weeds slightly reduce cereal grain yields, but the productivity of the system as a whole is higher than if they sprayed herbicides to control the weeds. And the environment is protected.

Feed and Fodder Requirement and Availability

Animal feed is food given to domestic animals in the course of animal husbandry. There are two basic types, *fodder* and *forage*. Used alone, the word "feed" more often refers to fodder.

Fodder

"Fodder" refers particularly to food given to the animals (including plants cut and carried to them), rather than that which they forage for themselves. It includes hay, straw, silage, compressed and pelleted feeds, oils and mixed rations, and sprouted grains and legumes. Feed grains are the most important source of animal feed globally. The amount of grain used to produce the same unit of meat varies substantially. According to an estimate reported by the BBC in 2008, "Cows and sheep need 8kg of grain for every 1kg of meat they produce, pigs about 4kg. The most efficient poultry units need a mere 1.6kg of feed to produce 1kg of chicken." Farmed fish can also be fed on grain, and use even less than poultry. The two most important feed grains are maize and soyabean, and the United States is by far the largest exporter of both, averaging about half of the global maize trade and 40% of the global soya trade in the years leading up the 2012 drought. Other feed grains include wheat, oats, barley, and rice, among many others.

Traditional sources of animal feed include household food scraps and the byproducts of food processing industries such as milling and brewing. Scraps fed to pigs are called slop, and those fed to chicken are called chicken scratch. Brewer's spent grain is a byproduct of

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beer making that is widely used as animal feed.

Figure: *A pelleted ration designed for horses*

"Compound feed" is fodder that is blended from various raw materials and additives. These blends are formulated according to the specific requirements of the target animal. They are manufactured by feed compounders as *meal type*, *pellets* or *crumbles*. The main ingredients used in commercially prepared feed are the feed grains, which include corn, soybeans, sorghum, oats, and barley. Corn production was valued at nearly $25 billion in 2003, while soybean production was valued at $17.5 billion. Roughly 66 percent of sorghum production, which was valued at $965 million in 2003, is used as livestock feed. Approximately 60 percent of barley production, which totaled 227 million bushels (4,610,000 metric tons) and was valued at $765 million in 2003, is used as livestock feed. Annual oat production in 2003 was valued at $218 million.

Compound feed may also include premixes, which may also be sold separately. Premixes are composed of microingredients such as vitamins, minerals, chemical preservatives, antibiotics, fermentation products, and other essential ingredients that are purchased from premix companies, usually in sacked form, for blending into commercial rations. Because of the availability of these products, a farmer who uses his own grain can formulate his own rations and be assured his animals are getting the recommended levels of minerals and vitamins.

According to the American Feed Industry Association, as much as $20 billion worth of feed ingredients are purchased each year. These products range from grain mixes to orange rinds to beet pulps. The feed industry is one of the most competitive businesses in the agricultural sector, and is by far the largest purchaser of U.S. corn, feed grains, and soybean meal. Tens of thousands of farmers with feed mills on their own farms are able to compete with huge conglomerates with national distribution. Feed crops generated $23.2 billion in cash receipts on U.S. farms in 2001. At the same time, farmers spent a total of $24.5 billion on feed that year.

In 2011, around 734.5 million tons of feed were produced annually around the world.

History

The beginning of industrial-scale production of animal feeds can be traced back to the late 19th century, around the time advances in human and animal nutrition were able to

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identify the benefits of a balanced diet, and the importance of the role processing of certain raw materials played. Corn gluten feed was first manufactured in 1882, while leading world feed producer Purina Feeds was established in 1894 by William Hollington Danforth. Cargill, which was mainly dealing in grains from its beginnings in 1865, started to deal in feed at about 1884.

The feed industry expanded rapidly in the first quarter of the 20th century, with Purina expanding its operations into Canada, and opened its first feed mill in 1927 (which is still in operation). In 1928, the feed industry was revolutionized by the introduction of the first pelleted feeds - Purina Checkers.

Manufacture

The job of the feed manufacturer is to buy the commodities and blend them in the feed mill according to the specifications outlined by the animal nutritionist. There is little room for error because, if the ration is not apportioned correctly, lowered animal production and diminished outward appearance can occur.

Asia

The world's largest feed manufacturer is the CP Group Thailand, producing 18 million tonnes of compound feed at various locations across East Asia.

Europe

The merge of the Hamburg-based traditional commodity trade firm, Cremer, and the Düsseldorf based Deuka (Deutsche Kraftfutterwerke), led to one of the largest feed companies in Europe. The new Cremer Group produces around 3.5 million tons. BOCM Pauls in the UK produces around the same amount if not more.

United States

Leading U.S. companies involved in prepared feeds production in the early first decade of the 21st century included ConAgra Inc., an Omaha, Nebraska-based firm; and Cargill, Incorporated, a diversified company that was the nation's top exporter of grain. In 1998, Ralston Purina Company, based in St. Louis, Missouri, formed Agribrands International, Inc. to control its international animal feed and agricultural products division. Agribrands produced feed and other products for livestock in markets outside of the United States, and had about 75 facilities operating in 16 countries. In 2001, it was acquired by Cargill. Other significant industry players included Conti Group Companies, Inc., the world's leading cattle feeder; CHS, Inc. (previously known as Cenex Harvest States Cooperative), which was primarily involved in grain trading; and Farmland Industries, Inc., the leading agricultural cooperative in the United States. Farmland was a worldwide exporter of products, such as grain. In May 2002, the firm declared bankruptcy, and in the following year, Smithfield Foods acquired most of Farmland's assets.

Forage

"Forage" is plant material (mainly plant leaves and stems) eaten by grazing livestock. Historically, the term *forage* has meant only plants eaten by the animals directly as pasture, crop residue, or immature cereal crops, but it is also used more loosely to include similar plants cut for fodder and carried to the animals, especially as hay or silage.

Diseases

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E. coli

Escherichia coli, although considered to be part of the normal gut flora for many mammals (including humans), has many strains. Strain *E. coli* 0157:H7 is associated with human illness (and sometimes death) as a foodborne illness. A study by Cornell University has determined that grass-fed animals have as much as eighty percent less of this strain of *E. coli* in their guts than their grain-fed counterparts, though this reduction can be achieved by switching an animal to grass only a few days prior to slaughter. Also, the amount of *E. coli* they do have is much less likely to survive our first-line defence against infection: stomach acid. This is because feeding grain to cattle makes their normally pH-neutral digestive tract abnormally acidic; over time, the pathogenic *E. coli* becomes acid resistant. If humans ingest this acid-resistant *E. coli* via grain-feed beef, a large number of them may survive past the stomach, causing an infection. A study by the USDA Meat and Animal Research Centre in Lincoln Nebraska (2000) has confirmed the Cornell research.

BSE (Mad Cow Disease)

Meat and bone meal can be a risk factor for bovine spongiform encephalopathy (BSE), when healthy animals consume tainted tissues from infected animals. People concerned about Creutzfeld-Jacob disease (CJD), which is also a spongiform encephalopathy, may favour grass-fed cattle for this reason. In the United States, this risk is relatively low as feeding of protein sources from any ruminant to another ruminant has been banned since 1997. The problem becomes more complicated as other feedstuffs containing animal by-products are still allowed to be fed to other non-ruminants (chickens, cats, dogs, horses, pigs, etc.). Therefore, at a feed mill mixing feed for pigs, for instance, there is still the possibility of cross-contamination of feed going to cattle. Since only a tiny amount of the contaminating prion begins the cascading brain disease, any amount of mixed feed could cause many animals to become infected. This was the only traceable link among the cattle with BSE in Canada that led to the recent US embargo of Canadian beef. No cases of BSE have been reported so far in Australia. This is largely due to Australia's strict quarantine and bio-security rules that prohibit beef imports from countries known to be infected with BSE.

However, according to a report filed in the Australian, on February 25, 2010, those rules were suddenly relaxed and the process to submit beef products from known BSE-infected countries was allowed (pending an application process). But less than a week later, Tony Burke, the Australian Minister For Agriculture, Fisheries and Forestry swiftly overturned the decision and placed a 'two year stop' on all fresh and chilled beef products destined for Australia from BSE known countries of origin, thereby relaxing fears held by Australians that contaminated US beef would find its way onto Australian supermarket shelves after a long absence.

Soybean meal is cheap and plentiful in the United States. As a result, the use of animal byproduct feeds was never common, as it was in Europe. However, U.S. regulations only partially prohibit the use of animal byproducts in feed. In 1997, regulations prohibited the feeding of mammalian byproducts to ruminants such as cattle and goats. However, the byproducts of ruminants can still be legally fed to pets or other livestock such as pigs and poultry such as chickens. In addition, it is legal for ruminants to be fed byproducts from some of these animals. A proposal to end the use of cow blood, restaurant scraps, and poultry litter (fecal matter, feathers) in January 2004 has yet to be implemented, despite the efforts of some

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advocates of such a policy, who cite the fact that cattle are herbivores, and that blood and fecal matter could potentially carry BSE.

In February 2001, the USGAO reported that the FDA, which is responsible for regulating feed, had not adequately policed the various bans. Compliance with the regulations was shown to be extremely poor before the discovery of the Washington cow, but industry representatives report that compliance is now 100%. Even so, critics call the partial prohibitions insufficient. Indeed, US meat producer Creekstone Farms alleges that the USDA is preventing BSE testing from being conducted.

Campylobacter

Campylobacter, a bacterium that can cause another foodborne illness resulting in nausea, vomiting, fever, abdominal pain, headache and muscle pain was found by Australian researchers to be carried by 58% of cattle raised in feed lots versus only 2% of pasture raised and finished cattle.

Bovine Leukemia Virus

Bovine leukemia virus (BLV) is insect-borne and found in 20% of US cattle, and 60% of US herds. Studies in Sweden and the Soviet Union have linked BLV outbreaks and increases in human leukemia. BLV and HTLV-1 share a common gene, HTLV-1 is the first human retrovirus ever shown to cause cancer.

Environmental Concerns

In arid climates such as the Southwestern United States, livestock grazing has severely degraded riparian areas, the wetland environment adjacent to rivers or streams. People have long recognised that riparian zones and rivers are the lifeblood of the western landscape, being more productive and home to more plants and animals than any other type of habitat. Scientists refer to riparian zones as hot spots of biodiversity, a characterization that is particularly apparent in arid and semiarid environments (like Nevada, where over 80% of the 300 represented terrestrial wildlife species are "directly dependent on riparian habitat"), where such zones may be the only tree-dominated ecosystems in the landscape. The presence of water, increased productivity, favourable microclimate, and periodic flood events combine to create a disproportionately higher biological diversity than that of the surrounding uplands.

"According to the Arizona state park department, over 90% of the original riparian zones of Arizona and New Mexico are gone". A 1988 report of the GAO was equally grim, estimating that 90% of the 5,300 miles of riparian habitat managed by the BLM in Colorado was in unsatisfactory condition, as was 80% of Idaho's riparian zones, concluding that "poorly managed livestock grazing is the major cause of degraded riparian habitat on federal rangelands."

Grass fed beef hides the controversial and heavy use of human sewage sludge by ranchers in the beef industry. Science has cited being more cautious and reevaluating the practice that was first legalized in 1992. There are new emerging toxic pollutants that could contaminate beef that ultimately end up on USA dinner plates.

Taste

The cow's diet affects the flavour of the resultant meat and milk. A 2003 Colorado State University study found that 80% of consumers in the Denver-Colorado area preferred the taste of United States corn-fed beef to Australian grass-fed beef, and negligible difference in taste preference compared to Canadian barley-fed beef, though the cattle's food was not the

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only difference in the beef tested, nor is Denver as representative sample of the world beef market, so the results are inconclusive. Grass-fed beef is not standardized. Most is leaner than conventional feedlot beef, but some is equally marbled due to carefully managed grazing, excellent pastures, and improved genetics. Another technique for producing well-marbled grass-fed cattle is to keep the animals on pasture for two years or more. Most pasture-based ranchers dry-age the beef for 7–21 days, enhancing the flavour and tenderness of the meat. Remarkably, in some circumstances, cattle are fed wine or beer. It is believed that this improves the taste of the beef. This technique has been used both in Japan and France.

Hay

Hay is grass, legumes or other herbaceous plants that have been cut, dried, and stored for use as animal fodder, particularly for grazing livestock such as cattle, horses, goats, and sheep. Hay is also fed to pets such as rabbits and guinea pigs. Pigs may be fed hay, but they do not digest it as efficiently as more fully herbivorous animals.

Hay can be used as animal fodder when or where there is not enough pasture or rangeland on which to graze an animal, when grazing is unavailable due to weather (such as during the winter) or when lush pasture by itself is too rich for the health of the animal. It is also fed during times when an animal is unable to access pasture, such as when animals are kept in a stable or barn.

Composition

Commonly used plants for hay include mixtures of grasses such as ryegrass (*Lolium* species), timothy, brome, fescue, Bermuda grass, orchard grass, and other species, depending on region. Hay may also include legumes, such as alfalfa (lucerne) and clovers (red, white and subterranean). Other pasture forbs are also sometimes a part of the mix, though other than legumes, which ideally are cut pre-bloom, forbs are not necessarily desired. Certain forbs are toxic to some animals. Oat, barley, and wheat plant materials are occasionally cut green and made into hay for animal fodder; however they are more usually used in the form of straw, a harvest byproduct where the stems and dead leaves are baled after the grain has been harvested and threshed. Straw is used mainly for animal bedding. Although straw is also used as fodder, particularly as a source of dietary fibre, it has lower nutritional value than hay.

It is the leaf and seed material in the hay that determines its quality. Farmers try to harvest hay at the point when the seed heads are not quite ripe and the leaf is at its maximum when the grass is mowed in the field. The cut material is allowed to dry so that the bulk of the moisture is removed but the leafy material is still robust enough to be picked up from the ground by machinery and processed into storage in bales, stacks or pits.

Hay is very sensitive to weather conditions, particularly when it is harvested. In drought conditions, both seed and leaf production are stunted, making hay that has a high ratio of dry coarse stems that have very low nutritional values. If the weather is too wet, the cut hay may spoil in the field before it can be baled. The hay may also develop rot and mold after being baled, creating the potential for toxins to form in the feed, which could make the animals sick. It also has to be stored in a manner to prevent it from getting wet. Mold and spoilage reduce nutritional value and may cause illness in animals. A symbiotic fungus in fescue may cause illness in horses and cattle.

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Figure: *Close view of loose grass hay.*

The successful harvest of maximum yields of high-quality hay is entirely dependent on the coincident occurrence of optimum crop, field, and weather conditions. When this occurs, there may be a period of intense activity on the hay farm while harvest proceeds until weather conditions become unfavourable.

Feeding Hay

Figure: *Horses eating hay*

Hay or grass is the foundation of the diet for all grazing animals and can provide as much as 100% of the fodder required for an animal. Hay is usually fed to an animal in place of allowing the animal to graze on grasses in a pasture, particularly in the winter or during times when drought or other conditions make pasture unavailable. Animals that can eat hay vary in the types of grasses suitable for consumption, the ways they consume hay, and how they digest it. Therefore, different types of animals require hay that consists of similar plants to what they would eat while grazing, and likewise, plants that are toxic to an animal in pasture are also toxic if they are dried into hay.

Most animals are fed hay in two daily feedings, morning and evening. However, this schedule is more for the convenience of humans, as most grazing animals on pasture naturally consume fodder in multiple feedings throughout the day. Some animals, especially those being raised for meat, may be given enough hay that they simply are able to eat all day. Other animals, especially those that are ridden or driven as working animals, are only free to eat

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when not working, and may be given a more limited amount of hay to prevent them from getting too fat. The proper amount of hay and the type of hay required varies somewhat between different species. Some animals are also fed concentrated feeds such as grain or vitamin supplements in addition to hay. In most cases, hay or pasture forage must make up 50% or more of the diet by weight.

One of the most significant differences in hay digestion is between ruminant animals, such as cattle and sheep; and nonruminant, hindgut fermentors, such as horses. Both types of animals can digest cellulose in grass and hay, but do so by different mechanisms. Because of the four-chambered stomach of cattle, they are often able to break down older forage and have more tolerance of mold and changes in diet. The single-chambered stomach and cecum or "hindgut" of the horse uses bacterial processes to break down cellulose that are more sensitive to changes in feeds and the presence of mold or other toxins, requiring horses to be fed hay of a more consistent type and quality.

Different animals also use hay in different ways: cattle evolved to eat forages in relatively large quantities at a single feeding, and then, due to the process of rumination, take a considerable amount of time for their stomachs to digest food, often accomplished while the animal is lying down, at rest. Thus quantity of hay is important for cattle, who can effectively digest hay of low quality if fed in sufficient amounts. Sheep will eat between two and four percent of their body weight per day in dry feed, such as hay, and are very efficient at obtaining the most nutrition possible from three to five pounds per day of hay or other forage. They require three to four hours per day to eat enough hay to meet their nutritional requirements.

Unlike ruminants, horses digest food in small portions throughout the day, and can only use approximately 2.5% of their body weight in feed in any 24-hour period. They evolved to be continuously on the move while grazing, (covering up to 50 miles (80 km) per day in the wild) and their stomach digests food quite rapidly. Thus, they extract more nutrition out of smaller quantities of feed.

However, when horses are fed low-quality hay, they may develop an unhealthy, obese, "hay belly" due to over-consumption of "empty" calories. If their type of feed is changed dramatically, or if they are fed moldy hay or hay containing toxic plants, they can become ill; colic is the leading cause of death in horses. Contaminated hay can also lead to respiratory problems in horses. Hay can be soaked in water, sprinkled with water or subjected to steaming to reduce dust.

Making and Transporting Hay

Hay production and harvest, colloquially known as "making hay", "haymaking", or "doing hay", involves a multiple step process: cutting, drying or "curing", processing, and storing. Hayfields do not have to be reseeded each year in the way that grain crops are, but regular fertilizing is usually desirable, and overseeding a field every few years helps increase yield. Methods and the terminology to describe the steps of making hay have varied greatly throughout history, and many regional variations still exist today. However, whether done by hand or by modern mechanized equipment, tall grass and legumes at the proper stage of maturity must be cut, then allowed to dry (preferably by the sun), then raked into long, narrow piles known as windrows. Next, the cured hay is gathered up in some form (usually by some type of baling process) and placed for storage into a haystack or into a barn or shed

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to protect it from moisture and rot.

During the growing season, which is spring and early summer in temperate climates, grass grows at a fast pace. It is at its greatest nutritive value when all leaves are fully developed and seed or flower heads are just a bit short of full maturity. When growth is at a maximum in the pasture, if judged correctly, the pasture is cut. Hay cut too early will not cure as easily due to high moisture content, plus it will produce a lower yield per acre than longer, more mature grass. But hay cut too late is coarser, lower in resale value and has lost some of its nutrients. There is usually about a two-week "window" of time in which hay is at its ideal stage for harvesting.

Hay can be raked into rows as it is cut, then turned periodically to dry, particularly if a modern swather is used. Or, especially with older equipment or methods, the hay is cut and allowed to lie spread out in the field until it is dry, then raked into rows for processing into bales afterwards. During the drying period, which can take several days, the process is usually sped up by turning the cut hay over with a hay rake or spreading it out with a tedder. If it rains while the hay is drying, turning the windrow can also allow it to dry faster. However, turning the hay too often or too roughly can also cause drying leaf matter to fall off, reducing the nutrients available to animals. Drying can also be sped up by mechanized processes, such as use of a hay conditioner, or by use of chemicals sprayed onto the hay to speed evaporation of moisture, though these are more expensive techniques, not in general use except in areas where there is a combination of modern technology, high prices for hay, and too much rain for hay to dry properly.

Once hay is cut, dried and raked into windrows, it is usually gathered into bales or bundles, then hauled to a central location for storage. In some places, depending on geography, region, climate, and culture, hay is gathered loose and stacked without being baled first.

Hay must be fully dried when baled and kept dry in storage. If hay is baled while too moist or becomes wet while in storage, there is a significant risk of spontaneous combustion. Hay stored outside must be stacked in such a way that moisture contact is minimal. Some stacks are arranged in such a manner that the hay itself "sheds" water when it falls. Other methods of stacking use the first layers or bales of hay as a cover to protect the rest. To completely keep out moisture, outside haystacks can also be covered by tarps, and many round bales are partially wrapped in plastic as part of the baling process. Hay is also stored under a roof when resources permit. It is frequently placed inside sheds, or stacked inside of a barn. On the other hand, care must also be taken that hay is never exposed to any possible source of heat or flame, as dry hay and the dust it produces are highly flammable.

Early Methods

Early farmers noticed that growing fields produced more fodder in the spring than the animals could consume, and that cutting the grass in the summer, allowing it to dry and storing it for the winter provided their domesticated animals with better quality nutrition than simply allowing them to dig through snow in the winter to find dried grass. Therefore, some fields were "shut up" for hay.

Up to the end of the 19th century, grass and legumes were not often grown together because crops were rotated. However, by the 20th century, good forage management techniques demonstrated that highly productive pastures were a mix of grasses and legumes,

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so compromises were made when it was time to mow. Later still, some farmers grew crops, like straight alfalfa (lucerne), for special-purpose hay such as that fed to dairy cattle.

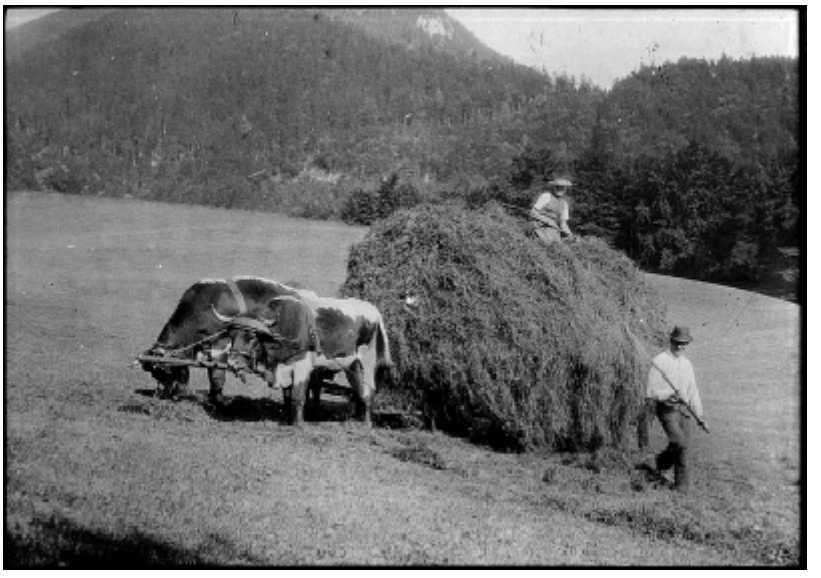

Figure: *July 1903 - on the Gaisberg, near Salzburg*

Much hay was originally cut by scythe by teams of workers, dried in the field and gathered loose on wagons. Later, haying would be done by horse-drawn implements such as mowers. With the invention of agricultural machinery such as the tractor and the baler, most hay production became mechanized by the 1930s.

After hay was cut and had dried, the hay was raked or *rowed up* by raking it into a linear heap by hand or with a horse-drawn implement. Turning hay, when needed, originally was done by hand with a fork or rake. Once the dried hay was rowed up, pitch forks were used to pile it loose, originally onto a horse-drawn cart or wagon, later onto a truck or tractor-drawn trailer, for which a sweep could be used instead of pitch forks.

Loose hay was taken to an area designated for storage—usually a slightly raised area for drainage—and built into a hay stack. The stack was made waterproof as it was built (a skilled task) and the hay would compress under its own weight and cure by the release of heat from the residual moisture in the hay and from the compression forces. The stack was fenced from the rest of the paddock in a *rick yard*, and often thatched or sheeted to keep it dry. When needed, slices of hay would be cut using a hay knife and fed out to animals each day. On some farms the loose hay was stored in a barrack, shed, or barn, normally in such a way that it would compress down and cure. Hay could be stored in a specially designed barn with little internal structure to allow more room for the hay loft. Alternatively, an upper storey of a cow-shed or stable was used, with hatches in the floor to allow hay to be thrown down into hay-racks below.

Depending on region, the term “hay rick” could refer to the machine for cutting hay, the hay stack or the wagon used to collect the hay.

Modern Mechanized Techniques

Modern mechanized hay production today is usually performed by a number of machines. While small operations use a tractor to pull various implements for mowing and raking, larger operations use specialised machines such as a mower or a swather, which are designed to cut the hay and arrange it into a windrow in one step. Balers are usually pulled by a tractor, with larger balers requiring more powerful tractors.

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Mobile balers, machines which gather and bale hay in one process, were first developed around 1940. The first balers produced rectangular bales small enough for a person to lift, usually between 70 and 100 pounds (32 and 45 kg) each. The size and shape made it possible for people to pick bales up, stack them on a vehicle for transport to a storage area, then build a haystack by hand. However, to save labour and increase safety, loaders and stackers were also developed to mechanise the transport of small bales from the field to the haystack. Later in the 20th century, balers were developed capable of producing large bales that weigh up to 3,000 pounds (1,400 kg).

Conditioning of hay has become popular. The basic idea is that it decreases drying time, particularly in humid climates or if rain interferes with haying. Usually, a salt solution is sprayed over the top of the hay (generally alfalfa) that helps to dry the hay. Conditioning can also refer to the rollers inside a swather that crimps the alfalfa to help squeeze out the moisture.

Fertilization and Weed Control

Modern hay production often relies on artificial fertilizer and herbicides. Traditionally, manure has been used on hayfields, but modern chemical fertilizers are used today as well. Hay that is to be certified as weed-free for use in wilderness areas must often be sprayed with chemical herbicides to keep unwanted weeds from the field, and sometimes even non-certified hayfields are sprayed to limit the production of noxious weeds.

However, organic forms of fertilization and weed control are required for hay grown for consumption by animals whose meat will ultimately be certified organic. To that end, compost and field rotation can enhance soil fertility, and regular mowing of fields in the growth phase of the hay will often reduce the prevalence of undesired weeds. In recent times, some producers have experimented with human sewage sludge to grow hay. This is not a certified organic method and no warning labels are mandated by EPA. One concern with hay grown on human sewage sludge is that the hay can uptake heavy metals, which are then consumed by animals.

Molybdenum poisoning is a particular concern in ruminants such as cows and goats, and there have been animal deaths. Another concern is with a herbicide known as aminopyralid, which can pass through the digestive tract in animals, making their resulting manure toxic to many plants and thus unsuitable as fertilizer for food crops. Aminopyralid and related herbicides can persist in the environment for several years.

Baling

Small bales: Small bales are still produced today. While balers for small bales are still manufactured, as well as loaders and stackers, there are some farms that still use equipment manufactured over 50 years ago, kept in good repair. The small bale remains part of overall ranch lore and tradition with “hay bucking” competitions still held for fun at many rodeos and county fairs.

Small bales are stacked in a criss-crossed fashion sometimes called a “rick” or “hayrick”. Since rain washes nutrition out of the hay and can cause spoilage or mold, hay in small bales is often stored in a hayshed or protected by tarpaulins. If this is not done, the top two layers of the stack are often lost to rot and mold, and if the stack is not arranged in a proper hayrick, moisture can seep even deeper into the stack.

People who own small numbers of livestock, particularly horses, still prefer small bales

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that can be handled by one person without machinery. There is also a risk that hay bales may be moldy, or contain decaying carcasses of small creatures that were accidentally killed by baling equipment and swept up into the bale, which can produce toxins such as botulism. Both can be deadly to nonruminant herbivores, such as horses, and when this occurs, the entire contaminated bale generally is thrown out, another reason some livestock owners continue to support the market for small bales.

Large Bales: Many farmers, particularly those who feed large herds, have moved to balers which produce much larger bales, maximizing the amount of hay which is protected from the elements. Large bales come in two types, round and square. "Large Square" bales, which can weigh up to 1,000 kilograms (2,200 lb), can be stacked and are easier to transport on trucks. Round bales, which typically weigh 300 to 400 kilograms (660–880 lb), are more moisture-resistant, and pack the hay more densely (especially at the centre). Round bales are quickly fed with the use of mechanized equipment.

The ratio of volume to surface area makes it possible for many dry-area farmers to leave large bales outside until they are consumed. Wet-area farmers and those in climates with heavy snowfall either stack round bales under a shed or tarp, but have also developed a light but durable plastic wrap that partially encloses bales left outside. The wrap repels moisture, but leaves the ends of the bale exposed so that the hay itself can "breathe" and does not begin to ferment. However, when possible to store round bales under a shed, they last longer and less hay is lost to rot and moisture.

Haylage

For animals that eat silage, a bale wrapper may be used to seal a round bale completely and trigger the fermentation process. It is a technique used as a money-saving process by producers who do not have access to a silo, and for producing silage that is transported to other locations. However, a silo is still a preferred method for making silage. In very damp climates, it is a legitimate alternative to drying hay completely and when processed properly, the natural fermentation process prevents mold and rot. Round bale silage is also sometimes called "haylage", and is seen more commonly in Europe than in either the USA or Australia. However, hay stored in this fashion must remain completely sealed in plastic, as any holes or tears can stop the preservation properties of fermentation and lead to spoilage.

Haystacks

Haystacks are stacks of harvested hay, stacked in many different ways, depending upon region of the world, climate, if baled or loose, and so on. Hay requires protection from weather, and is optimally stored inside buildings or other structures, but haystacks are also built in an open field. A fence may be built to enclose a haystack and prevent roaming livestock from eating it, or livestock may feed directly from a field-constructed stack as part of their winter feeding.

Loose Hay Stacking

Loose stacks are built to prevent accumulation of moisture and promote drying, or curing. In some places, this is accomplished by constructing stacks with a conical or ridged top. The exterior may look gray on the surface after weathering, but the inner hay retains traces of its fresh-cut aroma and maintains a faded green tint. They can be covered with thatch, or kept within a protective structure. One such structure is a moveable roof supported by four posts, historically called a Dutch roof, hay barrack, or hay cap. Haystacks may also be built on top

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of a foundation laid on the ground to reduce spoilage, in some places made of wood or brush. In other areas, hay is stacked loose, built around a central pole, a tree, or within an area of three or four poles to add stability to the stack.

One loose hay stacking technique seen in the British isles is to initially stack freshly cut hay into smaller mounds called foot cocks, hay coles, kyles, hayshocks or haycocks, to facilitate initial curing. These are sometimes built atop platforms or tripods formed of three poles, used to keep hay off the ground and let air into the centre for better drying. The shape causes dew and rain water roll down the sides, allowing the hay within to cure. People who handle the hay may use hayforks or pitchforks to move or pitch the hay in building haycocks and haystacks. Construction of tall haystacks is sometimes aided with a ramp, ranging from simple poles to a device for building large loose stacks called a beaverslide.

Safety Issues

Farmer's lung (not to be confused with silo-filler's disease) is a hypersensitivity pneumonitis induced by the inhalation of biologic dusts coming from hay dust or mold spores or other agricultural products.

Hay baled before it is fully dry can produce enough heat to start a fire. Haystacks produce internal heat due to bacterial fermentation. If hay is stacked with wet grass, the heat produced can be sufficient to ignite the hay causing a fire. Farmers have to be careful about moisture levels to avoid spontaneous combustion, which is a leading cause of haystack fires. Heat is produced by the respiration process, which occurs until the moisture content of drying hay drops below 40%. Hay is considered fully dry when it reaches 20% moisture. Combustion problems typically occur within five days to seven days of baling. A bale cooler than 120 °F (49 °C) is in little danger, bales between 120 and 140 °F (49 and 60 °C) need to be removed from a barn or structure and separated so that they can cool off. If the temperature of a bale exceeds more than 140 °F (60 °C), it can combust.

Due to its weight, hay can cause a number of injuries to humans, particularly those related to lifting and moving bales, as well as risks related to stacking and storing. Hazards include the danger of having a poorly constructed stack collapse, causing either falls to people on the stack or injuries to people on the ground who are struck by falling bales. Large round hay bales present a particular danger to those who handle them, because they can weigh over a thousand pounds and cannot be moved without special equipment. Nonetheless, because they are cylindrical in shape, and thus can roll easily, it is not uncommon for them to fall from stacks or roll off the equipment used to handle them. From 1992 to 1998, 74 farm workers in the United States were killed in large round hay bale accidents, usually when bales were being moved from one location to another, such as when feeding livestock.

Hay is generally one of the safest feeds to provide to domesticated grazing herbivores. However, some precautions are needed. Amount must be monitored so that animals do not get too fat or too thin. Supplemental feed may be required for working animals with high energy requirements. Animals who eat spoiled hay may develop a variety of illnesses, from coughs related to dust and mold, to various other illnesses, the most serious of which may be botulism, which can occur if a small animal, such as a rodent or snake, is killed by the baling equipment, then rots inside the bale, causing a toxin to form. Some animals are sensitive to particular fungi or molds that may grow on living plants. For example, an endophytic fungus that sometimes grows on fescue can cause abortion in pregnant mares. Some plants

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themselves may also be toxic to some animals. For example, *Pimelea*, a native Australian plant, also known as flax weed, is highly toxic to cattle.

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Chapter 4 : Issues and Perspectives in Livestock Production

The MRH system applies to approximately 14 percent of the global population. This ratio is particularly high in sub-Saharan Africa where 41 percent of the region's population is associated with the system and in Central and South America where it is 35 percent. The system is replacing grazing systems in Africa and Latin America. In Africa, the process is mainly driven by population growth, and, in Central and South America, by economic development and technological innovations. In many parts of the world, farmers are clearing rainforests to expand this system e.g. in South America along the Andean foothills (the western border of Amazonia) and in Central America. In Africa, this process is somewhat constrained by the tse-tse/trypanosomiasis complex.

This system is particularly important for large areas of sub-Saharan Africa. The main challenge is finding ways to increase the productivity of the system under serious constraints for both public and private investments. It is generally acknowledged that the biological potentials of mixed systems will be the key to productivity increases, and the expectation is that purchased feed inputs will be replaced by enhanced knowledge about the system, in particular, nutrient cycled within the system. In the more humid parts of Asia, annual crops have been replaced by perennial crops and livestock play a minor role.

In Latin America, low population density, high degrees of urbanization and relatively high *per caput* incomes have induced farming systems generally more oriented towards livestock production. In the tropical rain-forest regions, very resource consuming systems were established, in some cases driven by policies and in others by poverty. Many of the policies that promoted wasteful utilization of these resources have been stopped in the process of structural adjustment.

Arid and Semi-arid Tropics and Sub-tropics (MRA)

The MRA system is a mixed farming systems in tropical and subtropical regions with a vegetation growth period of less than 180 days. The main restriction of this system is the low primary productivity of the land due to low rainfall. The more severe the constraint, the less important crops become in the system and the more livestock take over as the primary income and subsistence source. The system is important in the West Asia and North Africa region, in parts of the Sahel (Burkina Faso, Nigeria), in large parts of India, and less important in Central and South America. Typical cases are dryland farming-sheep systems in northern Africa and in the Indian subcontinent, and also the small ruminant-cassava systems in northeastern Brazil.

Resources and Production

The more arid the conditions become the greater the necessity to keep livestock as an asset for farmers. Given the low intensity of the system and the multiple purposes of livestock, the introduction of improved breeds has been quite limited. Thus, loss of domestic animal biodiversity is not likely to be very significant under these conditions.

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Globally, 11 percent of the world cattle population and 14 percent of sheep and goats are found in this system. Small ruminants are particularly important in West Asia and North Africa under the MRA system.

Grazing land not suited for crop production is the main feed resource of the system supported by strategic use of crop stubbles and straw. Land not used for cropping is frequently community owned. Traditional rules on access to this resource have frequently not withstood the changes occurring in the last decades, particularly population pressure. This leads to common problems of overgrazing and resource degradation.

Given the high risk involved in crop production this system tends to produce crops mainly for subsistence. They are usually produced very extensively, thus minimizing the financial risks but also limiting the potential for good harvests. Livestock are produced extensively with minimal use of purchased inputs. As is the case in other largely smallholder systems, livestock have a range of simultaneous roles in this system, including animal traction, production of manure, use as cash reserve, in addition to the production of meat and milk. Fuel-wood is often scarce as a result of deforestation and range degradation, leading to the ever-increasing role of animals as providers of manure for fuel, in addition to means of transport.

Issues and Perspectives

While this system supports larger populations than any grazing system, only 10 percent of the world population is related to this system. Fifty-one percent of the population involved is in Asia, mainly India, and 24 percent in the West Asia and North Africa region.

The major concern related to this system is the degradation of land resources, due to their limited production potential under growing population pressure. In livestock terms, this relates particularly to overgrazing and range degradation. This is connected to increasing stock numbers but also to crop production being expanded into increasingly marginal lands.

Given the extensive livestock rearing practised, livestock in the MRA system produce relatively high amounts of methane per animal kept and more so per kilogram of meat or milk produced.

There is a close interaction with the LGA system. With increasing population pressure, the LGA system tends to evolve into mixed systems, mainly the MRA system, due to the greater caloric efficiency of cropping *vis-à-vis* ruminant production when land becomes scarce. The outlook for this system is relatively similar to the one for the LGA system. The resource base puts a clear ceiling to agricultural intensification. Low and variable response to inputs makes their use financially risky. Population growth in this setting is leading to over-exploitation of the natural resource base, as traditional property rights cannot cope with the growing demands on the resource base. Alternative development strategies and the reduction of population pressure on the resource base are key elements for the sustainable development of these regions.

In the past, irrigation has been seen as the logical strategy to cope with the central constraint to agricultural production in this region, i.e. low and variable rainfall. Results have been mixed at best. Some reasons for the frequent failures were the high investment, the length of the training required to educate rainfed farmers in efficient irrigation management, the short useful life of many irrigation schemes due to salinization. Furthermore, best locations for irrigation schemes have already been exploited by now. Thus, a blend of other strategies is

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required in these regions, which involves promoting the mobility of workers to other regions and sectors, the *in situ* development of other sectors of the economy such as mining, tourism, fisheries, etc.

Mixed Irrigated Systems

The geographic distribution of the mixed irrigated system, the mixed irrigated system contributes about 23 percent of the total meat production worldwide.

Temperate Zones and Tropical Highlands (MIT)

This system belongs to the group of the land-based mixed systems of temperate and tropical highland regions. The peculiar feature is the existence of irrigation, which strongly influences the feed availability for ruminants and the variability of crop production. This changes the production environment substantially and determines the competitiveness of animal production *vis-à-vis* crop production in a given location. This system is found particularly in the Mediterranean region (Portugal, Italy, Greece, Albania, Bulgaria) and in the Far East (North and South Korea, Japan, and parts of China). These are agro-ecologies in the transition between subtropical and temperate conditions, where plant growth is limited, both by low temperatures in the cold season and by moisture availability during the vegetation period. Their importance in tropical highlands is negligible.

Typical cases are south European family farms combining one cycle of irrigated crop production with livestock production based on the grazing of drylands, crop stubbles and some irrigated alfalfa.

The transition to mixed irrigated arid systems is gradual, with the latter having year-round production on irrigated land, thus reducing the opportunities for grazing crop stubbles. Far-east Asian mixed family farms are mainly based on irrigated rice and dairy cattle.

Resources and Production

Traditional local sheep and cattle breeds have been largely displaced as management practices and product prices allowed for more intensive production and the associated increase in the use of external inputs (energy for water pumping, fertilizers, agrochemicals.) In the Mediterranean region, the main feed resource has traditionally been the silvopastoral system, supplemented by crop by-products. In the land-scarce, intensive East Asian systems, the main resources are cereal straw, intensively managed pastures, forages and imported feeds.

Livestock production technology is basically the same utilized by the MRT-system. High product prices and a high opportunity cost for labour make intensive production systems viable. This implies a heavy effort to actively adjust seasonal feed supply to the rather constant requirements of the herds and flocks. This is achieved through forage conservation (hay, silage) and through the feeding of grains and grain by-products.

In the more extensive situations, such as in the Chinese MIT system, the integration of livestock into the farming system is broader in physical terms. Animal traction is an important input into the crop system. Less productive animal breeds are fed less concentrate feeds and therefore consume more crop by-products. Manure is actively allocated to the more productive irrigated fields thus transferring nutrients from other parts of the farm to the irrigated fields.

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Weeds are Fed to the Ruminants

Meat, milk and wool, the main outputs of this system, are mainly produced for the market. Manure is an issue only where animals are stabled, at least for certain periods of the day or the year. Animal traction has been displaced completely by engine-powered equipment in developed countries and the MIT system in China is gradually following the same path. Pigs, ducks, geese and chicken play a minor role, mainly in LDCs in utilizing crop by-products and family labour.

Issues and Perspectives

About 10 percent of the world population live in regions where this system is dominant. A large share of them belong to developed countries with relatively high income levels and where agricultural trade is important.

This system tends to be found in regions with rather high population density. The major issue in environmental terms is the use of water, with agriculture competing with the use for urban supply. Another important issue is the management of the lands that are not irrigated. Particularly in the Mediterranean region, complex silvopastoral systems have been developed combining rainfed tree crops (olive trees, hazel nuts, cork-oaks) with extensive grazing, mainly of small ruminants.

Interactions with other systems are mainly trade related and are expected to increase in the future as agricultural protection is reduced. This competition will be mainly with mixed rainfed temperate systems, which produce largely the same commodities. This system is clearly associated with very intensive agriculture in temperate regions with a high population density. This is the case of the Far East and the southern European regions.

They are producing typical commodities of temperate environments at very high levels of intensity. It is related to the historical land scarcity and to policies heavily protecting domestic agriculture. With the outcome of the General Agreement on Tariffs and Trade (GATT) negotiations, it can be expected that these systems will be less and less viable, having to compete with very efficient rain-fed systems producing the same commodities. The system can be expected to shift to more extensive production, using less water and chemical inputs. This will reduce the negative impacts of the system on the environment. The expansion of international trade and particularly the incorporation of southern European countries into the EU, has led to an increase in the intensive production systems of off-season vegetables and fruits on the best irrigated land. The integration with livestock has been reduced, with ruminant grazing systems declining in absolute terms and concentrating on the marginal sites.

Humid and Sub-humid Tropics and Sub-tropics (MIH)

This is a mixed system in tropical and subtropical regions with growing seasons of more than 180 days, in which irrigation of crops is significant. The MIH system is particularly important in Asia. High population densities require intensive crop production and the irrigation of rice makes it possible to obtain more than two crops per year, even under conditions of very seasonal rainfall, substantially reducing yield variability as compared with the yield of upland rice or other rain-fed crops. Animal production has in the past been closely linked to the animal traction issue. In many Asian countries, smallscale mechanization is replacing it now, releasing feed resources for animal production to the markets. Typical cases are irrigated rice-buffalo systems of the Philippines, Vietnam, etc.

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Resources and Production

Buffaloes and cattle have mainly been selected for animal traction in this system, involving both tillage and transportation. As mechanization expands, these animals selected mainly for the adaptation and animal traction performance may gradually be substituted by highly productive breeds to respond to a growing demand for meat and, to a lesser extent, dairy products. Pigs and poultry (particularly ducks and geese) play an important role in utilizing otherwise lost feed resources. Potentially valuable genes of adaptation to high fibre diets, tolerance to diseases, etc may be at risk in this system. Given the land scarcity, the major feed resources comprise crop by-products, straws, brans, weeds and roadside pastures. High yielding varieties of rice have emphasized grain production, frequently at the expense of their contribution to animal feed production (quality and quantity of straw, use of herbicides to control competition from weeds, etc). Highly productive forages for cut-and-carry systems, capable of growing on non-irrigated land are a potential avenue for intensification. Short term forage crops relay-planted into rice fields are also being tested. Tuber crops such as cassava and sweet potatoes, capable of producing acceptable yields of feeds of high energy concentration per kilogram of dry matter are an important resource for pig and to a lesser extent poultry production. The high productivity of land in this system is achieved through intensive land use of irrigated areas. Hence, the need for animal traction or mechanization to rapidly till the land after harvest to achieve a new crop cycle. This clearly limits grazing of stubbles and explains the efforts to harvest straw and treat it for feeding ruminants. Cattle and buffaloes are mainly tethered or fed cut-and-carry forages. Ducks are to some extent fed on insects in rice fields, a system in conflict with the increasing use of insecticides in rice production.

The main contribution of ruminants to this system has been animal traction. This function is gradually being taken over by small-scale machinery. Gradually, ruminants are assuming the role of providers of an additional cash income, a way to convert fibrous crop by-products and slack family labour into marketable livestock products, which are increasingly demanded by urban dwellers. Pigs and poultry provide meat for both home consumption and for the growing urban markets. MIH systems throughout the world produce 13 million tonnes of pork (18 percent of global production), more than any other land-based tropical system. Manure is recycled on the fields.

Issues and Perspectives

Among the tropical and subtropical systems, the MIH system is the one related to the largest population group, 990 million people, 97 percent of which are in Asia.

The environmental issues are related to the hygiene risks involved in keeping animals very close to people in areas of high population density. System-wide environmental issues are the frequently low efficiency of water utilization, and related erosion problems and the production of methane from paddy fields.

Competition for urban markets for livestock products is the main form of interaction with the landless monogastrics system, both domestically and globally through international trade.

This system has developed under high population pressure into a very closed system, capable of sustaining the basic needs of a large population. The challenge is how to maintain its sustainability in a changing setting: economic development is creating alternative employment and raising the opportunity cost of labour, consumers are purchasing increasing

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quantities of animal products and expecting products of different attributes: less fat, more homogeneous characteristics, more processing, etc. At the same time, expanding international trade is providing opportunities to access low cost feeds. These trends are promoting a certain degree of specialization while environmental concerns favour the maintenance of the traditional highly integrated system.

Arid and Semi-arid Tropics and Sub-tropics (MIA)

This is a mixed system of arid and semi-arid regions, in which irrigation makes year round intensive crop production feasible. It is found in the Near East, South Asia, North Africa, western United States and Mexico. Typical cases are luzerne/maize-based intensive dairy systems in California, Israel and Mexico; small-scale buffalo milk production in Pakistan; and animal traction based cash crop production in Egypt and Afghanistan.

Resources and Production

Cattle and buffaloes for milk and animal traction are the main ruminant resource. Sheep and goats are important where marginal rangelands are available in addition to irrigated land. In the MIA system, pigs are kept only in the Far East; they are virtually inexistent in West Asia and North Africa, largely for cultural reasons (Islamic and Jewish religions only). The main introduced breeds are dairy cattle to supply milk to large urban centres. Under good management conditions, intensive dairy schemes have been quite successful in hot but dry environments. Some of the world's highest lactation yields are achieved in the MIA system in Israel and California. The traditional smallholder MIA system in Asia relies heavily on buffaloes for milk production.

Luzerne is the forage crop favoured for use under irrigated conditions, due to the plant's capacity to colonize and improve desert soils brought into irrigation schemes. Furthermore, luzerne is high yielding and of high quality, a fact which makes it particularly suitable to supplement ruminant rations based on straws of low digestibility. Straw from irrigated crops is an important feed resource. In this system, efforts to treat straw to increase digestibility are quite attractive. Under developed country conditions, ample use of concentrates is made to feed high production dairy cows.

Milk production management in the MIA system is highly diverse, ranging from traditional buffalo management in backyards fed mainly cut-and-carry forages and straw to large-scale dairy farms milking several hundred cows, mainly Holstein Friesians. In this case, herd management is aided by computer programmes determining management interventions such as daily levels of concentrate supplementation, timing of drying, vaccinating, pregnancy checking, etc.

In the traditional MIA system, irrigated crop production is the main source of income with livestock playing a very secondary role. This is generally reflected in rather extensive management of the livestock enterprises.

Using irrigable land for forage production tends to be economical only for relatively efficient milk production, if an attractive urban market for fresh milk and dairy products exists. This is the case when imports of dried milk and dairy products are restricted or consumers are willing to pay a premium for products made from fresh milk *vis-à-vis* those based on reconstituted milk. Elsewhere, MIA systems are cash crop oriented and large

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ruminants are kept mainly for animal traction. Furthermore, fuelwood tends to be a scarce resource in these systems, a fact frequently leading to the use of manure as fuel.

Issues and Perspectives

The MIA system is predominant in regions that are home to over 750 million people, two thirds of them in Asia and one third in West Asia and North Africa. A large proportion of the total labour input into these systems is allocated to irrigated cash crop production. Milk production is mainly located in the proximity of urban centres. Particularly in modern, large scale operations, manure disposal tends to be an environmental problem. The main draw back of the MIA system, however, is water use, deficient drainage and salinization of irrigated land. The existence of certain fodder crops that tolerate relatively high levels of salinity, opens an avenue for livestock production as a strategy to live with the problem of salinization. The main interaction with other systems occurs through the international market, particularly for milk and dairy products. The MIA system makes an important contribution to food availability and employment in semi-arid and arid regions. The long term sustainability of these systems is nevertheless challenged by the problem of salinization of soils. Livestock play only an ancillary role, which may even decline in the development process, as appropriate mechanization becomes economically viable and as freer international trade and better infrastructure enhance the opportunities for consuming livestock products produced within more suitable environments.

Landless Systems (LL)

The developed countries dominate the picture of landless intensive production with more than half of total meat production. Asia is already contributing some 20 percent and eastern Europe 15 percent, with the latter recently in sharp decline.

Monogastric Production System (LLM)

Definition and Geographical Distribution

This system is defined by the use of monogastric species, mainly chicken and pigs in a production system where feed is introduced from outside the farm, thus separating decisions concerning feed use from those of feed production, and particularly of manure utilization on fields to produce feed and/or cash crops. Thus, this system is an open system in terms of nutrient flow.

The importation of nutrients normally occurs via markets, also international markets. While the return of nutrients through manure frequently causes problems given the high water content and thus high cost of transporting those nutrients to land-based systems capable of using them. On the other hand, mineral fertilizers are frequently a cheaper source of nutrients, thus reducing demand from other production systems for this resource, therefore turning it into "waste". Thus, the disposal of manure creates a major environmental impact of this system, particularly when production takes place close to highly populated urban centres. It also adds dimensions of pollution by odours and human health risks. Landless monogastrics systems are found predominantly in OECD member countries with 52 percent of the total landless pork production and 58 percent of the landless poultry production globally. In the case of pig production, Asia is second, with 31 percent of the world total. For poultry, Central and South America follow with 15 percent. To a large extent, this geographical distribution is determined by markets and consumption patterns, in addition to urbanization levels.

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In developed countries with abundant road and cooling infrastructure, large-scale landless operations are located close to ports in net grain importing countries such as pig operations in the Netherlands or northern Germany. In grain exporting countries, such as the United States, landless systems tend to be located in grain producing areas, such as the states of Iowa, Illinois, etc. In countries with less developed infrastructures, such as roads and chilling, these operations are close to major urban centres, reflecting the feasibility of transporting grains *vis-à-vis* animal products.

Resources and Production

The landless monogastric system is almost exclusively based on hybrid and high producing, exotic breeds. This genetic material is widely traded internationally. The expansion of this system is clearly linked with the extinction of traditional breeds. The system is frequently stratified, implying that different enterprises specialize in the production of parent material, the production of young animals or the fattening process. The short production cycle of these species implies a high turnover and therefore a capacity to rapidly adjust to changes in demand for the products and to prices of inputs. It also implies that stock numbers are a poor indicator for the importance of the sector. The system is characterized by an ample use of feeds of high energy concentration (mainly cereals, oilseeds and their by-products). This feature is central to understanding the rapid growth of the system worldwide. The high energy concentration allows transport of feeds over longer distances. This provides for the expansion of production pulled by market incentives, based on imported feeds. Production of feeds is separated from their utilization. Transportation of concentrate feeds can be achieved at substantially lower costs than that of perishable animal products, even though the quantities are larger. Furthermore, consumers tend to pay a premium for fresh animal products *vis-à-vis* frozen/preserved products. Seasonality of feed production is easily overcome through grain storage and/or deferred purchasing on the market. The system is very knowledge- and capital-intensive, easily transferred across agroecological conditions, given the scarce links to the land base. Production efficiency is high in terms of output per unit of feed or per man-hour, less so when measured in terms of energy units. Concentrate conversion rates range between 2.5 - 4 kg/kg of pork, 2.0 to 2.5 kg feed DM/kg of poultry meat, and even lower for eggs. Capital intensity is high in all cases but wide variations are found. Very sophisticated automated systems are used in developed countries, responding to high labour costs. Variability of production within individual enterprises over time is low as long as management systems in place control exogenous factors correctly, i.e. disinfection, isolation from animals external to the system, effective quality control of feed inputs, etc.

Capacity of traditional breeds to cope with these challenges has been replaced by ability to perform at higher levels of efficiency in terms of desired outputs, as long as these external challenges are controlled by management. Management and infrastructure requirements generate large economies of scale in these systems. This implies large herd/flock sizes, large volumes of wastes and high animal health risks. Since products of this system are almost exclusively geared to urban markets, they have to comply to standardization and other specific quality criteria to be efficiently transported, processed and marketed. Many of these criteria are determined by the processing industries, rather than by the final consumers *per se*.

Issues and Perspectives

Given the tradeable nature of the inputs and the animal products involved in these systems, this system cannot be related to specific populations. Consumers of the system's

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outputs are mainly urban populations, frequently close to where the production base is located but also in other urban settings due to the active trade. The large-scale nature of the system and the heavy investments lead to very high labour productivity but very low employment. Thus, this system produces outputs for a large number of urban consumers but generate employment for few people. This employment tends to be relatively stable over time due to the low seasonality of production. While the employment effect at the production level is low, it must be acknowledged that the forward linkages in processing, wholesaling and retailing, as well as the backward linkages in inputs and services required, generate additional employment. The most important interactions with the environment are generation of large volumes of wastes and air pollution, as well as the increased demand for cereals, with the impact of the latter on the land resource base. In addition, the genetic erosion related to traditional breeds of chicken and pigs is of concern. Finally, given the character of substitutes of ruminant meats, it can be argued that the rapid development of "modern" landless monogastric systems has reduced the market incentives to expand ruminant production, thus reducing pressures for deforestation and degradation of rangelands. The system is typically competing with traditional land-based production for market shares in the urban markets. It must be kept in mind that poultry and pork are close substitutes for beef and mutton, thus also interacting with the ruminant systems. In a broader sense, the demand for cereals created by these systems is also competing for land resources with land-based ruminant systems.

Given the strong demand for these commodities, production can be expected to continue growing rapidly, particularly in LDCs. Landless poultry and pig production systems account for the majority of the output in developed countries and are rapidly increasing their share in LDCs given their high supply elasticity in the short run. The landless monogastrics system is an open system where important market failures imply a need for regulations. The negative impacts related to waste management are generally clearly located and regulations as well as technological innovations are mitigating the negative effects, particularly in developed countries. An important trend is the move to select more appropriate sites for production, away from urban centres to where enough land is available to make manure disposal through farming feasible.

The environmental impacts of these systems related to their high derived demand of cereals are of a global nature, given the links of these systems to the international grain markets.

Ruminant Production System (LLR)

Definition and Geographical Distribution

This system is defined by the use of ruminant species, principally cattle and marginally sheep, in production systems where feed is mainly introduced from outside the farm system, thus separating decisions of feed use from those of feed production and particularly of manure utilization on fields to produce feed and/or cash crops. Thus, this system is very open in terms of nutrient flow. It shares this feature with the landless monogastrics system. The main difference is that ruminants need more fibrous rations and that the feed conversion of concentrates to liveweight gains is substantially lower. These systems are only competitive under market conditions where consumers can afford to pay a substantial premium for quality

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beef over chicken or pork.

Information on ruminant meat production. Milk production has not been included in the quantitative analysis because the border between landless and landbased production is particularly blurred as roughage is essentially required to produce milk from healthy cows. In many cases, transport of roughage over a certain distance is economic. Thus the system description includes considerations on milk production but no quantitative estimates are provided.

Landless ruminant production systems are highly concentrated in a few regions of the world. In the case of cattle, they are almost exclusively found in eastern Europe and the CIS and in a few OECD member countries. Landless sheep production systems are only found in western Asia and Northern Africa.

Typical cases are large-scale feedlots in the United States and in eastern Europe and the CIS. Intensive dairy operations in the same regions are more land-based, due to the need to feed palatable fodder, which cannot be transported economically over long distances. Small-scale peri-urban dairy production, frequent in many LDCs, particularly in Asia, was not included in this system due to its very distinct nature, where manure is frequently recycled to home gardens or used as fuel and feeds which are mainly roughage produced close-by. These types of production are considered under mixed small-holder systems. Examples are sheep fattening in Syria, feedlots in Texas and large-scale dairy operations in Eastern Europe.

Resources and Production

The landless ruminant system is based almost exclusively on high producing, specialized breeds and their crosses which, nevertheless, have not been bred specifically for performance under “landless” conditions. Furthermore, the limited proportion of total animals in these systems indicate that displacement of traditional breeds cannot be attributed specifically to this system. With regard to milk production, the Holstein Friesian breed is clearly the most important one as well as for beef production, English breeds predominate in the United States, while large European dual-purpose breeds provide animals for fattening. This clearly reflects the overall endowment with land and particularly range. The abundance of rangeland in the United States has led to the specialized production of calves from beef breeds for feedlot operations, while under European conditions these animals are a joint product with milk, mainly from mixed systems.

Apart from the high energy concentration feeds such as grains, this system requires fibrous feeds to maintain the rumen functions. This is frequently achieved through the use of silage, hay or fresh chopped forages. This requirement increases the complexity of these systems. To a large extent, ruminants are used like monogastric animals and their capability of efficiently utilizing fibrous feeds, not suitable for direct use by humans, is neglected. This is particularly true for the brief fattening process in North American feedlots, which improves carcass quality of young animals raised mainly on range of low opportunity cost.

This system is producing 12 percent of the global beef production. Production is highly concentrated in developed countries, mainly eastern Europe, the CIS and OECD member countries. The production system is highly capital-intensive, leading to substantial economies of scale. It is also feed-intensive and labour-extensive. Key efficiency parameters are daily weight gains and feed conversion, basically reflecting the efficiency in the use of capital invested in infrastructure or in the form of lean animals and feeds. Weight gains are usually in

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the range of 1 to 1.5 kg/day and feed conversion rates are about 8 to 10 kg of grains per kg of weight gain. In market oriented systems, such as the North American feedlot operations, economic performance is largely related to the evolution of prices of lean *versus* fat animals. Profitability is highest when the price differential for fat animals is large, as this effect is reflected in the price obtained for the total liveweight sold and not only for the additional weight gained in the feedlot. To avoid the downside risk involved in these price fluctuations, feedlot operators often hedge the risk through the option market. In this system products are almost exclusively geared to urban markets. In the case of the high quality beef produced, there is very limited processing involved. The situation of milk is more similar to the one of poultry and pork, a large and growing proportion being processed into dairy products.

Issues and Perspectives

Direct employment effects of this system are limited. Some additional employment is generated in specialized services and inputs required (particularly feed production, transportation, processing, supply of feeder cattle) as well as in the processing and marketing of the products.

These systems are competing for market shares and resources with all other livestock production systems through the cross-price elasticities for different meats and animal protein sources. Given the dependency on cooling and road infrastructure of trade in fresh animal products, this competition is stronger in developed countries than in countries with poor infrastructures. For the same reason, competition is stronger in cities close to ports than in the hinterland.

This system is closely linked to land-based systems that normally provide the young stock for landless systems. This constitutes an important difference to landless monogastrics systems, in which replacement stock is produced within the same system. These interactions are basically the same as those of landless monogastric systems. The most important ones are related to the production of animal wastes, leading to water and air pollution, acid rain and human health hazards. Furthermore, these systems induce extensive use of cereals with related environmental concerns (degradation of soils, nutrient transfers, use of agrochemicals, etc).

The landless ruminant system is producing only a small fraction of the ruminant meat output in developed countries and is of negligible importance in LDCs. It is critically dependent on high prices paid for quality beef and milk, and on ample supplies of low cost grains. The landless ruminant system can be expected to continue growing slowly in North America, driven by population growth, but with *per caput* consumption of beef stagnating. Its importance can be expected to decline in the European Community as production becomes more extensive in response to policies of reducing support to agriculture and promoting environmentally friendlier production systems.

The situation in eastern Europe and the former USSR is different. There, this system developed under central planning as an industrial process to produce these goods. With the shift to market economies, its importance is declining and ruminant production in that part of the world is shifting to the land base and to a smaller scale. A growing market for grain-fed beef exists in Japan and the newly industrialized countries of Asia. The growth rate of this market will depend mainly on the evolution of the international price of cereals and the increased *per caput* incomes. This market will in part be supplied domestically and through exports from the United States, Canada, Australia and possibly South America.

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Globally, the system will continue to be of limited importance and mainly concentrated in the United States and in a few high income, arid countries of the Near East.

Issues and Trends

Only 9.3 percent of total meat is produced in grassland-based systems, compared to 36.8 percent in landless systems and 5.3 percent for mixed farming systems. One system alone, LLM accounts for more than half (52.3 percent) of global monogastric meat production.

Similarly, the MRT system alone produces more than half (55.5 percent) of total milk production from all considered species and 62.6 percent of cow milk production. Egg production is even more concentrated: more than two-thirds of total production is generated by one system, LLM. The landless intensive systems, particularly the one producing monogastric meat, are the fastest growing meat producing systems. Their growth rate of 4.3 percent p.a. compares with 2.2 for the mixed systems and 0.7 for the grassland based systems.

Compared to cropping systems, the system-to-system evolution of livestock systems alone is much less complex. Originally, all livestock production was basically grassland-based. Where climatic, soil and disease conditions permitted, grassland-based systems developed into mixed farming systems which covered a wide range of intensities and production modes as described earlier. The process was basically driven by population density as were the various forms of interaction between the crop and livestock sub-systems. Wherever urbanization and income exceeded certain levels, landless systems developed in the vicinity of urban centres, capitalizing on the efficiency and supply elasticity of these systems. Similar to crops, two primary sources of production growth can be distinguished: expansion in livestock numbers through an enlargement of the feed resource base, i.e. through an increased intensity of range and pasture utilization and higher use of feed concentrates and agricultural by-products; and higher output of meat, milk or eggs per animal through improved management, feeding, breeds and animal husbandry technologies. For pigs, poultry and to a lesser extent dairy cattle, much of the increased output comes from landless intensive or mixed farming systems and the use of concentrate. Successes in grain production, on the one hand, and the limited potential for cost effectively increasing quantity and quality of feed from extensive range on the other lead to shift of growth from range to grainbased, production systems, particularly in Asia where growth rates are highest. The slow evolution from extensive to intensive production has led to increases in environmental degradation, particularly for grazing systems and mixed farming with low degrees of integration. There are considerable institutional and economic problems to be overcome in bringing livestock numbers into balance with forage and feed availabilities. These problems will be difficult to overcome in the short to medium term and are likely to grow in scope and gravity. Livestock production takes place under very diverse conditions in the different developing countries. However, the direction of change, even if gradual, is towards more intensive production with less dependence on open range feeding which imposes excessive burdens on the environment, and with improved and balanced feeding practices and improved breeds. The improved practices enables more of the feed to go production rather to inefficient maintenance. This has led lead to progresses in feed conversion efficiency.

Intensification must outweigh expansion if livestock production is to respond to effective demand for livestock commodities. Livestock production systems differ in ability to respond to extra demand for livestock products which is primarily due to the biological characteristics of the production process. As an example, poultry meat production has been

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demonstrated to be quickest in responding to increasing demand. This is due to the industrial type of production in which this commodity is produced, increasingly also in the developing countries. Fast reproduction cycles allow to react to changing demand within months. A wide range of commodities can be diverted from other uses (food, industrial uses) to feed, if prices permit - this allows for a fast adaptation of the feed resource base for poultry as opposed to ruminants. The demand for land is low which allows the establishment of production units close to consumer centres. High feed conversion efficiencies make poultry production a highly profitable enterprise.

There are other production systems which are also, to a large extent, driven by consumer demand (eggs, then pork, and to a lesser extent dairy) and the size and type of production units for these commodities are largely driven by market forces. The rate of expansion and intensification of these production systems usually does not allow a gradual transformation from traditional production into these modern types. The growth process here tends to be not evolutionary but discontinued. For red meat, the pace of growth is such that in most cases the evolution of traditional production systems into more intensified modes of production is through adaptation. The type of commodities (beef, mutton and goat meat, and, to a lesser extent, also dairy) lends itself to a more gradual transformation because of the long reproduction cycle, low feed conversion efficiency, and a lower degree of specialization. This is mainly due to the physical characteristics of the production process.

Traditional, integrated mixed farming systems are also unlikely to be highly responsive to increasing demand simply because of the other functions that livestock have to fulfil within the farm-household system. The production reserves in the form of productivity increases and production enlargement that can be realized through a gradual transformation of traditional farming systems are usually insufficient to respond effectively to growing demand. As a result, almost all developing countries experienced the emergence of modern production systems, similar to those in the developed countries. As traditional systems prove increasingly unable to meet the rising demand, an increasing share of total supply will come from highly intensive systems.

Among the regions, growth rates have been highest in Asia with a 7.8 percent increase annually in beef and veal production, 6.3 percent in sheep and goat meat, 7.0 percent in cow milk production, 7.0 percent in pork, 9.6 in poultry meat and 9.6 percent in poultry eggs. Comparing these growth rates with stock increases where possible (for ruminants) it shows that there is very little horizontal expansion (1.2 percent for cattle stock, 1.8 percent for sheep and goats, 2.3 percent for cattle dairy stocks). This means that annual productivity increases of between 4 and 6 percent have been obtained in the decade. This is unprecedented and can only be compared to the Green Revolution in crop production in the same region during the 1960s and early 1970s. For ruminants, the growth has taken place almost exclusively in mixed farming systems and landless ruminant systems have not developed to any significant scale. On the contrary, landless monogastric systems are now found in every country of the region and are quickly developing in the vicinity of urban centres. This, in analogy to the growth path precedented by OECD member countries, is driven by increasing *per caput* incomes, urbanization and changes in consumption patterns. Unless full sets of regulatory measures are established and enforced peri-urban landless systems will continue to grow quickly, responding to the surging demand of low-priced livestock products.

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Chapter 5 : Management of Livestock Production

Fibre digestibility: *Streptococccus bovis*, a numerically predominant bacteria in the rumen of crossbred cattle under different feeding regimes was charaterized. And the cellulase gene obtained from the best fibre degrading fungi isolated from the faecal matter of goat was cloned to *Streptococccus bovis* for enhancing the fibre digestibility of poor quality crop residues. Suppression of methane production: *In vitro* gas production test revealed that methane suppression among the tree leaves ranged from 4.6 to 82%— minimum recorded in jatropha leaves (4.6%) that contained lowest tannin and the maximum (82%) in *Ficus bengalensis* leaves.

Commonly used top feeds like *Sesbania grandiflora*, *Glyricedia maculata*, *Ficus mysorensis* and *Ficus religiosa* leaves showed a methane suppression ranging between 35 and 50%. A mixture of three plant species having antimethanogenic activity *in vitro*, exhibited 12% reduction in methane emission in crossbred calves, which confirmed that there is a potential in using tree leaves for reducing methane production from enteric fermentation.

Use of fungi for enhanced digestibility of straws: Lignin content of *ragi* straw decreased with all the white rot fungi, viz. *Phanerochate chrysosporium, Pleurotus sajorcaju, Pleuritous ostreatus* and *Vorialla voloraceae*. High protease activity was observed during the first two days of fermentation after which it declined, and lignolytic enzymes, viz. laccase, manganese peroxidase and lignin peroxidase concomitantly increased up to the fifth day of fermentation. *Phanerochaete chrysosporium* showed the best potential in improving the digestibility of *ragi* straw followed by *P. ostreatus*. Antifungal property of medicinal/ aromatic plants: Melissa and thyme leaves exhibited good anti-fungal activity (>50%) against *Aspergillus parasiticus*. *Pachouli* leaves, curry leaves, rosemary leaves, cinnamon leaves, *sarpagandha* leaves, thumbe leaves, sweet worm wood leaves, *aswagandha* leaves, chicory powder, yellow oleander leaves, *Selastras paniculatus*, *Tinospora cardifolia*, railway creeper and Indian acalypha leaves showed high anti-fungal activity (>50-90%) against *Fusarium moniliforme*.

Buffalo

Nutrition for the onset of puberty: GnRH challenge studies in the calf attaining maturity at 3 years of age due to nutritional perturbation showed immature status of hypothalamohypophyseal-ovarian axis even at the age of 2 years 4 months. Nutritional modulation of IGF: In sub-fertile male buffaloes nutritional modulation of IGF-I (as a mediator of metabolic hormonal effects) proved beneficial for various sperm functional attributes *in vitro*. The cleavage rate in embryos produced through IVF using such sperms, was also better.

Area Specific Mineral Mixture: Supplementation of area specific mineral mixture (Ca, P, Zn, Mn, Cu) to buffaloes based on the deficiency in the North east zone of Haryana, improved productive and reproductive efficiency as 70% buffaloes showed normal cyclicity,

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and 10% increase in milk production. Supplementation of area specific mineral mixture pellets @ 40g daily in cattle and buffaloes during lactation stage increased milk yield by 10-15%, brought cows into estrus within 30-45 days, and reduced the problem of skin keratinization.

Detection of pesticide residues: A rapid multiresidue method for analysis of neonicotinoid pesticides, viz. imidacloprid, acetamiprid and thiacloprid, was developed. The percent recovery from 0.5 to 2.0 ppm concentration varied from 95.6 to 81.17% for imidacloprid, 92.76 to 84.99% for acetamiprid, and 96.96 to 88.50% for thiacloprid with a detection limit of 5ppb, 10ppb and 20ppb, respectively.

Fibre digestibility: Isolates of anaerobic fungi collected from 5 different states and 6 different host species, revealed that isolates from Rajasthan had highest fibrolytic potential and the best isolate improved digestion of wheat straw in buffaloes.

Improving Eproductive Efficiency

Buffalo embryos were produced *in vitro* @ 64% cleavage with 20% blastocyst using an improved IVEP protocol.

- A three dimensional (3D) collagen gel culture system for the *in vitro* growth and survival of the buffalo preantral follicles with IGFI was developed.
- Early diagnosis of pregnancy (by day 20-21 post-breeding) was facilitated by using real time B-mode ultrasonography in goats and buffaloes.
- Bull-biostimulation curtailed the incidence of silent ovulation and service period and increased conception rate in post-partum buffaloes.

Enhancing Productivity: Strategic supplementation of protein (<20% CP) during midlactation increased productivity of buffaloes.

Vitamin E supplementation @300 IU daily was optimum to improve weight gain, and increased its concentration in the muscles of buffaloes. Early embryonic mortality: Dynamic status of antioxidant enzymes in relation to the stages of oestrous cycle and tissue remodeling was observed. Effective modulation of prostaglandin production by the uterus may rescue corpus luteum and prevent early embryonic mortality. Improvement of reproductive efficiency: Insemination dose could be reduced from 25 to 15 million spermatozoa without adversely affecting the conception rate. The results are being authenticated with more trials in farmers' herd. Frozen semen samples were evaluated for sperm motility attributes. Bulls with higher field conception rates also had higher sperm total motility, progressive motility, rapid motion and viability.

Sheep

Trace Element Status: Biochemical markers (Cu and Zn-dependent enzymes – ceruloplasmin and Cu/Zn- super oxide dismutase) were evaluated to assess the trace element (copper and zinc) status in sheep at different dietary levels of Cu and Zn. Prediction equations developed by correlating the absorbed Cu and Zn with Cu- and Zn-dependent enzymes; plasma Cu and Zn with Cu and Zndependent enzymes; liver tissue concentrations of Cu and Zn with absorbed Cu and Zn, revealed that Cu and Zn status of animals could be assessed by using these enzymes as biochemical markers. Production performance: Bharat Merino and Gaddi Synthetic sheep under migration to highland pastures gained higher body weights and produced more wool in comparison to stationary flocks.

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Utilization of Fibrous Crop Residues: Fortification with cellulase, xylanases, pectinase, phytase and protease enzymes enhanced dry matter digestibility by 7.00%, cell wall digestibility by 25.00%, and the end product fermentation by 15.00% of poor quality roughages. Supplementing probiotics of microbial origin like *Saccharomyces cerevisiae*, *Saccharomyces uvarum* and *Kluyveromyces marximanus* and a mixed yeast culture of above three in a ratio of 1:1:1 as microbial probiotics in lambs showed that *Saccharomyces cerevisiae* strain is superior in improving the growth of lambs. Bioavailability of nutrients: Diets supplemented with condensed tannins improved nutrient utilization, immune response besides protection from GI parasites and fasciolosis in sheep.Supplementation of *Tinospora cordifolia* as a functional food imparted positive influence on the nitrogen metabolism and antioxidant levels in seminal plasma besides significantly improving the erythrocytic antioxidant status and cell-mediated immune response of adult Muzzafarnagari rams. Undecorticated jatropha (*Jatropha curcas*) meal after processing with 1% common salt and 0.5% lime, could replace protein of conventional oil cakes up to 25% in the concentrate mixture of adult sheep and goat for short-term feeding, Goat.

Standardization of in Vitro Fertility Test

Hypo Osmotic Swelling Test (HOST): Sperms were evaluated for strongly coiled, weakly coiled and non-coiled under oil immersion lens. The best swelling in terms of strong coiling and total coiling was in 75-mosmol hypo- osmotic solution. There was significant difference in swelling in different strengths of hypo osmotic solution. For frozen sperm 75-mosmol and for fresh diluted semen 100-mosmol hypo-osmotic solution was found to be the best.

Dual Staining Test: Dual staining technique was standardized for testing viability and acrosomal integrity in frozen and fresh semen. It saved time and chemicals in testing viability and acrosomal integrity thereby avoiding separate tests.

Semen Quality: Twice a week semen collection, evaluation and freezing in Jamunapari bucks of 2-5 years of age group, indicated that the semen production was higher under intensively reared bucks compared to the semi-intensively managed bucks.

Rapid Estrus Detection Methods: Sponges of different sizes and shapes were tested for their retention in vagina for 12 days in Sirohi goats for estrus detection. Circular sponges with a diameter of 30 mm and cylindrical shaped sponges with a diameter 25 mm had the highest percentages (>83%) of retention. Mithun Feed blocks with locally available feed resources: Feeding of *Lagerstroemia speciosa* tree leaves based complete feed blocks to mithuns showed that the tree leaves could be incorporated in the ration up to 30% for feeding mithuns under semi-intensive or intensive system.

Organic Fertilizer: The excreta (faeces and urine) of both mithun and Tho Tho cattle were compared as a source of organic fertilizer. The quantum of faeces voided from mithun was more than that of Tho Tho cattle though faeces of Tho Tho cattle contained less water (more DM) compared to that of mithun. The chemical composition of faeces of mithun and local cattle did not differ significantly. Mithun produced more urine than Tho-Tho cattle. So per animal basis, mithun supplied more excreta as organic fertilizer than Tho-Tho cattle in Nagaland. Bakers yeast: Feeding bakers yeast (*Sacharomyces cerevisiae*), a probiotic on roughage based diet, significantly increased average daily gain of mithuns, intake of concentrate and roughage and also improved FCR.

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Estrus Synchronization Protocols: Experiments conducted to synchronize estrus in cyclic and postpartum mithun cows showed more prominent behavioural signs of estrus than spontaneous heat. Application of CIDR on day 45-50 after parturition, induced first postpartum estrus immediately after uterine involution (day 53-58 post parturition). Unlike other bovines, mithun cows exhibit first postpartum estrus at around 97±19.6 days postpartum. Use of CIDR was advantageous in terms of prominent behavioural signs of estrus thereby ease in detection of estrus. The first calf was born from an anoestrus mithun cow synchronized with CIDR. Hormone-induced maternal behaviour: Mother-neonate bonding was studied using oxytocin intranasal spray. Intranasal administration of oxytocin effectively induced maternal behaviour in primiparous bovine heifers where maternal behaviour was blocked chemically.

Embryo Transfer Technology: Estrus synchronization was performed by using CIDR protocol and four embryos (compact morula) were recovered successfully from two donors and subsequently transferred into three recipients.

Trace Mineral Supplementation: Soil, feeds and fodders of yak rearing zones are deficient in micronutrients, as reflected by the low productive and reproductive performances of yak. Supplementation of trace minerals like Zn, Cu, Co and Mn in the ratio of 40:20:2:1 along with the basal diet significantly increased milk production.

Production Performance During Winter: Body weight gain was significantly higher during October in calves but from November onwards no significant increase was observed. Bulls gained significantly higher body weight compared to calves up to December. The lactating yak cows lost about 5.84% of their body weight, and milk yield reduced mainly due to shortage of feed and fodder during long winter. Providing adequate nutrition during winter could help in ameliorating winter stress in yaks.

Modified Temperature Humidity Index: Y aks wer e co mfo rtab le at THI of 52 and when THI exceeds 52 yaks experienced heat stress, as expressed through increased physiological responses.

Poultry

Stress Related Hormone: Under heat stress condition some of the lymphocyte proteins were repressed whereas some others were induced in broiler.

Bioavailability of Micronutrients: Se supplementation in broiler chicken diets at 0.15 or 0.30 ppm complemented bioavailability of Zn. In contrast, Se antagonized retention of Mn, Cu and Fe in liver tissues. Se (0.15 ppm) and Zn (80 ppm) improved humoral and cell-mediated immune response in broiler chicks. Zn uptake by tissues was relatively more active during early age (2 week) than at later ages (4 and 6 week), whereas Se retention in tibia and liver was higher at 4 and 6 weeks than that at 2 weeks of age. Se inclusion in broiler chick diets from 0.15 to 1.35 ppm linearly enhanced its retention in bone and liver tissues and complemented Zn uptake by tissues. Both Cu and Fe responded negatively to Se increases in diets at 5 weeks of age. Vitamin E at 40 IU enhanced Se uptake by bone, but did not influence retention of Zn, Mn, Cu or Fe. Moderate levels of Se (0.15 or 0.45 ppm) and vitamin E at 40 IU produced higher antibody titres, better cell-mediated immune and reduced stress in 5-week-old broilers.

Enhancing utilization of macronutrients: Protease enzyme produced from *Bacillus*

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licheniformis were supplemented to broiler diets @ 4,000 IU/kg to enhance the feeding value of commercial meat meals and soybean meal low in protein by 3-4% over the recommended level (22%). Meat meal diets responded better to protease supplementation and performance of broilers was equivalent to the control group that was maintained on 22% protein diet. Inclusion of enzyme had significant impact on different production parameters compared to non-supplemented diets, particularly when dietary protein levels were lower than the recommended levels.

Female Reproductive System of Desi Fowls: Ovary and oviduct development was noticed clearly around 16 to 18 weeks of age in White Leghorn (WLH), around 20-22 weeks of age in Kadaknath (KN) and around 24 weeks in Aseel peela (AP). At the peak of sexual maturity, around 30 weeks of age, total length of the oviduct was greater in WLH (73 cm) as compared to *desi* fowl (66 cm). The transaminases activity of blood plasma, irrespective of breeds increased linearly with age. An increased pattern of ACP, GOT and GPT activity was found associated with maturation of female reproductive tract and reverse was true with ALP activity among all the breeds.

Enhancing Egg Production: Using simple feed formulation, egg production could be enhanced markedly over the age of 78 weeks in Aseel peela *desi* fowl. Large-scale replications at institute and field level are being taken up to validate the data.

Supplementation of Melatonin: Dietary inclusion of aflatoxin @0.15 ppm level adversely affected body weight, feed intake and FCR and caused lipid peroxidation with simultaneous depletion of antioxidant enzymes (superoxide dismutase and catalase) in broilers. Melatonin supplementation @ 40mg/kg feed alleviated the adverse effect of aflatoxicosis at lower levels (<0.15ppm).

Moulting for enhanced production: Birds were force moulted by feed withdrawal method for 10 days. As the period of fasting progressed from 0 to 10 days a gradual but steady reduction was noticed in the levels of serum triglycerides, which was more pronounced and significant from the fourth day of commencement of feed withdrawal.

A similar decline in serum total cholesterol concentration was noticed, which became very apparent from the sixth day after feed withdrawal and a reduction of 30% in total cholesterol concentration was achieved by the tenth day in the moulted hens. In contrast, serum HDL– cholesterol concentration progressively increased during the feed withdrawal period and peaked around the eighth day after withdrawing feed. Accumulation of high lipid in uterus in late laying age results in either shell less or poor shelled eggs. Feed withdrawal for longer period leads to mobilization of lipids from uterus.

Quail Semen Characterisation: Physical and biochemical characteristics of quail semen showed that birds having larger cloacal gland size ejaculated higher volume of semen and semen production was higher in CARI Uttam than CARI Sweta quails. Mass sperm motility in neat semen was only 50-60% immediately after collection that decreased continuously and reached to zero after 30 min.

Sperm abnormalities were higher in CARI Sweta than CARI Uttam. Among the enzymes LDH was exceptionally high in all groups in both the lines, cations sodium and potassium were higher in birds having larger cloacal gland size whereas magnesium and calcium were more in the seminal plasma of birds with smaller cloacal gland. Methylene blue reduction

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time test revealed that quail spermatozoa are more active than chicken.

Livestock Protection

A status of freedom from contagious bovine pleuropneumonia infection in cattle and buffalo was obtained from OIE.

Development and Improvement of Diagnostics and Vaccines

Vaccines

- A low volume saponified haemorrhagic septicaemia vaccine was found safe and effective in farm cattle.
- Possibility of DNA vaccine construct against bovine brucellosis was ascertained.
- Chicken cytokine genes (MIP-b, lymphotactin and IFNg) were expressed in mammalian cells thereby opening up the possibility of their use as genetic adjuvant in DNA vaccine.
- LPS and genomic DNA containing CpG from *Salmonella* Gallinarum activated the innate immune system of chickens and gave higher protection after immunization with inactivated NDV in challenged birds.
- Conjugation of Fc with flagellin protein was a good model for efficient antigen delivery resulting in higher immune response than antigen alone.

Diagnostics

- A nested RT-PCR was developed using primers from RNA dependent RNA polymerase region for differentiation of ruminant pestiviruses.
- C18L gene based conventional PCR and TaqMan probe based real time PCR were developed for specific detection of buffalo pox virus.
- Duplex PCRs were developed for specific detection and differentiation of buffalo poxvirus from other orthopox viruses, and camel pox from other orthopox viruses.
- C18L gene-based real time PCR was standardized for quantification of camel poxvirus in clinical samples.
- A hybridizing probe based real-time PCR was developed for diagnosis of PMWS and the disease was diagnosed in four private farms in Uttar Pradesh.
- The expressed protein of N gene of PPR virus could be an alternative to whole virus antigen in sandwich ELISA for diagnosis of PPR.
- Developed indirect ELISA for serodiagnosis of Japanese encephalitis in pigs.
- Transformed fibroblast antigen was much superior antigen for detection of anti-avian leucosis virus antibodies in the serum samples of chicken, as compared to gsAg, as determined by an indirect ELISA.
- A highly sensitive PCR targeting new gene of *Mycobacterium a. paratuberculosis* and a quantitative real-time PCR (RT-PCR) were developed for the diagnosis of paratuberculosis in small ruminants.
- Serotype specific PCR was developed for detection of *Salmonella* Typhimurium and *S.* Enteritidis.
- Duplex PCR was developed for simultaneous detection of *Salmonella* genus and Typhimurium serotype.

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- Germ tube formation test was developed for detection of chlamydospore in *Candida* albicans.
- Methodology for quick detection of *Echinococcus granulosus* genotypes by polymerase chain reaction coupled with restriction fragment length polymorphism was developed.
- A useful primer was developed and found effective in differentiating cryptic stage of *Echinococcus granulosus* and *Taenia.*

Molecular characterization of pathogens/receptors:

- Mutants of *E. granulosus* isolate from Indian cattle and buffalo origin, were detected on the basis of sequence analysis of mitochondrial gene and non-coding spacer gene.
- Molecular characterization of toll-like receptors (TLR2, and TLR4) of *nilgai* revealed higher expression in skin and immune cells of *nilgai*, as compared to buffalo indicating stronger innate immunity.

Herbal Medicines

- Immunomodulators prepared with extract of *Tinosporacordifolia* and a probiotic (*Mycobacterium phlei*) showedsignificant body weight gain in broiler birds and improvedtheir health.
- Significant antidiarrhoeal activity was detected in the seedextract of *Caeslipinea* bonducella.

Surgical and Clinical Interventions

- The epoxy-pin external skeletal fixation technique was developed, and used to treat a variety of compound fractures of different long bones in small animals.
- A novel design of bilateral external fixator having opposite threadings in the side bars was developed for the management of long bone fractures in large animals.
- Transplantation of autologous bone marrow cells, along with hydroxyapatite induced faster healing of radius fracture in rabbits, as compared to transplantation of hydroxyapatite alone.
- Application of autologous bone marrow cells subcutaneously in the periphery of incisional and open cutaneous wounds induced faster healing, as compared to conventional antiseptic dressing of wounds.

Foot-and-mouth Disease

Field samples (1,313) received from various states during the year were processed and subjected to sandwich ELISA for type identification. Only 705 samples were typed — 567 samples were typed as O, 58 samples as type Asia1, and 80 samples as A —, and no virus could be detected in rest of the samples. Samples were also processed in BHK 21 cells and virus could be recovered in 119 field samples comprising 24 type Asia 1, 75 type O and 21 type A. To improve the diagnosis of FMD in suspected clinical samples, a multiplex PCR (m-PCR) was developed and evaluated. Using the test, 42% of the outbreaks that went undiagnosed using ELISA, were identified indicating that mPGR could be used as best supplentary to ELISA to increase the percentage of FMD outbreak diagnosis in the country.

Two-dimensional micro-neutralization test (2DMNT), a modified form of SNT, was routinely used to test new field isolates to determine the appropriateness of the existing vaccine strains and to select new vaccine strains, if required. In serotype A the most worrying

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factor, which merits attention is the antigenic heterogeneity of the isolates. In the sense some strains show close antigenic match to the current vaccine strain (17/82) and others to the new strain (IND40/00) in *in-vitro* micro neutralization test. One isolate IND 53/08 from Chhattisgarh, was unique both antigenically and genetically forming a separate cluster with another isolate IND 109/06 from Chhattisgarh.

Among all serotypes prevalent in India, type A virus population is genetically and antigenically most heterogeneous in nature. VP1 coding (1D) region based molecular phylogeny has established circulation of four genotypes of type A so far in India. There is once again an upsurge in incidence of outbreaks due to lineage genotypes VII with amino cicer (aa) deletion at 59th position of VP3. This single aa deletion is at an antigenically critical position in structural protein VP3, which is considered to be a major evolutionary jump probably due to immune selection. Field isolates (17) of serotype A recovered from outbreaks in Karnataka, Tamil Nadu, Chhattisgarh, West Bengal and Haryana were sequenced at 1D (VP1) region for molecular epidemiological analysis.

The determined sequences were aligned with other Indian sequences and some of the retrieved exotic sequences. All the isolates clustered within genotype VII in the N-J tree. Genotype VII is restricted to only India as none of the exotic sequences clustered in this group. Thirteen out of the seventeen isolates sequenced, clustered in the deletion group. 1D region based phylogeny also revealed that this lineage is genetically diverging with time giving rise to three lineages (VII b, f and g) so far. In serotype O, PanAsia II strains dominated the outbreaks, nevertheless Panasia I and II 2001 also co-circulated. Asia 1 field isolates (19) were subjected to 1D gene sequence analysis. The isolates were grouped with lineage CI that dominated Asia 1 outbreaks. The isolates of 2007 and 2008 showed 15.4 to 16.7% and 12.4 to 14.7% divergence at nucleotide and amino acid level, respectively, from in-use vaccine strain (IND63/72). The Central laboratory, Mukteswar, contains 1,402 (893-O, 261-Asia 1, 233-A, 15-C) field isolates. Pre- and post-vaccinate serum samples collected up to sixth phase of FMD-CP showed increased levels of protective antibodies against serotypes O, A and Asia 1 over different phases of vaccination.

Animal Disease Monitoring and Surveillance

A large databank on the livestock diseases of the country, based on reports submitted to the Government of India by various state governments was developed at the PDADMS. The institution was involved in the sero-monitoring of rinderpest. Large number of sera samples from various parts of the country is maintained in the National Livestock Serum Bank for retrospective studies.

- An offline version of the databank of livestock diseases of the country was developed. Based on the custom queries, various epidemiological analyses are possible e.g., frequency of disease occurrence, top diseases of the country, eco-patho zones. The spatial and temporal analysis of animal disease data is being carried out using this software.
- Molecular diagnosis of brucellosis was standardized that helped in differential diagnosis of *Brucella abortus* and *B. suis*. Based on the results of the serological, biochemical and molecular techniques a rare case of brucellosis in swine due to *B. abortus* was diagnosed. A standardized A-B ELISA kit for the detection of bovine *Brucella* antibodies was developed. An indirect ELISA kit was standardized to identify the magnitude of disease in ovines. Molecular epidemiological studies are

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being standardized to diagnose and differentiate the brucellosis of cattle, ovine, caprine and humans. Tests were developed to detect the etiological agent directly from the clinical samples such as aborted foetus, placenta and uterine discharges.

- A multiplex PCR was standardized to diagnose the pathogenic leptospira. A repository of the leptospira isolates is being maintained.
- Molecular studies on BHV-1 were carried out. A multiplexPCR for detection of BoHV- • sequences was standardized. The PCR amplified products of

  gB (293 bp), gC (173 bp), gD (343 bp) and US 1 (464 bp) were subjected to partial nucleotide sequencing and aligned with different reference sequences of respective genomic regions.
- The PCR amplification of different 'tk' genomic region of BoHV-1 was standardized and the PCR amplicons thus obtained were confirmed using unique restriction enzyme. Multiple PCR using different combinations of primers specific for gB, gC and gD was standardized and was applied for screening of field samples. The partial nucleotide sequencing of gB, gD and US 1 were aligned with the reference sequences, and was analyzed with phylogenetic trees. These results would be of much help in profiling and characterizing BoHV-1 in livestock population.
- The serum samples obtained from Madhya Pradesh, Maharashtra, Andhra Pradesh, Manipur, Kerala, Orissa, West Bengal and Tamil Nadu, were screened for the presence of antibodies against IBR, using AB-ELISA kit and 41.90% of the samples were found positive for IBR antibodies.
- An mPCR for genome detection of leptospira, BoHV 1 and *Brucella* using known standards targeting the LipL32 gene of *Leptospira*, gB gene of BoHV 1 and bcsp31 gene of *Brucella,* was standardized.
- Occurrence of zoonotic bacterial pathogens from the livestock and livestock products was studied. The pathogens were isolated from various sources, and their molecular characterization was completed.
- A computer interface based BHV-1 whole antigen AB ELISA was developed as per the standards of IAEA, standardized and validated. The kit was critically evaluated both in-house and extensive field trials for detection of antibody to IBR virus in bovine serum. This test is highly sensitive, specific, economical and user friendly.
- A kit to detect the antibodies to *Brucella* in swine is being developed and is in the process of standardization.
- A PCR technique was developed to detect the carrier status in domesticated animals. A pair of primers specific to VSG gene of *Trypanosoma evansi* was developed. The PCR technique was standardized and 400 bp amplicon of VSG gene was obtained from the genomic DNA isolated from the blood of *T.evansi* infected experimental animal. Field validation of the technique is in progress.
- Serum Bank facility has more than 170,000 serum samples from all over the country, which is being used for long-term national surveys on various diseases of economic importance.

  * Development of relational database on Animal Health Information System
  * Development of *India.admasEpitrak* – a relational animal health information database software

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* Development and launching of National Animal Disease Referral Expert System
* Identification of disease specific Eco-patho zones in the country
* Providing eco-pathozones and spatial and temporal occurrence of diseases for effective vaccination and control of important diseases in different states e.g.

PPR in Andhra Pradesh and Karnataka, Brucellosis in West Bengal and Andhra Pradesh, FMD, PPR, HS and BQ in Maharashtra, Andhra Pradesh and Karnataka.

* Providing the logistic support to national network projectslike bluetongue and HS projects for disease monitoring andsurveillance.

Bluetongue

A repository of blue tongue virus isolates BTV- 1 (2 isolates), BTV-2 (4 isolates), BTV-9 (3 isolates), BTV-15 (5 isolates), BTV-18 (4 isolates) and BTV-23 (7 isolates) from Izatnagar, Hyderabad, Parbhani, Kolkata, Parbhani, Hisar and Chennai, was made. No outbreak of bluetongue was recorded in the country except Andhra Pradesh, Karnataka and Tamil Nadu. Disease forecasting model was developed. The incidence was as high as 95.5% sheep from Uttarakhand; 88.6% cattle from Panjab; 63.8% goat and 55.6% sheep from Manipur; 50.0% sheep from Jammu and Kashmir; and 18.22% goat from Delhi. A VP7 gene incorporated recombinant antigen based indirect ELISA kit was developed for detection of group specific antibodies in the sera. Inactivated pentavalent bluetongue vaccine was evaluated at different places particularly in the bluetongue affected states. Vaccine was satisfactory except a nodule formation at the site of inoculation. Type specific primer designing, VP2, VP5 and VP7 gene cloning and expression, multiplex RTPCR for BTV, RNA-PAGE and nucleotide sequence studies, were standardized. Confirmation of virus isolates was done by RT-PCR using VP7 gene specific primers.

Haemorrhagic septicaemia Isolates (93) of *Pasteurella multocida* were characterized and a new serogroup E of *Pasteurella multocida* was identified first time in the country. Most of the *Pasteurella multocida* isolates were sensitive to enrofloxacin, ofloxcin chloramphenicol, doxycycline and resistant to vancomycin, bacitracin, and sulphadiazine. Molecular characterization of different isolates of *Pasteurella multocida* recovered from different species of animals and poultry were carried out by PM-PCR, HSB-PCR, multiplex-PCR, ERIC-PCR and REPPCR.

A low volume saponified HS vaccine was validated successfully in farm cattle, and it was found satisfactory. The OMP vaccine against *P.multocida* type A in ducks provided higher protection as compared to the bacterins. The biofilm vaccine against *P.multocida* type A of sheep origin was prepared and compared with the whole cell vaccine, and it produced higher immune responses on using montanoide oil adjuvant. Economic loss of more than Rs 225 million was estimated due to haemorrhagic septicaemia in cattle and buffalo.

Gastrointestinal parasitism In Rajasthan software 'FROGIN' was evaluated for forecasting of gastrointestinal (GI) nematodosis in semi-arid and arid regions. It gives results as predicted faecal egg counts (FEC) on start of month, intensity of FEC for next 60 day and pasture larval burden for that month. The Garole sheep was not found completely refractory to infection of *Haemonchus contortus*. *Haemonchus, Bunostomum, Nematodirus* and *Oesophagostomum* spp. were found in all the zones in Sikkim. 170 kDa polypeptide of larval antigen of *H. contortus* was recognized by 4 day sera (prepatent sera) of sheep in western blotting. Zymogram studies revealed that 120 and 170 kDa polypeptide belonged to

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metalloproteases based upon protease inhibitor studies. In the ES product, cysteine protease and GST (glutathione-S-tranferase) were identified, which are of immunodiagnostic and immunoprophylectic value. In *H.contortus* ES antigen 30-32 kDa polypeptide showed protease activity, which was inhibited by E–64 confirming it to be a cysteine protease. GST was confirmed in western blotting utilizing anti-GST antibody.

ES antigen was better than gut antigen of *Ascaris suum.* Dipstic ELISA was comparatively found more efficient than plate ELISA. No correlation could be established between worm burden and antibody titre in naturally infected sera of pig with *A.suum.* Immunodominant polypeptide in *Bunostomum* and *Oesophagostomum* spp. was identified, and a diagnostic kit for serodiagnosis was developed and revalidated. Allele specific PCR was applied to field population of larvae for detection of benzimidazole resistance and was compared to FECRT and EHA. Frequency of BZrr (homozygous BZ-resistant) larvae in population ranged from 73.39 to 100% in Northern Rajasthan. Effect of *Fec* B gene on resistance to GIN was conducted in sheep naturally infected with GINs.

Lower incidence was observed in Garole sheep. H-11 and H-gal-GP polypeptides of *H. contortus* are being utilized for immunoprophylaxis and studies on H-gal-GP were completed. In H-gal- GP of *H. contortus* MEP-2 fragment showed 94% homology to other international strains. Equines Nation-wide active equine disease surveillance, sero-survey was conducted at Rajasthan, Haryana, Punjab, Uttar Pradesh, Madhya Pradesh, and Jammu and Kashmir. Antibodies to EHV-1 were detected in 7.1% samples, *Babesia equi* in 24.3% sera tested, and Japanese encephalitis in 5.5% serum samples tested.

None of the serum samples tested was positive for equine infectious anemia, African horse sickness, equine influenza and *Salmonella* Abortus-equi. Outbreaks of glanders reported from Uttarakhand, Andhra Pradesh, Himachal Pradesh and Haryana were investigated and diagnosed, and etiological agent *Burkholderia mallei* was islolated. Comparative sero-prevalence of JE in different animal species (equine, cattle, buffalo, pigs) was done in different regions of Haryana and highest incidence was in buffaloes followed by pigs, horses and cattle. EHV-4 virus was isolated from 11 out of 138 samples using equine embryonic lung cells. These results were confirmed by sequencing of PCR products. The centre succeeded in *in vitro* cultivation of bloodstream forms of *Trypanosoma evansi.* The characterization of *T. evansi* antigen by SDS-PAGE of sonicated antigen revealed five major polypeptides in the molecular weight range of 41-81 kDa and proteins of 35-41 kDa exhibited proteolytic activity. Serum neutralization test (SNT) and haemagglutination inhibition (HAI) were standardized for specific differentiation of two related arboviruses i.e., Japanese encephalitis (JE) and West Nile virus (WNV). On comparison sensitivity of HAI was 96.29% and specificity 100% in comparison to SNT. RT-PCR using Egene (291 bp) was also developed for diagnosis of JE in equines. An ELISA was developed for detection of *Babesia equi* specific antibodies. The sensitivity and specificity of the ELISA in comparison to commercial CI-ELISA was 94 and 96%, respectively. To study the polymorhphism of the MHC class II gene in Marwari horses, regions of MHC class-II (DRB-2a and 2b) gene fragments of 276 bp and 229 bp were amplified. Restriction analysis revealed that MHC-DRB2 (276 bp fragment) on digestion with *Hin*fI exhibits polymorphism in 48.39% genotypes. Microsatellite based parentage testing was done using 194 DNA samples collected from blood leukocytes of different horse breeds. Genotyping was performed by analysis of nine microsatellite and selected microsatellites were highly polymorphic as mean

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number of alleles ranged from 3.78 to 10.78. Total exclusionary power of both parents in all breeds was more than 0.9 and all the foals qualified the offspring-candidate parent compatibility.

Yak

A slide enzyme linked immunosorbent assay (SELISA) was standardized for the detection of *Babesia bigemina* antibodies in yak sera. Serological studies for detection of *B. bigemina* specific antibodies in yak from an organized farm and under field conditions revealed 44.16 and 56.10% seropositivity, respectively. It could be concluded that being more economical and technically simpler, SELISA could be used for seroprevalence studies on babesiosis in yak. Keratoconjunctivitis was noticed in yaks, and *Moraxella bovis* and *Neisseria* were recovered from the ocular swabs.

Serum samples from the affected animals were analyzed by viral neutralization test. ABELISA for the presence of bovine herpes virus -1 (BHV-1) specific antibody. Nested PCR conducted using glycoprotein B and glycoprotein E specific primers (of BHV-1) revealed the presence of BHV- 1 in the ocular swab of the affected yaks. The serological and molecular analyses indicated the possible role of BHV-1 in severe forms of keratoconjunctivitis in yaks. Yak sera samples collected from different yak tracts of India were screened for the detection of BHV-1 specific antibody. The overall prevalence of BHV-1 specific antibody was alarmingly high (more than 40%) in yaks. Sex and location of different yak tracts did not have any influence over the IBR prevalence. However, the prevalence increased with the age of the animals, and was highest in yaks more than 3-year-old. Conjunctivitis and reproductive abnormalities were predominant symptoms among the seropositive yaks. The common ecological niche for feeding, watering and grazing with other domestic and wild animals is the possible avenue of infection in yaks.

Poultry

Marek's disease virus (MDV) circulating in PDP flocks was low virulent strain. MD incidence could be reduced more effectively with HVT (cell free) double dose or HVT+SB1 cell associated vaccines than single dose of HVT vaccine. Tumour samples could be safely stored in phenol-chloroformisoamyl alcohol for PCR. Leg weakness associated with osteomyelitis caused by *Staphylococcus* spp. was recorded in young broilers, while aspergillosis was observed in female line of Gramapriya.

Fisheries

Marine fish landings and catch structure: The marine fish landings of India during the year 2007 has been estimated as 2.88 million tonnes with an increase of about 1.7 lakh tonnes (6.5%) against the estimate of the previous year. The pelagic finfishes constituted 57%, demersal fishes 25%, crustaceans 14%, and molluscs 4% of the total landings. The sector-wise contributions were — mechanized landings 68%, motorized landings 28% and the atisanal landings 4%. Among the commercially important groups, the landings of oil sardine (26% increase over the previous year), penaeid prawns (13.4%), Indian mackerel (26%), croakers (41.9%) and other clupeids (55.6%) recorded substantial increase over their previous year's landings. The landings of non-penaeid prawns (18.6% decrease from the previous year), ribbon fishes (44%), Bombay duck (4.8%), thread fin breams (16.3%) and cuttle fish (27.2%) recorded marginal to substantial reduction from their previous year's landings. The estimates of region-wise production in the total production were—north-east region 13.2%, south-east region 22.6%, north-west region 29.3%, and south-west region

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34.9%. Ring seine fishery for oil sardine along the northern coast of Tamil Nadu: Oil sardine (*Sardinella longiceps*), is the most important pelagic resource on the west coast of India, and its occurrence along the east coast was considered sporadic and rare. In July 2008, large shoals of oil sardine appeared in the near shore coastal waters of Devanampattinam, Cuddalore and Puducherry. This supported high catches in the ring seine units newly introduced fishing practice, from the near shore waters for a month. Inland fisheries Exotic fish species invasion in West Bengal wetlands – a cause of concern: During fish stock assessment, breeding populations of exotic tropical South American Sailfin catfish, *Pterygoplichthys disjunctivus* and *Pterygoplichthys pardalis,* were recorded in Gomokpota *beel* under East Kolkata Wetlands. Huge biomass of these species, approximately 20 metric tonnes, was caught in a single month. These fishes do not fetch remunerative price as food fish but occasionally find place in aquaria. These species are prolonged breeders and voracious detritivores. A number of other exotic fish species, viz. *Barbonymus gonionotus* (*Puntius gonionotus*), *Pangasianodon hypophthalmus* (*Pangasius sutchi*), *Clarias gariepinnus, Oreochromis niloticus niloticus* and *Piaractus brachypomus* were also recorded in some other wetlands in the state. This has serious ecological and economic implications for the wetland fisheries in the state.

Culture Fisheries

Reservoir fisheries enhancement: Fisheries enhancement in reservoirs Dahod in Madhya Pradesh and Pahuj in Uttar Pradesh, was attempted through stocking of fish seed and improvement of institutional arrangements for fish catch and marketing. This resulted in improved fish production by over 60% in one year of experimental intervention. The catch/month, total fish catch and per month fishing days increased. The case studies will be helpful in formulating strategies for reservoir development in the Indo-Gangetic basin.

Freshwater Aquaculture

Labeo gonius in polyculture system: The compatibility of *Labeo gonius* with other major carps was studied through three combinations catla, silver carp, rohu and gonius; catla, silver carp, mrigal and gonius; and catla, silver carp, rohu and mrigal at combined density of 7,500 fingerlings/ha. Silver carp gave higher overall species survival, while catla showed the lowest level. Survival of rohu, mrigal and gonius, was intermediate and did not differ among them.

Coastal Aquaculture

Low fish meal feed for shrimp: A low fish meal shrimp feed was developed by replacing fish meal and other marine protein sources with plant protein sources. Shrimp production after four months of feeding on the low fish meal feed was 1,308 kg shrimp/ha with a feed conversion ratio (FCR) of 1.31:1. This feed can be successfully used for culturing tiger shrimp at low cost of production. WSSV risks to shrimp farming due to increased culture of crabs: Crabs are known carriers of white spot syndrome virus (WSSV), hence to address apprehensions of shrimp farmers to crab culture, studies were carried out to assess WSSV risks to shrimp farming due to enhanced culture of crabs.

The prevalence of WSSV in crustaceans in different geographical regions was estimated based on samples from Andhra Pradesh, Tamil Nadu, Maharashtra and West Bengal. The prevalence levels in crabs used for crab fattening or those found in wild crabs indicate that they do not pose any additional WSSV risks.

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International Accounting Standard 41

Agriculture

The objective of this Standard is to prescribe the accounting treatment and disclosures related to agricultural activity.

This Standard shall be applied to account for the following when they relate to agricultural activity:

(a) biological assets;

(b) agricultural produce at the point of harvest; and

(c) government grants covered by paragraphs 34–35.

This Standard does not apply to:

(a) land related to agricultural activity; and

(b) intangible assets related to agricultural activity.

This Standard is applied to agricultural produce, which is the harvested product of the entity's biological assets, only at the point of harvest. Thereafter, IAS 2 *Inventories* or another applicable Standard is applied.

Accordingly, this Standard does not deal with the processing of agricultural produce after harvest; for example, the processing of grapes into wine by a vintner who has grown the grapes. While such processing may be a logical and natural extension of agricultural activity, and the events taking place may bear some similarity to biological transformation, such processing is not included within the definition of agricultural activity in this Standard.

The table below provides examples of biological assets, agricultural produce, and products that are the result of processing after harvest:

Biological assets	*Agricultural produce*	*Products that are the result of processing after harvest*
Sheep	Wool	Yarn, carpet
Plants	Cotton	Thread, clothing
Dairy cattle	Milk	Cheese
Pigs	Carcass	Sausages, cured hams
Bushes	Leaf	Tea, cured tobacco

Agriculture-related Definitions

The following terms are used in this Standard with the meanings specified:

- *Agricultural activity* is the management by an entity of the biological transformation and harvest of biological assets for sale or for conversion into agricultural produce or into additional biological assets.
- *Agricultural produce* is the harvested product of the entity's biological assets. A *biological asset* is a living animal or plant.
- *Biological transformation* comprises the processes of growth, degeneration, production, and procreation that cause qualitative or quantitative changes in a biological asset.
- A *group of biological assets* is an aggregation of similar living animals or plants.
- *Harvest* is the detachment of produce from a biological asset or the cessation of a

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biological asset's life processes.

- *Costs to sell* are the incremental costs directly attributable to the disposal of an asset, excluding finance costs and income taxes.

Agricultural activity covers a diverse range of activities; for example, raising livestock, forestry, annual or perennial cropping, cultivating orchards and plantations, floriculture, and aquaculture (including fish farming). Certain common features exist within this diversity:

(a) *Capability to change*. Living animals and plants are capable of biological transformation;

(b) *Management of change*. Management facilitates biological transformation by enhancing, or at least stabilising, conditions necessary for the process to take place (for example, nutrient levels, moisture, temperature, fertility, and light). Such management distinguishes agricultural activity from other activities. For example, harvesting from unmanaged sources (such as ocean fishing and deforestation) is not agricultural activity; and

(c) *Measurement of change*. The change in quality (for example, genetic merit, density, ripeness, fat cover, protein content, and fibre strength) or quantity (for example, progeny, weight, cubic metres, fibre length or diameter, and number of buds) brought about by biological transformation or harvest is measured and monitored as a routine management function.

Biological transformation results in the following types of outcomes:

(a) asset changes through

(i) growth (an increase in quantity or improvement in quality of an animal or plant),

(ii) degeneration (a decrease in the quantity or deterioration in quality of an animal or plant), or

(iii) procreation (creation of additional living animals or plants); or

(b) production of agricultural produce such as latex, tea leaf, wool,and milk.

General Definitions

The following terms are used in this Standard with the meanings specified:

(a) the items traded within the market are homogeneous;

(b) willing buyers and sellers can normally be found at any time; and

(c) prices are available to the public.

- *Carrying amount* is the amount at which an asset is recognised in the statement of financial position.
- *Fair value* is the amount for which an asset could be exchanged, or a liability settled, between knowledgeable, willing parties in an arm's length transaction.
- *Government grants* are as defined in IAS 20 *Accounting for Government Grants and Disclosure of Government Assistance*.

The fair value of an asset is based on its present location and condition. As a result, for example, the fair value of cattle at a farm is the price for the cattle in the relevant market less the transport and other costs of getting the cattle to that market.

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Recognition and Measurement

An entity shall recognise a biological asset or agricultural produce when, and only when:

(a) the entity controls the asset as a result of past events;

(b) it is probable that future economic benefits associated with the asset will flow to the entity; and

(c) the fair value or cost of the asset can be measured reliably.

In agricultural activity, control may be evidenced by, for example, legal ownership of cattle and the branding or otherwise marking of the cattle on acquisition, birth, or weaning. The future benefits are normally assessed by measuring the significant physical attributes.

A biological asset shall be measured on initial recognition and at the end of each reporting period at its fair value less costs to sell, except for the case described in paragraph 30 where the fair value cannot be measured reliably.

Agricultural produce harvested from an entity's biological assets shall be measured at its fair value less costs to sell at the point of harvest. Such measurement is the cost at that date when applying IAS 2 *Inventories* or another applicable Standard.

The determination of fair value for a biological asset or agricultural produce may be facilitated by grouping biological assets or agricultural produce according to significant attributes; for example, by age or quality.

An entity selects the attributes corresponding to the attributes used in the market as a basis for pricing. Entities often enter into contracts to sell their biological assets or agricultural produce at a future date. Contract prices are not necessarily relevant in determining fair value, because fair value reflects the current market in which a willing buyer and seller would enter into a transaction. As a result, the fair value of a biological asset or agricultural produce is not adjusted because of the existence of a contract. In some cases, a contract for the sale of a biological asset or agricultural produce may be an onerous contract, as defined in IAS 37 *Provisions, Contingent Liabilities and Contingent Assets*. IAS 37 applies to onerous contracts.

If an active market exists for a biological asset or agricultural produce, in its present location and condition, the quoted price in that market is the appropriate basis for determining the fair value of that asset. If an entity has access to different active markets, the entity uses the most relevant one. For example, if an entity has access to two active markets, it would use the price existing in the market expected to be used.

If an active market does not exist, an entity uses one or more of the following, when available, in determining fair value:

(a) the most recent market transaction price, provided that there has not been a significant change in economic circumstances between the date of that transaction and the end of the reporting period;

(b) market prices for similar assets with adjustment to reflect differences; and

(c) sector benchmarks such as the value of an orchard expressed per export tray, bushel, or hectare, and the value of cattle expressed per kilogram of meat.

In some cases, the information sources listed in paragraph 18 may suggest different conclusions as to the fair value of a biological asset or agricultural produce. An entity

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considers the reasons for those differences, in order to arrive at the most reliable estimate of fair value within a relatively narrow range of reasonable estimates.

In some circumstances, market-determined prices or values may not be available for a biological asset in its present condition. In these circumstances, an entity uses the present value of expected net cash flows from the asset discounted at a current market-determined rate in determining fair value.

The objective of a calculation of the present value of expected net cash flows is to determine the fair value of a biological asset in its present location and condition. An entity considers this in determining an appropriate discount rate to be used and in estimating expected net cash flows. In determining the present value of expected net cash flows, an entity includes the net cash flows that market participants would expect the asset to generate in its most relevant market. An entity does not include any cash flows for financing the assets, taxation, or re-establishing biological assets after harvest (for example, the cost of replanting trees in a plantation forest after harvest). In agreeing an arm's length transaction price, knowledgeable, willing buyers and sellers consider the possibility of variations in cash flows. It follows that fair value reflects the possibility of such variations.

Accordingly, an entity incorporates expectations about possible variations in cash flows into either the expected cash flows, or the discount rate, or some combination of the two. In determining a discount rate, an entity uses assumptions consistent with those used in estimating the expected cash flows, to avoid the effect of some assumptions being double-counted or ignored.

Cost may sometimes approximate fair value, particularly when:

(a) little biological transformation has taken place since initial cost incurrence (for example, for fruit tree seedlings planted immediately prior to the end of a reporting period); or

(b) the impact of the biological transformation on price is not expected to be material (for example, for the initial growth in a 30-year pine plantation production cycle).

Biological assets are often physically attached to land (for example, trees in a plantation forest). There may be no separate market for biological assets that are attached to the land but an active market may exist for the combined assets, that is, for the biological assets, raw land, and land improvements, as a package.

An entity may use information regarding the combined assets to determine fair value for the biological assets. For example, the fair value of raw land and land improvements may be deducted from the fair value of the combined assets to arrive at the fair value of biological assets.

Gains and Losses

A gain or loss arising on initial recognition of a biological asset at fair value less costs to sell and from a change in fair value less costs to sell of a biological asset shall be included in profit or loss for the period in which it arises.

A loss may arise on initial recognition of a biological asset, because costs to sell are deducted in determining fair value less costs to sell of a biological asset. A gain may arise on initial recognition of a biological asset, such as when a calf is born.

A gain or loss arising on initial recognition of agricultural produce at fair value less

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costs to sell shall be included in profit or loss for the period in which it arises. A gain or loss may arise on initial recognition of agricultural produce as a result of harvesting.

Inability to Measure Fair Value Reliably

There is a presumption that fair value can be measured reliably for a biological asset. However, that presumption can be rebutted only on initial recognition for a biological asset for which market-determined prices or values are not available and for which alternative estimates of fair value are determined to be clearly unreliable. In such a case, that biological asset shall be measured at its cost less any accumulated depreciation and any accumulated impairment losses. Once the fair value of such a biological asset becomes reliably measurable, an entity shall measure it at its fair value less costs to sell. Once a non-current biological asset meets the criteria to be classified as held for sale (or is included in a disposal group that is classified as held for sale) in accordance with IFRS 5 *Non-current Assets Held for Sale and Discontinued Operations*, it is presumed that fair value can be measured reliably.

The presumption in paragraph 30 can be rebutted only on initial recognition. An entity that has previously measured a biological asset at its fair value less costs to sell continues to measure the biological asset at its fair value less costs to sell until disposal. In all cases, an entity measures agricultural produce at the point of harvest at its fair value less costs to sell. This Standard reflects the view that the fair value of agricultural produce at the point of harvest can always be measured reliably.

In determining cost, accumulated depreciation and accumulated impairment losses, an entity considers IAS 2 *Inventories*, IAS 16 *Property, Plant and Equipment* and IAS 36 *Impairment of Assets*.

Government Grants

An unconditional government grant related to a biological asset measured at its fair value less costs to sell shall be recognised in profit or loss when, and only when, the government grant becomes receivable.

If a government grant related to a biological asset measured at its fair value less costs to sell is conditional, including when a government grant requires an entity not to engage in specified agricultural activity, an entity shall recognise the government grant in profit or loss when, and only when, the conditions attaching to the government grant are met. Terms and conditions of government grants vary. For example, a grant may require an entity to farm in a particular location for five years and require the entity to return all of the grant if it farms for a period shorter than five years. In this case, the grant is not recognised in profit or loss until the five years have passed.

However, if the terms of the grant allow part of it to be retained according to the time that has elapsed, the entity recognises that part in profit or loss as time passes.

If a government grant relates to a biological asset measured at its cost less any accumulated depreciation and any accumulated impairment losses, IAS 20 *Accounting for Government Grants and Disclosure of Government Assistance* is applied.

This Standard requires a different treatment from IAS 20, if a government grant relates to a biological asset measured at its fair value less costs to sell or a government grant requires an entity not to engage in specified agricultural activity. IAS 20 is applied only to a

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government grant related to a biological asset measured at its cost less any accumulated depreciation and any accumulated impairment losses.

Disclosure

General

An entity shall disclose the aggregate gain or loss arising during the current period on initial recognition of biological assets and agricultural produce and from the change in fair value less costs to sell of biological assets.

An entity shall provide a description of each group of biological assets. The disclosure required by paragraph 41 may take the form of a narrative or quantified description. An entity is encouraged to provide a quantified description of each group of biological assets, distinguishing between consumable and bearer biological assets or between mature and immature biological assets, as appropriate. For example, an entity may disclose the carrying amounts of consumable biological assets and bearer biological assets by group. An entity may further divide those carrying amounts between mature and immature assets. These distinctions provide information that may be helpful in assessing the timing of future cash flows. An entity discloses the basis for making any such distinctions. Consumable biological assets are those that are to be harvested as agricultural produce or sold as biological assets. Examples of consumable biological assets are livestock intended for the production of meat, livestock held for sale, fish in farms, crops such as maize and wheat, and trees being grown for lumber. Bearer biological assets are those other than consumable biological assets; for example, livestock from which milk is produced, grape vines, fruit trees, and trees from which firewood is harvested while the tree remains. Bearer biological assets are not agricultural produce but, rather, are self-regenerating. Biological assets may be classified either as mature biological assets or immature biological assets. Mature biological assets are those that have attained harvestable specifications (for consumable biological assets) or are able to sustain regular harvests (for bearer biological assets).

If not disclosed elsewhere in information published with the financial statements, an entity shall describe:

(a) the nature of its activities involving each group of biological assets; and

(b) non-financial measures or estimates of the physical quantities of:

(i) each group of the entity's biological assets at the end of the period; and

(ii) output of agricultural produce during the period.

An entity shall disclose the methods and significant assumptions applied in determining the fair value of each group of agricultural produce at the point of harvest and each group of biological assets. An entity shall disclose the fair value less costs to sell of agricultural produce harvested during the period, determined at the point of harvest.

An entity shall disclose:

(a) the existence and carrying amounts of biological assets whose title is restricted, and the carrying amounts of biological assets pledged as security for liabilities;

(b) the amount of commitments for the development or acquisition of biological assets;

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and

(c) financial risk management strategies related to agricultural activity.

An entity shall present a reconciliation of changes in the carrying amount of biological assets between the beginning and the end of the current period. The reconciliation shall include:

(a) the gain or loss arising from changes in fair value less costs to sell;

(b) increases due to purchases;

(c) decreases attributable to sales and biological assets classified as held for sale (or included in a disposal group that is classified as held for sale) in accordance with IFRS 5;

(d) decreases due to harvest;

(e) increases resulting from business combinations;

(f) net exchange differences arising on the translation of financial statements into a different presentation currency, and on the translation of a foreign operation into the presentation currency of the reporting entity; and

(g) other changes.

The fair value less costs to sell of a biological asset can change due to both physical changes and price changes in the market. Separate disclosure of physical and price changes is useful in appraising current period performance and future prospects, particularly when there is a production cycle of more than one year. In such cases, an entity is encouraged to disclose, by group or otherwise, the amount of change in fair value less costs to sell included in profit or loss due to physical changes and due to price changes. This information is generally less useful when the production cycle is less than one year (for example, when raising chickens or growing cereal crops). Biological transformation results in a number of types of physical change— growth, degeneration, production, and procreation, each of which is observable and measurable. Each of those physical changes has a direct relationship to future economic benefits. A change in fair value of a biological asset due to harvesting is also a physical change.

Agricultural activity is often exposed to climatic, disease and other natural risks. If an event occurs that gives rise to a material item of income or expense, the nature and amount of that item are disclosed in accordance with IAS 1 *Presentation of Financial Statements*. Examples of such an event include an outbreak of a virulent disease, a flood, a severe drought or frost, and a plague of insects.

Additional disclosures for biological assets where fair value cannot be measured reliably. If an entity measures biological assets at their cost less any accumulated depreciation and any accumulated impairment losses. At the end of the period, the entity shall disclose for such biological assets:

(a) a description of the biological assets;

(b) an explanation of why fair value cannot be measured reliably;

(c) if possible, the range of estimates within which fair value is highly likely to lie;

(d) the depreciation method used;

(e) the useful lives or the depreciation rates used; and

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(f) the gross carrying amount and the accumulated depreciation (aggregated with accumulated impairment losses) at the beginning and end of the period.

If during the current period, an entity measures biological assets at their cost less any accumulated depreciation and any accumulated impairment losses, an entity shall disclose any gain or loss recognised on disposal of such biological assets and the reconciliation required by paragraph 50 shall disclose amounts related to such biological assets separately. In addition, the reconciliation shall include the following amounts included in profit or loss related to those biological assets:

(a) impairment losses;

(b) reversals of impairment losses; and

(c) depreciation.

If the fair value of biological assets previously measured at their cost less any accumulated depreciation and any accumulated impairment losses becomes reliably measurable during the current period, an entity shall disclose for those biological assets:

(a) a description of the biological assets;

(b) an explanation of why fair value has become reliably measurable; and

(c) the effect of the change.

Government Grants

An entity shall disclose the following related to agricultural activity covered by this Standard:

(a) the nature and extent of government grants recognised in the financial statements;

(b) unfulfilled conditions and other contingencies attaching to government grants; and

(c) significant decreases expected in the level of government grants.

Need for Accounting Standards for Agriculture and Livestock

According to the NAFSCOB (National Federation of State Cooperative Banks Ltd) report there are 30 SCBs (State Co-operative Banks), 962 branches, 370 DCCBs (Districts Central Co-operative Banks and 1,06,384 primary societies in India by 31/3/2006.

The Government of India established NABARD to finance the agricultural sector through state and District Co-operative Banks. All the DCCBs and PACS (Primary Agricultural Credit Societies) are lending loans and advances for the development of agricultural sector and uplifting of weaker section.

The DCCBs and PACBs in India provide loans and advances for different agricultural schemes. These schemes are formulated and approved under the supervision and control of NABARD. The high yielding cultivable crops are identified for different regions and financial assistances are offered under Short Term and Medium Term (ST & MT), Schematic lending, ST & MT Agricultural loans and SAOs (Seasonal and Agricultural Operations) Financial assistance is provided for marketing, storage, purchase of seeds, fertilizers and pesticides and for all the agricultural activities.

The commercial crops are also identified and loans and advances are provided for production, marketing and for other related needs under separate schemes and plans. In the books of accounts of any DCCB or PACS we can find plenty of loans and advances provided for cattle purchase, poultry, goat farm etc. In the accounting parlance these are brought under

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the category of 'Livestock'. As per schedule VI of the Companies Act the livestock is included in fixed assets. Normally fixed assets are brought under the purview of depreciation as per the generally acceptable accounting principles and standard practices. It is obligatory as per legal provisions of certain Acts. The stock of inventories is categorized as current asset and valued according to the standard practices followed by the respective organizations.

According to AS 9 - Revenue Recognition concept, the minimum amount of sale income earned from agriculture can be reliably measured even at the time of completion of production. This may be due to support price set by the Government or immediate marketability.

The price is pre-determined before marketing it. In such case the revenue may be recognized as soon as the production or harvesting is completed at the pre-determined price and that will be the selling price. There are so many crops for which no adequate support price is being provided and immediate convertibility into cash is also not possible. We could find a dispute in existing support price or the price determined every year by the Govt.

The IAS-41 (International Accounting Standard) has been introduced for Agriculture. The General Clarification (GC) - 12/2002, issued by the Accounting Standard Board of the ICAI on applicability of accounting standards indicated that the Accounting standards would apply to all the activities of the co-operative societies including those which are not commercial, Industrial and or business in nature.

The Auditors should examine the books of accounts of them in accordance with Accounting Standards and deviations must be disclosed. According to Accounting Standard 2 revised (AS-2 revised) the stock of inventories that is one of the current assets must be valued at 'Net Realizable Value'. The AS-2 is not applicable to producer's inventories of livestock, agricultural and forest products, mineral oils, ores and gases.

According to AS-2 and IAS-2 (International Accounting Standards) they are measured at net realizable value in accordance with well-established practices in those concerns. It is obligatory to follow similar accounting policies consistently in all accounting periods. Any change must be disclosed in the financial statement. AS-10 deals with Fixed Assets. All the depreciable assets must be depreciated as per the standard practices. The depreciation is calculated under SLM (Straight Line Method), WDV (Written down Value method), unit of production method or any other standard method permitted to follow. Now the questions raised on stock of agricultural produce and live stock are :

1. What are the procedures for recording such items?
2. What are the methods of valuing such stock?
3. If the current practices followed are approved which are the Standard practices to be considered prudential?

When these questions are raised to a group of practicing Charted Accountants, they said it is an unimportant area and hence they accept the current method of valuation followed by their client for agricultural produces or livestock. Since it is neglected as an unimportant area, proper emphasis was not given so far. But, India is an agricultural based country and more than 90% of village population has livestock. Most of the farmers and villagers earn their livelihood from livestock and income from crops. They take crop loan and schematic

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loans from DCCBs and PACSs available in their respective jurisdiction.

Even the authorities concerned accept that they do not follow any standard practice for valuing the yield of livestock. The breeding animals loan and all kinds of loan granted for livestock are highly hypothetical. It seems that it is granted on trial and error basis.

In practice the DCCB and PACS ask the party to produce a "Veterinary Doctor Certificate" about the health condition of the cattle or the livestock to approve the loan. Many of their methods are substandard and unrealistic. The agricultural loans and crops loans are provided based on the agricultural schemes and plans that are prepared on unrealistic assumptions on the value of yield and duration of the yield. So in order to develop standard practices, the Indian Accounting Standard Board must come forward to formulate an Accounting Standard in the form of guidelines or provisions.

While formulating it, cautions must be taken to prevent contradictions with other Accounting Standards, Concepts and Conventions, especially with revenue recognition concept and matching concept. It is expected that this will give a convincing solution for the following questions.

1. What are the Principles to be followed in recording Agriculture produce and livestock in books of accounts?
2. What are the methods of valuing the yield before and after the harvest of commercial and non-commercial crops?
3. What are the situations in which livestock can be considered as fixed assets?
4. What are the situations in which the livestock can be considered as current Assets?
5. How to value the Livestock?

This would help to develop standard and productive practices in granting loan to develop rural population in the long run. The lending policies and collection of overdue would not thrust any burden or risk. The people will use the rural credit wisely only on productive schemes.

The unscrupulous persons could be prevented from misusing such facilities available in co-operative banks. This would facilitate to reach the schemes and plans to the right people. The people will feel their moral responsibility of repaying the loan and the NPA (Non-Performing Assets) in the DCCBs and PACS in India could be brought under control.

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Chapter 6 : Practical Technologies and Options for the Genetic Improvement of Livestock

Some of the implications for breeding strategies regarding the need to promote sustainable animal production systems in the developing world. Due to restrictions of space, cattle in the lowland tropics are taken as the main example and it is hoped that many of the same considerations will be applicable to other species. The choice seems justified on the grounds of the numerical importance of cattle in the tropics and the fact that so much more needs to be known about tropical lowland, compared with temperate, zone systems in all fields including animal breeding. Since such large areas of the lowland tropics are characterised by acute poverty and hunger that the case also well illustrates the need faced by developing countries to ensure immediate increases in cheaply priced food whilst, at the same time, conserving their natural resources.

National Objectives

Sustainable cattle production systems in the lowland tropics must contribute to the alleviation of poverty, hunger and national indebtedness in both the short and long term. Priority must be given to those systems which offer the best opportunities for providing cheap food and other products. This means that they will be based primarily on locally abundant feed, animal and human resources. The improvements proposed must also be widely applicable and not directed solely to an economic or technical elite, otherwise they will not contribute fully to rural development. These restrictions immediately define certain biological aspects of the systems which should be given priority, as well as also important guidelines for genetic improvement. Of the biological aspects, the nutritive basis of the systems is perhaps the most important single feature because it determines the type of animal which must be used. To comply with the objectives outlined above, the base feeds involved will be those which are locally abundant.

Throughout the tropics, these will include agro-industrial byproducts, crop residues and, in some regions, tropical grasslands. Grains, particularly imported cereals, will be restricted and, in general, concentrate supplementation reduced to the strategic use of specific nutrients to optimise ruminal function and the efficiency of use of the diet as a whole (Preston and Leng, 1987).

The use of by-products and grasslands through animals contributes to the sustainability of the whole production system. Furthermore, animals can use wastes which have little alternative use and simultaneously provide traction and fertiliser, if needed. They also contribute to sustainability in the direct economic sense by providing a source of low-risk savings and, if milked, of daily income (Winrock, 1978). Tropical Latin America alone has over 500 million hectares of grasslands, often occupying marginal acid soils or steep slopes (Sere and Jarvis, 1989). Grazing systems under these conditions have a key role to play in soil erosion control and fertility improvement, particularly when legumes are included. In

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addition, the improvement of grazing systems already established on cleared tropical forest should help to stem the rate of forest destruction by providing a better livelihood from the land which is already cleared.

These considerations have important implications from the genetic point of view. In the first place, whether by-products or tropical grasslands provide the basis of the diet, their nutritive value is low and the levels of individual production will not be high. Expressed in terms of milk yield, perhaps 4 to 10 kg/cow/day are reasonable limits. Yields much above this level will involve the use of resources (e.g. imported grains, heavy capital investments, advanced technical skill) which prevent the systems from meeting the socioeconomic objectives originally set out.

Thus, the genetic potential of the cattle for production must be carefully matched to the resources available and, in this respect, the temperate zone criteria are irrelevant. Secondly, all improvement measures, including genetic ones, must be simple and cheap enough to be widely applicable and the selection of appropriate measures must ensure that they make the best possible use of the resources involved. These same principles appear to be equally relevant to other animal species, whether ruminant or non-ruminant.

One of the most unsatisfactory features of pig and poultry production systems in many parts of their tropics is their total dependence on imported stock, technology and, often, feeds. This disregards the potential of small animals as contributors to rural development by exploiting their ability to make use of local feedstuffs, including wastes, and frequently represents an incomplete and unsustainable production system of which the feed base (e.g. imported cereals) is highly dependent on fossil fuels.

Breed Substitution

One possible strategy for genetic improvement is breed substitution. Defined as the introduction of commercial females, as well as males, this seems to be the least satisfactory option, if the strict socioeconomic objectives are borne in mind. In the first place, if the constraints of the local environment are correctly assessed and the products required from the animals precisely determined, it may well be that existing genotypes are adequate and able to respond sufficiently and economically to improvements in the system. Frequently, the complexity of the required product is often overlooked. Pigs, for example, play an important role in many small farming systems as a low-cost and, therefore, low-risk source of savings. Once exotic genotypes are introduced, purchased inputs become essential and risks increase to a level at which the original objective is lost.

In the case of cattle, many lowland tropical systems require them to produce fuel, fertiliser and traction, besides meat and milk. Even where the first three are less important, as in most of Latin America, there are still strong arguments in favour of dual purpose, as opposed to specialised meat or milk production (Preston, 1976; Sere and Vaccaro, 1985). These multiple functions of cattle are an intrinsic element of the stability of the whole production system, which may well be upset if the existing stock are replaced. Resistance to disease and parasites may also be of vital importance. The trypanotolerance of West African N'Dama cattle is a case in point and increasing attention may be expected to be given in future to parasite resistance due to the high cost of insecticides and environmental concern.

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Tick resistance which is a characteristic of zebus or resistance to cattle flies such as *Dermatobia hominis* found in Latin American criollos (such as the Colombian Blanco Okejinegro) will also take on increasing economic importance.

Secondly, even where existing breeds have insufficient production potential, their substitution with new genotypes is, at least in the case of large species, a high-cost, high-risk measure which cannot be expected to solve the problems of the majority of farmers in a given locality. With cattle, neither substitution with another tropical genotype nor a temperate breed seems likely to be justifiable.

Few tropical breeds, or crosses, have sufficient numbers of genetically evaluated stock to justify importation, even presuming that their performance in the new environment could be predicted. Whatever their success, the possibility seems remote that the introduced animals will have any advantage over the crossbreds which could be derived from the existing population, except in terms of the time required to produce the crosses; which is, however, relative. Usually overall productivity of the existing animals is limited by poor reproduction and survival.

Investment in measures to improve these traits will have an important permanent impact on the efficiency of the production system and will pave the way for the higher potential crossbreds to be bred while the improvements are being organised. It would seem, therefore, that investment in environmental improvements along with crossbreeding is more likely to prove a cost effective alternative than the introduction of new tropical stock. The introduction of European breeds into the lowland tropics is also unlikely to be a suitable option. Tropical forages are less digestible than temperate ones (Minson, 1980) and their utilisation therefore generates more metabolic heat. As European cattle do not have efficient heat dissipation mechanisms, high levels of concentrates are required if they are to survive and produce.

The concentrates are typically derived from cereals, often imported. These systems are clearly less sustainable in the long term than grazing systems or those based on by-products, for which pure European breeds are generally unsuitable. Furthermore, past evidence suggests that European dairy cattle will be unable to maintain their herd numbers, due to short and involuntary culling (Vaccaro, 1990). No genetic programme can be sustainable if it relies constantly on the importation of females. Besides, the costs involved in terms of concentrate feeds, veterinary supplies, technical skill and capital investment remove systems based on European cattle from the grasp of the ordinary farmer and prevent them from making the desired impact on rural development. Recent Latin American experience also questions their potential for providing low-cost food, since milk production costs have been found to be higher and profitability lower than with crossbred stock. It is extremely likely that the same arguments will apply to the introduction of exotic breeds of small ruminants and also, to some extent, to pigs.

Crossbreeding

A second option to be considered is crossbreeding. In the case of cattle, evidence from all over the lowland tropical world shows that, in one generation, tropical populations can increase yields to levels very close to the limits set by the locally available feed resources and which fit conveniently with the levels of technical skill, capital investment and service support infrastructure available.

Despite this, there are few examples of successful, stabilised crossbreeding schemes in

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commercial populations on a large scale, and many cases of patent failure - usually involving grades of European crosses above the levels which the local environment can sustain.

This situation cannot be attributed to any lack of discussion of the theoretical merits of different crossbreeding schemes for tropical cattle, at least in the context of milk production (Cunningham and Syrstad, 1987; Bondoc et al., 1989).

The difficulty appears to lie in the fact that the field success of crossbreeding schemes depends far more on their practical feasibility than on their theoretical merits. It is suggested therefore, that genuinely sustainable crossbreeding systems will not evolve unless the practical restrictions set by the local production systems are very carefully taken into account.

The more common of these practical restrictions deserve further examination. Systems which require the simultaneous use of more than one breed of bull per farm are difficult to put into practice unless there is sufficient infrastructure (fences, records) to separate one bull and his appropriate mates from the other. Although these difficulties could be overcome by changing the bull breed after a period of time, the problem of identifying sources of bulls of known genetic quality at reasonable prices remains. Extending the system to three or more breeds would seem to preclude its use on a wide scale in most practical circumstances. Besides, whatever advantages might be expected from additional heterosis are only of interest if there are no important additive genetic differences between the breeds available for the programme.

Table: *Relative costs and profits derived from crossbred cattle of intermediate levels of European breed inheritance, compared with others under different systems in Latin America (50% European crosses = 100).*

Country/System	Breed Group	Relative	
		Costs	Profit
Bolivia*			
Pasture + supplement	Local cross	100	100
	European	100	- 300
Confined	European	210	- 300
Brazil**			
Low level management	50% European-zebu	100	100
	25% European-zebu	40	40
	European	- 13	- 13
High level management	50% European-zebu	51	
	25% European-zebu	- 11	
	European	29	
Venezulela***			
Lowland, medium level management	50% European-zebu	100	100
	75% European-zebu	109	83
Highland, high level management	European	167	70

* *Wilkins et al., 1979*

** *Madalena, 1989*

*** *Holmann, 1990*

Thus, for example, rotational crossbreeding schemes involving Zebu and European breeds for milk must take into account the much lower yield to be expected from the Zebu bulls' daughters. Similarly, under Latin American conditions at least, it would be questionable whether a second European breed, besides the Holstein, would make a sufficient

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contribution to a dual-purpose crossing scheme involving zebu cattle to warrant the additional complication, due to the superiority of the Holstein with it most common rival the Brown Swiss (Syrstad, 1985). It is therefore not surprising, that the evidence available to McDowell (1985) suggested that no advantage has generally been observed from the addition of a third breed to crossbreeding schemes for milk production.

The practical difficulties involved in dealing with various breeds of bull on the farm could in theory be solved by using AI, although the difficulty of obtaining semen of good genetic quality remains. In this context, it is necessary to draw attention to the risks which are commonly associated with using AI for the production of routine pregnancies (as opposed to occasional, strategic uses). Before proposing any crossbreeding scheme which depends on AI, care must be taken to avoid the risk of losing more calves and lactations through lower conception rates compared with natural service, than can be compensated for by genetic improvement. This risk is typically high in lowland tropical cattle populations. From commercial dual purpose herds in Venezuela, Gonzales (1981) reported a 12% lower pregnancy rate using AI than with natural service and even under experiment station conditions, Paterson *et al*. (1983) reported a 22% difference between the two mating systems in South Africa. Differences of this magnitude are difficult to justify on the grounds of the genetic quality of the AI sires.

A second practical restriction refers to the lack of infrastructure for selecing local cows and bulls, which affects the potential success of *inter se* crossbreeding systems and of new "synthetic" breeds. Extremely few lowland tropical communities can take on successfully the challenge of being self-sufficient for genetic improvement, which is required once the population is closed. This probably explains why so few of the attempts to form new breeds in the tropics have succeeded. Cow selection requires more than recording schemes: data must be processed routinely to evaluate genetic merit. To this author's knowledge, no lowland tropical cow population is at present evaluated routinely for estimated genetic merit for production traits. The selection of bulls, through progeny testing, raises practical problems which will be discussed later, although it is relevant to point out that the problems associated with effective bull progeny testing represent one of the limitations of the *inter se* crossbreeding schemes.

Inter se crossbreeding programmes can also be criticised on the grounds that they are inflexible. Under Latin american conditions, a very small geographical area will include farms with widely different environmental conditions. Which would require animals of different levels of European breed blood and a fixed genotype is therefore of limited use.

These considerations lead to the conclusion that the most widely applicable crossbreeding schemes will allow: a) the use of natural service, b) the simultaneous use of one, or at most two, genotypes of bull per farm, c) the routine introduction of improved germplasm from outside, to bolster local selection efforts or even supplant them under extremely difficult circumstances, and d) the provision of different genotypes so that farmers, with suitable technical assistance, they may generate the type of crossbred which will be most productive under their specific conditions.

An option which may be of wider use is that of the using crossbred bulls, bred from selected local dams and proven European breed sires. Work is in progress to determine the optimum genetic merit of European sires to be used and, once this is clear, the possibility of

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giving tropical cattle populations access to the huge range of constantly improving temperate zone germplasm will open back. Local selection efforts to identify dams of potential bulls are required, but this can be done in pilot or nucleus herds without necessarily having to carry out recording and selection on the majority of commercial farms. It is assumed that a native (zebu or criollo) populations will be continuously available to provide bull dams using, perhaps, more marginal lands unsuitable for the crossbreds. If not, the scheme degenerates into a "grading up" programme.

Within Population Improvement

It is difficult to demonstrate whether the genetic progress to be expected from selection within an indigenous population is likely to justify the investment required. Heritabilities are seldom known with precision and selection intensity is frequently low under precarious economic conditions since sales tend to be determined more by immediate monetary needs than by biological criteria. On the other hand, the cost of obtaining, processing and interpreting records is likely to be high, because of poor and unreliable infrastructure, and equally difficult to predict.

Despite this, it seems unacceptable to propose that nothing should be done. Tropical cattle herds are extremely variable in production characters and whatever genetic basis for differences between individuals may be, effective management requires that superior cows should be retained and inferior ones culled. The need to get rid of unproductive animals is all the greater under conditions of restricted feed supply. Furthermore, farmers, certainly in Latin America, take great pride in the acquisition of bulls and regularly assign resources to this purpose. The opportunity for introducing improved germplasm into herds by this means should not be missed. Finally, in our experience, the process of encouraging farmers to assess their cattle individually and to take decisions as to their merit, is very well received and associated with spontaneous efforts on their part to introduce other improvements.

Table: *The potential for selection in commercial dual purpose herds:the variation in production levels between the best and worst cows on five farms in Falcon, Venezuela*

Deviation from the group mean (kg)*				
Farm No	Milk yield/lactation		4 month calf weight	
	Highest	Lowest	Highest	Lowest
1	3058	-1694	52	-27
2	922	-861	38	-37
3	1175	-1096	42	-18
4	1484	-1391	26	-24
5	1634	-1215	39	-22

** 1584–2896 kg milk; 58-100 kg calf weight at 4 months.*

Selection criteria and methods should be allowed to vary in complexity according to the stage of development of the programme. The important point is to start the scheme on sound, sufficiently simple principles, for it to be carried out properly. A step-wise approach for dual purpose cattle in Latin America which takes this evolution into account has been described elsewhere (Vaccaro and Vaccaro, 1989). At first, cow selection could be based on calf growth and/or milk and reproductive efficiency. The inclusion of some measure of fertility seems essential because of the evidence in zebu populations that heritability is moderate

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(Plasse, 1988) and the consistent evidence of a negative phenotypic correlation between fertility and milk production under tropical conditions. Where herd size is small, approximately valid contemporary groups can be made by uniting data across herds, classified according to production system and, possibly, mean production levels.

Table: *Example of the negative relationship shown between milk yield and fertility in crossbred European x zebu cows in dual purpose systems in the lowland tropics of Venezuela.*

Milk yield/ lactation (kg)	*Interval from calving to conception*	*Anoestrus cows (%)*
< 1000	68.1	17
1001 – 1500	92.6	22
1501 – 2000	104.7	28
2001 – 2500	121.6	42
2501 – 3000	137.4	57
> 3000	141.9	65

Source: Gonzalez (1980)

Bull selection for milk production poses special problems; to assume that they can be effectively evaluated by progeny testing may well be unrealistic. Tropical herds are characterised by low reproductive efficiency, late age at first calving and high mortalities, low culling and lack of identification. In addition, milk yield which is the trait of principal interest is extremely variable compared with temperate zone standards. The size of the population which is mated by AI and performance recorded is usually small in the lowland tropics and, because of the high variation, low fertility and high rates of loss; more dams must be inseminated to produce the necessary number of daughters. This has been estimated at 30 in Cuba Menendez, (1985) and McDowell (1983) showed clearly the inaccuracies which result when daughter groups are smaller.

As a result, too few bulls can be tested reliably to permit an intensity of selection sufficient to justify the whole operation. In addition, the generation interval is prolonged by the late age for production of freezable semen and of first calving, as well as by the typical long process involved in processing and publishing the results. Once superior bulls are identified, their impact on the whole population is limited by the scope of the AI programme and low fertility associated with artificial breeding and by the high rates of loss before the end of the first lactation. An exercise to demonstrate the relative genetic and economic benefits of various selection options for dual purpose herds in Latin America showed little increase in genetic progress for milk due to progeny testing and a reduction in progress for 18 month body weight. It was concluded that the exorbitant cost of progeny testing under these conditions could not be justified.

Table: Simulated effects of different sire selection options on genetic progress in dual purpose herds under lowland tropical conditions in Latin America

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Selection Method	Mean Generation Interval (yrs)	Cost/bull selected (Bs)	Calving %	Genetic Progress per year (kg)	
				Milk	18 mth body weight
Dam records (DR)	5.4	-	85	20.7	2.4
Sire records (SR)	5.4	-	85	56.8	2.4
DR + SR	5.4	-	85	76.8	2.4
DR + SR with embryo transplants	5.9	1,500	85	87.4	2.2
DR + SR with progeny testing of bull	8.8	341,600	65	89.5	1.5

Source: Vaccaro (1988)

Practical improvement programmes should therefore explore alternatives to progeny testing. In native populations, emphasis can be given to bull dam selection and in crossbred populations to sire selection as well if, as proposed above, bull sires are routinely selected from temperate zone breeds and used on native dams.

Where progeny testing can be carried out effectively, BLUP procedures are usually recommended. Few tropical populations are likely to have the required information and it is of interest to note that a comparison made in Cuba showed no difference in the ranking of 20 Holstein bulls whether the methods used were BLUP (with or without taking the between bull relationships into account), contemporary comparisons or least squares (Cordovi *et al.*, 1983).

Field performance recording is generally difficult under lowland tropical conditions, especially where herds are far apart and rains seasonally intense. Whole sections of various Latin American countries, including Peru and Colombia, are presently intransitable because of high personal safety risks. The best investment is probably to show farmers how to keep and use their own records. Wives and children will often spontaneously undertake record keeping and this source of enthusiasm should be tapped. Record processing may best be done locally. National organisations usually lack the stability and agility to be effective. Governments should therefore be encouraged to participate in the establishment of overall guidelines for record keeping and then delegate responsibility to properly trained scientists working locally in institutions such as universities.

The schemes should start on a small scale. The most usual bottlenecks are the time lag between record collection and return of the processed information to the farm, and the failure to present the results in a way which permits farmers to see the order of genetic merit of their animals for traits of priority importance. These common faults should be overcome before the programme is allowed to expand.

Given the difficulties set out above the establishment of pilot or nucleus herds appears essential. In extreme cases, recording and selection would be confined to these farms. The effects would filter down into the rest of the population at rates which vary according to their number and size. Nucleus herds would generally be considered to be specific units but a very simple low cost scheme consists of providing suitable scientific advice to progressive commercial farms and using them as nucleus herds to provide at least some of the bulls and replacement females required by the rest. Care must be taken to admit only those farms which represent the priority production system, avoiding the temptation to use high yielding herds which do not. Also, the farmers must be genuinely convinced that the selection criteria agreed

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upon are valid. The applicability of the proposal will vary between regions and will depend partly on herd size. The important principle is that official organisations in developing countries tend to be unstable and poorly budgeted, and there are clear advantages in locating the programme directly in farmers' hands.

One of the most important of the advantages is that it minimises the risk of selection under unrepresentative environmental conditions. The programme should then grow under its own momentum and be sustainable in the sends that it becomes increasingly independent of outside inputs. Such a scheme is currently in progress in Venezuela. Outstanding zebu cows are inseminated with semen from proven Holstein bulls and the young males distributed to surrounding farmers, who are kept informed of the number, genetic credentials and prices of the bulls available. The university base of the project is useful, at least in the first years of the programme, to give some assurance to purchasers that information is unbiased.

In other circumstances, it may be necessary to collect animals into one site to that proper recording and selection can be undertaken. For dairy cattle (or sheep) it might be the only practical way in which bull mothers can be mated to a few selected sires. If such a unit can be established on the basis of reasonably accurate estimation of breeding value, the genetic lift can be substantial. However, this may not be possible in all cases, and the major gain could simply be having adequate numbers to provide contemporary comparisons and the opportunity of recording objectively.

Screening a population to obtain the "best" animals is an important component of the establishment of a nucleus. Even where an existing herd is used as a nucleus, it is useful to sample the population outside albeit with the objective of only taking very few animals in. The principle of using contemporary comparisons can be maintained even though the group may be a village rather than each villager's herd.

There are clearly some criteria whic h c an be used in all circumstances - contemporaneity and acceptability on a physical basis (if this is not so, dissemination may not take place). The criteria will range from proper direct measurements to stockmen's memory/judgement. If possible, it is useful in the early stages to obtain average animals from the same sources as the outstanding ones. Once together, the Comparison will provide a useful guide to the accuracy of the criteria and a direct indication to those interested of the value of genetic selection. Examples of this type of screening and nucleus formation are given by Timon (1990) and the results.

Table: Genetic Screening Results - Awassi Sheep Turkey

	Nucleus	Control	%
Lactation Yield (kg) (range)	310 7.7 (254 – 469)	223 9.3 (97 – 360)	+ 3%
Lactation Length (days) (range)	206 1.7 (159 – 224)	187 4.4 (95 – 222)	+ 10
Maximum Daily Yield (range)	2.7 0.1 (2.1 – 4.2)	2.1 0.1 (1.0 – 4.3)	+ 29%
No of animals	43	43	

Nucleus herds can allow selection to take place with limited training (in terms of numbers of people) since only the staff needed to run the unit and to record the necessary parameters need be trained. As long as proper monitoring is built in to such a system there is probably little need for a geneticist on site (except as a regular but infrequent visitor). While a central nucleus enables additional records to be taken (if cost effective), there is always the

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risk that the environment may not be representative of the sustainable production system or of a reasonable level of intensity within that system. The nucleus should never be provided with an environment better than that anticipated for commercial production two/three generations ahead. At least, such a constraint should allow the correlated response in commercial production to be within acceptable limits.

Open nucleus breeding schemes (usually known as ONBS) under most circumstances can achieve faster rates of genetic change although under certain circumstances (MLC, 1981) progress can be lower. However, the real advantages of the ONBS are the reduction in inbreeding and the fact that dissemination of the improved genetic material is built into the system. Such a fact also provides a good reason for achieving high health status in the nucleus but this can lead to major problems as stock transferred down the pyramid may well not be able to withstand the health challenges encountered.

Dissemination of Improved Stock

Perhaps one of the problems of all schemes in developing countries is the fact that if infrastructure is poor for recording it is equally poor for dissemination of genetic material. Certainly the derelict European style AI centres in Africa are witness to the problem. However, effective dissemination can be achieved using local resources as exemplified by the use of pig AI in some areas of China where local public transport and bicycles are the main forms of transport.

The problem of heat detection is always present where herds are of few animals and with buffalo, the problem is present in all herds unless a bull is used for this purpose. In cattle, the risk involved in the use of AI to obtain routine pregnancies under most lowland tropical conditions has been pointed out above. Usually, therefore, AI should be confined to use in specific cases, of which bull breeding would be one and the production of an initial crossbred generation perhaps another. Where natural service is required to ensure adequate birth rates, a great deal can be done to help farmers organise a reliable supply of males of known genetic quality through cooperatives or more informal networks.

Large quantities of resources are currently spent even in poor tropical countries on MOET. The excitement of new technology easily diverts scientists' (and politicians') attention from the strict socioeconomic objective of the production system. The possible benefit of alternative uses of the same resources (e.g. through AI) must be carefully measured before MOET is accepted as a viable option. The true genetic merit of the donor females must also be properly evaluated before transfer is carried out.

The difficulty of doing this properly should not be underestimated, especially for traits such as milk production which are of low heritability. It is possible that ET and also cloning could provide useful methods of multiplication. Where AI is likely to be difficult, it may be more feasible to provide "improved" male embryos for rearing within the locality so that distribution is achieved while still relying on natural service. Whether implantation is done centrally and females distributed or is done in the locality will depend on local circumstances. Again, however, it is essential to estimate the cost of the operation in terms of genetic gain and determine whether it does indeed make best possible use of existing resources.

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Genetic Resource Conservation

It is widely accepted that genetic diversity is an essential element of the long term sustainability of production systems. It seems, however, unrealistic to propose that countries which now face severe problems of food production and poverty should devote their resources to the preservation of genotypes which are not at present commercially viable. Reduction in population numbers usually means that the economic potential of the animals is uncompetitive. It could also be argued that, given the wide diversity of natural ecosystems throughout the temperate and tropical world, a diversity of genotypes will automatically be maintained in production systems, at least in the case of species which are commonly relatively little protected from the natural environment (e.g. ruminants). In that case, it should be possible to obtain genes which might be required at a given moment, from populations which are maintained commercially in some ecosystems, even perhaps on another continent.

From these considerations it would appear, first, that endangered breeds in developing countries should not necessarily all be conserved. Realistic criteria must be established for deciding which cases are justifiable. These should include productive and adaptive aspects and the process could possibly be refined by genetic distance estimation procedures. It would also seem reasonable to propose that funds for this purpose should be obtained from international sources and that the work should be organised on a regional basis so that complementarity between individual nations' efforts can be improved. In considering conservation methods, the possibility of maintaining populations in natural parks or reserves should not be discounted although the risks of loss from disease and hunting must not be underestimated.

Finally, governments could reasonably be encouraged to take concrete measures to evaluate existing, small populations which could prove useful in the future in specific circumstances (e.g. in crossbreeding schemes or in traditional, small-farm production systems). One important element is to carry out the local research required to demonstrate the value of such animals in production systems considered most likely to be sustainable.

Planning Considerations

While it is relatively simple to comment with hindsight on programmes, the initial planning and development of schemes is frequently difficult. The difficulties often stem from the fact that different pressures are put on those involved in planning improvement programmes - political (governmental), breed societies/cooperatives, regional interests - and, in general, a belief that breed improvement is an automatic and acceptable solution. Since genetic improvement is relatively slow to provide change it can never be the "quick fix" so often cherished by politicians. The failures of so many schemes based on exotic semen are witness to that fact. The planner requires information on:

- the future production systems - feeds, management, housing (all based on the need for sustainability);
- the future market requirements and the likely infrastructure;
- the existing breeds and the population dynamics together with known performance.

Only then can long term, sustainable systems be planned and specific projects within the

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plan can be selected on the priorities agreed by those in the decision making role. This provides a more useful background for improvement since specific projects are known to fit into an overall picture rather than the more frequent occurrence of adopting a project and then trying to fit it into the long term strategy.

Policy Issues in Livestock Production in Arid Regions and the Management of Extensive Grazing Lands

Importance of Extensive Grazing Lands of The Arid Regions

Arid and semi-arid regions may be defined as areas where rainfall, relative to the level of evapotranspiration, is inadequate to sustain reliable crop production (eg Meigs, 1953) These areas are covered by grasslands, shrublands, savanna, semi-arid woodlands or desert. Kassas (1975) estimated that 43% of the world's surface is arid and Harrington (1981) suggested that in 1973 more than 40% of the world's population of sheep, 30% of goats and 25% of cattle were found in the arid zone.

Exploitation Systems

It is important to emphasise that the exploitation of extensive arid areas is concerned with land use and not the production of crops. Social organisation, ownership and access have profound effects on grazing management. There are four main systems of exploitation defined by the movements of the flocks and the extent to which the herders are sedentary.

Nomadic Systems: These systems are found in desert and desert fringes, where rainfall is extremely erratic and the flocks and their herders move to wherever forage is available, with no set seasonal patterns. True nomadic systems are becoming rare.

Transhumant Systems: Characterised by regular, seasonal movements of the flocks between grazing areas, often at different altitudes. In west Asia and north Africa flocks often move into the cultivated areas to utilise stubbles and by-products. The many changes that have occurred in transhumant systems recently are discussed below.

Semi-sedentary Systems: These systems are found mainly in Sub-Saharan Africa, where herders live in non-transportable dwellings but abandon them, if necessary, to move to other areas at times of feed shortage.

Sedentary Systems: Extensive grazing lands, where sedentary systems are practised, occur mainly in the developed countries of the Americas, Australia and southern Africa, where properties have boundary fences and are often divided into fenced paddocks. In other areas an important, but declining, area of extensive grazing land close to villages is exploited by the flocks of village farmers. Now, with the availability of trucks to transport water, sedentary systems are extending rapidly into large areas of extensive grazing land that formerly were only grazed seasonally because drinking water was not available for large periods of the year. Private ownership of extensive grazing land is only found in South America, southern Africa and parts of the USA. In Australia, arid rangelands are owned by the State governments and in the USA parts of the range are owned by Government agencies.

The State, or Government agency, leases the land to graziers and, ultimately, they have the power to control the worst abuses of the land. Elsewhere, extensive grazing is generally an open-access or common-property resource, which may or may not have well defined regulations in relation to stock numbers and the duration and timing etc of their grazing.

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Regulation often existed on tribal lands or within tribal groups and, although it was often maintained under colonial rule, it has generally disappeared with independence. It is widely assumed that degradation of extensive grazing areas is linked to over grazing and over exploitation of communally grazed areas, but it is clear that degradation has occurred and is occurring in areas where extensive grazing is owned or leased. There have been problems on leased land in Australia (Harrington *et al.,* 1990) and on freehold range in USA (Stoddart *et al.,* 1970). On privately owned ranches in Patagonia and Argentina stocking rates are now 25–30% lower than 50 years ago because overstocking caused degradation of the natural vegetation and serious erosion (Mueller, personal communication).

Long-term sustainability of extensive grazing land can, therefore, be a problem under any system of land tenure. The remainder of the paper will discuss the factors in ruminant production, predominantly sheep and goats, in west Asia and north Africa (WANA), which lead to the widespread degradation of the extensive grazing land in these areas.

Trends in Small Ruminant Production in the West Asia and North Africa Region

The recent and detailed analysis by Boutonnet (1989) of the Algerian ruminant livestock industry, which is dominated by small ruminants, has been taken as a starting point in this discussion. The number of ewes in Algeria has risen from 3.9 million in 1966 to 6.1 million in 1976 reaching 9.5 million in 1986. Seven million of these ewes, together with cattle, goats, horses and camels equivalent to 3 million ewes, are kept in the steppe.

Between 1971 and 1985, it is estimated that the carrying capacity was reduced by a half from 0.18 to 0.09 ewe equivalents per hectare. The 11 million hectare of steppe, therefore, can only provide about 10% of the feed requirements of the animals kept on it. Consequently, three quarters of the requirements of the sheep in the steppe are brought into the area and this necessitates the transport of 4.7 million tonnes of feed annually, comprising of 500,000 tonnes of barley, 400,000 tonnes of bran and 3,800,000 tonnes of straw. The remaining 15% of feed requirements is obtained by spring grazing in the desert and in the areas of cultivation after harvest.

The demand for red meat is high, mainly as a result of the rapidly increasing population (12.0 million to 23.0 million between 1966 and 1987), and a slight increase in consumption per head (eg 3.4 to 4.1 kg of sheep meat/head/year between 1970 and 1987), partly as a result of Urbanisation. A key factor, however, in the expansion of sheep numbers has been the distortion of the market, created by regulations enforcing the compulsory sale of cereals to the Government, at fixed prices, while the market for red meat has remained free.

Thus, the wholesale price of sheep carcase, adjusted for the cost of living index, increased from 38 DA/kg in 1970 to 102 DA/kg in 1987. In the same period the adjusted price for barley rose from 1.29 to 1.55 DA/kg. The ratio between the prices of sheep meat and barley widened from 30:1 to 66:1.

A further factor in this complex picture is the wide spread speculation in sheep. With a national flock of approximately 9 million ewes, Boutonnet estimates that nine million sales of ewes and ewe lambs occur annually, with large fluctuations in price. He states that the art of the flock owner in Algeria is less in the maximisation of meat production and more in the

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management of his capital of live animals.

Before independence, Algerian sheep production was characterised by periodic large fluctuations in sheep numbers with the affects of climate on feed availability. In bad years part of the flock was sold and the worst effects of drought on the steppe prevented. For 30 years since independence, the sheep population has steadily increased, as the state has always made sufficient imported barley available for the sheep numbers to be maintained in any particular year. Boutonnet quotes a peasant "in the past, in bad years, the shepherd sold part of his flock and kept only the sheep he could feed; now he sells his wife's jewellery to buy barley".

The increase in sheep population has been accompanied by a decrease in productivity. Carcase production per ewe and per year has declined as a result of a reduction in the number of sheep sold per ewe, in spite of an increase in individual carcase weight.

	Sheep sold/ewe	***Carcase wtkg***	***Carcase wt/ewekg***
1964-69	0.85	13.1	11.2
1974-79	0.72	13.4	9.7
1982-87	0.56	15.2	8.5

Boutonnet's description of the changes in Algeria and their causes has been presented in considerable detail, because it is derived from a careful analysis of a large amount of data and gives many insights into a complex situation. It emphasises the importance of the ratio between the prices of cereals and of sheep meat in stimulating flock expansion. In these circumstances, sheep enterprises, which in the past played a role as a reserve against uncertainty, have become a way of making speculative gains.

Boutonnet says "there is no need, in these circumstances, to invoke obscure reasons of tradition or socio-cultural prestige to understand the general propensity for an increase in the number of animals, since the economics of sheep production permit it, or for the lack of interest in improving flock productivity, in spite of the high price of meat". A further point made in Boutonnet's analysis is that, although the rural population of Algeria has declined as a percentage of the total population, the actual rural population has not decreased because of the dramatic increase in total population.

This strong and continuing pressure of rural people is in itself a contributory factor to the increase in sheep numbers. Where the ratio of meat to barley prices is favourable and there is access to grazing land, crop residues or even vegetable matter from urban waste, starting a small flock is a way of creating capital from a small initial investment. The large families mean that there is no shortage of children to shepherd the flock.

Boutonnet's report identified examples of this amongst farmers surveyed in the area of Sidi-Bel-Abbes. Small farmers with less than 20 ha of land, generally had no flock and sold surplus feed and byproducts. If, however, they had a flock, the stocking rate was more than 10 ewes per hectare, far higher than could be supported by their land, and the flock was fed mainly on purchased feed.

These flocks were generally financed from outside the farm, usually by some agreement with urban investors or landless shepherds.

Table: *Total and Rural Populations in 8 Countries of north Africa and west Asia (FAO*

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Country	Total Population (million)		Rural Pop. as % of total		Rural Population (million)	
	1975[1]	1987[2]	1975	1987	1975	1987
Morocco	17.3	23.3	54	38	9.3	9.1
Algeria	16.0	23.1	55	26	8.8	6.0
Tunisia	5.6	7.6	45	27	2.5	2.1
Libya	2.4	4.1	23	15	0.6	0.6
Jordan	2.6	2.9	30	7	0.8	0.2
Syria	7.4	11.2	49	26	3.7	2.9
Iraq	11.0	17.1	43	23	4.8	3.9
Turkey	40.0	52.6	61	51	24.5	24.8

= mean of 1974, 75 & 76

= mean of 1986, 78 & 88

FAO data for four countries in north Africa and four in west Asia and show that similar trends to those in Algeria are occurring in the other countries of the region. There are large increases in the human population in all these countries, except Jordan. The rural population, as a percentage of the total population, has declined in all these countries but the changes in the actual rural population vary considerably: no decline in Turkey, very slight in Morocco and small in all the other countries, except Jordan and Algeria.

Sheep numbers have increased in all these countries, except Iraq and Turkey, in the latter, between 1975 and 1987 the numbers increased and then declined again. The FAO statistics appear to be too inaccurate to make any judgement as to whether the decrease in off-take of slaughter sheep and the increase in slaughter weight found in Algeria is a general trend.

The area of barley cultivation and the production of barley increased in all countries except Libya and Jordan, both small producers.

Table: *Area and Production of Barley and Sheep Population in 8 Countries of north Africa and west Asia*

Country	Barley Area (1000 ha)		Barley production (1000 tons)		Sheep population (million)	
	1975[1]	1987[2]	1975	1987	1975	1987
Morocco	2026	2446	2279	2869	15.02	15.18
Algeria	826	1107	554	820	9.27	14.47
Tunisia	367	411	259	244	5.73	5.83
Libya	374	138	178	95	4.04	5.67
Jordan	57	37	22	27	0.71	1.12
Syria	960	1654	770	1509	5.87	12.55
Iraq	554	1243	516	1013	11.09	9.00
Turkey	2599	3314	4243	7133	40.67	40.12

1 = Mean of 1974, 75 and 76.

2 = Mean of 1986, 87 and 88

Syria - Degradation of the Steppe and Attempts at Prevention

In the last 15 years, major degradation has occurred in the Syrian steppe, where 75% of the sheep population is kept. This has happened in spite of the adoption of a range of measures intended to prevent continued over-utilisation.

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In the mid 1970s it was possible to describe (eg Nygaard *et al.*, 1982) the traditional seasonal movements of flocks from the steppe to the agricultural land in June to graze stubbles and other byproducts. The flocks then returned to the steppe from November until the following June. Movements still occur but they are now less regular and, when they return to the steppe, the flocks stay in a small area around the family's house and are fed purchased feed.

A number of factors have contributed to the degradation. Masri (1979) suggests that a key factor in starting the process of degradation was the introduction of tractors in the 1950's, which allowed easy cultivation of the steppe, with the areas with the best rainfall and soils being cultivated first. Later, in the 1960's, drilling of new wells by the Government allowed grazing in areas which were formerly protected from grazing for long periods by lack of water.

Then the purchase of water tankers permitted richer flock owners, with capital, to graze the remoter areas for longer periods. Before, these remote areas were a reserve, not because of tribal tradition or agreement, but because of their isolation and lack of regular watering facilities. Pick-ups enabled large areas to be covered looking for good grazing and the flocks could be moved rapidly by lorry. Thus the pressure on the remaining steppe increased. This was further intensified by the progressive abandoning of the tribal control of range land and the permitting of areas to be transferred to individual owners, which is still continuing.

From about 1960, the Syrian Government introduced a series of measures, which experts at the time thought would prevent further decline of the steppe. About 50 sheep and range cooperatives were established between 1968 and 1978 to provide credit to nomadic flock owners for the purchase of feed and livestock, with the aim of reducing fluctuations in stock numbers.

The survey by Nygaard *et al.* in 1982 makes almost no reference to the improvement of range, which was initially a major objective of these co-operatives. To help decrease the grazing pressure in the steppe, about 50 fattening co-operatives were also set up to take light lambs from steppe flocks and fatten them on cereals. Membership of these co-operatives gave preferential access to feeds at controlled prices from the Government purchasing organisation.

The results of these initiatives have not been, as was intended, a stabilisation of the fluctuations in sheep numbers, and in the cycle of low prices for sheep meat in dry years and high ones in good years. Instead it has resulted in a steady expansion in sheep numbers since about 1970. This has led to a rising demand for barley, although the ratios between the prices of sheep meat and barley have been much less favourable than those in Algeria.

For example, in 1988 the ratio was 15:1 with the free market price of barley and 18:1 with the controlled market price, and in 1989, when drought increased sales of sheep and depressed the price, the rations fell to 9:1 and 10:1 respectively. The demand for barley has caused a steep rise in the area planted to barley (Fig 1), which further intensifies the grazing pressure in the decreased area of steppe. The palatable bushes are over-grazed and disappear, and the unpalatable ones are often removed for fuel, especially in settled areas, which now extend far into the steppe. Even unpalatable bushes are important for the survival of the degraded steppe, as they help stabilise the soil and offer some protection from grazing for a few annual plants until they can flower and set seed. Further rapid degradation and

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complete loss of bush cover results from speculative barley growing financed by urban investors and which now extends into areas with less than 200 mm of rainfall.

Policy Issues

This description of the situation and changes in the west Asia and north Africa region indicates the enormous scale of over-grazing and environmental degradation in the region. The only possibility of achieving long-term sustainability in animal production systems is for governments to tackle the social and economic situation of the flock owners and farmers in these areas, so that it becomes economic for them to adopt more sustainable systems.

It is almost impossible to believe that this can be done by any government, whether democratic or not, before further major damage to the environment occurs. This is mainly because the pressure of rapid population increase is the major determining factor and this cannot be altered in the foreseeable future.

Other policy issues, which could have some effect in reducing problems of over-grazing are discussed below.

Limiting Rural population

Rural depopulation and the availability of alternative employment will undoubtably have some effect in reducing the agricultural population towards a level that the land can sustain. In general, however, in these areas, rural populations are not declining quickly and some are still increasing.

If stocking rates are to be reduced to levels that are sustainable in the long term, governments will have to introduce strong legislation and strictly enforce it.

Again, it seems unlikely that this will happen: in the short term such legislation would cause enormous hardship to one of the poorest sections of society and its introduction would require either the provision of alternative employment or compensation for loss of a traditional way of making a living.

Pricing Policy for Inputs

It is clear that low prices for purchased feed are a major cause of flock expansion, because flock owners make rational economic responses. Government policy should be directed to eliminating subsidies and market distortions.

To be effective, it must extend to bread flour, as subsidised bread becomes an animal feed when the price ratios are right. Fuel pricing policy must also be considered, as low diesel prices reduce the costs of cultivation and of the transportation of feed, animals and water.

Investment Policy

It is clear that sheep production is a good investment in many of these arid, developing countries, where there may be very limited ways for private investment.

Speculation, however, in barley growing in the Syrian steppe, financed from the towns, is a serious cause of degradation.

Availability of alternative investments in countries with poor financial services, might help to divert speculative investment from these forms of environmentally hazardous

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production.

In the Islamic countries, where the gaining of interest on loans is forbidden by the sharia, there are particular difficulties.

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Chapter 7 : Food Safety and Quality as Affected by Animal Feedstuff

In recent years public concern about the safety of foods of animal origin has heightened due to problems arising from bovine spongiform encephalopathy (BSE), dioxin contamination, outbreaks of foodborne bacterial infections, as well as growing concern about veterinary drug residues and microbial resistance to antibiotics.

These problems have drawn attention to feeding practices within the livestock industry and have prompted health professionals and the feed industry to closely scrutinise food quality and safety problems that can arise in foods of animal origin as a result of animal feeding systems. It is important to note, nonetheless, that despite the magnitude of livestock production, the frequency of health problems associated with this sector is very low.

The livestock sector plays an essential role in agricultural and economic development as well as food security. The global livestock output grew at a rate of 2.4% in 1998: increase by over 70% in the next 30 years, and world demand and consumption of livestock products is expected to nearly double in the next 20 years. Most of this increase is expected to take place in developing countries associated with greater population growth and emerging economies, particularly in Asia. Europe has a stable population and, overall, only a modest increase in consumption of livestock products is predicted although notably recent trends in Eastern Europe and the Commonwealth of Independent States (CIS) have shown a modest decline in meat consumption. More detailed analysis of world statistics shows that almost all the growth in demand is in the poultry and pig meat sectors and, even in Europe, there is an increase in white meat consumption and a decline in red meat. This has important implications because it is the poultry, pig and dairy industries that are the principal users of processed animal feeds. On a global average for 1997, animal products provided about 16% of the calories in the diet. This value increased to 25% in developed countries and dropped to 12% in developing countries. The global value for dietary proteins from animal products over the same period was about 37%, with about 56% in developed countries and 29% in developing countries. Meat and other animal products also provide essential fatty acids, vitamins and minerals. The iron in meat and meat products is easily assimilated by humans and is a key to preventing iron deficiency anaemia, high prevalences of which have been reported in Eastern Europe. The livestock industry therefore can be seen to have great economic and nutritional significance in the world on the whole.

The livestock sector comprises widely differing production systems ranging from subsistence livestock farming to highly intensive systems. The problems related to the quality and safety of foods of animal origin can therefore be highly variable in different regions of the world. This paper discusses linkages between animal feedstuffs and safety of foods of animal origin and highlights steps that have been taken and further steps that are necessary to ensure that animal feed poses no threat to public health. For the purposes of this paper, animal feed includes any substance, whether processed. semi-processed or raw which is used for animal consumption. This includes feed of varied origin such as: pasture, feed grains and compound feeds, crop residues and agro-industrial by-products.

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Animal Feeding Practices in Europe

In livestock production, overriding considerations are the availability, quality and efficient use of feed resources, including grassland. In order to meet current demand for meat and animal products, a wide range of systems have been developed to efficiently feed animals. Worldwide, the volume of feed produced annually exceeds 4 billion tonnes.

Animal feeding systems in the wider Europe range from the highly developed systems in the West to less intensive systems especially in rural areas in the East. However, the general model is common and the countries in transition aspire to similar production methods. Poultry and pig production have become almost exclusively intensive in large units. Dairying has followed a similar trend, although grass-based for half or more of the year. Intensive beef production is carried out but this has become increasingly based on grass or maize silage since intensive cereal feeding became less economic during the 1970s. Sheep production is largely extensive and attempts at intensification have proved uneconomic although high stocking rate grazing systems have been sporadically adopted. There are small specialist sectors in goats, milking sheep, deer and buffalo.

Poultry and pigs require protein supplementation and this protein must be of high quality (balanced for essential amino acids) to sustain efficient growth and feed conversion. Selection of improved genotypes has increased the protein and amino acid requirements because of increased protein growth potential and reduced fat. Hence, cereals and other energy feeds must be balanced with additional protein meals. Although these may be of vegetable origin (soyabean, rapeseed, etc.), they require supplementation with amino acids (lysine and methionine) and the best sources (from a nutritional viewpoint) are animal and fish meals. In practice, animal meals are less palatable to pigs and poultry and their use has been limited.

Similarly high producing dairy cows require additional protein supplementation to sustain yields. This is because the cow producing 25 litres or more of milk per day cannot consume sufficient energy and must use body reserves during peak lactation, hence there is not enough energy to provide for microbial protein production in the rumen. Research has shown that this is best supplied with ‘by-pass protein’, that is protein not degraded in the rumen (also known as undegradable protein). Again, the best sources of ‘by-pass protein’ are animal and fish by-products. Animal meals were therefore incorporated into dairy concentrates up to the time of the emergence of BSE in the UK.

Gardner reported that the EU was largely self-sufficient in animal feeds, with more than half the annual requirement for feeding its large livestock population coming from grassland and fodder crops. In addition, the EU is a substantial producer of animal feed grains. While being a net exporter of feed grains, the EU is a substantial importer of proteins and non-grain feed ingredients. There is also a continuing trend towards greater intensification of livestock production, particularly in the pig and poultry sectors, leading to an increase in compound feed manufacture and sales. Nutritionally complete feeds are also used in the intensive salmon catfish and marine fish industries of Europe.

The proportion of different ingredients in processed animal feeds in the EU is shown.

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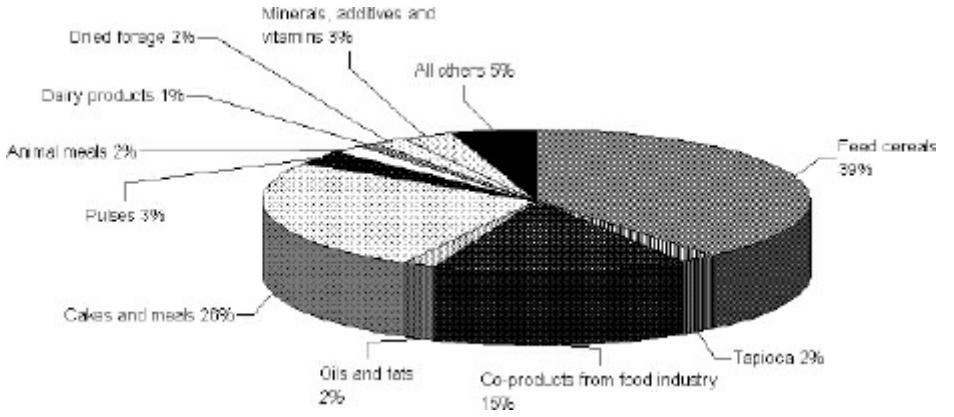

Figure: *Raw material consumption in industrial compound feeds in the EU-15 in 1996*

The growth of industrial livestock has been associated with serious environmental problems. As a result of these concerns, it is predicted that there may be a downsizing of industrial livestock production in some EU countries. The Netherlands has experienced a trebling of its pig population in the last thirty years and is now reducing numbers (FAOSTAT). This may lead to the growth of intensive systems in the Baltic States and other Eastern European countries with a view to exporting to EU countries to supply the demand.

Potential Hazards and other Issues Associated with Animal Feeds

Mycotoxins

Mycotoxins are secondary metabolites produced by fungi of various generations when they grow on agricultural products before or after harvest or during transportation or storage. Both intrinsic and extrinsic factors influence fungal growth and mycotoxin production on a given substrate. The intrinsic factors include water activity, pH, and redox potential whereas extrinsic factors which influence mycotoxin production are relative humidity, temperature and availability of oxygen.

Many mycotoxins, with different chemical structures and biological activities, have been identified. They may be carcinogenic (e.g. aflatoxin B1, ochratoxin A, fumonisin B1), oestrogenic (zearalenone), neurotoxic (fumonisin B1), nephrotoxic (ochratoxins, citrinin, oosporeine), dermonecrotic (trichothecenes) or immunosuppressive (aflatoxin B1, ochratoxin A, and T-2 toxin). Much of the published information on toxicity concerns studies in experimental animals and these may not reflect their effects in humans and other animals. In addition, the implications for human health of the presence of combinations of mycotoxins are not well understood.

Mycotoxins are regularly found in feed ingredients such as maize, sorghum grain, barley, wheat, rice meal, cottonseed meal, groundnuts and other legumes. Most are relatively stable compounds and are not destroyed by processing of feed and may even be concentrated in screenings. Different animal species metabolise mycotoxins in different ways. For example in pigs, ochratoxin A can undergo entero-hepatic circulation and is eliminated very slowly while it is rapidly excreted by poultry species. The polar mycotoxins, such as fumonisins, tend to be excreted rapidly.

Mycotoxins, or their metabolites, can be detected in meat, visceral organs, milk and eggs. Their concentration in food is usually considerably lower than the levels present in the feed

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consumed by the animals and unlikely to cause acute intoxications in humans. However residues of carcinogenic mycotoxins, such as aflatoxin B1 and M1, and ochratoxin A, when present in animal products pose a threat to human health, and their levels should be monitored and controlled. The Codex Alimentarius Commission is currently considering maximum limits for Aflatoxin M1 in milk. The extent of mycotoxin accumulation in fish tissues due to consumption of contaminated feed is poorly understood.

Veterinary Drugs

Veterinary drugs may be administered in animal feeds for livestock and aquaculture. If good veterinary practices are employed then Maximum Residue Limits (MRLs) should not be exceeded, however, if GVP is not adhered to, residues in foods of animal origin may exceed MRLs.

Consumer concern about residue levels in foods has fuelled recent trends towards organic and other agricultural production systems that feature reduced reliance on artificial chemical inputs. Foods produced by such systems contain reduced or zero veterinary drug and chemical residue levels. Organic agriculture is one of the fastest growing sectors of agricultural production with an overall persistent growth rate in the EU of around 25% per year for the last ten years.

The need for the containment of anti-microbial resistance due to the use of anti-microbials in livestock, including their addition to feedstuffs, is gaining much attention. Anti-microbials are used for therapeutic, prophylactic or growth purposes, and in the latter case they are added to feed and/or water. Even first-line antimicrobials (e.g. glycopeptides) are being used as feed additives for growth promotion. The assessment and containment of public health risks associated with the use of antimicrobials in livestock is a matter of priority.

Agricultural and other Chemicals

Potential contaminants in feedstuffs include excessive residues of pesticides and fungicides, or other environmental contaminants such as the polychlorinated biphenyls (PCBs), dioxins and heavy metals including mercury, lead, or cadmium.

Dioxins and PCBs are ubiquitously present as contaminants in the environment and dietary intake represents the most common route of human exposure. PCBs and dioxins have similar physical and chemical properties. They are both lipophilic and persistent compounds that accumulate in the food chain, consequently biological samples often contain both dioxin and PCB congeners. Foods of animal origin are the greatest source of human exposure to these contaminants and animal feeds may be an important source of contamination for livestock. Contaminated fats or oils added either intentionally or unintentionally to manufactured feeds can be a source of dioxins and PCBs. These industrial pollutants may be emitted into the air contaminating soil and water and remaining deposited on pastureland. In this case grass-fed animals in highly contaminated areas may give rise to unsafe food products.

Weak associations have been reported between exposure to dioxins and soft tissue carcinomas and lung cancer. Initial symptoms of high PCB exposure are reversible dermal and ocular effects and persistent respiratory problems. Foetal exposure to dioxins and/or PCBs might be associated with cognitive deficits in infants and children. An increase in

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tumour incidence, as well as neurological, endocrine, hepatoxic and immunotoxic effects were observed in populations accidentally exposed to high levels of PCBs, polychlorinated dibenzofurans and polychlorinated quaterphenyls. Maximum levels of these contaminants allowed in foods of animal origin have been established in some countries, but existing limits are quite variable.

Plant materials growing in areas with high levels of other environmental pollutants such as radionuclides and heavy metals that are used as feed may also lead to unacceptably high levels of contamination in food products of animal origin. Similarly, fish oils used as animal feed ingredients, may contain high levels of lipid-soluble contaminants if they are produced from fish grown in polluted areas. In Western Europe, effective measures to limit environmental pollution have been put in place. In Central and Eastern Europe some areas of high contamination occur due to industrial activity.

Infectious Agents

Animal feed may be the source of a limited number of infections for farm animals that could lead to human illness on consumption of foods of animal origin. These include Salmonella enterica, Bacillus anthracis, Toxoplasma gondii, Trichinella spiralis and possibly the agent of bovine spongiform encephalopathy. The risk to human health from several other infectious agents which may contaminate feed or forage, appear to be either negligible or non-existent.

Heat treatments of varying severity are commonly used to ensure the microbiological quality of animal feed. Irradiation may be considered a potentially important control measure for certain microbial agents in the feed of food-producing animals.

The Joint FAO/IAEA/WHO Study Group on High Dose Irradiation which convened in Geneva, in September 1997, concluded that food irradiated to any dose appropriate to achieve the intended technological objective is both safe to consume and nutritionally adequate. As their conclusion was partly based on animal feeding studies in a broad cross section of species, fed a variety of diets, it may be assumed that the study group conclusion would also apply to irradiated animal feed. Notably, irradiation is not permitted either by EC Regulation or by Codex Guidelines in organic production systems.

Transmissible Spongiform Encephalopathies (TSEs)

TSEs in ruminants are non-febrile neurological diseases of man and many animal species including ruminants. They have a long incubation period and are ultimately fatal. TSEs are associated with incompletely defined agents, currently termed prions, which are resistant to normal heat treatment of feed and food. Sheep scrapie has been recognised for over 250 years, while Bovine Spongiform Encephalopathy (BSE) was first recognised in the United Kingdom in 1986. For BSE, it has been postulated that the aetiological agent enters the feed primarily through rendered infected tissues (notably the tissue of the central nervous system and the reticuloendothelial system) under conditions of insufficient heat treatment to destroy or inactivate the infectious agent. The reported occurrence of a new variant of the human TSE, Creutzfeldt-Jacob Disease (CJD), has raised the possibility of an association with BSE in cattle with CJD in humans through consumption of meat from BSE infected cattle. At the present time, there is a strong presumption of a link between this new variant and the possible transmission of the infective agent from infected bovine tissue to humans.

Other Infectious Agents

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Salmonellae are widely distributed in nature, and animal feed is only one of many sources for farm animals. Animal and plant origin feed ingredients are frequently contaminated with Salmonellae. Processed feed can be contaminated from these raw feed ingredients. There are over 2000 Salmonella serotypes and these can be divided arbitrarily into three unequally sized groups. These include the species specific serotypes such as S. dublin (cattle); the invasive serotypes which may cause septicaemic disease in several animal species (e.g. S. enteritidis and S. typhimurium); and the non-invasive serotypes which tend not to result in septicaemia. Members of the first group are not recognised as foodborne pathogens. The third group is by far the largest and may be associated with subclinical infections in farm livestock. They can cause disease on occasion and are associated with food poisoning in humans. The principal manifestation of human salmonellosis is a gastroenteritis. Septicaemia occurs in a proportion of patients.

Toxoplasma gondii, the protozoan is found in cats and based on serological surveys also in birds, other domesticated species including sheep, pigs, goats, and horses. The primary source of infection for animals is feedstuffs contaminated with faeces of cats and possibly rodent tissues. A proportion of humans may become infected following the handling or consumption of contaminated raw meat.

Trichinella spiralis is a nematode which parasites the intestinal tract of mammals, particularly pigs. The larvae encyst in the tissues, particularly the muscles which act as a source of infection for humans who consume raw or partially cooked meat. The clinical manifestations include fever, muscle pain, encephalitis, meningitis, myocarditis and rarely death. The cysts can be killed by freezing infected carcasses at -18 degrees C for 20 days. They are also heat sensitive and are killed by traditional rendering temperatures. Effective cooking of raw meat and table scraps before feeding to farm animals would eliminate this hazard. Bacillus anthracis, which causes anthrax, sporulates on exposure to air and the resulting spores can survive for long periods in the environment and in contaminated animal feed. The spore is widespread in some CIS countries. There have been cases of anthrax in people who have consumed the meat of infected animals.

Genetically Modified Organisms

A new issue concerning animal feed relates to the inclusion of genetically modified organisms (GMOs) in animal feeds. Given that approximately 60% of soy beans planted in the USA are GMOs and this is a principal source for importing into Europe, it is inevitable that they are likely to be present in compound feeds made in the European Region.

This also applies to maize products. While there are no proven harmful effects about the transfer of modified DNA along the food chain, there has been public concern and recent incidents involving protests against this practice. A study by the UK Ministry of Agriculture Fisheries and Food (Report CS0116) was carried out in Leeds University to determine the extent to which DNA in animal feed is degraded under various processing conditions. It addressed concerns over the transfer of foreign genes introduced into GM crops, especially antibiotic resistance marker genes to bacteria, which would render common infectious diseases untreatable. The main conclusions are that DNA is not degraded under most commercial processing conditions, nor in silage, and that further studies on GM material should be undertaken. Notably, potential feed safety problems related to the use of antibiotic marker genes may be avoidable through the use of marker-free transgenic systems which have now been developed.

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Control of Feedborne Hazards

Given the direct links between feed safety and safety of foods of animal origin, it is essential that feed production and manufacture be considered as an integral part of the food production chain. Feed production must therefore be subject, in the same way as food production, to quality assurance including food safety systems based on Hazard Analysis and Critical Control Points (HACCP).

Industry is ultimately responsible for the quality and safety of the food and feed that it produces. National authorities should provide guidance to industry including codes of practice and standards that they must respect. Governments must also establish the necessary controls to ensure that industry consistently meets mandatory quality and safety requirements.

The foregoing outlines the responsibilities of both industry and national governments in ensuring safety of feed and food. It is important to realise, however, that the large volume of international trade in foods of animal origin as well as in feedstuffs adds an important international dimension to the control of animal feedstuffs. Furthermore the World Trade Organisation's (WTO) Agreement on the Application of Sanitary and Phytosanitary Measures (SPS) advocates that national standards related to food safety be harmonised with international standards.

In view of existing shortcomings in the regulation of feed safety, several actions and activities have been undertaken at international level to develop sound standards, guidelines and recommendations in this area. International organisations also have an important role to play in providing information and training which could be used at national level to improve the knowledge and skill of those involved in all areas of the feed industry, including primary producers of feed materials, in order to prevent failures in food/feed safety systems rather than control them.

Work at International Level on the Safety of Animal Feedstuffs

Several international organisations are actively involved in work related to the safety of animal feedstuffs. They generate and disseminate information on various aspects of feeds and their use including potential food safety hazards linked to feed. Furthermore, they provide technical assistance to countries aimed at improving feed production, feeding practices and feed control programmes.

Animal feed safety has become one of the priority areas in the Animal Production and Health Division of FAO which has established a substantial information system on animal feed resources available on the World-Wide-Web, CD-Rom and in printed publications. The system includes detailed scientific and practical information on over 700 feedstuffs, with data sheets, full text articles and reviews. There will be increasing emphasis on feed safety and several reports have been already commissioned on this subject, including one on the use of wastes and by-products.

Interrnational Standards and Guidelines

The Codex Alimentarius Commission (CAC), which was established by the Joint FAO/WHO Food Standards Programme in 1962, is an intergovernmental body comprising 165 members whose responsibility it is to develop and publish international standards, guidelines and codes of practice related to food quality and safety. Codex Alimentarius standards are recognised in the WTO SPS Agreement as the bench marks for food safety.

The issue of animal feed is a complex one requiring multi-disciplinary inputs and

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collaboration from the fields of human and veterinary medicine, agriculture, academia and from national control agencies. Several organisations are already involved in various aspects of this issue and it is important that there be coordination and discussion among the different parties involved if clear and sound guidance that is widely supported is to be developed in a timely manner. The Intergovernmental Codex Task Force on Good Animal Feeding is an important forum for the required collaboration and consensus.

One of the main tasks facing the Task Force is the completion of the Draft Code of Practice for Good Animal Feeding that was prepared by a panel of experts on the subject during an FAO Expert Consultation that was held in Rome in 1997. The draft code, along with comments submitted by several countries and international organisations will form the basis of the discussions on this topic. All food safety issues identified by the CAC in the terms of reference of the task force can be considered in the elaboration of the new code. It is considered by some parties that the development of positive and negative lists of feed ingredients may be an important contribution to the control of animal feed internationally.

Antimicrobial Resistance

The matter of antimicrobial resistance is actively being considered by the International Office of Epizootics, which has set up an ad hoc expert group on the topic. Among other issues, this group will consider the development of technical guidelines on the prudent use of antimicrobials and the monitoring of quantities of antimicrobials used in animal husbandry. The ad hoc expert group called upon FAO to take up the role of coordinator with regard to the use of antibiotics as growth promoters.

WHO has held a series of meetings on the question of antimicrobial resistance and based on their findings has recommended the termination of the use of antimicrobials as growth promoters if similar products are also licensed in human medicine. The European Commission Scientific Steering Committee on Antimicrobial Resistance made a similar recommendation in the report of a meeting held in May 1999. The WHO has also prepared draft guidelines for the containment of antimicrobial resistance from antimicrobial use in livestock, which will form the basis of discussions in an expert consultation on the same subject in June 2000. This will have direct implications for animal feeding practices.

The question of microbial resistance is also being discussed within the Codex Committee on Residues of Veterinary Drugs in Foods (CCRVDF) and the Codex Committee on Food Hygiene (CCFH). The former CCRVDF receives scientific advice from the FAO/WHO Joint Expert Committee on Food Additives which currently considers the impact of antimicrobial residues on the gut but does not consider the transfer of antimicrobial resistance arising from the use of antimicrobials and their release into the environment, as this is beyond their terms of reference. The role of CCRVDF in broader discussions of the question of antimicrobial resistance is uncertain. CCFH considers antimicrobial resistant bacteria in relation to food hygiene. This committee is already involved in risk assessment associated with microbiological contamination of food, and is therefore well-placed to take a risk analysis approach to the question of antimicrobial resistance.

Environmental and Industrial Contaminants

The recent problems originating from the contamination of animal feed in Belgium highlighted the existing disparity among regulations in different countries related to the presence of dioxins and PCBs in foods including their maximum allowed limits. The Codex

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Committee on Food Additives and Contaminants (CCFAC) has requested that the FAO/WHO Joint Expert Committee on Food Additives (JECFA) consider these groups of compounds and provide scientific advice to guide the Committee in its task of establishing guideline or maximum levels in food and feed.

WHO held an expert consultation on assessment of the health risk of dioxins in Geneva in May 1998. The consultation evaluated the tolerable daily dose of dioxins to which a human can be exposed without appreciable health risk. In light of epidemiological data concerning the effects of dioxins at low levels of exposure and based on animal studies, the TDI was reduced from 10pg/kg body weight to a range of 1-4pg/kg body weight.

CCFAC has also initiated work on a proposed draft Code of Practice for Source Directed Measures to Reduce the Contamination of Food with Chemicals. At the 32nd Session of this Committee it was decided to forward this proposed draft to the Executive Committee for preliminary adoption. This work is important in terms of reducing contamination of animal feed which is produced in areas highly affected by environmental pollutants. CCFAC is also currently working to establish maximum limits for the presence of lead and cadmium in food and feed materials.

Programmes to monitor and control levels of environmental and other chemical contaminants in food and feed must be supported by adequate analytical expertise and equipment. The dioxin crisis revealed that until recently, few laboratories were equipped to carry out testing for this group of contaminants. FAO is frequently involved in providing technical assistance to countries to improve their capability in food contaminant analysis. Ongoing FAO Technical Cooperation project in Lithuania and the Slovak Republic involve such aspects of food/feed control.

Mycotoxin Contamination

During its 32nd Session held in Beijing in March 2000, the Codex Committee on Food Additives and Contaminants decided to create a single general Code of Practice for the Prevention of Mycotoxin Contamination in Cereals, including specific Annexes related to the prevention of Ochratoxin A, Fumonisins and Zearalenone contamination in cereals, for consideration at its next meeting. Given that approximately 26% of the world cereal production is used directly for animal feeding (FAOSTAT) this work has direct implications for the control of mycotoxin contamination in feed.

The capability and reliability of food control analytical services are important considerations in the implementation of national programmes to ensure feed safety. FAO, in collaboration with the International Agency for Atomic Energy (IAEA), has been widely involved in improving analytical quality assurance in laboratories carrying out mycotoxin analysis and has implemented several training courses on this topic. Another such training course is planned for the countries of Eastern Europe in October 2000. These training programmes help prepare laboratories to obtain official accreditation.

Transmissable Spongiform Encephalopathies

Research and investigation continues in the area of TSEs due to the important implications for the safety of foods of animal origin. In December 1999 WHO, in collaboration with the International Offices of Epizootics (OIE), held a consultation on Public Health and Animal Transmissable Spongiform Encephalopathies - Epidemiology, Risk and Research Requirements. The recommendations of this consultation included the need for

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continued priority to be placed on surveillance of Creutzfeldt-Jacob Disease (CJD) and evaluation of animal TSE zoonotic potential; and, continued emphasis on programmes for the control and eventual eradication of TSEs in livestock including the development of improved diagnostic testing methods.

Genetically Modified Organisms

In relation to the use of GMOs in animal feedstuff the main concerns relate to: the possibility of DNA of inserted or modified genes or their products causing adverse health effects in animals; and the possibility of DNA fragments or proteins being transferred to or accumulated in foods of animal origin (milk, eggs and meat) leading to adverse health effects in humans consuming such foods. Research carried out so far has not demonstrated any hazard posed by GMOs, but further work is required.

One of the several important issues facing the Codex Task Force on Good Animal Feeding relates to the use of GMOs in animal feed. The work of the task force for the Safety of Novel Foods and Feeds which has been established by the Organisation for Economic Cooperation and Development (OECD) is also highly relevant to this issue. The question is a complex one and further research will be necessary to resolve some food/feed safety issues. What is essential in the short term, however, it to achieve consensus in the international community concerning the approach to the evaluation and regulation of GMOs in food and feed. This process is already well underway.

There is general agreement that the concept of substantial equivalence elaborated by OECD is the most practical approach to address the safety evaluation of food or feed components produced by modern biotechnology.

The safety evaluation itself should follow risk analysis principles as elaborated by relevant international organisations, including a precautionary approach in cases where there is insufficient knowledge or understanding to support an exhaustive risk assessment. This matter is being considered by the Codex Ad Hoc Inter-Governmental Task Force on Foods Derived From Biotechnology, which held its first session in Japan, 14-17 March 2000. A Joint FAO/WHO Expert Consultation on Foods Derived from Biotechnology was held in Geneva, May/June 2000, to elaborate further on the concept of substantial equivalence and to consider other pertinent issues.

There is also agreement on the consumer's right to be informed of how their food is produced. The Cartagena Protocol requires that GMOs moving in international trade be identified as such. Furthermore, the issue of labelling of foods produced by biotechnology is currently being discussed within the Codex Committee on Food Labelling.

Code of Practice for Good Animal Feed Production, Handling and Storage

The FAO Expert Consultation on Animal Feeding and Food Safety held in 1997 noted that quality assurance (QA) begins with the concept of what the feed product is to be, in terms of the species being fed and the results being sought. Ingredient specifications are important to quality assurance in defining the quality of the feedstuffs to be accepted by the processor when the raw materials are received for processing. The formulation of the finished feed, including any added medications, should meet the regulatory requirements of the government as well as satisfy the animal production objectives of the customer. Other QA factors involve the manufacture and distribution of the feed. Key elements in effective quality assurance at the feed production facility should include proper sampling, laboratory testing and microscopy,

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in-plant quality control, control of drug carry-over, plant sanitation and integrated pest management, plant cleanliness, the receiving area, and storage. Quality assurance procedures must be clearly documented and records maintained.

Clear guidance from governments to industry regarding required features of feed quality assurance programmes constitutes an important preventative approach to feed safety. Such guidance can be provided through codes of practice for the animal feed and livestock sectors covering all stages of feed production, handling and storage to its ultimate use. The code could cover such issues as: production of feed materials; sourcing of feed materials; use of additives and veterinary medicinal substances; structures, equipment and materials used in feed manufacture, packaging, handling or storage; product and personnel flows through the facilities; processing operations; labelling requirements; transport and storage of finished product; traceability mechanisms; and, appropriate record-keeping.

Applying HACCP ensures that all potential safety hazards are thoroughly analysed and assessed, that critical limits are established for all points along the chain that must be controlled to avoid occurrence of safety hazards, that effective systems for monitoring the critical control points are in place, and that plans for corrective action are established in the event of problems within the production chain. Processors and handlers of animal feed must further ensure that adequate documentation is maintained to demonstrate their adherence to HACCP principles. The work currently being undertaken at international level to establish a Code of Practice for good animal feeding will be instrumental in ensuring a uniform approach to assuring the quality of feed.

National Programmes to Prevent Foodborne Hazards Related to Animal Feed

A basic component of the national controls necessary to guarantee the quality and safety of feeds and foods includes legislation and regulations. The legislation defines responsibilities and designates authority with respect to the wide spectrum of activities involved, establishes basic procedures to be followed in enforcing the legislation, and provides standards, guidelines and other recommendations to be respected by the industry in the production of animal feed.

Legislation and regulations concerning the production, manufacture, handling, storage and use of animal feed should be coherent and complementary parts of national food legislation. The development and implementation of food law is a political process, which is dynamic and evolutionary and often reflects changing public and political concerns. Unless governments undertake periodic review of food/feed legislation to ensure its coherency, it may become a patch work of additions and revisions leading to overlapping, redundant and conflicting jurisdictions for government agencies and gaps that could give rise to public health problems. Recent food safety problems involving unsafe feed have demonstrated certain weaknesses and gaps in existing legislation in force in many countries.

Some countries may wish to update policies in line with today's food and feed safety issues. For example given the current possibilities of modern biotechnology, it may be necessary that regulations and procedures for the evaluation, authorisation and labelling of foods produced from biotechnology, be established. Measures instituted should not be more restrictive than necessary to meet legitimate food/ feed quality and safety objectives.

The WTO SPS Agreement calls upon members to harmonise food safety measures internationally. Recent food safety crises linked to feed contamination have heightened

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international awareness of existing disparity among national legal limits for maximum levels of contaminants that could be associated with animal feedstuffs. This raises questions about the appropriate level of consumer protection and also constitutes a barrier to trade. Current work by relevant international organisations to determine appropriate guidelines on the levels of contaminants is necessary to facilitate eventual harmonisation of regulations without compromising public safety.

Enforcement of legislation and regulations depends on effective administration of feed control programmes, the existence of an inspection service whose staff is well trained in feed production and manufacture and related safety issues, analytical services adequately equipped with sufficient capacity and the required technical expertise to carry out the volume and types of analyses necessary to support monitoring and surveillance programmes as well as routine regulatory testing. There is agreement throughout the international community that food safety measures should be scientifically justified. This highlights the need for research on feed-related safety hazards in foods of animal origin. The establishment of research networks could be a useful strategy to promote sharing of scientific information the improving the chances of building more rapidly on scientific developments to arrive at reliable answers on questions regarding feed safety and quality.

Where potential problems associated with feed are not effectively covered by existing rapid alert systems for food safety, governments should take the necessary steps to ensure the implementation of swift action to contain and eliminate any feed safety problems with the potential to cause public health risk. In the case of feed in international trade, Codex provides guidelines for the Exchange of Information in Food Control Emergency Situations (CAC/GL 19-1995).

In seeking to address the weaknesses in feed control that have become apparent in recent years, governments must pay considerable attention to the inter-relations that exist between different agencies and the need to establish cooperative and coordinating mechanisms to ensure the best possible implementation of all programmes while giving privilege to public health concerns when these arise. The composition and safety of feed have important food safety implications, but are also critical considerations in animal health and husbandry. It is fitting therefore that governments establish suitable mechanisms for food safety agencies, agriculture departments and veterinary services to work together in determining the best policies and actions with regard to animal feed. It must be emphasised that an important aspect of control lies in training. Poor practices within the animal feed industry are often linked to lack of knowledge of associated hazards and how these should be managed. The development of relevant training and extension programmes for people involved in the feed industry or in animal feeding at farm level is an important aspect of control of animal feed.

The control of BSE offers a clear illustration of the need for close collaboration among food control and other concerned agencies. Measures that have been established in Europe and elsewhere centre around surveillance and notification of BSE in live animals, establishment of processing conditions for mammalian tissues to be used in animal feed and prevention of the use of mammalian tissues in feedstuffs for ruminants. The first of these activities would fall under the responsibility of veterinary services. The complexity of the flows of raw material, animal meal and compounds containing animal meal highlights the need for close cooperation between various agencies in order to achieve public health objectives. Certain chemical substances and biological agents incorporated into feed at any

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stage of production up to the point of feeding, either intentionally or unintentionally, can result in hazards in food of animal origin. National food safety programmes should therefore include the control foodborne hazards that originate in feedstuffs.

Effective control of animal feedstuffs requires multidisciplinary input. There is a need for collaboration between all parties involved in feed and animal production, especially those in a position to provide veterinary clinical and epidemiological information, to establish the linkage between any identified or potential hazard and the level of risk. Such information is essential for the development and maintenance of appropriate risk management options and safe feeding practices. The disciplines that apply to international trade in both food and feed, as well as in feed ingredients were agreed upon during the Uruguay Round of Multilateral Trade Negotiations and set out in the SPS Agreement. Considerable work has been undertaken by the international community to support a uniform approach towards ensuring feed safety that is consistent with SPS principles.

Recommendations

Based on the above findings and conclusions, Member Nations could consider adopting the following measures:

- review existing food safety and quality legislation so as to ensure that it provides an adequate basis for the control of feed-related hazards with the potential to cause public health risks;
- participate to the fullest extent possible in the work being undertaken by international organisations involved in developing standards, guidelines and recommendations relating to feed-borne hazards;
- support research into the public health implications of animal feeds to support risk analysis of feedborne hazards; this would facilitate the setting of MRLs and the determination of effective control measures for protecting public health.
- develop suitable analytical and diagnostic methods for rapid screening and confirmation of feedborne hazards in national surveillance and monitoring programmes as well as in routine regulatory testing;
- establish mechanisms to ensure multidisciplinary scientific input, involving human medicine, veterinary medicine, animal science, crop science, food/feed technology, environmental science and toxicology, into policy and programme decisions relating to the control of feedborne hazards;
- encourage dialogue among producers of feed or feed ingredients, livestock and aquaculture industries and government as an essential part of the process of elaborating codes of practice for the feed industry; this will ensure that eventual regulations and guidelines are practicable and widely supported;
- establish, as needed, coordination and cooperation among several government agencies and departments to ensure successful and efficient implementation of feed control programmes;
- establish policies and programmes for the evaluation, authorisation and labelling of feed containing GMOs; these programmes should be no more restrictive than required to meet legitimate objectives.

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International organisations should continue to develop and make available information related to animal feed safety to their member countries thus supporting national feed control programmes.

Animal Feeding and Food Safety

Potential Hazards Associated with Feed

Mycotoxins: Mycotoxins are secondary metabolites produced by fungi of various genera when they grow on agricultural products before or after harvest or during transportation or storage. Some fungi such as *Fusarium* spp. typically infest grains before harvest, others such as *Penicillium* spp. can invade grain after harvest, while *Aspergillus* spp. can grow on grains both before and after harvest. It must be emphasised that the presence of the fungi does not necessarily imply that mycotoxins can be found. Conversely, the absence of fungi does not necessarily mean the absence of mycotoxins.

Both intrinsic and extrinsic factors influence fungal growth and mycotoxin production on a given substrate. The intrinsic factors include water activity, pH, and redox potential whereas extrinsic factors which influence mycotoxin production are relative humidity, temperature and availability of oxygen.

Many mycotoxins, with different chemical structures and biological activities, have been identified. Mycotoxins may be carcinogenic (e.g. aflatoxin B_1, ochratoxin A, fumonisin B_1), oestrogenic (zearalenone and I and J zearalenols), neurotoxic (fumonisin B_1), nephrotoxic (ochratoxins, citrinin, oosporeine), dermonecrotic (trichothecenes) or immunosuppressive (aflatoxin B_1, ochratoxin A, and T-2 toxin). Much of the published information on toxicity concerns studies in experimental animals and these may not reflect their effects in humans and other animals.

In addition, the significance of the presence of most mycotoxins in foods of animal origin is not completely understood. Mycotoxins are regularly found in feed ingredients such as maize, sorghum grain, barley, wheat, rice meal, cottonseed meal, groundnuts and other legumes. Most are relatively stable compounds and are not destroyed by processing of feed and may even be concentrated in screenings. Different animal species metabolise mycotoxins in different ways. For example in pigs, ochratoxin A can undergo entero-hepatic circulation and is eliminated very slowly while it is rapidly excreted by poultry species. The polar mycotoxins, such as fumonisins, tend to be excreted rapidly.

Mycotoxins, or their metabolites, can be detected in meat, visceral organs, milk and eggs. Their concentration in food is usually considerably lower than the levels present in the feed consumed by the animals and unlikely to cause acute intoxications in humans. However residues of carcinogenic mycotoxins, such as aflatoxin B_1 and M_1, and ochratoxin A, when present in animal products pose a threat to human health, and their levels should be monitored and controlled.

Table *Examples of food of animal origin which may be naturally contaminated with mycotoxins*

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Mycotoxin	*Potential effects on humans*	*Occurrence*	*Maximum level reported*
Aflatoxin B_1	Hepatic cancer	Eggs	0.4 ppb
		Pig liver	0.5 ppb
		Pig muscle	1.04 ppb
		Pig kidney	1.02 ppb
Aflatoxin M_1	[1]	Cow's milk	0.33 ppb
Ochratoxin A	Renal damage	Pig liver	98 ppb
		Kidney	89 ppb
		Sausages	3.4 ppb
Zeralenone	Oestrogenic	Pig liver	10 ppb
		Pig muscle	10 ppb

There is insufficient evidence to describe aflatoxin M1 as a human carcinogen although it is a potent carcinogen in rodents.

In most instances the principal source of mycotoxins for humans is contaminated cereals and legumes rather than animal products. This means that the exposure to mycotoxins may be greater in developing countries in which cereal grains and legumes form the staple diet and the intake of animal products, including meat, is low.

There is little information available regarding the occurrence of mycotoxin residues in animal products intended for human consumption. Examples of maximum levels in force in various countries include 0.05-1 ppb for aflatoxin M_1, 5 ppb for aflatoxin B_1, 25 ppb and 50 ppb ochratoxin A in porcine kidneys and cereals respectively and, depending on the country, 30-1,000 ppb for zearalenone in corn and foods. The levels of mycotoxins detected are usually below the maximum levels accepted in most countries.

Infectious Agents

Transmissible Spongiform Encephalopathies in Ruminants

The transmissible spongiform encephalopathies (TSEs) are non-febrile neurological diseases. They have a long incubation period and are ultimately fatal. TSEs are associated with incompletely defined agents currently termed prions which are resistant to normal heat treatments of feed and food. The TSEs recognised in food producing animals are BSE and scrapie. Sheep scrapie has been recognised for over 250 years. BSE was first recognised in the UK during 1986. The BSE infectious agent enters feed primarily through infected tissues (notably the central nervous system and the reticuloendothelial system) rendered under conditions of insufficient heat treatment to reduce the concentration of the infectious agent to an ineffective dose.

In the case of sheep scrapie, infection is naturally maintained by transmission between sheep. It is likely that humans have been exposed to the scrapie agent by eating brain and other tissues from infected sheep although there is no evidence that the occurrence of either CJD or nv-CJD has been associated with scrapie. With respect to BSE, humans can potentially be exposed through consumption of the infected tissues. The occurrence in humans of nv-CJD has raised the possibility of an association with the BSE agent. At present, with the limited number of diagnosed cases, there is no proven link between nv-CJD and the possible transmission of the infective agent from bovine tissue to humans.

Salmonella Enterica

There are over 2,000 salmonella serotypes and these can be divided arbitrarily into three

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unequally sized groups. These include:

1) the species specific serotypes such as *S. dublin* (cattle) and *S. gallinarum* and *S. pullorum* (poultry);
2) the invasive serotypes which may cause septicaemic disease in several animal species (e.g. *S. enteritidis* and *S. typhimurium);* and
3) the non-invasive serotypes which tend not to result in septicaemia. Members of the first group are not recognised as feedborne pathogens.

The third group is by far the largest and may be associated with subclinical infections in farm livestock. Occasionally they can cause disease and are associated with food poisoning in humans. The principal manifestation of human salmonellosis is gastroenteritis. Septicaemia occurs in a proportion of patients. The case mortality rate is low with the young, old or immuno-compromised being most susceptible.

Salmonellae arc widely distributed in nature, and feed is only one of many sources for farm animals. Feed ingredients, of both animal and plant origin, are frequently contaminated with salmonellae although the most common serotypes isolated are rarely the most prevalent in animals including man. The two most important serotypes associated with human disease, *S. enteritidis* and *S. typhimurium,* are rarely isolated from feed. Feed can be contaminated by contact with raw ingredients after processing.

Toxoplasma Gondii

The protozoan *Toxoplasma gondii* is found in cats, and based on serological surveys, in birds, and in domesticated species including sheep, pigs, goats, and horses. The primary source of infection for animals is feeds contaminated with cat faeces. Cats are an important source of infection for humans, with the handling or consumption of raw meat also being implicated. Pregnant women who become infected may abort or give birth prematurely, and infants often develop central nervous system disorders and ocular disease. Immuno-compromised patients are at particular risk.

Trichinella Spiralis

Trichinella spiralis is a nematode which parasitises the intestinal tract of mammals, particularly pigs. The larvae encyst in the tissues, particularly the muscles, which act as a source of infection for humans who consume raw or undercooked meat. The clinical manifestations include fever, muscle pain, encephalitis, meningitis, myocarditis and very occasionally, death. The cysts can be killed by freezing infected carcasses at -18°C for 20 days. They are also heat sensitive and are killed by traditional rendering temperatures. Effective cooking of raw meat and table scraps before feeding to farm animals will eliminate this hazard.

Veterinary Drugs and Agricultural and other Chemicals

Veterinary Drugs: Veterinary drugs may be administered in animal feeds. If the concentration used results in foods of animal origin with residues exceeding the established Maximum Residue Limits (MRLs) such as those established by Codex, there may be a potential risk to human health. Codex MRLs should not be exceeded if concentrations used are correct, withholding times are observed and Good Agricultural Practices (GAP) and Good Veterinary Practices (GVP) are applied.

Agricultural and Other Chemicals

The potential hazards may include excessive residue levels of herbicides, pesticides, and

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fungicides and industrial/environmental or other extraneous contaminants such as the polychlorinated biphenyls (PCBs) and heavy metals including mercury, lead, or cadmium. Cereals and treated seeds are the most likely source of these contaminants. The most significant hazards to human health are those chemicals that accumulate in animal tissues or are excreted in milk or become incorporated in eggs at levels in excess of established limits such as the Codex MRLs for pesticides or maximum levels for contaminants in a food or feed.

Assessment of the Risk

The risk analysis approach has been adopted within the Codex system and used as the fundamental method underlying the development of food safety standards. The Consultation therefore saw one of its tasks as to provide an assessment of the risk of foodborne hazards that enter the food chain via feeds. Risk analysis is composed of three separate but integrated elements, namely risk assessment, risk management and risk communication. Risk assessment has been defined by Codex as being the scientific evaluation of known or potential adverse effects resulting from human exposure to foodborne hazards. The risk assessment process consists of the following steps: (i) hazard identification, (ii) hazard characterisation, (iii) exposure assessment, and, (iv) risk characterisation. The definition includes quantitative risk assessment, which emphasises reliance on numerical expressions of risk, as well as an indication of the attendant uncertainties. Hazard identification is defined as the identification of known or potential health effects associated with a particular agent. Exposure assessment is the qualitative and/or quantitative evaluation of the degree of intake likely to occur. Risk characterisation is the integration of hazard identification, hazard characterisation and exposure assessment into an estimation of the adverse effects likely to occur in a given population, including attendant uncertainties. For chemical agents, a dose/response assessment should be performed. For biological or physical agents, a dose-response assessment for hazards should be performed if the data are available or obtainable.

In general terms, the Consultation recognised that there are risks arising from foodborne hazards that enter the food chain via feeds. However, on balance, the judgement was that the risk of these hazards was low in comparison to foodborne hazards that originate from other sources. The risks from *Salmonellae* for example, may be considerably greater during processing of carcasses and subsequent animal product processing. The exposure to mycotoxins is far greater from eating contaminated cereal grains than from eating foods derived from animals fed contaminated grains.

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Chapter 8 : Feedstuffs in Livestock

Feeding farm animals is a process of priority decision-making involving at least two general conditions. The first is an abundance of food material which is not in a usable form or aesthetically acceptable as human food, and the second is a surplus of food material accompanied by a standard of living sufficiently high that the nutrient losses involved in feeding animals are compensated for by the increased desirability and nutritional excellence of foods of animal origin.

Decisions relevant to the first set of conditions include determining the optimum numbers and kinds of animals that can be productively supported by the available feedstuffs. Efforts should be made to maximise production; but also to allocate nutrient supplies in a competitive situation for the maximum benefit to the society concerned. These decisions are among the most critical that civilization faces today.

Decisions can be made only on the basis of reliable information concerning the composition of all feed materials used in animal feeding. This information is fundamental in assigning priorities to the use of available feed supplies in animal agriculture.

International Network of Feed Information Centre (INFIC)

German documentation began in 1949 and the United States began in 1952. Although there was some contact between the two centres for several years, it was not possible to combine or adapt the systems to each other. Personnel at the Utah (United States) centre contacted FAO concerning the need for world cooperation. FAO, in turn, sent a consultant to review on-going international activities in the fields of feed data collection and methods for retrieval of these data, and to report on possibilities for collaboration on an international basis. The report (Alderman, 1971) enumerated the value of a collaborative effort in this field, both to developing countries and to animal production at the international level and recommended that FAO act as the coordinator for international activities in collection of data on feed composition and its summarisation and dissemination.

The first consultation meeting was held in 1971, in Rome. At that time representatives from several feed information services formed the International Network of Feed Information Centre (INFIC Publication 1, 1977). Members (besides FAO) were: Australian Feed Information Centre, Sydney, Australia; Agriculture Canada, Ottawa, Canada; International Feedstuffs Institute, Utah State University, Utah, U.S.A.;. US AID Feed Composition Project, University of Florida, Gainesville, Florida, U.S.A., and Universität Hohenheim, Dokumentationsstelle, Stuttgart, Federal Republic of Germany.

Since then, meetings of the INFIC group have been held annually, and the following centres have joined INFIC: The Arab Centre for Studies of Arid Zones and Dry Lands (ACSAD), Damascus, Syria; College of Fisheries, Aquaculture Division, University of Washington, U.S.A.; The International Livestock Centre for Africa (ILCA), Addis Ababa, Ethiopia; Institute d'Elevage et de Médecine Vétérinaire des Pays Tropicaux (IEMVT), Maisons-Alfort, France; the Latin American Programme for Feed and Feeding Systems, at the

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Institute Interamericano de Ciencias Agricolas (IICA), San Jose, Costa Rica; and the Tropical Products Institute (TPI), London, United Kingdom. In the meantime, the US AID Feed Composition Project in Florida has been terminated and its responsibilities were transferred to the Utah Centre. Participation by other feed information services throughout the world is encouraged by INFIC. All centres function independently with regard to financing, personnel, data retrieval, research and publications.

An International Feed Nomenclature

Naming and describing feeds for data processing must be carried out systematically. This means that a precise nomenclature had to be established. This nomenclature contains controlled terms (descriptors) which constitute the "International Feed Vocabulary". These descriptors are used for coining the international names of feed. Thus, the nomenclature can be expanded by combining the existing descriptors.

Many of the by-products arising from the preparation of human food are suitable for animal feeds. As new technology develops for processing human foods, additional by-products are constantly being introduced. Unless well-defined guidelines are established for naming these products, confusion will reign.

Many grain products are changed by subjecting them to some form of mechanical process; e.g., blending, grinding, pelleting, and steam or dry rolling. This often results in an alteration in the nutritive value of feeds. Generally, these changes increase nutritive values resulting in increased efficiency of animal production. However, this complicates the task of precisely naming these materials. The names of many feeds are controlled officially by regulation in the U.S.A., Canada and the European Community. These names include descriptions of processes used in their manufacture and may include guarantees of quality. Such names, however, are usually common or trade names and do not describe the feed accurately.

In reviewing the literature, more than 20 percent of the common names were found to be different names (synonyms) for the same product from different areas of the world. This complicates the identification of feeds. A new international system was proposed by Harris (1963) and Harris et al. (1968) to overcome inconsistencies in naming feeds. This system was modified and is now known as the International Feed Vocabulary.

Using this vocabulary, over 18 000 feeds have been recorded and given International Feed Descriptions or Names in English, German and French. Portuguese and Spanish versions are being prepared. These International Feed Names are now in wide use.

The International Feed Vocabulary is designed to give a comprehensive name to each feed as concisely as possible. Each feed name is coined by using descriptors taken from one or more of six facets.

Facet 1: Origin : The origin or parent materials may be one of three types:

(i) plants, specific (barley, oats, coconut, soybeans), non specific (cereals, grass, meadow)

(ii) animals, specific (cattle, chickens, swine), non specific (animal, poultry, fish)

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(iii) minerals, chemical products, drugs and others.

For specific plants and animals, each descriptor of this facet is composed of:

(i) scientific name

(ii) common name.

Feeds should be described by their common names at up to three levels as far as this is possible. The first level should be the generic name; e.g., cattle, fish, clover, wheat, etc. The second level should be more specific (such as breed or kind); e.g., Hereford, cod red (clover), winter (wheat), etc. The third level should list other important characteristics (such as strain; e.g., Delmar).

Facet 2: Part Fed to Animals as Affected by Process (es). This component of the feed description represents the actual part of the parent material fed. In the past, the edible parts of plants and animals were obvious such as leaves, stems, seeds, meat trimmings, or bones. Today, due to the extensive fractionation of plant seeds and the reconstitution of many of the parts into new processed foods, innumerable by-products are available for animal feeding.

Each part has to be described unambiguously by a descriptor, the use of which is defined as far as necessary.

Table: *International Feed Description: Origin (Examples)*

With Specific Origin				
genus	Bos	Gadus	Trifolium	Triticum
species	Taurus	Morrhua	Pratense	Aestivum
Level 1 generic name	Cattle	Fish	Clover	Wheat
Level 2 breed or kind	Hereford	Cod	Red	Winter
Level 3 strain	-	-	-	Delmar
With Non Specific Origin				
Level 1 generic name	Animal	Grass	Poultry	Meadow plants
Level 2 breed or kind	-	-	-	-
Level 3 strain	-	-	-	-

The above are examples of feeds with specific origins. Some feeds may have no specific origin, and are described by their common name; e.g., animal, grass, poultry, meadow grass.

Minerals, drugs and chemicals are listed according to the nomenclature of CRC (1968). The chemical formula are designated where applicable.

Table: *International Feed Description: Origin + Part (Examples)*

genus	Bos	Gadus	Trifolium	Triticum
species	Taurus	Morrhua	Pratense	Aestivum
generic	Cattle	Fish	Clover	Wheat
breed or kind	Hereford	Cod	Red	Winter
strain	-	-	-	Delmar
part	Milk	Whole	Aerial part	Grain

Facet 3: Process (es) and Treatment (s). Many processes may be used in the preparation of a feed for consumption and some of these may significantly alter their nutritional value. Heat may damage some nutrients and, conversely, it may make others nutritionally more available. Pelleting increases consumption while grinding may affect digestibility of protein and carbohydrates.

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It is important, then, that a feeder be aware of the processes to which a feed has been subjected. Also, the type of animal and its physiology must be considered relative to these factors. Therefore, origin and part terms are followed by those distinguishing the different methods of processing which are used alone or combined; such as separating, reducing size or thermal. The term dehydrated (descriptor: DEHY) when applied to AERIAL PART means feeds which are artificially dried. Similarly, FAN AIR DRIED indicates the AERIAL PART (hay) dried indoors by air convection.

The term, mechanically extracted (MECH EXTD) has been used rather than expeller extracted, hydraulic extracted, or old process.

Table: *International Feed Description: Origin + Part + Process (Examples)*

genus	Bos	Gadus	Trifolium	Triticum
species	Taurus	Morrhua	Pratense	Aestivum
generic	Cattle	Fish	Clover	Wheat
breed or kind	Hereford	Cod	Red	Winter
strain	-	-	-	Delmar
part	Milk	Whole or cuttings	Aerial part	Grain
process	Boiled	Mech Extd Dehy Ground	Ensiled	Ground

Facet 4: Stage of Maturity or Development. Although stage of maturity may be unimportant or may not even apply to many feeds such as grain by-products, it is probably the most important factor influencing the nutritive value of forages. There is an optimal stage of maturity for forage crops beyond which lignification or the reduction of the ratio of leaf to stem greatly reduces digestibility. Examples of International Feed Descriptions with stage of maturity for plants and animals are given in Table.

Facet 5: Cutting. Many forage crops are cut and harvested several times during the year. Each cutting has a unique nutrient content as well as characteristic physical properties. The descriptor for cutting refers to the sequence of cutting from the first to the last during the year (cut 1, cut 2, etc.). The maturity terms refer to stage of growth or of regrowth and, therefore, must be considered within the limits of cutting.

In tropical and subtropical areas, crops may be cut throughout the year, particularly if they are irrigated.

Table: International Feed Description: Origin + Fart + Process + Maturity + Cut (Examples)

genus	Gallus	Gadus	Trifolium	Digitaria
species	Domesticus	Morrhua	Pratense	Decumbens
generic name	Chicken	Fish	Clover	Pangolagrass
breed or kind	Leghorn	Cod	Red	-
strain	-	-	-	-
part	Whole	Whole	Aerial part	Aerial part
process	Fresh	Boiled	Dehy	Ensiled
maturity	Day old	-	Early bloom28-42 days' growth	
cut	-	-	Cut 1	Cut 2

The time to start counting cuttings for non-irrigated forages would be the first rainy season. For irrigated forages, the count should start from the first crop.

Since stage of maturity is more important than cutting data, the various cuts for forages are sometimes combined with the stage of maturity when data are summarised for feed

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composition.

genus	Glycine	Medicago	Gadus
species	Max	Sativa	Morrhua
generic name	Soybean	Alfalfa	Fish
breed or kind	-	-	Cod
strain	-	Ranger	-
part	Seeds without oil	Aerial part	Whole
process	Solv Extd	Dehy	Boiled
maturity	-	-	-
cut	-	Cut 1	-
grade	More than 44% protein	17% protein	-

Facet 6: Grade. Some commercial feeds and feed ingredients are given official grades on the basis of their composition and other quality characteristics. Such feeds are sold on a quality description basis in accordance with their official gradings. Thus, these grades and quality designations must be included as a definitive component in the description of the feed. These guarantees for various attributes are expressed in terms of "MORE THAN" (minimum) and "LESS THAN" (maximum) of some percentage of crude fibre, protein, fat, etc. LOW GOSSYPOL is an example of a quality grade. These guarantees and quality are used as descriptors in this facet.

Classes of Feeds by Composition and Usage

Feeds are grouped into eight classes on the basis of their composition in the way they are used for formulating diets.

By necessity these classes are arbitrary, and in borderline cases the feed is assigned to a class according to the most common use made of it in usual feeding practice. For instance, some bran samples may contain over 18 percent fibre and more than 20 percent protein and yet are classed as forages because they are normally used in this way.

Table: *Classes of Feeds by Composition and Usage*

Code		*Class Description*
1	Dry forages and roughages	Hay; straw; fodder (aerial part); stover (aerial part without ears, without husks or aerial part without heads); other products with more than 18 percent crude fibre (dry basis); HULLS This class includes all forages and roughages cut and cured. Forages or roughages are low in net energy per unit weight, usually because of the high fibre content. Thus, such products as SEED COATS, PODS, rice BRAN, etc. are included in this group.
2	Pasture, range plants, and forages fed green	Included in this group are all forage feeds either not cut (including feeds cured on the stem) or cut and fed fresh.
3	Silages	This class includes only ensiled forages (MAIZE, ALFALFA, GRASS, etc.), but not ensiled FISH, GRAIN, ROOTS and TUBERS.
4	Energy feeds	Included in this group are products with less than 20 percent protein (dry basis) and less than 18 percent crude fibre (dry basis) as, for example, FISH, GRAIN, mill by-products,
5	Protein supplements	This class includes products which contain 20 percent or more of protein (dry basis) from animal origin (including ensiled products) as well as oil meals, GLUTEN, etc.
6	Mineral supplements	

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7	Vitamin supplements (including ensiled yeast)	
8	Additives	This class includes further feed supplements as antibiotics, colouring materials, flavours, hormones and medicants.

[1/] Short feed names are used with or without the genus, species or variety

International Feed Description

An international feed description is composed of the previously described six facets and descriptors within the facets. The feed descriptions are maintained in an "International Feed Description Name File".

A six-digit "International Feed Number" (IFN) is assigned to each feed description. The first digit of this IFN denotes the class of feed. This reference number is used in computer programmes to identify the feed for use in calculating diets, summarisation of the data, for printing feed composition tables and for retrieving on-line data for calculating diets for maximum profit.

A complete International Feed Description consists of all descriptors applicable to that feed. It is numerically identified by the IFN.

Short Feed Names

Short names are used for Feed Composition Tables, compiled for use in particular countries or regions, when it is inconvenient to use the longer and more precise International Feed Description; however, the Short dame cannot be used for describing a feed when adding material to the feed data bank.

Official Country Names

In some countries feeds have been given official names. Usually, these names are not used as international feed descriptions because they are either incomplete or do not begin with the origin or parent material. However, they are used as additional names to relate the country name to the international feed description.

These names may be listed after the short feed names for a given country or region.

The Systematic Collection and Recording of Data on Feed Composition

The International Source Form

A system for recording data on an "International Source Form" was first devised by Harris et al. (1968) and Harris (1970) . This form has been revised by INFIC so that data on additional attributes such as toxic constituents, fertilizer and pollution can be recorded.

Each INFIC Centre may devise other source forms appropriate to their needs. The example source forms are used to record nutritional data about a feed. Items that may be recorded on the source form are outlined below. However, only those which are applicable to the particular feed sample are recorded. Completed source forms are forwarded to regional INFIC Centres where the information is coded for entry into the databank. Each source form is designed so information may be punched directly into 80 column computer cards or onto

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magnetic tape. A description of information to be filled in for each area of the source form follows.

Information Provided In Source Form

Card 10

Origin of Data, Origin of Sample and Description of Feed.

Project No. This number is filled in by the project leader.

Country. Give the country where the laboratory is located that analysed the feed sample.

State, province or department. Give the state, province or department within the country where the laboratory is located that analysed the feed sample.

Laboratory sample number. Give the number assigned to the sample. When source forms are prenumbered, this number could be used as the laboratory number; however, other numbers may be used. For example, the first sample collected in 1977 could be 77-1, the second 77-2, etc.

Origin of Sample

Date originally collected. Record date the sample was collected. This is especially important for forages as the nutritive value is influenced by the age of the plant.

Country: Give name of the country where feed originated. For example, anchovy fish meal may have come from Chile and be fed to livestock in Brazil. In this case, enter Chile for country.

Climatic zone: To be filled in by the Feed Centre. This is a geographic area within a country (or countries) with similar altitude, latitude, and rainfall.

Fishing area: Give the nearest state, province or department within a country where the fish were caught. This includes rivers, lakes or the oceans.

State, province or department. Give name.

Country, district or region. Record name. This will assist in identifying areas where plants exhibit nutritional deficiencies and/or toxic levels of materials when fed to animals. When sufficient data are collected, maps can be drawn outlining these areas.

Literature reference No.: This is primarily used at the Centre when data are collected from the literature. However, if the data being reported have been published, fill in literature reference, giving the senior author, year, journal, volume number, and page.

Description of Feed

If the feed can be identified, write in the international feed name in the scientific name area from the list of feed names in the appendix. Fill in the international feed number taken from this list above the aquares on the source form reserved for this purpose. If the international feed name and the international feed number are filled in, the blanks down to the short name do not need to be filled in.

When the international name cannot be identified, describe the sample by using the common name and fill in the other blanks as described below, i.e., class of feed, scientific name, common name, part, process, etc.

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Class of feed. Check one of the squares as appropriate.

Scientific name (variety or kind). When this area is not used for the international feedname as outlined above, give the variety or kind, i.e., Zea mays indentata.

Common name for scientific name. Common names are an important part of feed terminology. Many are part of our everyday language. List here all the common name(s) by which the feed is known in your locality.

Part of plant, animal or other product. A list of words or phrases describing the part of the plant, animal or feed product is given in the Glossary. Study these words or phrases carefully. When there is a word or phrase which fits your feed sample, insert it here. These terms are used in the international feed names.

Process undergone before fed to animal. A list of processes which the feed may undergo before it is fed to the animal is given in the Glossary. Study these carefully; if a word or phrase fits the feed, insert it under Processes Undergone Before Fed to Animal. If a word or phrase in the Glossary does not fit the feed, make up a new one and insert it in this space.

Other descriptive terms such as rained on, mouldy, frozen, weathered, insect damage, etc., may be added to obtain a more accurate description.

Stage of plant maturity or development or age of animal. Use one of the terms listed in the Glossary. Some forages, especially those in the tropics, bloom intermittently. For these forages, list the length of time in days since the plant started to grow or since previous cuttings.

When the sample is of animal origin, give the stage of development of the animal.

Number of cut. This refers to the number of times the plant is cut and harvested. Fill in first, second, third cut, etc.

Official grade (name and number). Many countries have an "Official" grading system for hays and grains. If your country has such a system, obtain an official grade on your sample and insert it under this item. Some countries have a "Feed Control Service" that describes feeds which are sold. They may specify minimum and maximum guarantees for certain attributes. If feeds in your country carry guarantees, indicate the percentages "less than" or "more than"; for example: wheat, flout by-product, less than 2.5 percent fibre.

Short Name: To be filled in at the Centre.

Plant Cross: When a plant cross is on the market as a commercial feed, give the plant cross and state "sold on the market". This name will then be added to the name file. However, if the plant cross is not sold on the market, give the plant cross and state "not sold on the market". The plant cross will then be coded by the Centre so the data can be retrieved at a later date if the plant cross becomes a commercial product.

Additives: Give name of additive. These are materials added in small amounts example, sodium hydroxide in treating straw or molasses added to silage.

Weight or Additive: **Check appropriate square: mg, g, or kg.**

Weight per metric ton. Give amount of additive per metric ton of feed.

Season: Record one of the following: dry or wet (rainy).

These reasons apply primarily to the tropics or to areas which have long dry and rainy

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seasons. Note: the stage of maturity takes care of the season in temperate climates so for these climates leave this area blank.

Card 21

Quality of Feed, Soil and Fertilization: Quality designations for feeds. These designations are:

- Grade 1 good
- Grade 2 fair
- Grade 3 poor
- Grade 4 inferior.

Degree of purity percent. Give the percent of feed (origin) material present in the sample. Most samples contain impurities. This information helps in establishing a grade.

Foreign material. Record one of the following: mineral contamination, weed seeds, other foreign material.

Soil

Note: Each Centre could use the soil classifying system used in the country or area they serve. If such a system is used, record the soil class. At the present time, it is not possible to use an international soil classification system. However, the following soil information may be used when the Centre does not have a system to classify soils.

Soil Type: Give one of the following: old surface, volcanic, or alluvial.

Kind of Soil: Depending on surface texture, state: sand, loam, or clay.

Soil pH. Give the pH value of the soil.

Water (type). Record one of the following:

- Rainfall
- irrigation (sprinkler)
- irrigation (furrow)
- irrigation (border flooding)
- irrigation (drip). Irrigation plus rainfall. Give total water in mm.

Fertilization

Nitrogen fertilizer-type. Give one of the following:

- nitrogenous fertilizer
- anhydrous ammonia, NH_3
- ammonium nitrate
- urea
- calcium ammonium nitrate
- calcium nitrate
- calcium cyanamide
- nitrate of soda
- ammonium sulphate, or the name of other nitrogen fertilizer used.

Quantity in kilogramme per hectare. Give kg applied per hectare.

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No. of days between last application and harvest. Give number of days.

Quantity in kilogramme per hectare. Give kg applied per hectare.

No. of days between last application and harvest. Give number of days.

Phosphorus fertilizer, type. Give one of the following:

- 28-30 percent P_2O_5 and 12-15 percent $CaCo_3$
- Novaphos
- Rhenania phosphate, $CaNaPO_4 + CaSiO_3$,
  - o raw phosphate o superphosphate
- Thomasphosphate $Ca_3P_2O_2 \cdot CaO + CaO \cdot SiO_2$ or the nameof other phosphorous fertilizer used.

Quantity in kilogramme per hectare. Give kg applied per hectare.

Calcium fertilizer, type. Give one of he following:

- quicklime, burned lime
- lime, ground, from iron works
- calcium carbonate
- slaked lime or the name of other calcium fertilizer used. Quantity in kilogramme per hectare. Give kg applied per hectare. Organic manuring, type. Give one of the following:
- green manure
- guano
- semi-liquid manure
- horn meal
- liquid manure, slurry
- sewage sludge
- bone meal
- compost
- garbage
- plant residues, plant refuses
- peat moss
- stable manure, barn manure or the name of other organic manure used.

Quantity in kilogramme per hectare. Give kg applied per hectare.

Trace element fertilizer, type. Give one of the following:

- boron fertilizer
- chlorine fertilizer
- cobalt fertilizer
- iron sulphate
- copper sulphate
- magnesium fertilizer

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- manganese fertilize
- molybdenum fertilizer
- sodium fertilizer
- sulphur fertilizer
- lime fertilizer or the type of trace element fertilizer used. Quantity in kilogramme per hectare. Give kg applied per hectare. Mixed fertilizer, type. Give one of the following:
- P-K fertilizer
- N-Mg fertilizer
- phosphate – potassium
- P-K fertilizer, 15-18 percent, 20-25 K, nitrogen – phosphate
- Thomasphosphate – potassium
- Nitrophoska grey (11.5% N, 8.5% P_2O_5, 18% K_2O)
- Nitrophoska red (13% P_2O_5, 21% K_2O), 12% N, 12% P_2O_5, 20%K_2O) or the name of other mixed fertilizer used.

Quantity in kilogramme per hectare. Give kg applied per hectare.

Card 22

Storage Structure

This card is used primarily for silage, however, the height when cut may apply to other feeds.

Height when cut. Record height above stubble in centimetres.

Storage place. Record one of the following:

- Cellar
- Pit
- Trench
- Kiln
- Granary
- Case
- Stack
- temporary silo:
- upright high stack silo
- upright half high stack silo
- attached silo
- flat silo moveable silo
- fence silo
- metal or plastic silo
- silo made with pressed material (plywood)
- sealed upright silo
- experimental silo.

Kind of building material. Record one of the following:

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- concrete
- wood
- metal
- straw
- store
- soil
- plastic
- miscellaneous.

Kind of covering or lock. Record one of the following:

- concrete cover
- plastic sheet
- inner race lock
- clamp lock
- mechanical pressing
- sound bag lock
- seeger retaining ring
- dipping cover.

Number of days stored. Record the number of days stored.

Temperature (°C). Record the temperature to the nearest whole degree.

Air humidity (percent). Record the air humidity to the nearest whole degree.

Light and air conditioning. Record one of the following:

- light with air exchange
- semi-dark with air exchange
- dark with air exchange
- air tight with light
- air tight and semi-dark
- air tight and dark.

Card 30

Digestibility Trial

When a digestibility trial has been conducted on the feed sample, fill in this section of the source form.

Animal Kind: The data reported for digestion coefficients, percent rumen digestion (nylon bag), digestible energy, metabolisable energy, nitrogen-equilibrium metabolisable energy, nitrogen-equilibrium metabolisable energy, NE_m, NE_{gain}, TDN, or other measures made on animals are tied to animal kind; therefore, animal kind must be filled in if these data are reported.

Do not put estimated data on the source form. Examples of animal kind are cattle, llama, horse, sheep, swine, etc.

Animal Breed: Give the breed name, such as Holstein, Brahman, Nallore, Hampshire.

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When the animal is a crossbreed, list the male first.

Sex : State whether male, castrate male, female, or spayed female.

Age: Give age of animal in years and months; months and weeks; or in weeks.

Number of Animals in Treatment: Give number of animals used in the trial for each feed.

Average Weight of Animals: Record the actual weight expressed in kilogrammes or grammes according to the following schedule:

(kg) :

- Alpaca
- Ass
- Camel
- Cat
- Cattle
- Chicken
- Deer
- Dog
- Duck
- Fish
- Fox
- Goat
- Goose
- Hare
- Horse
- Llama
- Man
- Mule
- Reindeer
- Roe (deer)
- Sheep
- Swine
- Turkey
- Water-buffalo
- Zebra
- Zebu

(g) :

- Guinea-pig
- Hamster
- Mink
- Mouse
- Pigeon
- Quail
- Rabbit
- Rat
- Test tube (in vitro).

Record the weight to the nearest 0.1 kilogramme or gramme. When weights are given only to the nearest whole kilogramme or gramme, add a zero (implies accuracy to 0.1 unit) after the decimal point.

Physiological State: Check the appropriate condition in each of the following areas:

- non-pregnant, pregnant first 2/3, or pregnant last 1/3;
- losing weight, maintaining weight, gaining weight or fattening;
- lactating, laying eggs or working;

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- very thin, thin, thrifty, fat, or very fat.

Percent of test ingredient in ration fed (100.0% dry matter). Calculate and fill in only when feed is not fed alone.

Ad libitum feeding or controlled feeding. Check which method was used. Feed fed alone or feed not fed alone (digestion by difference). Sometimes it is not possible to feed a single ingredients, such as meat meal (animal, carcass, residue, dry rendered dehydrated ground) to cattle. In this case, the meat meal is fed with some other feed. When water and minerals only are given-with a feed, it is considered to be fed alone. Indicate method used (feed fed alone or feed not fed alone).

Method: Check whether the faeces were measured by the total collection method or by the indicator method.

Length of Trial: Record length of the preliminary period and the collection period.

Daily dry matter consumed. Record the average daily dry matter consumed during the collection period according to the schedule given in g or kg (for each animal kind) for average weight of animals outlined above.

Record weights to the nearest 0.01 of a kilogramme or 0.001 of a gramme, as appropriate for the animal. When feed weights are not determined to this accuracy, record zeros in positions to the right of the least significant digit.

Card 40

Chemical and Biological Data: Each datum should represent a single observation; however, if individual data are not available, average values may be used (taken from the published literature).

Check Analyses Wanted: The squares under this heading are for convenience of the chemist. The squares opposite the attribute are checked for the analyses wanted. At this time, chemical analysis work sheets are made up by entering the laboratory number of source form number in the appropriate chemical analysis work book (Harris, 1970).

Some attributes to be analysed on the sample not be on the source form. The next step is for the chemist to analyse the sample. The chemical and biological analyses are then copied onto the source form.

Dry Matter: Record the as-fed dry matter (attribute identified by number 001 for dry matter) on the source form. A sample may be accepted without an “as fed” dry matter providing the data are reported on a partially dry or dry basis. However, an as fed dry matter is helpful to correct the data to an as fed basis.

Dry matter basis on which analytical data are reported on this form. This area must be filled in for the data to be entered into the system. Check appropriate square and enter one dry matter value opposite 002, 003, or 004 to indicate the dry matter of the data on the form. Note: when the basis of the data is on an as fed basis, attribute 001 and 002 must be filled in using the same value for each.

The following are definitions of as fed, partially dry and dry:

As-fed refers to the feed as it is consumed by the animal; the term as collected used for materials which are not usually fed to the animal, i.e., urine, faeces, etc. If the analyses on a sample are affected by partially drying, the analyses are made on the as fed or as collected

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sample. Similar terms: air dry, i.e., hay; as received; fresh, green, wet.

Partially dry refers to a sample of 'as fed' or 'as collected' material that has been dried in an oven (usually with forced air) at a temperature usually about 60°C or freeze dried and has been equilibrated with the air. The sample after these processes would usually contain more than 88 percent dry matter (12 percent moisture).

Some materials are prepared in this way so they may be sampled, chemically analysed and stored. This analysis is referred to as "partial dry matter percent of 'as fed' or 'as collected sample". The partially dry sample must be analysed for dry matter (determined in an oven at 105°C) to correct subsequent chemical analyses of the samples to a 'dry' basis. This analysis is referred to as dry matter percent of partial dry sample . Similar terms: air dry (sometimes air dry is used for as fed).

Dry refers to a sample of material that has been dried at 105°C until all the moisture has been removed. Similar terms: 100 percent dry matter; moisture free. If dry matter (in an oven at 105°C) is determined on an 'as fed' sample it is referred to as "dry matter on as fed sample . If dry matter is determined on a partial dry sample, it is referred to as "dry matter of partial dry sample . It is recommended that analyses be reported on the dry basis (100 percent dry matter or moisture free), and in addition the "as fed dry matter" should be reported (Harris et al., 1969; Harris and Fonnesbeck, 1977).

Analyses of data. Record the analytical data on the source form in the spaces provided. Digestion coefficients such as 106, 104, 84 or 56 are to be recorded using whole numbers only (do not use decimal points). The least significant digit must be recorded in the right most column, and in case of a negative coefficient, the minus sign must be indicated in the column just left of the most significant digit. Positive sighs are assumed and need not be recorded.

Record animal kind for card 30 if biological data such as digestion coefficients, metabolisable energy etc. are filled in.

Other analyses and other digestion coefficients. When analyses are determined by methods other than those indicated under method of analyses, record under "other analyses and other digestion coefficients". Also in the space provided record analyses not shown on the source form. Specify, decimal, unit, kind and method of analysis.

When amino acids are reported on a protein basis (g/16g N) record the name of the amino acid under other analyses and record the unit as (g/l6g N). When a ratio for amino acids is recorded, there must be a protein value.

If fatty acids are recorded as g fatty acids/100 g fat, record the fatty acid and the unit as g fatty acids/100 g fat. If fatty acids are recorded as g fatty acids/100g fatty acid, record the fatty acid and the unit as g fatty acids per 100 g fatty acid. When a ratio of fatty acids is recorded, there must also be a fat value (ether extract).

Record the weight per litre in this area (only applicable for grains and by-product feeds). To obtain this information, fill a litre measure without shaking or packing the feed. Scrape off the excess level with the top of the container and weigh (subtract container weight from total weight).

Supplementary information about feeds. Put any additional information about the feed here. It is helpful to know other factors which may influence the nutritive value of the feed, such as a complete description of the fertilizer used, whether the crop was irrigated or not

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irrigated, class of plant, crop badly weathered, or otherwise damaged.

Calculations Used in Summarisation of Feed Composition Data

The International Network of Feed Information Centres (INFIC) uses the caloric system for, recording energy values, although some propose that the joule be used. Older terms for expressing energy value of feeds such as Total Digestive Nutrient (TDN), Starch Equivalent (SE), and the Scandinavian Feed Unit system are still in widespread use, but INFIC encourages their substitution by the caloric system.

The raw data must be modified and certain calculations made before they are in their most useful form. It is not possible to obtain experimental values of all feeds, therefore, some values are estimated with equations. Whenever this occurs, these data are identified by an asterisk (*) as shown in the formulae below. These modifications and estimations are performed by using a computer programme that adapts the data to a standard format. The steps in summarising the data are as follows:

- *Original Data:* Original data are collected on source forms, coded and punched on to computer cards and entered onto a magnetic tape.
- *Preferred Unit and Dry Basis:* All data are calculated to the preferred unit basis (metric system) and to a dry matter basis (moisture free). Data are exchanged among centres on this basis.
- *Means and Coefficient of Variability:* All values for each attribute (for each feed) are totalled, means calculated, and where there are four or more values, the coefficient of variability is calculated.
- *Nitrogen Free Extract :* The mean nitrogen-free extract (NFE) in percent is determined by adding the percentage sums of ash, crude fibre, ether extract and protein.

Nitrogen-free extract is no longer used as an entity to calculate diets, but until sufficient data are available to replace TDN with the calorie system, there is some advantage in having nitrogen-free extract so DE and ME may be calculated from proximate analyses or from TON.

- Digestible Energy (DE) Digestible energy for each animal kindis calculated:
  (a) from the mean of digestible energy in kcal/g or Mcal/kg
  (b) DE in kcal/g = GE(kcal/g) × GE digestion coefficient
  (c) from TDN for cattle-and sheep (Crampton et al., 1957; Swift, 1957): *DE in Meal/kg = % TDN × 0.04409
  (d) from TON for horses, equation derived from data (Fonnesbeck et al., 1967 and Fonnesbeck, 1968): *DE in Mcal/kg = 0.0365 × % TDN + 0.172
  (e) from TDN for swine (Crampton et al., 1957; Swift, 1957): *DE in kcal/kg = % TDN × 44.09.
- Metabolisable Energy (ME) Metabolisable energy (ME) foreach animal kind is calculated:
  (a) from the average metabolisable energy in kcal/kg or Mcal/kg
  (b) from nitrogen-corrected metabolisable energy (ME) for chickens and turkeys (National Research Council, 1969)
  (c) from true metabolisable energy (TME) for chickens (Sibbald, 1977)
  (d) from DE for cattle and sheep (Moe and Tyrrell, 1976): ME(Mcal/kg DM) = -0.45

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+ 1.01 DE (Mcal/kg DM)

Moe and Tyrrell's formula is for dairy cattle, but it is believed it can be applied to sheep until a better formula can be found

(e) from DE for horses as *ME in Mcal/kg = 0.82 DE(Mcal/kg DM)

(f) from DE for swine as (Asplund and Harris, 1969): *ME in kcal/kg = (0.96 - 0.00202 × % crude protein) × DE (kcal/ kg DM).

- Net Energy (NE) Net energy (NE) for finishing cattle:

(a) from the average net energy maintenance (NE_m) or for weight gain (NE_{gain})

(b) net energy values for some cattle feeds are calculated from equations developed by Garrett (1977): NE_m (Mcal/kg DM) = $1.115 - 0.8971ME + 0.6507ME^2 - 0.1028ME^3 + 0.005725ME^4$

NE_g (Mcal/kg DM) = $3.178ME - 0.8646ME^2 + 0.1275ME^3 - 0.006787ME^4 - 3.325$

(c) net energy values for lactation (NE_1) are estimated byusing the formula of Moe and Tyrrell (1976):

NE_1 (Mcal/kg DM) = -0.12 + 0.0245 TDN (% of DM)

- Total Digestible Nutrients

Total Digestible nutrients (TDN) for each animal kind are calculated:

(a) from average TON

(b) from digestion coefficients as the sum total of the following: 1 × % digestible protein 1 × % digestible crude fibre 1 × %, digestible nitrogen free extract 2.25 × %, digestible ether

(c) from DE for cattle and sheep (Crampton et al., 1957; Swift, 1957):

$$*\%TDN = \frac{DE \text{ in Mcal/kg}}{0.04409}$$

(d) from DE for horses an equation derived from data inFonnesbeck et al. (1967) and Fonnesbeck (1968):

* % TDN = 20.35 × DE (Mcal/kg) + 8.90. This formula isonly used for class 1 feeds

(e) from ME for cattle and sheep as (Crampton et al., 1957;Swift, 1957):

* % TDN = 27.65 × ME in Mcal/kg

(f) *from regression equations

(ix) Starch Equivalent.

In some areas starch equivalent (SE) is still used to measure energy of feeds. Like TON, it should be replaced by the caloric system.

Starch equivalent, according to Kellner (1905) is calculated on the basis of the digestible nutrients taking into consideration special factors for the single nutrients and correction factors for the raw starch value.

The special factors for single nutrients-vary from one group of feeds to another for protein, ether extract and NFE, but are constant for crude fibre (= 1.0). The mode of

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correction and the correction factors which have to be used vary for forages and concentrates. For forages the raw starch value is corrected by the crude fibre correction factor, for concentrates by the value number.

Starch equivalents are calculated using codes assigned on the basis of correction factors when the feeds are first described.

The basis of Kellner's system with steers is the amount of fat produced over maintenance by pure nutrients added.

The amount is:

- 248 g per kg metabolised starch
- 235 g per kg metabolised protein
- 474 g per kg roughage fat
- 526 g per kg grain fat
- 598 g per kg oil meal fat.

Using the carbohydrate unit as base, the correction factors for the respective fat sources will be: 1.91, 2.12, and 2.41.

Table: *Regression Equations to Estimate Total Digestible Nutrients*

Animal kind	*Feed class*	*Equation*
Cattle	1	* %. TDN = 92.464 - 3.338 (CF) - 6.495 (EE) - 0.762 (NFE) + 1.115 (Pr) + 0.031 $(CF)^2$ - 0.133 $(EE)^2$ + 0.036 (CF) (NFE) + 0.207 (EE) (NFE) + 0.100 (EE) (Pr) - 0.022 $(EE)^2$ (Pr)
	2	* % TDN = -54.572 + 6.769 (CF) - 51.083 (EE) + 1.851 (NFE) - 0.334 (Pr) - 0.049 $(CF)^2$ + 3.384 $(EE)^2$ - 0.086 (CF) (NFE) + 0.0687 (EE) (NFE) + 0.942 (EE) (Pr) - 0.112 $(EE)^2$ (Pr)
	3	* % TDN = -72.943 + 4.675 (CF) - 1.280 (EE) + 1.611 (NFE) + 0.497 (Pr) -0.044 $(CF)^2$ - 0.760 $(EE)^2$ - 0.039 (CF) (NFE) + 0.087 (EE) (NFE) - 0.152 (EE) (Pr) + 0.074 $(EE)^2$ (Pr)
	4	* % TDN = - 202.686 - 1.357 (CF) + 2.638 (EE) + 3.003 (NFE) + 2.347 (Pr) + 0.046 $(CF)^2$ + 0.647 $(EE)^2$ + 0.041 (CF) (NFE) - 0.081 (EE) (NFE) + 0.553 (EE) (Pr) - 0.046 (EE)2 (Pr)
	5	* % TDN = - 133.726 - 0.254 (CF) + 19.593 (EE) + 2.784 (NFE) + 2.315 (Pr) + 0.028 $(CF)^2$ - 0.341 $(EE)^2$ - 0.008 (CF) (NFE) - 0.215 (EE) (NFE) - 0.193 (EE) (Pr) + 0.004 $(EE)^2$ (Pr)
Horses	1	* % TDN = 52.476 + 0.189 (CF) + 3.010 (EE) - 0.723 (NFE) + 1.590 (Pr) - 0.013 $(CF)^2$ + 0.564 $(EE)^2$ + 0.006 (CF) (NFE) + 0.114 (EE) (NFE) - 0.302 (EE) (Pr) - 0.106 (EE)2 (Pr)
Sheep	1	* % TDN = 37.937 - 1.018 (CF) - 4.886 (EE) + 0.173 (NFE) + 1.042 (Pr) + 0.015 $(CF)^2$ - 0.058 $(EE)^2$ + 0.008 (CF) (NFE) + 0.119 (EE) (NFE) + 0.038 (EE) (Pr) + 0.003 $(EE)^2$ (Pr)
	2	* % TDN = - 26.685 + 1.334 (CF) + 6.598 (EE) + 1.423 (NFE) + 0.967 (Pr) - 0.002 $(CF)^2$ - 0.670 $(EE)^2$ - 0.024 (CF) (NFE) - 0.055 (EE) (NFE) - 0.146 (EE) (Pr) + 0.039 (EE)2 (Pr)
	3	* % TDN = - 17.950 - 1.285 (CF) + 15.704 (EE) + 1.009 (NFE) + 2.371 (Pr) + 0.017 $(CF)^2$ - 1.023 (EE)2 + 0.012 (CF) (NFE) - 0.096 (EE) (NFE) - 0.550 (EE) (Pr) + 0.051 $(EE)^2$ (Pr)
	4	* % TDN = 22.822 - 1.440 (CF) - 2.875 (EE) + 0.655 (NFE) + 0.863 (Pr) + 0.020 $(CF)^2$ - 0.078 $(EE)^2$ + 0.018 (CF) (NFE) + 0.045 (EE) (NFE) - 0.085 (EE) (Pr) + 0.020 $(EE)^2$ (Pr)
	5	

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		* %. TDN = - 54.820 + 1.951 (CF) + 0.601 (EE) + 1.602 (BFE) + 1.324 (Pr) - 0.027 (CF)2 + 0.032 (EE)2 - 0.021 (CF) (NFE) - 0.018 (EE) (NFE) + 0.035 (EE) (Pr) - 0.0008 (EE)2 (Pr)
Swine	4	* % TDN = 8.792 - 4.464 (CF) + 4.243 (EE) + 0.866 (BFE) + 0.338 (Pr) + 0.0005 (CF)2 + 0.122 (EE)2 + 0.063 (CF) (NFE) - 0.073 (EE) (NFE) + 0.182 (EE) (Pr) - 0.011 (EE)2 (Pr)

1/ In the equation CF = Crude fibre; EE = ether extract; NFE = nitrogen free extract; Pr = Protein; taken from Harris et al. (1972)

The mode of correction and the correcting factors which have to be used vary also from one feed group to another. The mode of correction can be either the use of a crude fibre correction factor or the use of a value number. Further details of this system are available from INFIC Centres.

Digestible Protein

Digestible protein is calculated for each kind of animal by the usual formula:

$$\text{digestible protein} = \frac{\%\text{protein} \times \text{protein digestion coefficient}}{100}$$

Amino Acids and Fatty Acids

If amino acids are reported on a protein basis (g/16g N) they are converted to percent amino acid in dry matter of feed. If fatty acids are reported on a fat basis (g fatty acids/ 100 g fat) or fatty acid basis (g fatty acids/100 g fatty acids) they are converted to a percent fatty acid in dry matter. If it is desired to report amino acids or fatty acids on a ratio basis this information is calculated on the computer as follows:

$$\text{Amino acid(g/1g N)} = \frac{\%\text{amino acid in dry matter}}{\text{protein\% of dry matter}} \times 100$$

$$\text{Fatty acid(g fatty acid/100 g fat)} = \frac{\%\text{fatty acid in dry matter}}{\text{fat\% of dry matter}} \times 100$$

$$\text{Fatty acid(g fatty acid/100 g fatty acid)} = \frac{\%\text{fatty acid in dry matter}}{\text{fatty acid\% of dry matter}} \times 100$$

Vitamin A Standards: The international standard for vitamin A activity as related to vitamin A and beta-carotene are as follows:

One International Unit (IU) of vitamin A = the vitamin A activity of 0.300 microgramme of crystalline vitamin A alcohol (retinol) which corresponds to 0.344 microgramme of vitamin A acetate or 0.550 microgramme of vitamin A palmitate.

Beta-carotene is the standard for provitamin A. One IU of vitamin A = 0.6 microgramme of beta-carotene.

One microgramme of beta-carotene = 1.667 IU of vitamin A.

International standards for vitamin A are based on the utilisation of vitamin A and beta-carotene by the rat. Because the various species do not convert carotene to vitamin A in the same ratio as rats, it is suggested that the conversion rates.

Table: *Equations Used to Estimate Digestible Protein (Y) from Protein (X) for Five Animal Kinds and Four Feed Classes* [1/]

Animal Kind	*Feed Class*	*Regression Equation*
Cattle	1	Y = 0.866 X - 3.06

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Cattle	2	Y = 0.850 X - 2.11
Cattle	3	Y = 0.908 X - 3.77
Cattle	4	Y = 0.918 X - 3.98
Goats	1 & 2	Y = 0.933 X - 3.44
Goats	3	Y = 0.908 X - 3.77
Goats	4	Y = 0.916 X - 2.76
Horses	1 & 2	Y = 0.849 X - 2.47
Horses	3	Y = 0.908 X - 3.77
Horses	4	Y = 0.916 X - 2.76
Rabbits	1 & 2	Y = 0.772 X - 1.33
Sheep	1	Y = 0.897 X - 3.43
Sheep	2	Y = 0.932 X - 3.01
Sheep	3	Y =0.908 X - 3.77
Sheep	4	Y = 0.916 X - 2.76

[1/] Knight, et al. (1966)

Table: *Conversion of Beta-Carotene to Vitamin A for Different Species* [1/]

Species	***Conversion of mg of Beta-Carotene to ID Vitamin A***	***IU of Vitamin A Activity (Calculated from carotene), %***
	mg IU	
Standard	1 = 1,667	100.0
Beef cattle	1 = 400	24.0
Dairy cattle	1 = 400	24.0
Sheep	1 = 400-500	24.0-30.0
Swine	1 = 500	30.0
Horses	growth	1 = 555 33.3
	pregnancy	1 = 333 20.0
Poultry	1 = 1,667	100.0
Dogs	1 = 833	50.0
Rats	1 = 1,667	100.0
Foxes	1 = 278	16.7
Cat	Carotene not utilised	-
Mink	Carotene not utilised	-
Man	1 = 556	33.3

[1/] Beeson (1965)

Energy Feeds

According to the notation in the outline classification, energy feeds are low-protein concentrates. The upper limit for protein is conveniently set at 20 percent, because this includes wheat bran which is otherwise difficult to classify. However, it is the entire seed of the cereals that is the typical energy feed./ If an average is taken of the protein, fat, fibre, TDN, Ca and P for the six common grains (barley, corn, milo, oats, rye and wheat), a

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workable chemical description of an energy feed in terms of those nutrients and proximate principles most useful in determining its proper place in a livestock ration will result.

Chemical Characteristics

Protein: In practice, one will not go far astray by assuming energy feed protein to be 75 percent digestible. The quality of the protein of energy feeds is uniformly low as measured by any scheme that rates biological value numerically. All feeds of this group show lysine as their first limiting amino acid, which is of importance in the choice of a protein supplement to be used in a balanced ration. It also explains why substitution between energy feeds is not likely to alter appreciably the protein quality of the mixture.

Ash

Energy feeds are low in calcium. In practice, they are often neglected in making calculations for calcium supplementation. The content of phosphorus, on the other hand, is enough that some classes of pigs, and sometimes cattle and sheep also, need no special supplements, but this will depend on the kind and amount of roughage also fed to the herbivorous species.

Carbohydrates

About two thirds of the weight of the seed is likely to be starch, which will usually be about 95 percent digested. Not only is this high concentration of easily digested carbohydrate the distinguishing feature of energy feeds, but variation in this characteristic determines the consequences of substituting among feeds of this category.

Fat

The cereal grains belonging to the energy feeds normally contain from 2 to 5 percent ether extract, but a few by-product feedstuffs contain up to 13 percent fat, as does rice feed, the mill-run by-products of the manufacture of polished rice. Oat groats contain 7 or 8 percent fat, as does corn, hominy feed. The-fat of non-oily seeds is concentrated in the germ, and any processing that removed an appreciable proportion of the protein or carbohydrate, but not of the germ will leave a byproduct with higher fat content than the parent seed. A knowledge of the processing involved in the production of a by-product feed is often helpful in understanding the composition of the product. The official definition of feeds may partially define the processing of byproducts, as will the international feed names.

The production of starch, on the other hand, involves a wet-milling process. The corn grain, after being softened with warm water and slightly acidified, is partly macerated and then allowed to soak in water in large tanks. The germ, because of its oil content, floats to the top, where it is removed, defatted, and dried into corn germ meal. The residue from the germ separation is reground and sifted to remove the hulls, bran tip cap, and other fibrous material. The gluten and starch are removed from the remaining mass in suspension and later separated centrifugally. The coarse residue made up of hulls, bran, etc.

Crude fibre

The average crude fibre of the energy feeds is about 6 percent but individual feeds vary considerably. The upper limit for concentrates is taken as 18 percent, partly because in Canada - by legal definition - feeds with over 18 percent fibre must be registered as roughages. In particular, the coarse grain (barley and oats) may show wide deviations in fibre from sample to sample, ordinarily because of either an increase in hull or a decrease in the starch filling of the groat. Differences in fibre affect markedly their available energy value

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and hence their relative feeding value. The most important consequence of substitution between energy feeds is usually traceable to differences in the crude fibre of the products. Fibres of different origin are often quite different nutritionally.

Table: *Digestibility of Crude Fibre*

Common Name	*Crude Fibre from; International Feed Name*	*Class*	*Coefficient of Digestibility (%)*
Wheat	Wheat, grain	4	33
Wheat bran	Wheat, bran, dry milled	4	36
Wheat shorts	Wheat, flour by-product, 7 fibre	4	60
Oats	Oats, grain	4	32
Rolled oats	Oats, cereal by-product, ground more than 2 fibre	4	80
Oat clippings	Oats, grain, clippings	1	58
Oat hulls	Oats, hulls	1	40

Common Name	*Crude Fibre from; International Feed Name*	*Class*	*Coefficient of Digestibility (%)*
Barley	Barley, grain	4	45
Barley feed	Barley, pearl by-product, ground	4	18
Brewer's grain	Grains, brewer's grain, dehy	5	49
Malt sprouts	Barley, malt sprouts, with hulls, dehy, more than 24 protein	5	83
Flaxseed	Flax, seeds	5	84
Linseed oilmeal o.p.	Flax, seed, mech extd ground	5	50
Linseed oilmeal solvent	Flax, seed, solv extd ground	5	43
Soybeans	Soybean, seeds	5	37
Soybean oilmeal	Soybean, seeds, solv extd toasted ground	5	68
Corn	Corn, grain	4	30
Corn bran	Corn, bran	4	63
Corn gluten feed	Corn, gluten with bran, wet milled dehy	5	78
Corn oilmeal	Corn, germ, dry milled, solv extd dehy	5	82
Corn distillers' grains	Corn, distillers grains, dehy	5	64

[1/] International feed names have been included to illustrate how much more information about a feed they give

It seems probable that processing which! involves soaking improves the digestibility of the fibre. The digestibility of the fibre of corn grain is 57 percent, but that of corn bran, corn gluten feed, corn oil meal, and corn distillers' grains ranges from 72 to 92 percent, with an average of 80 percent. Solvent extraction also appears to have improved the digestibility of the fibre of flaxseed and of soybeans.

These data are from ruminant digestion trials and may be too high for omnivora. Regardless of species of animal, any part of the apparent utilisation of the fibre of these feeds, not due to chemical error, must be due to attack by digestive system microflora. One might argue that the unprocessed fibre of seeds, which in its natural state is an outer protective coating of the seed, is relatively resistant to bacterial attack. This resistance may

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be due to lignification, or to waxy, horny, or other weather-resistant coatings. In the milling or wet processing of such seeds, some of these coatings may be partially disintegrated or dissolved, thus exposing the cellulose to easy attack by microorganisms of the digestive system. 'Digested' crude fibre, of course, yields as much energy to the animal as digested starch.

Thus, although we may not be able to predict the reaction of the animals to a change in the source of crude fibre in a ration, we can usually trace the important changes in the feeding value of a ration that are caused by energy feed substitution, directly or indirectly, to the crude fibre. It is also generally true that amount of fibre and of available energy of energy feeds of feed mixtures are negatively correlated. Thus, raising the percentage of fibre means greater bulkiness and lower available energy, which in turn demand larger amounts of feed. In other words, high-fibre feeds are relatively less efficient sources of productive energy.

Non-chemical Characteristics of Energy Feeds

Bulk

In a general consideration of characteristics of energy feeds as a group, there are some non-chemical characteristics we should mention. The first one in order of importance is probably bulkiness. A bulky feed is relatively low in its yield of biologically available energy. We can usually assume safely that among energy feeds DE or TDN is positively correlated with bulk density. The reason for this relationship is ordinarily traceable to the percentage of fibre in the feed, because of the four potential energy-yielding fractions, crude fibre is likely to be the least digestible. We get an idea of the situation from examining a few typical energy feeds, for two reasons. First for weight per unit volume of ground energy feeds are subject to considerable error, because of the difficulty in controlling the degree of packing of the feed when filling the measure; and second, values for the TDN of specific feeds are determined directly or indirectly.

Table: *Relationship of TDN, Bulk Density, and Percent of Fibre in Some Ground Energy Feeds*

Feed	*TDN (swine)*	*Bulk Density (g/litre)*	*Percent of Fibre*
Wheat, grain	80	810	4
Rye, grain	75	750	2
Barley, grain	70	560	6
Oats, grain	65	355	10
Wheat, standard middlings	64	385	7
Wheat, bran	57	255	9
Oat, mill feed	23	150	27

The significance of these relationships lies in the consequences of substitutions between energy feeds in a meal mixture formulation. Obviously the use in a meal mixture of a bulky feed in exchange for a heavier one will mean a lowering of the TDN of the mixture; consequently, more of the new mixture will be needed to meet the total energy needs of an animal. Put into other terms, bulky feeds are less efficient when we measure efficiency as feed required per unit of gain for an animal or for its production.

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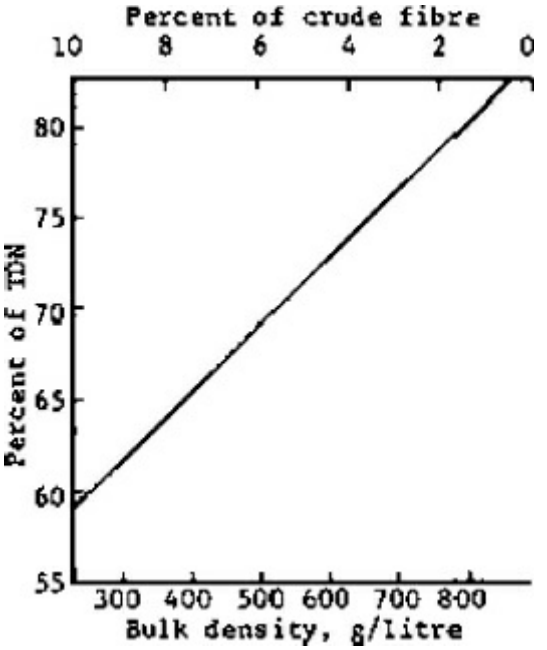

Figure: *Relationship of TDN of swine feeds to weight per unit volume and to percent of crude fibre, × = intercept of TDN and percent of crude fibre of a feed; o = intercept of TDN and pounds per quart of the same feed. Regression fitted by inspection.*

Simple restriction of total feed allowance has undesirable effects on animals' behaviour. They are continuously hungry and hence restless and perhaps irritable. If they are in groups, feed restriction leads to fighting for food and to the uneven distribution of the limited supply between the more and less aggressive individuals.

The stockman's way of solving this management problem is often to feed a light, bulky feed in quantities sufficient to satisfy appetite, but at the same time to restrict the intake of TDN as desired.

Thus, wheat bran, alfalfa meal, oat feed, etc., are sometimes deliberately incorporated in a mixture because of their low available energy.

Such rations can be self-fed without the undesirable consequences of heavy intakes of more concentrated rations. The more serious situation is where cost of feed versus cost of TDN is involved. Ordinarily, bulky feeds cost less per ton than dense feeds. If the price is in proper relation to the TDN it may matter little which feed is used.

The increased quantity of feed needed to supply the available energy will be balanced by its lower cost per pound. Unfortunately, feeders may not have the data necessary to determine the equivalent values. The problem of bulkiness of feeds arises again in the feeding of very young animals, which, because of limited gastric capacity, cannot consume enough of a bulky feed to meet their energy needs for the rate of growth desired. High fat in a man-made ration, however, is often a liability because of its unstable nature.

Experiments with puppies weaned at two weeks, guinea pigs at two days, pigs at ten days, and calves at two weeks, all show that self-fed, dry, low-fat rations can permit as rapid gains in body weight and be nutritionally as satisfactory as liquid milk in all other ways. When such rations are fed as a water gruel, the progress of the young is less satisfactory, unless enough fat is incorporated to maintain, in spite of the water dilution, the energy level at that of the dry meal.

Corn (Maize)

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Of the energy feeds of the low-fibre group, corn is the key feed in livestock rations. It is the lowest in crude protein and highest in available energy. Under favourable conditions of growth, a hectare in corn will produce about twice as much TDN, or useful energy, as in any other cereal grain.

This high production is an economic consideration and makes it clear why corn is so important a crop in areas having climatic conditions favourable for its growth.

Table: *Relative Values of Energy Feeds as Carbohydrate Concentrates*

Grain	*Percent of Protein (Morrison)*	*Percent of Net Energy (Morrison)*	*Total Feed Value (Kellner)*
Corn (maize), grain	74	100	100
Barley, grain	91	86	98
Kafir, grain	92	93	-
Milo, grain	87	93	-
Oats, grain	92	88	95
Rye, grain	74	86	97
Wheat, grain	100	97	95

The nutritional properties of corn cannot be dealt with so simply. Corn, like all other grains, is subject to variation in make-up because of varietal differences and the specific conditions under which it is grown and harvested. The make-up of corn may be more meaningful if we look at them in relation to the recommended proportions of nutrients in a meal mixture for market pigs. Of course, the comparisons must be general, because rations for other classes of stock will differ from those for a market pig. Corn is introduced into a balanced ration, it will lower the protein, calcium, phosphorus, manganese, and niacin. It is generally recognised that the quality of protein in corn will not meet non-herbivore needs. When corn is used for cattle or sheep feeding the calcium and sometimes the phosphorus may be adequately provided by the roughage, and the quality of protein is, of course, not an important factor. But as a source of energy, regardless of how one chooses to measure it, corn stands at the top among the energy feeds.

For cattle feeding, perhaps other than for adult breeding stock, the feeding problem we meet most commonly is how to provide enough energy to permit growth, production or fattening. High energy may be a liability, for there are situations where the animal or the product may be subject to damage by rations of high energy. For market-hog feeding the high energy of corn will, under full or self-feeding, produce a carcass with more fat than is desired for so-called “lean” bacon.

The rashers from corn-fed carcasses are also likely to have a smaller “eye of lean” as has been shown in experiments at Macdonald College. This overfinish occurs merely because the more rapid gains in weight have brought the pigs to market weight at younger ages and hence with less muscle development that would be found on older pigs.

As we might expect from their nutrient make-up, wheat shows the same tendency as corn to fatten, while oats, which have five or six times as much crude fibre and about 20 percent less TDN (for swine) produces a bacon rasher with 40 percent more lean and 50 percent larger “pork chop” eye of lean.

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Figure: *Typical bacon rasher from between third and fourth lumbar vertebrae for differing diets. (Oat fed)*

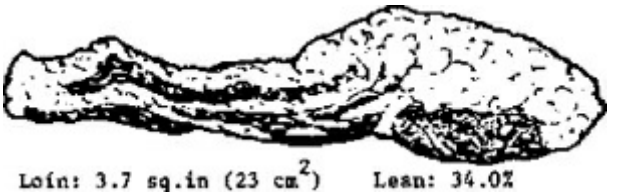

Figure: *Typical bacon rasher from between third and fourth lumbar vertebrae for differing diets. (Wheat fed)*

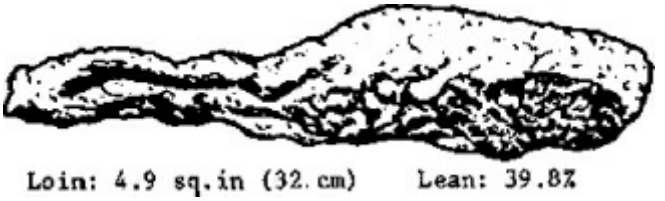

Figure: *Typical bacon rasher from between third and fourth lumbar vertebrae for differing diets. (Barley fed)*

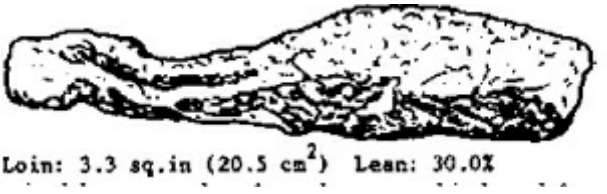

Figure: *Typical bacon rasher from between third and fourth lumbar vertebrae for differing diets. (Corn fed)*

Table: *Proximate Composition of Hull and Groat of Oats and Barley*

Feed	*Percent of Crude Protein*	*Percent of fat*	*Percent of Fibre*	*Percent of TDN (Ruminant)*
Oats				
-grain	12.6	5.2	8.9	67.0
-hull	2.7	1.1	30.3	33.0
-groat	15.9	5.9	1.9	92.0
Barley				
-grain	11.9	2.4	4.5	76.0
-hull	5.9	1.3	26.4	41.0
-groat	11.6	2.0	2.4	78.0

Economically the variation in the protein percentage of corn may be highly important. In compounding batches of balanced rations, much more protein supplement may be needed with low-protein corn than with high-protein corn to prepare a mixture of some desired percentage of protein. Assume a ration is to be compounded with corn as the energy feed plus a mixed protein, and that a final mix of 15 percent protein is wanted. Two other characteristics of corn should be mentioned. The one concerns its fat (or ether extract) content, which is higher than the average of energy feeds. This is both an asset and a liability. There is little doubt that a part of the acceptability of corn to animals is traceable to its fat component, not on the physical nature of the ground grain.

Ground corn is not dusty and, unless ground to an abnormally fine module, does not become pasty with mastication. Although there is no direct proof that the high palatability of corn to all classes of stock is traceable to the fat, it is probably significant that in feeding studies at Macdonald College the addition of about 5 percent vegetable oil improved the

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acceptability of dry, low-fat diets for young pigs, puppies and guinea pigs. Without the oil the rations contained about 2 percent ether extract. That the oil did not improve the diets otherwise is evidenced by the fact that they were no more efficient per calorie in producing weight gains than the low-fat mixtures.

The high fat level, however, can be a distinct liability, since ground corn goes rancid easily. The effect may be slight, and may represent merely a superficial loss of palatability, or it may be extensive enough to result in heating or moulding with the attendant loss in nutritive value. In general, ground corn cannot be stored without risk of such damage. The other characteristic of corn is its moisture content. Samples of corn as harvested are likely to vary more in water content than those of any other grain. They may range from 8 percent water for fully mature corn to 35 percent for frosted immature grain. Ear corn containing over 25 percent water, and shelled corn containing more than about 15 percent, will not store without damage in the usual types of cribs or bins. Aside from the effect of moisture content on storage, the nutritive value of the grain will decline as it is "diluted" with more and more water.

Quality in Energy Feeds

Sample-to-sample variation in quality is a special problem with energy feeds. The important feeds of this group fall into two subgroups of crude fibre. Corn, wheat, and rye or a type of plant seed that is without an enveloping hull make up one group. Barley and oat kernels, on the other hand, after threshing, remain encased in their flowering glumes, and because of this attribute, they are referred to as coarse grains. Because of this division of energy feeds, it may be helpful in considering quality to discuss in some detail the characteristics that give various energy feeds their special nutritional properties or that require consideration in making substitutions in ration formulation.

The Coarse Grains

As we have already implied, it is the glume on the hull that accounts for the higher fibre of the so-called coarse grains, as is clearly shown and giving the pertinent data for barley and for oats.

The difficulty with these grains is that the proportions of groat to hulls are widely variable within the species, and are further modified by seasonal growing conditions. Not only do the seeds themselves vary but the crops as harvested may include, in addition to the grain intentionally planted, the seeds from an assortment of other plants of volunteer origin from a previous crop or from weed impurities in the planting grain. Corn (maize) and wheat are relatively free (or are easily freed) from such contaminants, but with barley and oats purity of sample is often a factor influencing feeding value.

Barley

Many of "the problems of nutritional quality in energy feeds are particularly well-illustrated by barley as it is grown, sold, and used in Canada. This grain may be grown for malting purposes or for feeding livestock. The Canadian scheme by which the producer is paid for barley delivered to elevators involves a grading according to the purity of the crop, its variety, and its soundness. Samples, which because of admixtures of seeds from grains other than barley, or because of frost or heating damage or poor filling of kernels, are not suitable for malting, are classed as feed barley.

There are three U.S. grades for feed barley. No. 1 feed barley is essentially pure barley,

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but because of frosting or for some other reason it is below the standard weight of 48 lb per measured bushel for malting barley. Barley is also found in this category because of variety and is not suitable for malting. (Some varieties of barley peel too easily and, consequently, are not wanted in malting grades.) Barley that is still lighter in weight per bushel and that may also contain up to 10 percent other material is classed as no. 2 feed. The no. 3 feed grade has no minimum weight per bushel and, furthermore, need only be 80 percent in purity.

Table: *Partial Description of Feed Grades of Western Canadian Barley*

Grade name	*Minimum lb per bushel*	*Maximum tolerance of foreign material*			
		Percent of weed seeds (to large to pass 4/64 screen)	*Percent of wild oats*	*Percent of other grains*	*Percent of total foreign material not to exceed*
No. 1 feed	46	1	4	4	4
No. 2 feed	43	2	10	10	10
No. 3 feed	-	3	20	20	20

The botanical make-up of the foreign material in barley as harvested (presuming pure barley was seeded) will depend largely on what crop was grown on the area the year immediately preceding and on the extent of the weed pollution. An extensive survey of the 1949 Western Canada barley crop deliveries to county elevators yielded the purity and chief grain diluents.

Table: *Botanical Make-up of Barley as Harvested*

Percent of oats	*Percent of Wheat*					
	0	*5*	*11*	*15*	*20*	*25*
0	52	11	2	0.5	0.5	0.5
5	12	4	2		0.5	
10	8	2	1			
15	1	1	0.5			
20	0.5					
25	0.5					

Table indicates that a little more than half the individual crops as harvested were essentially pure barley, and balance of the crops on the whole would be similar in feeding characteristics to mixtures containing 80 percent barley. Similar surveys in subsequent years revealed the same distribution of the “barleys as harvested”. All commercial Canadian feed barley contains approximately the maximum tolerance of nonbarley. This is accomplished by blending at terminal elevators, sometimes with wild oats and coarse grains removed from wheat. To describe the feeding value of barley as this crop actually appears in commercial channels in Canada is, consequently, not a simple matter. To be realistic we must consider under the name barley at least four products:

(1) Pure barley (including No. 1 feed grade).

(2) Barley containing 9 percent of an unspecified combination of oats, wild oats, wheat, or flax plus 1 percent coarse weed (no, 2 feed grade).

(3) Barley containing 17 percent of an unspecified combination of oats, wild oats, wheat, or flax plus about 3 percent coarse weed seeds (no. 3 feed grade).

(4) Barley as harvested on the farm.

There is a further complication, in that the proportion of oats vs. wheat within tolerance

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of “other grains” may appreciably affect the feeding value of the barley, oats tending to reduce and wheat to increase the available energy of the final mixture.

The Canadian grading scheme is of interest here only because it brings out clearly the difficulties of describing with any simple index the feeding value of a particular sample of a coarse grain. The variability in the purity of the barley is itself an important factor, and one that neither the name nor the usual chemical analysis defines. In addition, its protein may run from 9 to about 16 percent, its crude fibre from 2.5 to 8.5 percent, its weight per bushel from less than 40 to over 50 lb, and its TDN from 62 to 81 percent. With this range of variability, both botanical and chemical, it is not surprising that the performance of animals fed on rations composed chiefly of barley may not always be according to book specifications.

All barleys are, nevertheless, energy feeds and as such are used in livestock rations primarily as sources of energy. As measured by the nutritional needs of animals, all barleys are deficient in salt, calcium, phosphorus, iron, iodine, and cobalt, and in vitamins A and D. Except for herbivorous animals, barley also requires supplementation with protein if it contains less than about 12 percent protein, and in all cases to improve its quality by increasing particularly the lysine content.

There is no evidence that, once animals are accustomed to it, pure barley is less acceptable than any other entire cereal grain. Contamination with weed seeds will adversely affect its palatability, and use of such samples may explain the lower opinion some feeders have of barley than is justified by results with clean samples. Barley is frequently planted on wheat land that has become fouled with weeds, and among wheat raisers it is referred to as a cleaning crop. Thus, more weed seeds. Barley meal made from such tow-grade grain may be unpalatable, but this should not be changed to a characteristic of the barley itself.

Nutritionally the limit of its inclusion in specific livestock rations is set only by the quantities of other products that must be included to make good the nutritional deficiencies of the barley, except that for very young animals it may be desirable in some way to reduce the hull of the ration either by coarse grinding and sifting or by dilution with low-fibre feeds. In practice, there are at least two uses to which barley is often put where the kind of other grain diluent may be of significance. When market pigs intended for lean bacon are finished on barley diluted with wheat, they tend to produce overfat carcasses. On the other hand, dilution of barley with oats tends to reduce the percentage of available energy and, consequently, tends to produce less fatterning. Similarly, non-producing stock being carried on maintenance rations can advantageously use the barleys of lower weight per bushel, such as oat or wild oat and light barley combinations.

Finally, it may be in order to call attention to the black sheep of the barley family - a product officially designated as barley feed. It consists of the mill-run residue from the production of pot and pearl barleys. The residue is barley hull plus the outer layers of the kernel that are polished off the dehulled grain to get rid of the bran and embryo portions. This product is of low feed value, having at best only two-thirds the digestible nutrients of typical barley. This is mentioned because it is sometimes illegally incorporated into barley-containing meal mixtures. Its presence will lower the efficiency of the feed containing it, both by reducing the acceptability of the ration to the stock and by reducing available energy.

Oats

What has been said concerning the variability of barley as harvested applies, in general,

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to oats as energy feed, the chief difference being that whereas barley normally contains about 6 percent crude fibre, oats contains 10 or 11 percent. Oats, in other words, has a lower energy value than barley. Variation between samples is fully as great as with barley, and the consequences of the differences in weight per bushel follow the same pattern as those described for barley. The botanical make-up of "as harvested" Canadian oats is shown.

Table: *Botanical Make-up of "Oats" as Harvested*

Percent of wild oats and chaff		*Percent of wheat and barley*			
		Wheat: 0		*Wheat: 5*	
		Barley: 0	*Barley: 5*	*Barley: 0*	*Barley: 5*
Wild oats: 0	chaff: 0	45[a]	5	7	2
	chaff: 5	9	2	2	
Wild oats: 5	chaff: 0	11	1	3	
	chaff: 5	3			
Wild oats: 10	chaff: 0	2			
	chaff: 5				

[a] read as "45% of crop contained 0% wild oats, 07, wild oats, 0% chaff, 07, wheat, and 0% barley"

There is no experimental evidence to support the contention put forward by some feeders that oats has any special nutritional virtue for any particular class of stock. It is true that the hull of the oat is somewhat softer and perhaps less irritating in the digestive tract then the hull of barley. Barley groats, oat groats, wheat, polished rice, and corn all are rich sources of available energy and have about equivalent feeding value in the ration. The chief differences in these grains as feeds are traceable to the proportions of the hull, more specifically, to the percentage of crude fibre.

Buckwheat

Perhaps the only other feed that requires special mention is buckwheat. First we should call attention to the problem of names of buckwheat products.

The offal of buckwheat milling consists primarily of black hulls and middlings, the latter made up of the seed coat, the adhering endosperm, and the embryo. The hulls, which represent almost 30 percent of the weight of the entire buckwheat, have little feeding value. The middlings are rich in protein and fat, which are derived chiefly from the aleurone layers and the embryo, tissues. So-called buckwheat feed is a mixture of hulls and middlings. The proximate composition of these three products as given by Winton.

The one particular feature that we should mention here is that products containing the hulls are likely to contain enough of a photoporphyrine to cause light sensitisation in white-skinned animals. When exposed to the sun a rash may develop of such severity as to adversely affect the performance of the animals.

Entire buckwheat is frequently incorporated into poultry scratch grain mixtures but is less often used for other classes of stock. Buckwheat middlings, however, is a common feedstuff in districts where buckwheat growing is a regular practice. The hulls, because of their woodly nature, are particularly indigestible and practically useless for feeding purposes.

Table: *Proximate Composition of Buckwheat By-products*

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	Water	*Protein*	*Fat*	*Fibre*	*N-free extract*	*Ash*
Entire seed	12.6	10.0	2.2	8.7	64.4	2.1
Hulls	6.5	7.8	1.4	33.6	47.1	3.6
Middlings	10.0	26.7	7.2	6.8	44.6	4.7
Flour	12.0	6.4	1.2	0.5	79.5	0.9
Feed	10.0	15.9	4.1	22.0	44.8	3.2

Wheat Bran and Other Wheat Milling By-products

Wheat bran has had a rather checkered career as a feedstuff. Originally discarded as a worthless offal from the milling of wheat for flour, it was suggested and eventually popularised as a livestock feed. Its light, bulky nature, its 16 percent high-quality protein (a chemical score equal to that of beef muscle), and its high phosphorus content give bran a unique place in livestock feeding. About 40 percent of the wheat germ is in the bran, which accounts for its high-quality protein. Included in the herbivore ration, it provides supplementary phosphorus to correct the common shortage in the forage, and its cellulose-hemicellulose carbohydrate is an acceptable source of energy for these animals. Its bulk is often advantageous as a means of lightening a predominantly corn ration.

The bulkiness of bran is of special usefulness in the preparation of non-fattening rations, as for the bacon hog, to whom bran yields less energy than to cattle. Thus its introduction-into the meal mixture of market pigs during the last two months of feeding before slaughter curtails the energy intake and the fattening of the pig, without restricting the feed. Canadian experiments and practical experience have demonstrated that hog-finishing rations diluted with 25 percent wheat bran by weight can be self-fed to market pigs without leading to the excessively fat carcasses which otherwise result from self-feeding practices.

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Chapter 9 : Animal Husbandry Development Programmes

The contribution of animal husbandry and dairying to total gross domestic product (GDP) was 5.9 per cent in 2000-2001 at current prices. The value of output of livestock and fisheries sectors was estimated to be Rs 1,70,205 crore during 2000-2001, which is 30.3 per cent of the total value of output of Rs 5,61,717 crore from the agricultural and allied sectors. The contribution of the milk group alone (Rs. 1,01,990 crore) was higher than wheat (Rs. 47,091 crore) and sugarcane (Rs. 27,647 crore). It is estimated (1993-94) that almost 18 million people are employed in the livestock sector in principal (9.8 million) or subsidiary (8.6 million) status. Women constitute about 70 per cent of the labour force in livestock farming. The overall growth rate in the livestock sector is steady (around 4.5 per cent) in spite of fact that investment in this sector is not substantial.

As the ownership of livestock is more evenly distributed with landless laborers and marginal farmers, the progress in this sector will result in a more balanced development of the rural economy.

Review of Ninth Plan

Cattle and Buffalo Development

The broad framework of the cattle and buffalo breeding policy being followed since the mid-sixties envisaged selective breeding of indigenous breeds in their breeding tracts and use of such improved breeds for upgrading of the nondescript stock. While the States accepted the framework, appropriate implementation through field level programmes could not be done. Lack of interest in promoting Breed Organisation/Societies and related farmers' bodies contributed to the gradual deterioration of indigenous breeds. Government intervention for breed improvement is not available to majority of owners of indigenous breeds of cattle. Eventually, the availability of good quality bulls needed for natural mating in breeding tracts became scarce, leading to further deterioration of indigenous breeds in these tracts.

Production of quality indigenous bulls has been a long-neglected area and would require a major thrust in order to harvest the best male germplasm available in the country. The present production capacity of frozen semen doses is about 30 million against the estimated requirement of 65 million doses annually. Except for a few pockets in important breeding tracts and in sperm stations, indigenous bulls of unknown pedigree and with poor quality semen are generally used. Crossbreeding, which was to be taken up in a restricted manner and in areas of low producing cattle, has now spread indiscriminately all over the country. Continuous emphasis on cross breeding with exotic breeds even in the tracts of indigenous breeds led to the near extinction of some of the known breeds. Further, the indiscriminate use of contaminated semen or infected bulls results in the spread of sexually transmitted diseases like Infectious Bovine Rhinotracheitis (IBR) at an alarming rate.

Milk Production

Milk production in India remained more or less stagnant from 1950 to 1970. Thereafter,

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it increased rapidly, reaching 84.6 million tonnes (mt) in 2001-02 (anticipated). But the Ninth Plan target of milk production (96.49 mt) was not achieved. The per capita availability of milk increased from 112 gm per day in 1973-74 to about 226 gm per day in Achievements in Livestock Sector India is currently the largest producer of milk (84.6 million tonnes during 2001-02) in the world.

India ranks 5th in Egg production (33.6 billion nos during 2001-02). Rinderpest, a dreadful disease of ruminants has been eradicated from the country 2001-02. However, it is still below the world average of 285 gm per day. Investment in the dairy sector in the Ninth Plan decreased significantly compared to the Eighth Plan. Out of 168 Milk Unions, 58 Milk Unions (34.5 per cent) were running in loss as of March 2000. So far, the Government policy in the dairy sector has been to give preference to the establishment of milk processing plants linking rural milk producers to urban consumers through a network of cooperatives. Restrictions on establishing new milk processing capacity under Milk and Milk Products Order (MMPO) has now been removed.

No policy measures have been undertaken so far to give a fillip to the unorganised sector involved in the production of Indian dairy products (like ghee, paneer, chhena, khoa etc.), which have tremendous potential in the export market in Asian and African countries.

Egg Production

The Indian poultry industry has come a long way – from a backyard activity to an organised, scientific and vibrant industry. It is estimated that the egg production in the country is about 33.6 billion numbers (2001-02) against the Ninth Plan target of 35 billion numbers. The most notable growth among the livestock products has been recorded in eggs and poultry meat. Since 1970-71, their output has grown at 5.87 per cent per annum. The significant achievement in poultry development has come from the initiatives taken up by the private sector for commercial pure-line breeding. However, despite the huge investment made, mostly by the private sector, the poultry-processing sector is incurring losses.

The status of the poultry sector as to; whether it falls under agriculture or industry, is somewhat ambiguous and, therefore, it has remained deprived of various benefits available to these sectors. Poultry farming should be declared as an agricultural activity. The poultry production model in vogue (high input-high output using commercially developed strain of birds) has been primarily responsible for the rapid growth in production of eggs and broiler meat in the country, but it is successful mainly in large-scale units (more than 1,000 units of birds). Due to high feed cost, non-availability of credit and marketing support, most of the small farmers have become contract farmers and are exploited by middlemen. Government intervention, by way of various support mechanisms, is now needed for the promotion of poultry in rural areas. Indigenous poultry breeds, including the improved strains that can survive with low quality raw feed and better resistance against diseases, can be reared under free range conditions by rural unemployed youth and women for some additional income and employment.

Meat Production

In India, meat production is largely a byproduct system of livestock production utilising spent animals at the end of their productive life. Meat production was estimated at 4.6 mt in 1998. Projects sanctioned during the Seventh and Eighth Plans for improvement/modernisation of abattoirs and carcass utilisation centres for fallen animals are

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still to be completed.

Goat Development

Despite the least attention from the planners, goat population in India has increased at the fastest rate among all major livestock species during last two decades. However, instead of increasing the goat population, emphasis should be laid on productivity per animal, organised marketing and prevention of emergence of new diseases like Peste des petits ruminants (PPR) which has led to higher mortality and abortion in goats. The goat improvement programme is to be given a push through extending credit to the poor landless farmers.

Sheep Production

During the last four decades, there has not been much increase in the sheep population. Production of wool has increased from 43.3 million kg in 1996-97 to 49.0 million kg (anticipated) in 2001-02. The Ninth Plan target of wood production (54.0 million kg) was not achieved. The fine wool production in the country is around 4 million kg against the demand of around 35 to 40 million kg. Indian wool is primarily used for the production of carpet, drugget, wall hangings etc. To enhance the quality and quantity of carpet wool, shepherds need incentives like credit, health coverage, breed improvement programmes and timely disposal of wool and surplus animals at a reasonable price.

Pig Development

Pig husbandry is the most important activity in the animal husbandry sector in the northeastern region inhabited by tribal people. The region also has a substantial pig population, which constitutes around 25 per cent of the country's pig population. The bulk of the population is, however, of the indigenous type whose growth and productivity is very low. The major difficulty in pig development is the acute shortage of breeding males.

Animal Health

Since the Second Plan, efforts have been made to control diseases namely, Rinderpest, Foot and Mouth Disease, Haemorrhagic Septicemia, Black Quarter and Anthrax. Although Rinderpest has been eradicated from the country, the prevalence of the other diseases continues to be one of the major problems in the animal production programme. Some of the emerging diseases like PPR, Bluetongue, Sheep Pox and Goat Pox, Classical Swine Fever, Contagious Bovine

Pleuropneumonia, New Castle Disease (Ranikhet Disease) are causing substantial economic losses. The programme for creation of diseasefree zones was sanctioned in the Ninth Plan but was not implemented. The Department of Animal

Husbandry and Dairying is also not well equipped with the necessary infrastructure and qualified technical manpower to execute the programmes and perform its mandatory duties and responsibilities like disease diagnosis and accreditation as per the international standards, development of an effective surveillance and monitoring system for diseases, mass immunisation against the most prevalent diseases etc. Dovetailing the Animal Research Institutes of the Indian Council of Agricultural Research (ICAR) with the Department would not only improve its efficiency but also provide it with an effective delivery machinery to carry out its regulatory and certification authority functions, including the conservation of endangered breeds of livestock. The suggestion for the establishment of an Indian Council for Veterinary and Fisheries (ICVFR) by carving out the animal science and fishery institutes from ICAR has not yet materialised.

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Animal Statistics

The Livestock Census Scheme suffers from quantitative as well as qualitative problems. The present arrangements for conducting the Livestock Census in the States and Union Territories are not satisfactory in relation to timely collection of data and reporting. The Integrated Sample Survey Scheme for estimation of production of major livestock products also needs improvement.

Conservation

The last few decades have witnessed serious erosion, and even extinction, of some indigenous animal breeds in the country. Many existing breeds are facing varying degrees of threat, endangerment and are heading towards eventual decimation. In all States, crossbreeding of cattle is now occupying a dominant position in the production programme and, in this process, the native cattle breeds, which are well adapted, have suffered wilful neglect resulting in their progressive elimination from the production system. India is bestowed with rich domestic animal biodiversity, having 30 breeds of cattle, 12 breeds of buffalo, 20 breeds of goats, 40 breeds of sheep, eight breeds of camel, six breeds of horses, three breeds of pig and 18 of poultry. Besides, there are other species like equine, mithun, yak, turkey, ducks, etc. Indigenous breeds/types are rich in variability and are endowed with many positive traits like superior disease resistance, better tolerance to high heat and humidity and other characteristics suitable to particular agro-climatic environments.

It has also been noted that indigenous breeds are more efficient in feed conversion particularly the crop residues and naturally available low quality roughages. Indigenous breeds at risk are:

Cattle : Red Sindhi, Sahiwal, Tharparkar, Punganur and Vechur.

Buffaloes : Nili-Ravi, Bhadawari and Toda.

Sheep : Nilgiri, Muzaffarnagri, Malpura, Chokla, Jaisalmeri, Munjal, Changthangi, Tibetan, Bonpala from Sikkim and Garrole sheep

Goat : Beetal, Jamunapari, Chegu, Changthangi, Surti and Jakhrana.

Camel : Bacterian, Jaisalmeri and Sindhi.

Poultry: All the 18 indigenous breeds of poultry are facing extinction. The three important breeds are Aseel, Kadaknath and Naked Neck, It has been globally recognised that conservation and improvement of native animal genetic resources are essential for sustainable development in agriculture and animal husbandry. The conservation and improvement programme should be decentralised and each State/adjoining States where a breed exists should take necessary steps with the active involvement of institutions, Gaushalas, Non-government Organisations (NGOs) and Breed Societies. The efforts should, however, be effectively coordinated centrally.

Given the severity of the resource constraint, all the Central sector and Centrally sponsored schemes were subjected to zero-based budgeting during the Ninth Plan. The objective was to retain only those schemes that are demonstrably efficient and essential. The schemes that are similar in nature would be converged to eliminate duplication and resource flow would be linked to performance. Out of 41 schemes, 23 schemes were weeded out, one scheme was transferred and six schemes were merged.

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Tenth Plan Focus and Straregy

Animal husbandry and dairying will receive high priority in the efforts for generating wealth and employment, increasing the availability of animal protein in the food basket and for generating exportable surpluses. The overall focus will be on four broad pillars viz. (i) removing policy distortions that is hindering the natural growth of livestock production; (ii) building participatory institutions of collective action for small-scale farmers that allow them to get vertically integrated with livestock processors and input suppliers; (iii) creating an environment in which farmers will increase investment in ways that will improve productivity in the livestock sector; and (iv) promoting effective regulatory institutions to deal with the threat of environmental and health crises stemming from livestock.

The Tenth Plan target for milk production is set at 108.4 mt envisaging an annual growth rate of 6.0 per cent. Egg and wool production targets are set at 43.4 billion numbers and 63.7 million kg respectively. The allocation for animal husbandry, dairying and fishery is Rs. 2500 crore during the Tenth plan. The scheme-wise break-up of the Tenth Plan outlay given in the Appendix. A transition from subsistent livestock farming to sustainable and viable livestock and poultry farming Technology support is imperative not only for enhancement of productivity but also reduction of per unit cost.

Transfer of Technology

Use of technological and marketing interventions in the production, processing and distribution of livestock products will be the central theme of any future programme for livestock development.

The generation and dissemination of appropriate technologies in the field of animal production as also health care to enhance production and productivity levels will be given greater attention. Integration of Animal Research Institutes with the Department of Animal Husbandry and Dairying is essential to facilitate transfer of technology as well as to undertake sanitary and phyto-sanitary measures. This would provide an effective delivery machinery to the Department enabling it to work primarily as a regulatory body in the liberalised era.

Human Resource Development and Extension

Sustainable rapid growth and development in this sector can only be ensured if the livestock owners, service providers, veterinarians and planners become knowledge based and acquire the ability to absorb, assimilate and adopt developments in the veterinary sciences and related technologies.

Efforts will be made to improve the skills and competence of all stakeholders by involving village schools, veterinary colleges and universities in collaboration with the ICAR and its institutions including Krishi Vigyan Kendras (KVK), State.

Agricultural Universities and their Field Stations

Steps will be taken to ensure that veterinary education is regulated as per the guidelines of the Veterinary Council of India. Introduction of animal science education (rearing of poultry, cattle, sheep, goat and pig) in the school curriculum will be one of the focus areas during the Tenth Plan.

Training of para-veterinarians, Artificial Insemination (AI) technicians, laboratory

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technicians on a regular basis will be given priority. Similarly livestock extension, which is primarily based on providing services and goods, will be treated differently from crop-related extension activities that are primarily based on transfer of knowledge. Livestock extension will be driven by technology transfer. As women play an important role in animal husbandry activities, deployment of women extension workers will be encouraged and they will work as links between farmers, the animal husbandry department and workers of NGOs.

Integration of Programmes

Besides the Ministry of Agriculture, schemes relating to animal husbandry and dairying are being implemented by other ministries viz. Ministry of Rural Development, Ministry of Nonconventional Energy Sources etc. Many schemes operated by these ministries have similar and overlapping objectives and target the same population. Generic components like extension, training, and infrastructure get repeated in most of such schemes and are not complementary. Efforts will be made to consolidate and bring in convergence in these areas.

Livestock Services

Most of the livestock services like artificial insemination/natural service, vaccination, deworming etc. are time-sensitive, which Government institutions, at times, are not able to deliver due to financial as well as bureaucratic constraints. This necessitates the providing for efficient and effective decentralised services in tune with demands emanating from users. Efforts will be made to provide such services at the farmer's door, linked with cost recovery for economic viability. Availability of credit in time and technology support are the two important services needed for livestock development in the rural areas.

Livestock Breeding Strategy

A national livestock breeding strategy needs to be evolved to meet the requirements of milk, meat, egg and other livestock products. Major thrust will be given to genetic upgradation of indigenous/native cattle and buffaloes using proven semen and high quality pedigreed bulls and by expanding the artificial insemination and natural service network to provide quality semen and other services at the farmer's level. Improved bulls for natural breeding will be made available to private breeders, Gaushalas, NGOs and panchayats in remote and hilly areas. The programme of providing exotic males for improvement of sheep in the northern temperate region and pigs in the northeastern region will continue in the Tenth Plan. Financial and technological support would be needed to promote breeding programmes.

Conservation of Breeds

Conservation of threatened breeds of livestock and improvement of breeds used for draught animals and packs would be one of the major goals of the Tenth Plan. It will be the national priority to maintain diversity of breeds and preserve those showing decline in numbers or facing extinction. The improvement programme of indigenous breeds possessing desirable characteristics like disease resistance, heat tolerance, efficient utilisation of low quality feed etc. will be taken up. This is essential even for a sustainable crossbreeding programme.

Steps will be taken to coordinate all the activities related to the efficient utilisation of draught animal power and animal by-products. Similarly efforts will be made to conserve indigenous birds and propagation of other birds like quail, guinea fowl and duck in those parts of the country where they are popular.

Milk Production

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The bacteriological quality of raw milk at the time of milking in India is comparable with that in the advanced dairying nations. Subsequently, however, the quality deteriorates due to improper handling of milk and lack of availability of infrastructure like all-weather roads, cooling facilities, potable water, regular electric supply and sewage disposal. A holistic approach will be taken to address the issue of clean milk production, which is imperative for marketing and promoting export of dairy products. Steps will also be taken for development of unorganised milk sector that controls a significant portion of the liquid milk and sweetmeat market.

Fodder Development

The importance of feed and fodder in livestock production hardly needs to be emphasised. Three major sources of fodder supply are crop residual, cultivated fodder and fodder from common property resources like forests, permanent pastures and grazing land. A significant portion of crop residue, particularly paddy and wheat straw, is being wasted. Emphasis will be given on enrichment of straw/stover, preparation of hay/silage to overcome fodder scarcities during the lean season, conversion of fodder into feed block to facilitate transport of fodder from surplus areas, establishment of fodder banks and promotion of chaff cutters.

The productivity as well as carrying capacity of public and forestland are decreasing due to improper management of common property resources and lack of coordination between the different agencies involved. For sustainable and economic livestock production, this problem will be addressed through scientific utilisation of traditional pastures and integration with the Watershed Development Programme, especially for silvi-pastoral development. For enhancement of grass production, measures will be taken to bring larger areas under joint forest management and treatment of wastelands and areas under problem soils. As the scope for increasing areas under cultivated fodder production is limited, efforts will be made to increase productivity through promotion of intensive fodder production technologies, quality fodder seed production by specialised agencies and use of wasteland for tree and bush based fodder production.

Animal Feed

Oil cakes, maize and cereal by-products are important ingredients of animal feeds. Coarse grains and cottonseed are traditionally used as cattle feed. Measures will be taken to fill up the deficit in the requirement of feeds in quantitative and qualitative terms.

At present, a very small portion of grains produced in the country is utilised for livestock and poultry feeding. Rain-fed and arid zones present enormous prospects for production of feed grains. Steps will be taken to develop specifications for many agro by-products like mango seed kernel, mahowa cake, neem cake, soya pulp, whey powder etc. so that these could be utilised for feeding livestock. Quality control of animal feed will be given importance in the Tenth Plan.

Animal Health

Enhanced and sustainable productivity through improved animal health will be one of the major strategies during the Tenth Plan. After the successful eradication of Rinderpest disease, the major thrust will now be to adopt a National Immunisation Programme against the most prevalent animal diseases. Animal disease diagnosis and accreditation as per the international standards, development of an effective surveillance and monitoring system for

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animal diseases, animal quarantine, certification and enforcement will be the major functions of the Department of Animal

Husbandry and Dairying and necessary schemes will be evolved during the Tenth Plan. Further, measures will be taken to ensure that firms producing veterinary biologicals like vaccine, diagnostic kits etc. are following Good Manufacturing Practices (GMP) and meeting Good Laboratory Practices (GLP) requirements.

Poultry Production

The present system of production of commercial hybrid broilers and layers has become highly successful. To give a boost to export of poultry products, measures will be undertaken for the development of infrastructure like cold storage, pressured air cargo capacity and reference laboratory for certification of health and products.

Programmes will be formulated to improve indigenous birds and promotion of backyard poultry farming which could help employment generation as well as economic empowerment of poor women in rural areas. There is tremendous scope for exporting poultry products produced from birds fed on organically produced feed.

Carcass Utilisation

Projects sanctioned during the Seventh and Eighth Plans for improvement/modernisation of abattoirs and carcass utilisation centres will be completed. Emphasis will be given on establishing/improving carcass utilisation centres for naturally fallen animals in rural areas.

Marketing

The development of a marketing network and remunerative price support to the producers are great incentives for higher animal productivity and these will be encouraged for all types of livestock products. Even the advanced countries are giving direct and indirect price support to livestock farmers. Priority attention should also be given to improve processing, marketing and transport facilities for livestock products and value addition thereon. External markets are an extremely important source of demand and these will be tapped much more aggressively. In order to encourage exports, licensing control for processing of livestock products/by-products will be repealed and restrictions on the export of livestock and its products will be removed. The immediate focus will be on export of animal and poultry products to Asian and African countries. The minimum requirements for sustainable export are creation of disease-free zones, organic farming and potable water. These will be made available in selected areas having large marketable surplus. India has a large number of animal markets where livestock are traded but these are not developed on scientific lines. Market facilities are generally inadequate and, if available, are poorly maintained. Development of organised markets with adequate facilities will, therefore, be taken up. The concept of organic farming can also be extended to animal products. Indian animals are reared in village pastureland and they are not generally treated with hormones, feed-antibiotics, or other drugs, so their products are healthy, wholesome and natural in every sense of the word.

In rural India, cow dung and biomass are primarily used as manure. Initiative for export of 'Grassfed' animal products will be taken. Necessary infrastructure for certification procedures related to organic animal farming will be promoted.

Quality and Safety of Livestock Products

Quality and safety of livestock products depend upon a quality and safety assurance

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system for which legislation for setting up standards, corresponding to Codex standards, is obligatory.

These do not exist nor is there any method for reviewing and rationalising the quality and safety guidelines. Efforts will also be made for harmonisation of infrastructure facilities for testing food quality and safety with international standards.

Database

Currently, there is absence of a lot of data like those relating to breed-wise milk production of cattle and buffalo, egg production from commercial farms and households, cost of production of milk, egg and wool, availability of livestock resources etc. A National Animal Health and Production Information System will be established with the active involvement of research Institutions, Government departments, panchayati raj institutions (PRIs), urban local bodies (ULBs), private industries, cooperatives and NGOs. This will work as the national database.

Animal Welfare

Animal welfare is also related directly with the productivity of animals. The well-being of animals is affected during management under the intensive production system, in the animal market, during handling and transportation, rearing of buffalo male calves in urban areas etc. There is a great deal of wastage, as well as animal suffering due to ill-designed agri-implements, carts and implements attached to animals. Efforts will be made to strengthen the institutions working on a livestock care system so that they can ensure and promote animal care and well-being. Research and technology development will be taken up for enhancing efficiency and reducing drudgery of animals by improving the design of carts, yokes, implements and toolbars used in agriculture. A good example is the buffalo-drawn bogey fitted with rubber tyre and bearings.

Development of Location Specific Animals

Camel will continue to be important in desert areas for quite some time. Effective support for providing nutrition and health cover is needed for its improvement. The Department of Animal Husbandry will continue its programme for improvement of better studs both for horses and donkeys used for transport in hilly areas. Horse riding is now becoming an integral part of amusement parks and this will be encouraged as a niche industry. To encourage the breeding of horses, mules and asses, technological and financial support will be extended to entrepreneurs. Animals indigenous to specific agro-climate regions like Yak and Mithun will be developed.

Capital Formation

Public sector lending in the livestock sector is low and inadequate credit support leads to poor capital formation. As the organised financial sector is unwilling to finance livestock programmes that are not in their interest, especially after the initiation of financial sector reforms, the livestock farmers are mainly dependent on the financial intermediaries and they end up bearing a higher interest rate than would be available otherwise. Attempts would be made to create a favourable economic environment for increasing capital formation and private investment. Financial institutions would actively participate in livestock credit programmes through standardised ready-made bankable projects with back-ended subsidy. Creation of a venture capital fund is needed to assist the private entrepreneur in establishing

units that could provide services and goods at the district/block level.

The Path Ahead

The programmes that will be emphasised during the Tenth Plan are:

1. The major thrust will be on genetic upgradation of indigenous/ native cattle and buffaloes using proven semen and high quality pedigreed bulls and by expanding artificial insemination and natural service network to provide services at the farmer's level. Production of progeny-tested bulls in collaboration with military dairy farms, government/institution farms and gaushalas will be taken up.
2. Conservation of livestock should be the national priority to maintain diversity of breeds and preserve those showing decline in numbers or facing extinction.
3. After the successful eradication of Rinderpest disease, the focus would now be to adopt a national immunisation programme to control prevalent animal diseases. Efforts will be made for the creation of disease-free zones.
4. Development of fodder through cultivation of fodder crops and fodder trees, regeneration of grazing lands and proper management of common property resources.
5. Improvements of small ruminants (sheep and goat) and pack animals (equine and camel) should be taken up in the regions where such animals are predominant.
6. Building infrastructure for animal husbandry extension network. Panchayats, cooperatives and NGOs should play a leading role in generating a dedicated band of service providers at the farmer's doorstep in their respective areas
7. Strengthening infrastructure and programmes for quality and clean milk production and processing for value addition.
8. Programmes would be implemented to improve indigenous birds and promotion of backyard poultry in rural areas.
9. An information network would be created based on animal production and health with the active involvement of Research Institutions, Government departments, private industries, cooperative, and NGOs.
10. Strengthening of veterinary colleges as per the norms of Veterinary Council of India. Strengthening of Department of Animal Husbandry and Dairying is also crucial if it has to work as a regulatory and monitoring authority.
11. A regular interaction between the Department of Animal Husbandry and Dairying and research institutes like the Indian Veterinary Research Institute, National Dairy Research Institute, Institutes on cattle, buffalo, sheep, goat, equine and camel.

Fisheries

The fisheries sector is one of the important sectors in the socio-economic development of the country. More than six million fishermen and fish farmers, a majority of whom live in 3937 coastal villages, besides fishermen hamlets along major river basins and reservoirs in the country, depend on fisheries and aquaculture for their livelihood. The sector has also been one of the major contributors to foreign exchange earnings through exports. India is the third largest fish producer in the world and second in inland fish production. The fisheries sector contributes Rs. 19,555 crores to national income which is 1.4 % of the total GDP.

The country is endowed with an Exclusive Economic Zone (EEZ) extending to 20.2 lakh sq. kms. with a continental shelf area of about 5.2 lakh sq. kms. having about 8118 kms.

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coastal length with some of the richest fishing grounds in the world.

The estimated potential for fish production from inland water bodies is about 4.5 million tonnes(mt). The main inland fishery resources include about 1.20 million hectares (m ha.) of brackish water area, about 23.81 lakh ha. of fresh water ponds & tanks, about 7.98 lakh ha. lakes and about 20.31 lakh ha. of reservoirs, besides about 1,91,000 kms of rivers and canals. During the last five decades, fish production has increased with an annual growth rate of 4.1 percent. Fish production touched 5.67 mt in 1999-2000 and is estimated to be about 5.66 mt in 2000-01. It is likely to reach a level of 6.12 mt by the end of the Ninth Plan, which is much below the target of 7.04 mt. This is because of slow progress in the fish production to the extent of 1.44 percent per annum [marine : (-) 1.32 percent and inland :4.87 percent] during the first four years of the Ninth

Plan. At present, resource-wise (reservoirs/rivers/ponds/tanks etc.) data on fish production and productivity are not available in the country. In the absence of any major initiative for strengthening of infrastructure, fish seed production remained almost static (16,000 million fry per annum) during the first four years of the Ninth Plan.

Inland Fish Production: The share of inland fishery sector in fish production, which was 29 percent in 1950-51 (0.22 mt), has increased to about 50 percent in 1999-2000 (2.84 mt). In spite of this, the present level of fish production in the country is about 67 percent of the estimated potential of 8.4 mt. There is enormous scope both for augmentation of production potential as well as enhancement of productivity in the inland fishery sector. The 429 Fish Farmers Development Agencies (FFDAs) have covered about 5.67 lakh ha. (inclusive of 1.70 lakh ha. in Ninth Plan) of the total water area under scientific fish culture and trained 6.51 lakh fish farmers (1.11 lakh in Ninth Plan). But the average productivity from waters covered under this programme remained almost static at about 2.2 tonnes/ ha./year during the Ninth Plan period. States like Andhra Pradesh, Punjab and West Bengal have shown better response and faster development. The highest productivity of about 5 tonnes/ha/annum from FFDA ponds/tanks has been achieved in Punjab. About 6240 ha. Was brought under brackish water aquaculture activities during the Ninth Plan through 39 Brackish Water Fish Farmers Development Agencies (BFDAs). The performance of the programme has also been affected due to litigation.

Marine Fish Production: Marine capture fisheries play a vital role in India's economy. The sector provides employment and income to nearly two million people. Marine fish production level has risen from 0.53 mt in 1950-51 to 2.81 mt in 2000-01 with a growth rate of 3.43 per cent. Most of the major commercially exploited stocks are showing signs of over exploitation. Problems of juvenile finfish mortality and bycatch discards increased with the intensification of shrimp trawling. Plateauing of catches and over-fishing at several centres and inter sectoral conflicts in the coastal belts have highlighted the need for caution. Proper management of coastal fishery resources with suitable enforcement mechanisms like uniform ban on fishing during monsoon which is considered the breeding season for majority of commercial species, regulation on craft and gears etc. are the priority issues in the sector to allow for its rational exploitation.

The development of the deep-sea fishery industry is of concern to the entire marine fishery sector because it would have considerable impact on the management of near-shore fisheries, shore-based infrastructure utilisation and post-harvest activities both for the

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domestic market and exports. With the growing demand for sea food, it becomes imperative that the current level of marine fish production from the exploited zone to be sustained by closely monitoring the landing and the fishing effort and by strictly implementing the scientific management measures.

Infrastructure: The existing fishing harbours and infrastructures need to be modernised to meet minimum international standards necessary for fish quality assurance. Under the Fisheries Extension & Training Programme 28 training centres and 15 awareness centres have been established for the benefit of fishermen and fish farmers during the Ninth Plan. Research projects in the area of aquaculture and marine biotechnology are supported to strengthen the gap in the areas of fish health and disease diagnostics, transgenic aspects, cell and tissue culture, intensive prawn culture, carp-culture, feed and seed production, bio-active compounds and development of culture technology in non-conventional species etc. by the Department of Biotechnology during the Ninth Plan.

Development of Fisheries: The major thrust during the Tenth Plan will be on integrated development of riverine fisheries, habitat restoration and fisheries development of upland waters, development of reservoir fisheries, management of coastal fisheries, deep-sea fisheries with equity participation, vertical and horizontal development of aquaculture productivity, infrastructure development and improved post-harvest management, policy intervention including monitoring, control and surveillance. The Tenth Plan has proposed a fish production target of 8.19 mt envisaging a growth rate of 5.44 percent per annum (marine 2.5 percent and inland 8.0 percent).

Development of Aquaculture: In the recent years, there has been a spurt in the growth of aquaculture in the country. The inland fisheries sector has registered an impressive growth rate of 6.55 percent per annum in the 1990s. However, in spite of the vast resources of culturable water bodies as well as availability of proven technology for aquaculture, the levels of production and productivity are not adequate and there is a large gap between the potential and actual yields.

Therefore, increase in productivity and production of fish/shrimps from freshwater and brackish water areas under ongoing programmes would continue during the Tenth Plan. The present production level of about 2.2 tonnes/ha./year from fish farming will be raised considerably by adopting existing advance technology. Programmes will be devised to develop fisheries in fallow derelict water bodies, waterlogged areas, saline waters, lakes, beels, etc. for enhancing fish production. Aquaculture activities will also be taken up for development of cold-water fisheries in the hill areas of the ecologically fragile zone. On the basis of experience of pilot projects taken up for fisheries development in reservoirs during the terminal year of the Ninth Plan, programme to enhance fish production will be formulated on a large scale during the Tenth Plan. An integrated approach to marine and inland fisheries, designed to rational exploitation and to promote sustainable aquaculture practices, will be adopted. Biotechnological applications in the field of genetics and breeding, hormonal application, immunology and disease control will receive particular attention for increased aquaculture production.

Seed and Feed Development : Seed and feed are critical inputs required for the development of fisheries and aquaculture for enhancing production and productivity. Research and development (R&D) programmes will be taken up for production of quality

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fish/shrimp seed and feed. The present level of fish seed production of 16,000 million fry will be raised to 25,000 million fry by the end of the Tenth Plan at an 8 percent growth rate per annum. Diseases-free and diseases-resistant fish/shrimp seed will be ensured with strict quarantine measures. Besides, adequate infrastructure will be required for increasing production and productivity of other commercially important fishes/prawn such as freshwater prawn, catfish, sea bass, grey mullet, grouper, snapper, chanos, etc. for diversifying fishing activities during the Tenth Plan. The Research Institutes under the ICAR like Central Institute of Fisheries Education (CIFE), Mumbai, Central Marine Fisheries Research Institute (CMFRI), Kochi, and Central Institute of Fresh Water Aquaculture (CIFA), Bhubaneswar, have developed technology for pearl culture, which needs to be taken up on a commercial basis through concerted efforts for further development during the ensuing Plan period.

Training of Fisher women: Traditionally, women have played an important role in the fishery sector, and they have a much larger role to play in the emerging scenario of fisheries and aquaculture development. One of the important ways to improve the status of fisher-women in a community is to train them to improve their participation in their own development. Programmes for human resource development with emphasis on training and skill development in post-harvest/processing and marketing activities particularly for fisher women besides other income generating revenues will be taken up. Emphasis will be laid on the development of marketing infrastructure and techniques of preservation/storage and transportation with a view to reducing post-harvest losses and ensuring a better return to the grower.

Strengthening of Database: Notwithstanding the existing efforts made by several agencies, the fisheries database is poor and needs considerable strengthening. In the inland sector, the priorities are standardization of methodologies for estimation of catch from the diverse aquatic resources and establishing mechanisms for regular collection and dissemination of data by States and Union Territories. In the marine sector, the existing methodologies need revision and also subsequent re-orientation of the Departments of Fisheries on collection and estimation of methodologies. To strengthen the efforts in this direction, the use of remote sensing and Geographical Information System (GIS) in estimation of resource size and productivity also needs to be integrated in the existing programmes of fisheries catch statistics.

Overexploitation of Coastal Resources: A major emphasis will be placed on positive and purposeful checks on over exploitation of resources in the near shore areas through appropriate regulations on the number of fishing vessels, their operational areas, ban on monsoon fishing/close season, mesh size, use of the right type of fishing gear and other such restrictions to prevent uneconomic and oversize fishing.

Exclusive Economic Zone: Exploitation of offshore resources in the EEZ will be considered in terms of both the resource available and the infrastructure. Along with the absolute right on the EEZ, India has also acquired the responsibility to conserve, develop and optimally exploit the marine living resources within this area. Efforts will be made to exploit fishery resources in the EEZ on a priority basis. Satellite-assisted Vessel Monitoring System (VMS) will be helpful in the EEZ for both Indian and foreign fishing vessels. This would ensure the safety of fishers and vessels, and also provide emergency help whenever required. This would also help in the collection of fishery-related technical data as well as determining the number of fishing vessels required in a particular area for exploiting the available fishery

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resources.

Formulation and introduction of a new deep sea fishing policy consistent with the national interest to exploit fishery resources in the EEZ should be given top priority. The present gap in the potential and current exploitation has several repercussions, the more important of which is leaving the EEZ opening to other neighbouring countries like Nepal, Bhutan etc. and owners of foreign fishing vessels which may take advantage of the situation. Besides, even land locked neighbouring countries like Bhutan, Nepal etc. may stake their claim legally unless we put our efforts together on under-exploited marine resources in the Indian EEZ.

Efforts are also needed to maintain World Trade Organisation (WTO) catch levels by rational exploitation of our resources and to counter measures taken by neighbouring countries like Pakistan in collaboration with USA which is resulting in the over-exploitation of resources in the adjoining areas and there by curtailing our rights in these areas. Besides it should also be ensured that suitable measures are taken to exploit resources beyond the EEZ so that we put our due stake in the international waters along with other countries.

Investment: Increasing public/private investment is needed for strengthening infrastructure for diversifying fisheries and aquaculture activities enhancing fish production and productivity. Enhanced public investment is also required in research programmes, strengthening infrastructures for training, post-harvest, marketing etc. Setting up of minor fishing harbours and creation of common facilities for maintenance and usage of dredgers by the Government should be given priority for improvement of infrastructure facilities in the marine fishery sector. Product development by value addition of low quality fish and development of products like chitosene out of wastes like prawn shells, products out of fish bladder etc. need to be encouraged. Private sector investment in fisheries will also be encouraged particularly in seed and feed production, adopting existing technologies for higher production, human resource development, post-harvest management and marketing.

For sustainable development of coastal areas, establishment of agro-aqua farms along coastal regions, linking ecological security with livelihood security would be encouraged by States/NGOs. Such farms involve concurrent attention to culture and capture fishery and forestry and agroforestry programmes. Besides, conservation of fisheries resources, these farms would also be used for demonstrations of diversifying activities of different techniques to be used for fishing operations. Emphasis would be given for technological upgradation of the traditional fishing sector with improved motorised crafts and gears for the development of coastal fisheries and for the introduction of new generation of fishing vessels, for development of off-shore fishing with modern communication equipments to ensure safety of fishermen while out at sea etc. Proper credit and technological support for standard bankable projects and ventures by small fishermen groups in the inland sector and setting up of cooperative marketing network in marine sector should be ensured through institutional finance from the National Bank for Agriculture and Rural Development (NABARD) and National Cooperative Development Corporation (NCDC).

New Initiatives

The new initiatives for development of fisheries during the Tenth Plan would be to increase production and productivity from deep seas, inland capture fishery resources like rivers, canals etc. and from culture sources like reservoirs, beels, ox-bow lakes, measures for

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replenishment of fishery resources through mariculture etc. Besides, development of infrastructural facilities for better post-harvest management, technology for sustainable aquaculture, setting up of cold storage and marketing network through viable fishermen cooperatives etc., are also proposed to be taken up to ensure better livelihood for fishers and enhance export promotion for economic development of the country.

The Path Ahead

The main thrust for fisheries development during the Tenth Plan would be to utilise the full potential of inland fishery resources as well as deep seas to increase per capita consumption to a substantial level from the present level of 9 kg. per head per annum. Special emphasis will be given on:

- Increasing the depth of fishing harbours especially for small fishermen using dredgers and the upgradation of hygienic conditions there.
- Strengthening of data base and information networking in the fisheries sector for standardisation of methodologies and estimation of catch from diverse aquatic resources.
- Aquaculture and development of capture fisheries of inland water resources.
- Measures will be taken to increase fish production from the deep sea marine sector.
- Infrastructure development, post harvest management for marketing by setting up of model fish markets and establishment of cold chain through viable fishermen cooperatives.
- Popularisation of pearls developed by CIFA, CMFRI etc. and value added products developed by the Central Institute of Fisheries Technology (CIFT), Kochi and Integrated Fisheries Project (IFP), Kochi made out of low value fish with suitable credit/subsidy support.
- Welfare measures for fishers will be strengthened to ensure their safety at sea etc. and also to involve more women in fisheries sector.
- Research & technology needs in fisheries institutes to be upgraded to meet the growing demands.

Formulation of a comprehensive deep sea fishing policy and passing of the Aquaculture Authority Bill in Parliament to be expedited for rational exploitation of deep sea fishery resources and sustainable aquaculture development.

- Strategy for an effective enforcement mechanism is needed to prevent poaching in the EEZ and thereby safeguard our resources.
- Suitable mariculture programmes need to be undertaken for commercially important fin/shell fish species for replenishment of resources in our seas.
- Setting up of disease control laboratories and quality certification centres to ensure international standards for fishery products.
- Technologically improved fishing boats with proper communication network etc. to be introduced for the benefit of small fishermen.

Extension Educational Systems

Today's Industry, its' Educational needs and how to Provide the Answers

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The poultry industry in the Midwest has undergone extensive consolidation and concentration in all segments within the past 10 to 15 years. The size of the industry has grown very rapidly, while the number of independent producers have been decreasing. To provide technical information for the rapidly changing industry, effective means of delivering this information is important. Also, as the poultry industry has expanded, the number of poultry extension personnel has decreased. Thus, the concept of regionalizing poultry extension programs becomes more and more important.

This idea necessitates interaction among poultry extension specialists in adjoining states to put together a meeting and bring in the best speakers to present information on various subjects to industry personnel. Providing the most current and accurate information to the clientele is of greatest importance.

Regionalizing extension programs in commodities other than poultry has been successful. A four-state dairy extension program involving the states of Illinois, Iowa, Wisconsin, and Minnesota has sponsored the Four-State Dairy Nutrition Conference for a number of years. In the poultry area, there is a New England poultry regionalization effort involving the states of Maine, Rhode Island, Connecticut, Massachusetts, New Hampshire, and Vermont.

This group has sponsored several programs for the poultry industry and one of them is called the New England Poultry Management Conference. In the Midwestern states, a regional poultry extension program has been conducting extension seminars and conferences for the past 15 years. These programs have provided commercial poultry producers in the states of Illinois, Indiana, Kentucky, Michigan, and Ohio with information to help them operate a successful poultry business. To our knowledge, there has not been any published articles concerning the specifics of these regional programs including how successful they have been. Therefore, the purpose of this paper is to describe the poultry regionalization programs conducted in the Midwest and present advantages and disadvantages of conducting poultry extension programs on a regional basis.

Characteristics of Five State Area

The poultry industry in the Midwest is dynamic and has been expanding. While the poultry industry is expanding the number of poultry extension personnel are declining. Two Poultry Science Departments have been absorbed into Animal Science Departments as well. Currently there are five Animal Science Departments with eight poultry extension personnel with only 5.05 full-time equivalents in extension.

A Successful Regional Poultry Extension Program

The poultry extension specialists at Purdue University, Michigan State University, The Ohio State University, University of Illinois, and University of Kentucky have formed what is called the Multi-State Poultry Extension group. In 1984, Dr. Richard Adams, Poultry Extension Specialist, Purdue University, contacted Dr. Cal Flegal at Michigan State, Dr. Carl Parsons at Illinois, Dr. Ed Nabor at Ohio State and Dr. Austin Cantor at Kentucky to see if there was interest in putting on an industry-oriented meeting involving the area of poultry nutrition. Everyone agreed that this would be a good regional extension programming effort, so the first meeting was held in Indianapolis, Indiana in 1984. Since that first meeting, the Multi-State Poultry Feeding and Nutrition Conference has been held every year with very good success.

In 1987, Drs. Adams and Flegal suggested that the group expand a Michigan Game Bird

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Conference into a Multi-State Game Bird Conference. All states agreed to do this and this has been a cooperatively sponsored meeting ever since. The Multi-State Game Bird meeting is held in Michigan every other year and then rotates among the other states. Another multi-state meeting, called the Multi-State Poultry Health and Management Conference was also held in 1987. In order to meet the educational needs of other groups, additional regional multi-state meetings have been held and other states such as Wisconsin and Minnesota have participated. One of the programs that was most successful, with respect to the number of attendees, was the Multi-State Big Bird (Ratite) Conference. The first of these conferences was held in the Fall of 1992 in Indianapolis, IN and approximately 350 people attended the two-day meeting. This conference was held every six months for the next three years.

Another multi-state regional project was initiated in 1989. Dr. Gerald Havenstein, who at that time was the Head of the Poultry Science Department at Ohio State, initiated what was called the AMulti-State Poultry Extension and Research Newsletter.@ Poultry related faculty at each of the cooperating five state universities prepared articles for publication in this newsletter. This newsletter received excellent reviews by the poultry industry, but is currently not being published.

In addition to the above mentioned multi-state regional poultry extension programs, several meetings were conducted in Michigan that were Atailor-made@ for several egg producing companies. Since the other multi-state meetings had been so successful, several poultry companies have come to us to see if we would put on a program dealing with specific subjects.

These programs have been nearly self-supporting, and with continued cooperative efforts they will be entirely self-supported. Based on the attendance and written evaluation of these meetings, they have been very successful in delivering current educational information to our clientele. The goals of these meetings are to: 1) provide high quality educational information, 2) provide information for area poultry producers, 3) attract outstanding outside speakers, and 4) secure extramural funding. Conducting successful Multi-State meetings has several specific requirements. The first is to obtain financial support from industry sponsors in addition to funds received from registration. Contributions from companies for sponsoring speakers, receptions, coffee breaks, meals, and other general costs is a must to conduct the meeting. As is the case with the Multi-State Poultry Feeding and Nutrition Conference, each state specialist secures funding in the amount of about $1,000 to help defray these meeting costs. In addition, several major companies solely sponsor receptions and meals functions for this meeting.

These Multi-State programs and conferences have been successful because of the work of the Purdue University Division of Conferences. The conference coordinator's office is responsible for mailing out the program, assembling the proceedings, taking registrations and taking care of many other specific tasks. So, it is critical to the success of any regional extension program to have professional assistance to take care of the details involved.

Disadvantages and Pitfalls of Regional Poultry Extension Programs

There are some pitfalls and disadvantages with regional programs. When conducting a regional extension program increased travel and expenses should be expected. The five-state area is a large geographical area. In order to have a central location for meetings some participants must travel a greater distance and for a longer period than for a state program.

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There is great state loyalty in the five-state area. Producers are reluctant to travel to another state. Distance is not the limiting factor. Producers will travel long distances within their own state, but a segment of the target population do not want to travel out of state. To overcome this we have rotated some meetings from state to state in order to attract a new clientele. Once they have participated in a meeting they are more likely to continue attending the conference even if it is held in a different state.

The administration procedures at Land Grant Universities were developed with the idea that education programs would be developed at the local and state levels. As an example, an extension specialist can travel 500 miles within their state without any prior approval. However, out-of-state travel regulations require prior approval for travel only 20 miles into the other state. This can reduce the effectiveness of specialists to respond to request for help in a timely manner. When a regional project is conducted, the personnel of various universities become interconnected. The staffing problems at one university can impact the effectiveness of personnel at the cooperating universities. In the multi-state program we have experienced retirements and resignations of key personnel, which have impacted the work load of the remaining participants. Even though a close working relationship between colleagues of the different universities is essential for the multi-stage effort to be successful, input into the selection process for replacements have not been solicited from cooperating institutions.

Advantages of Regional Poultry Extension Programs

The advantages of conducting regional multi-state poultry extension programs are many. First of all, quality extension educational programs are conducted. In our planning meetings, we decide which topics and problems are most important to the industry, then decide who can address that problem or topic the best. First we look for an individual who is a good speaker, then we decide if that person has the experience and knowledge to address the topic. We try to choose speakers that work in the industry as well as those who are employed at universities in both extension and research positions. By adhering to these methods of picking speakers, we know that we will have a high quality program. Another advantage of conducting these regional educational conferences is that we can reach a larger audience than if we were to conduct these seminars individually in our own states. By doing this, we can address topics that are common to everyone because these problems usually are regional in scope. Thus, these regional multi-state conferences have increased the efficiency of our individual extension educational efforts.

An important task that university administration likes to see accomplished is the securing of extramural funding. For our multi-state conferences, we have been able to do this for every meeting conducted. The companies which give financial support are recognised on the program brochure. These companies feel that this support enhances their exposure to key industry clients, and they view this as good advertising. Thus, the extramural funding we have received has been sufficient to financially support these conferences.

Decreasing human and monetary resources for poultry extension programs will require that more regional efforts be implemented. Regional programs can work if they are developed over a reasonable period of time and if all participants are committed to the program. The previous discussion about the success of the Multi-State Poultry Extension group is proof that this type of regional extension programming effort can be accomplished. Thus, this multi-state poultry extension programming effort should serve as a model for other commodity, livestock,

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species, and general extension groups.

Multi-State regional conferences and programs initiated:

1. Poultry Feeding and Nutrition Conference
2. Game Bird Conference
3. Big Bird Conference
4. Poultry Health and Management Conference
5. Ergonomics Conference
6. Pet Bird Conference
7. Pest Management Workshop
8. Poultry Extension and Research Newsletter Specific requirements for conducting a conference:

1. Secure extramural funding from supporting companies to cover cost of proceedings, sponsor speakers, coffee breaks and meals.
2. Establish program brochure-printing and mailing
3. Update and maintain accurate mailing list
4. Determine location of conference
5. Secure hotel/motel accommodations
6. Develop proceedings of talks
7. Work with conference coordinator.

Agricultural Extension

Agriculture must continuously move forward for which adoption of newer methods of farming becomes imperative. The University helps in assessment of refinement of latest agricultural technologies to be disseminated to farmers, extension functionaries and other agencies involved in development of agriculture. University has constituent and affiliated Krishi Vigyan Kendras (KVKs) which are located in each district. The University has recently launched innovative technology assessment and refinement project for institute cum village linkage programme (IVLP). The concept is based on participatory mode, ensuring greater scientists cum farmers linkage in predominant bottom-up approach. Considering role of women in Agriculture and allied activities, the University has also undertaken the programme for training and involvement of women in agriculture.

The extension functions as transfer of technology rests with the State Department of Agriculture with the jurisdiction as the entire State of Maharashtra. The Agricultural Universities are entrusted with the responsibility of extension education activities which include imparting education as training of extension personnel-Village Extension Workers (VEWs), Subject Matter Specialists (SMSs), facials of developments like forestry, fisheries, banks etc. and farmers with uptodate technology with methods of communication. It includes the activities executed through demonstrations, meetings, discussions, farmers rallies, training, use of publicity material and communication media. The principal objective of all extension education activities is to develop necessary skills and knowledge of improved agricultural technology among the extension functionaries to increase the agricultural production.

With a view to fulfil the mandatory requirements of extension education, the extension

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activities are undertaken by the University through the following units:

1. Agricultural college extension block
2. Extension education scheme
3. Extension research scheme
4. Training and Visit system
5. Krishi Vigyan Kendras
6. Communication Centre
7. Pilot project on technology assessment and refinement through institution-village linkages
8. Participation of scientists/teachers.
9. Agricultural Technology Information Centre
10. Regional Extension Centres.

College Extension Block: With a view, to give practical training in the subject of agricultural extension to students of agricultural collages, extension block of about 50-60 villages is attached to each agriculture college at Pune, Dhule, and Kolhapur. The extension block also serves as ground to transfer the improved technology developed through agricultural research programmes to test its viability and usefulness under real farming situations. The staff members organise various types of activities inclusive of demonstration on farmers' fields for quick dissemination of technology. This includes introduction of crops, their varieties, improved seeds, seed treatment, proper sowing methods, fertilizer practices, irrigation water management, plant protection measures, use of implements, processing, marketing and storage. An effort is made to introduce horticultural crops, animal husbandry and dairy programmes. The block staff visit farmers from time to time and provide help in giving on-spot guidance as farm advisory service, alongwith the help in supply of seeds and seedlings and organising tours of farmers to different institutes engaged in agricultural research and development.

Extension Education Scheme: To test and transfer the improved technology time to time in adjoining area of the respective research and educational institutes, the scheme for development of extension education is initiated in the three constituent college viz., Pune, Dhule, Kolhapur in addition to the University. Each extension education unit consists of four Subject Matter Specialist in the subject of Agronomy, Animal husbandry, Horticulture and Plant Protection.

The Staff under the scheme usually undertake activities relating to transfer of technology in adjacent areas of the college. With the introduction of T & V scheme of agricultural extension the staff undertake activities relating to attending monthly district workshops, fortnightly training programmes, organising demonstration on farmers' fields, attending farmers' rallies and providing technical guidance to farmers.

Extension Research Scheme: Research sub-section was attached to the Extension Wing of the College of Agriculture, Pune, Dhule and Kolhapur with an intension to undertake research, review of the extension development programme, the feedback in respect of adoption of new technology by farmers about improved technology, to study impact in respect of socio-economic development of community people with introduction of different development programme.

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Training and Visit System: The Agricultural Universities have been assigned the training component of the scheme. It includes elevation of technical skills and competence of extension workers in agriculture. Under the system, five Extension Agronomists are functioning in the jurisdiction of this University. The Extension Agronomists have been involved in organising monthly district workshops, refresher course, subject matter seminar-cum-workshops, crop production technology orientation courses, pre-seasonal training courses, shetkari melawas and farm trials through extension functionaries provided in the system.

Krishi Vigyan Kendras: The Krishi Vigyan Kendras (Farm Science Centre) was established in 1983 at Agriculture College, Dhule with a view to cater the training needs of tribal areas in Dhule district and adjoining districts. The programme of the KVK includes conducting short duration institutional training programmes of 1 to 7 days duration, non-institutional training programmes and other activities including field days, farmers' rallies, publicity through film show, lab-to-land programme, front line demonstration and on-farm trials, organising of Mahila Mandal and related programmes for the grass-root level workers and farmers in selected areas. Special training courses are organised in poultry keeping, dairy farming, goatery, raising of nursery, tailoring, child development, fruit preservation and making of handicraft material for generating self employment in the tribal communities.

Communication Centre: The Communication Centre of the University was established in the year May 1982 with the financial assistance of ICAR New Delhi, for 5 years. The centre is established for effective use of mass media in transfer of technology. The unit produces literature for the farmers and extension workers viz., folders, booklets, magazines, krishi darshani and organises publicity of news items, exhibitions, preparation and production of audio-visual aids, broadcasting of agricultural programmes in transfer of technology through All India Radio and Doordarshan, and organising public relating media for communication of agricultural technology and guidance through correspondence.

Pilot Project on Technology Assessment and Refinement through Institution-Village Linkage: The research system has generated very useful results for synthesis of appropriate technologies for farmers. However, it has not been possible to develop and integrate the results in the form of appropriate technology for different production systems, the essential conditions of which are adequate understanding of the farming situations, resource availability and needs and aspirations of farmers having different socio-economic and cultural background. This is mainly due to the lack of appropriate scientist-farmers linkages. Therefore, the need for change in technology transfer approach was felt. With this broad perspective ICAR has decided to implement Pilot Project on "Technology Assessment and Refinement through Institution-Village Linkages." The project gives central importance to the farmers' perspectives, needs, resource endowment and real life situations. The project bases itself on Participatory Rural Appraisal (PRA) techniques. The duration of the project is two years. In the State of Maharashtra, Solapur centre is one of the four identified Centres.

There are two teams viz., Core and Optional teams of multidisciplinary scientists at each centre for the implementation of the pilot project. There will be 4-5 scientists in core team. A team will be headed by Team Leader. A Nodal Officer is identified for the project at each Centre. The information in a comprehensive manner on various farming situations and resource availability, various changes, needs and aspirations of farm families of the selected

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Wadala and Darphal of Solapur centre was obtained. The information gathered through PRA tools was carefully documented. The farmers were then asked to identify their problems, find out their causes and come out with solution measures. Further the identified problems were classified and priorities were given by the group of farmers based on their farming situations so as to fulfil their immediate needs. Then the core team scientists in consultation with participating farmers have formulated 'Technological Modules' suitable for various production system categories.

Participation of Scientists/teachers in Extension Activities:

The scientists/teachers usually undertake extension activities either by themselves or in group together in different magnitudes. The activities undertaken usually includes-field demonstration, visit to farmers' fields, visit to farm trials, group discussion, farmers rallies, exhibitions, answering queries through correspondence, writing transfer of technology articles in newspapers and magazines, radio and television.

With the help of communication media like radio, TV, newspapers efforts are being made for the rapid dissemination of improved technologies. We have good rapport with the development departments and NGOs which helps in getting feed back of field problems. This helps in reorienting the research programme making it need based and problem oriented. The university is publishing Krishi Darshani, a diary incorporating useful findings of research as well as the university news and 'Shri Sugi' (University Magazine) for kharif, rabi and summer seasons.

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Chapter 10 : Poultry Production Techniques

Poultry is the category of domesticated birds that people keep for the purpose of collecting their eggs, or killing for their meat and/or feathers. These most typically are members of the superorder Galloanserae (fowl), especially the order Galliformes (which includes chickens, quails and turkeys) and the family Anatidae (in order Anseriformes), commonly known as "waterfowl" (e.g. domestic ducks and domestic geese). Poultry also include other birds which are killed for their meat, such as pigeons or doves or birds considered to be game, like pheasants. Poultry comes from the Latin word, poule, which means to hang. The term also refers to the flesh of such birds.

Cuts of Poultry

The meatiest parts of a bird are the flight muscles on its chest, called breast meat, and the walking muscles on the first and second segments of its legs, called the thigh and drumstick, respectively.

Figure: *In the poultry pavilion of the Rungis International Market, France*

White meat has less oxygen-carrying myoglobin than the dark meat, and is thus lighter in colour. Dark meat comes from muscles more heavily exercised, which therefore have more fat stored in them. This accounts for dark meat's reputation as being both unhealthier and more flavourful than white meat. Birds that fly rarely (domestic turkey) or sporadically (chicken) have white meat breasts, and birds that fly frequently or long distances (ducks, geese and doves) have dark meat breasts. Quail breast meat is intermediate in colour.

Globally, production of poultry meat approached 70 million metric tons (MT) in 2000, with an average annual growth rate of 5.3% during the last four decades. Currently, the US, China, European Union (EU), and Brazil are the primary poultryproducers, with a combined output of 65% of total poultry meat production in 2000. Poultry meat production increased at an average rate of 10.2% in Brazil, 7.7% in China, 4.3% in US, and 4.0% in the European Union since 1960's. Poultry meatproduction in China exceeded to that of EU for the first time in early 1990's. Expansion in world poultry meat supply has not been exclusively from industrialized countries. World poultry meat production in developing countries has exceeded that of developed countries during the last decade, with a per annum expansion rate of 7.4% during the last four decades.

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Worldwide, chicken (primarily broilers, but also include spent breeder hens and males, and spent table egg layers) continues to be the most popular poultry meat, representing about 85% of the total poultry meat output. Broiler meat production in 2001 is estimated at 70% of total poultry meat production (or about 43 million metric tons). Whereas, turkey, duck, goose, and other species (guinea fowl, pheasants, quail, squab, and ratites) only account for 7.5%, 4.2%, 2.8%, and 0.5%, respectively, of the world total poultry meat production (FAO, 2001). Last year, (except for turkey meat) chicken, duck and goose meat production in developing countries exceeded that of developed countries. The US leads the world in chicken (14 million MT) and turkey (2.4 million MT) meat production. China, on the other hand, is the worlds' largest producer of duck (1.9 million MT) and goose (1.8 million MT) meat.

Trade in Poultry Meat Products

The poultry sector of the global meat supply has experienced a dynamic growth in production, consumption, and trade since the mid 1980's (Vink, 1999), primarily paralleling economic prosperity in developing countries. Most of the growth in production is attributed to intensification of production, vertical integration of the industry, relatively low feed prices, and further processing. Poultry meat and eggs continue to be the most efficient and economical way to convert feed grains to animal protein. International trade in poultry products now exceeds 6 million MT, with US exports reaching 18% of its total production (2.9 million MT) in 2001 (NCC, 2001). The major export markets for US poultry are Russia, Hong Kong, and China. Broiler supply and demand is expected to grow more internationally, especially for frozen whole birds, parts, paws, bone-in-leg quarters, and boneless dark meat, driven primarily by large fastfood chains (Aylward, 2000).

The demand for animal protein tends to be income-elastic and follow the Gross Domestic Product (GDP). During the next decade, poultry meat consumption is expected to increase significantly in Asia with an estimated GDP of 6.6, as compared to the developed economies (2.8), the transitional economies (3.7), and the world (3.5). Demographically, this is very significant as well; as population is also expected increase in Asia, but shrink in developed economies such as Europe and Japan, both of which are currently net importing markets for poultry meat. Poultry products are in demand in all parts of the world. When there are no religious or cultural barriers, poultry meat usually takes consumer preference (Van der Sluis, 2001). Poultry meat also enjoys popularity in developed markets, due to its lower price and perceived safety and health advantages compared to other meat sources. However, per capita consumption of poultry meat varies substantially around the globe, ranging from 0.7 kg in India to 44 kg per annum in the US.

Poultry Processing and Products

Development of new and efficient processing systems, adoption of advanced technologies, and introduction of novel products that meet the market chain requirements and end-consumer needs have contributed significantly to the increases in global poultry meat consumption. Poultry production and processing technologies have become readily accessible, and implemented on a worldwide basis, and hence, will allow continued expansion and competitiveness in this meat sector (Aho, 2001). Processing and marketing of

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poultry ranges from live bird markets or a very primitive on sites laughter and sale, to a highly sophisticated, fully automated and International Standards Organisation (ISO) certified facilities and ready-to-eat convenience products, in many parts of the world.

Ironically, sometimes these extremes in processing and marketing methods are observed within the same country. Lack of or in adequate refrigeration is probably the single largest obstacle to the marketing of many perishable foods, including meat and poultry. In many developing countries, even the subtle improvements in the cold storage capabilities have significantly increased the trade, storage, distribution, and consumption of poultry products, whether domestic or imported (Babji, 2001). On the other hand, the adoption of modern freezing, packaging, and transportation technologies has provided large poultry companies the flexibility to export their high quality, mostly value-added premium cuts to all corners of the world, especially at times of domestic surpluses and low market demands. However, as the global poultry market expands, differences in labour and freight costs, and tariffs may alter the competitive advantages of traditional poultry exporters.

Although whole birds, with or without giblets, and cut-up parts dominate the market forms of poultry in many parts of the world, there has been a global shift to "well-differentiated, name-branded" poultry products in the marketplace (Keeton, 1997). Whole bird and tray-pack markets, domestic or international, usually demand high quality (A Grade) product. High market share of whole birds in Middle East, South America and Eastern Europe directly relates to consumer preference for traditional meat preparation methods and chicken broth, and expanding roasting or rotisserie markets. Religious and cultural practices have always been important considerations for poultry products, especially in export markets, as many countries have strict requirements (laws) for Kosher and Halal slaughter and processing of poultry.

Historically, introduction of many novel poultry products into the market was an attempt to find outlets for trimmings, low-value cuts, and parts from fabrication of whole birds. Later, expansion of food service and fast-food chains, increasing demand for finger foods, availability of mechanically deboned poultry meat (MDPM) for frankfurters and luncheon meats, and development of marination/ injection technologies have all contributed to the product diversification at the retail level. Most of these value-added products, formulated primarily to suit the local palate, not only target the changing needs of consumers (i.e., convenience, nutrition, health, quality, variety, shelf-life), but also allows a marketing edge over imports. Many exotic recipes and ready-to-cook marinated stick products from Asia, developed primarily for domestic markets, are now in demand by the poultry importing countries elsewhere (Europe, Japan, Australia, New Zealand). Consumers worldwide demand a protein supply that is safe, wholesome, nutritious, abundant, and affordable. However, food safety standards are currently not uniform, or equally enforced, around the world.

Differences, for example, in hygiene or inspection regulations often lead to trade disputes and stagnation between the countries. Several international bodies, such as the Codex Alimentarius Commission of World Health Organisation (WHO) and Food and Agricultural Organisation (FAO), International Commission on Microbiological Specifications for Foods (ICMSF) and the World Trade Organisation (WTO) Agreements on Sanitary and Phytosanitary Measures (SPS) and Technical Barriers to Trade (TBT) develop and provide guidelines for the equivalency in international standards to protect the health of consumers

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and to ensure fair practices in food trade (Bilgili, 1999). As we move into a global market economy, poultry production will continue to increase in those countries that have the natural resources, economically competitive and politically open to business investments (Aho, 2001). Many countries or regions, on the other hand, will continue to struggle to compete in this market, either because of limited infrastructure (raw materials, land, utilities, labour, transportation) or political constraints (environmental and welfare concerns, tax structure, trade policies).

Domesticated Birds

Domestication

Behaviour changes : From the moment any one decides to take a bird or animal from the wild, they are influencing the future of those birds or animals. How the birds are captured influences the survival rates and how they will be treated.

Pair selection : Most people choose which birds are paired to each other just by looking at the birds. Avian veterinarians and experienced breeders will often select a pair using additional parameters. Visual judgement often does not allow for a lot of valuable traits that have allowed the species survive up to now. We purchase birds by visual examination and price.

In the wild or in a colony situation the birds can choose their own partner. Many keepers remove this natural pair selection by only offering the choice of one partner.

Human compatibility : Birds that have adapted to accept people around or in an aviary are the most likely to be bred in the highest numbers. Birds that can be bred in an indoor cage are the most popular and the birds that beginners often start with. Birds that make good pets have the best chance of having a long term monetary value and community popularity.

Libido Dictionary definition : "The psychic drive or energy associated with the sex instinct". The natural instinct to breed. Birds are placed in close proximity in our aviaries. This can promote hostilities and aggression just prior to and during the breeding season. In young "teenage" birds the mating aggression may extend outside the breeding season. To eliminate hostilities between pairs, avoiding the possibility of injury between rival birds, we place the pairs in separate aviaries or cages. Rivalry between breeding age birds is a natural selection process to offer the next generation the best genes to survive in their environment. The birds with the strongest desire to breed, that have the necessary skills to build or find an appropriate nest, will generally be successful breeders. Unsuccessful birds may have to wait till the dominant birds leave or they may provide a "nanny" type service to assist the young of the successful breeders.

Placing birds in an artificial environment with the choice of only one partner may limit the chances of successful breeding. "Teenage" birds often will breed no matter what conditions they are placed under. After the raging hormone levels subside, the breeding rates often decline. As the birds get older, breeding results often become erratic and in some seasons no eggs may be laid. The cost of additional aviary space and the cost of purchasing additional pairs may limit what a keeper can provide. Solo pairs often need some form of competition to stimulate good breeding results. Some birds such as Red crested Cardinals prefer no competition and like to be the only pair of their species in the area.

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Some macaws like to be in a "group" of about 4 or 5 pairs. They do not have to be in the same aviary. Once the population exceeds a given aviary complex density (often 5 pairs) the birds breeding success declines. If the density is too high, the need for a species to continue breeding may decrease or cease. Some birds such as a pair of Shamas, may need to be separated during the non-breeding season. Cock bird and hen bird placed in separate aviaries that are out of sight of each other during the non-breeding season. These birds are gradually reintroduced to each other prior to the start of the next breeding season.

Some birds such as the weavers may breed in very close proximity to each other. In the wild, dozens of pairs may nest in the same tree. Different birds have differing requirements to guarantee the long term survival of their species. All bird keepers should try to provide the environment and individual needs of each species to maintain the best breeding genetic lines in our aviaries.

"Clucky" trait: Many of the exotic species of quail have lost the desire to incubate their own eggs. These birds are so prolific at laying eggs, poultry producers now produce vast numbers of these birds for the restaurant trade and for domestic consumption. Many species of exotic Quail should be classified as "poultry" and not as regular aviculture species. How many Californian Quail are in our aviaries that incubate and rear their own young? These birds are of little or no value for the beginner bird breeder because beginners usually do not have the equipment or skills to use incubators.

Importation of new birds: The import of birds into Australia ceased about 50 years ago and is not likely to restart. CITES listings have stopped the export of birds from most countries.

Vibration: My favourite topic!!!!!! How many articles have you read about the effects vibration can have in an aviary or captive bird situation?.

More Info to Come

Original stock: How the original stock was obtained may have determined the genetic and physical traits of aviary stock we now keep.

Grain "baits" were laid in an area for a predetermined time and then the net was thrown over the wild birds. The captured birds were the ones who preferred the commercial grains. The birds that did not like the "bait" grains were less represented in those initial consignment. The logic of the trappers was fairly sound in respect to minimizing the death rate in the captured birds. If you start with birds that prefer commercial grains, they will more readily continue to eat these grains in captivity and then have a commercial monetary value. The trait of not requiring live food as part of a natural breeding diet is valued by many bird keepers.

Nest Robbing for Eggs or Young

Netting of Fledged or Adult Birds

Culling Defective Birds: Captive birds are rarely culled due to physical, mental, disease susceptibility, or behavioural defects. Can the bird be sent off for sale to a beginner or gullible breeder?

Antibiotic Resistance: Like the problem with antibiotic resistance in human due to

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overuse or inappropriate antibiotic use, the same problem is increasing in animals and birds. Over use and unnecessary use of antibiotics must be avoided. Always abide by avian veterinarian advice and do not rely on second hand amateur advice. Over use or incorrect use of an antibiotic can reduce the fertility of a bird.

Breeding Longevity : Does the longevity of breeding stock influence the genetic viability of future bloodlines. The integrity of human reproduction declines as the age of the parent approaches the end of the natural breeding years. Birds in the wild rarely die of old age. Something will probably catch and eat it, or it will be killed as a result of an accident long before old age is attained. If the genetic integrity of the young is determined by the breeding age of the parent, does the "breed till the birds drop" attitude help the survival of rare birds.

Colour mutations: Is the loss of the pure "normal" colour bird of concern to the long term survival of a species? For a re-release back into the wild, the birds must be in the pure wild genetic colour. A colour mutation is a abnormality or defect in the wild population's normal genetic coding. Mutations rarely survive as the phenotype state in the wild. The colour gene is still in some of the wild population as a split or recessive trait. Also refer to the next topic.

Fertility: Does the pursuit of colour breeding result in the decline in fertility of future generations. Birds become "delicate".

Hybri dizati on: For colours-Lorikeets and Asiatic birds hybridized species to transfer colour mutations to the other species.

Aviary and Cage Sizes: Suspended cages. Outdoor aviaries. Habitat aviaries for non parrot birds.

Suspended Cages: Cabinets. Indoor cages. Over clean floor-does this reduce the natural resistance to minor infections?

Controlled Environment Breeding Rooms: Many birds in their natural environment are able to survive low temperature or freezing nights then have to endure high temperature days. Desert environments can provide these wide temperature variations along with wide variations in humidity and rainfall. Indoor controlled environment breeding rooms often are restricted to temperature variations of only a few degrees. Humidity is modified and the lighting duration and intensity is programmed to fine tolerances. The natural genetic selection for ability to survive in harsh environments will be gradually lost.

Foods Standardized Diets: Standard for parrots, conures, macaws etc-one fits all.

Food availability: Captive birds have seed mix availably in adequate quantities at all times. Live foods are often only given at breeding time. Cost of livefood versus the value of the bird.

Obesity: Infertility and general lack of general fitness is increasing in many species and is often the result of being over weight or obese. Excess food intake along with restricted opportunity for flying a reasonable distance, and the modified environment contribute to obesity.

Austerity Diets: Austerity diets (or restricted feed intakes) during the non breeding season are promoted to keep birds from gaining weight and stimulate the birds to breed when the normal diet is resumed just before the start of the next breeding season.

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Nest Construction: Birds are now offered the nest materials that are either cheap, readily available, left overs from last season, "hand me downs" from other people, what the keeper "thinks the birds need", what the retailers sell them, or the lucky ones that are given the correct materials based on experience or from experienced breeders. The lucky birds are given a variety of materials that allow the adult birds to build a nest based on their natural instinctive programming.

The availability of brush, such as tea tree, is commonly used by finch breeders to use as a nest site but is becoming harder to purchase or obtain legally. Nest boxes are placed in an aviary as a substitute for the natural branch and foliage nest sites. In a tree or shrub the birds have to build a strong, weather proof, predator proof nest. If we place a rigid performed nest in the aviary or cage as a substitute for natural materials the birds may loose the instinct to build the necessary framework for a successful nest. Many birds retain the ability to correctly line the nest with suitable soft materials but cannot build a strong outer nest. Half open wooden nest boxes and wire frames are becoming common in aviaries. Just to make it easier and quicker for the birds, the owner will often fill the nest with coarse nest material then push their fist or hand into the material to make a hollow. All the birds have to do is add a few soft materials to line the nest and lay the eggs. In the wild, the selection of the nest site, selection of nest material and the building of the nest will help build a strong bond between the pair and synchronize their breeding cycle. If the birds are at a different part of their breeding cycle the end result can be infertile eggs.

In the wild the finch cock bird (particularly weavers and whydahs) may build part of a nest waiting for the hen to give her approval for the choice of nest site and the quality of construction. Some cock birds may need to part build 10 or more nests before the hen gives her approval and accepts the nest. In the aviary with a choice of only a few preformed artificial nests, this pre-selection and quality approval skills are minimized.

Finches no longer need to build a nest that is waterproof or weather resistant as polycarbonate roof materials and solid walls do a better job. Species from the genus Estrilda (waxbills) often build a "cock's nest" above the brooding chamber if the nest is built in the open in a natural setting. If we give the aviary birds a timber nest box, a commercial wicker or wire preformed nest the bird may not have enough space to build the top part, or cock's nest chamber. If this was to continue for a number of generations, that genetic line may loose the instinct or natural ability to build a nest similar to the birds in the wild. Many commercial wicker finch nests have a long tunnel entrance incorporated in the manufactured design. The bird no longer needs to use their skills to build tunnel entrance. Preformed nest boxes also minimize the need for the birds to build a quality outer nest structure. Even the worst built nest in a rigid artificial frame will be sufficient for a pair to lay and raise a clutch of young. The waxbills usually build a nest on or close to the ground. In an aviary situation the artificial nest is placed at a convenient height for the keeper to inspect. Just another factor potentially effecting the natural nesting instinct.

Fostering: Imprinting of young.

Incubation: Incubation of quail eggs has led to many species of non-Australian quail no longer incubating their eggs or rearing their young.

Handrearing: Does the hand rearing of birds reduce the ability of the next generation to maintain the natural instinct of parent rearing the young?

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Digestion Micro Flora: Many animals and birds transfer some helpful "bugs" to their progeny during the feeding and rearing period. Does the incubation of the eggs and subsequent handrearing of the young limit the transfer of beneficial "bugs" and make those birds less able to resist some avian pathogens?

Health Issues: Home made remedies, pharmaceutical drugs, pathology diagnostic tests.

Genetic Diversity: How many breeding birds are available to breed from.

Genetic Availability: Are some of the rarer birds kept as pet or companion birds. Is stock being held by people who have no intention of breeding the rarer birds or keeping them as a "trophy" bird.

Sub-species Identification: Very few people cared about breeding true to sub-species level when birds were imported. The result is a line of current birds that are a possible mix of different nominate and subspecies. As long as the birds were similar the breeders were happy. Even today most breeders have the same attitude. Some parrots are a mix of 2 or 3 sub species whereas some finch species could be a mix of 10 or more sub species. This has resulted in some species of birds in Australia having a similar, but not identical, appearance to overseas stock. The possible benefit is the provision of a wider genetic diversity in the Australian stock.

Pet Birds: Parrots-Parrots such as macaws are becoming popular as pets by people are prepared to pay for these exotic colourful birds. Does the removal of rare birds for pets damage the genetic variability of the remaining birds? Pet owners often are prepared to pay top price for the best bird and then place the bird in an environment that will not allow that bird to have a mate or breed. Removing the best birds from a low gene pool species can reduce the long term viability of the remaining birds.

Natural Species Song: Do captive birds retain their natural imprinted song? We place a pair of birds, usually finches in an aviary with a number of species of birds that they would never meet in the wild. Does the fostering by another species of finch such as a Bengalese, influence the song of the original bird?

Often one pair of a particular species is placed in an aviary with several other species of birds. After the young are fully independent of their parents, the young are removed to another aviary so the parent birds can start a new clutch of eggs. The young are placed with another group of birds that may not include their own species. Who will teach them the correct song or mating call for their own species? Will they add components of other birds song to their own? Many overseas visitors to Australian aviaries comment that some of our birds "sound different" to their aviary birds.

Natural Plumage Colour: The rearing of birds on a standard commercial diet may result in the loss of the intensity of feather colour. Housing birds in indoor or fully covered aviaries may also result in loss of plumage colour.

Secrets: Many breeders take their knowledge to the grave. Lack of publication of accurate observations impedes the next generation of bird breeders. Equally the non-publication of things that go wrong or result in bad outcomes should be published. Why should each generation be subjected to make the same mistakes. An outline of the methods and materials should be described and this can be a starting point for other people to review that data and possibly refine or redesign some aspects of the initial attempt. The fear that is often

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used for the keeping of “secrets” is-”If I tell people how to breed those birds, they will have better breeding results and the extra birds will reduce the price of the birds I sell”.

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Chapter 11 : Alternative Poultry Production Systems and Outdoor Access

Alternative poultry production involves speciality systems such as a cagefree environment or other access to the outdoors as alternatives to conventional poultry housing and cages. Alternative poultry production may be large-scale but is often small-scale and integrated into a diversified farm. Alternative poultry production is an important part of sustainable agriculture to boost farm income while protecting the environment and addressing consumer concerns.

Outdoor access is an important feature of most alternative poultry production and allows the birds to express natural behaviours such as foraging and dustbathing. It allows "extensive" production in which the birds have access to ample space, sunlight, and fresh air —a healthy environment that reduces stress. The birds have access to comfortable indoor housing as well as the outdoors and can choose an environment, to maximize welfare. "Extensive production" is in contrast to "intensive production," where birds are permanently housed at a high stocking density.

The history of poultry production includes a long chapter on outdoor access. In the past, even the conventional poultry industry raised birds with outdoor access. Production moved indoors largely because of concerns about predators and disease, but also to allow production on an intensive scale with automated feeding and watering. Free-range producers must keep in mind the reasons production moved indoors and avoid practices that historically caused problems outdoors. (1,2) Poultry production based on outdoor access is often seasonal, which can introduce variation in performance and product quality. Alternative poultry production is also often on a relatively small scale compared to conventional models, and may be more labour-intensive. Many producers attend to several small flocks instead of a single large one.

A lot of information is available on conventional poultry production. This publication focuses on alternative production, for which information is less available. It contains real-life observations and highlights several innovative producers. This "how-to" manual addresses production systems and outdoor access for poultry. For information on breeds, nutrition, health, economics, etc., refer to other resources.

Alternative Poultry Production Systems

Defining Production Systems

Alternative production systems are defined in some countries in order to assist in marketing so that consumers will understand how the birds were raised. For example, in addition to maximum stocking densities for indoor and outdoor areas, the type of breed and feed may be specified. There are few definitions in the U.S.

The following classifications and general definitions constitute accepted terminology among both conventional and alternative poultry producers.

Layers

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Poultry are mainly raised in the following ways for egg production:

- Cages
- Cage-free or "barn"
- Free-range.

In the U.S., these are not regulatory terms. In contrast, in the European Union, they are "special marketing terms" with legal standards and definitions.

Cages: Indoor production is used by the large-scale conventional industry and is usually climate-controlled. Large houses allow intensive production and a high level of automation of feeders, waterers, etc. Layers are housed in cages in conventional indoor production, usually tiers of adjacent cages or "battery cages." Most U.S. producers provide 67 to 86 square inches per hen. However, many consumers are concerned about the small amount of space in battery cages and the fact that birds cannot perform natural behaviours such as nesting, perching, and scratching. In the European Union (EU), battery cages will be banned by 2012. Only enriched cages can be installed, which provide more space (at least 116 square inches), as well as nesting, perch, and scratching areas.

Cage-Free: Cage-free layers are raised loose on a floor, which is generally covered with litter to absorb manure and allow birds to scratch. Eggs from cage-free layers are sometimes called "cage-free" or "barn eggs." Maximum stocking density should be no more than one bird per 1.5 square feet, but can be increased up to 1.2 square feet with slats and multiple levels of flooring on litter. Slatted floors permit a higher stocking density since birds roost on the slats at night, droppings fall into a pit below, and less manure accumulates in the litter. However, some programs limit the amount of slats that can be used in the house in order to ensure birds have sufficient solid floors with litter for scratching. In the EU, the "Barn" system requires 1.2 square feet per hen and 39 square inches of litter, along with perch space.

Aviaries are speciality, multi-tiered buildings for cage-free layers that provide several levels of flooring and use vertical space (perches and platforms) to allow birds to jump to different levels. Aviaries can actually maintain a high density of hens.

Free-range. The U.S. Department of Agriculture (USDA) does not currently have specific regulatory definitions for "free-range," although the term is allowed on labels under certain circumstances. When applying for label approval, the producer must submit a brief description of the housing, which the USDA reviews to determine that poultry have access to the outdoors for at least half their lives. In the EU, the definition for "free-range eggs" requires outdoor access with a maximum outdoor stocking density of 1 hen per 43 square feet (the equivalent of 1,000 hens per acre), and also requires the use of the housing in the "Barn" system described above.

Meat Chickens

Meat chickens are generally raised in two ways:

- Indoors on litter
- Free-range.

Indoor. The large-scale conventional industry raises broilers in houses. They are raised on the floor on litter, usually at a stocking density between 6.5 to 8.5 pounds per square feet, which is less than 1 square foot per bird. Sometimes birds are provided with additional space and marketed on the basis of having extensive space indoors.

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Free-range. As mentioned, the USDA does not have specific definitions for free-range. In contrast, the EU defines "Free-Range" and "Traditional Free-Range." These definitions specify maximum indoor and outdoor stocking density, the type of feed (70 percent cereal at finishing), the minimum slaughter age, and the amount of pophole space to encourage birds to go outside. "Free-range" limits indoor stocking density to 5.5 pounds per square feet and outdoor to 10.8 square feet per chicken (4,033 chickens per acre). "Traditional Free-Range" is basically the French Label Rouge standards and requires more space. Stocking density is limited to 5.1 pounds per square foot indoors and 21.6 square feet per chicken outdoors (2,026 chickens/ acre). It also requires the use of a slow-growing breed and limits the number of birds per house and the number of houses on a farm.

Outdoor access is also required in most organic programs in addition to the use of organic feeds, preventive health care practices, and a prohibition on the use of antibiotics. The USDA National Organic Program requires outdoor access but does not specify stocking density or flock size. Instead, the standards are more descriptive, requiring fresh air, direct sunlight, the opportunity to express natural behaviours and exercise. In contrast, EU organic legislation specifies maximum stocking densities both indoors and outdoors.

Stocking density/flock size. In general, stocking density is related to bird welfare and carcass quality. Outdoors, stocking density is used to maintain vegetation and reduce pathogens and excess nutrients. Programs have specific stocking densities, but as a general rule-of-thumb indoor maximum stocking density for meat chickens should not be more than 1 bird per square foot or about 6 pounds per square foot. For the outdoor area, the Soil Association recommends no more than 1,000 meat chickens per acre or 400 hens per acre on pasture that is rotated. Cage-free layers should have at least 1.5 square feet per hen indoors on litter. Meat chickens can be stocked at a higher rate than layers, because meat chickens are around for a shorter time.

Many programs limit the size of the flock or number of birds in a house. The Soil Association recommends that flocks be kept to 500 birds or less but allows flocks of 2,000 hens or 1,000 meat chickens.

Free-Range Systems

Free-range systems vary widely, from large fixed houses with yards to small portable houses that are moved regularly. The main free-range production systems are

- Fixed houses
- Portable houses
- Pasture pens
- Integrated systems.

Fixed Houses

Advantages to a fixed house include the relative ease to provide electricity to power automated equipment. The house can also be large in size because it is not moved. Fixed houses open to yards to provide outdoor access, and birds are usually closed in the house at night. This type of production is done by most large free-range poultry companies in the U.S. and is sometimes called "semi-intensive." On a small scale, it is the familiar chicken coop and yard.

A major disadvantage of this system is that unless the birds are rotated from one yard to

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another, access to the same ground is continual. When birds stay on the same ground, they damage the vegetation and turn the yard into dirt or mud. Turf damage may be especially bad right around the house, and birds may track mud into the house and dirty the eggs. Excessive pathogens and nutrients can build up in the yard, contributing to disease and pollution. A fixed house and yard may work in very dry climates, such as parts of the western U.S., where biological activity is low and pathogens do not survive, or with a low density of birds. (Young pullets or broilers are more susceptible to pathogens than older birds like layers.) Otherwise, it is critical to rest or rotate pastures to prevent these problems. If the house is fixed, a rotation should be used to rest the pasture.

One way to help rest or rotate pasture is "double yarding"— subdividing the yard in two with a fence and rotating the flock between the yards. The Soil Association recommends dividing the yard into at least four paddocks and planting trees or using shelters at least 30 to 60 feet away to draw birds from the area around the house, which is the most heavily used. In the Soil Association program, the pasture must be rested for nine months after every laying flock; for meat chickens, the pasture should be rested at least two months per year, plus one year in every three years. A layer of mulch or gravel around the house helps reduce mud outside the popholes and keeps birds from tracking mud into the house. Slats on either side of the popholes also help clean feet. Fencing may be permanent or temporary. Temporary fencing such as electronet fencing can be used and is easily moved to provide more yards.

Ideally, yards are covered with vegetation but sometimes are simply dirt scratching or exercise areas. Ground coverings such as gravel, straw, mulch, or sand are preferable to a dirt lot and help reduce mud. The area may even be completely or partially covered with a roof, making a veranda. Screens may be used to enclose the birds in a "winter garden" or curtains can be used. This allows access to sunlight and fresh air while protecting birds from weather and wildlife. In some cases, a screened porch with a mesh floor allows manure to pass through so it can be collected and removed.

Portable Houses

Mobile houses are necessarily small since they are built to be moved regularly to a new location, usually with a tractor, pickup, all-terrain vehicle, or draft animal. Portable housing ranges from crude shelters to well-constructed, insulated houses. Houses may have wheels or skids and are moved every few days or less frequently. Pastures usually have a perimeter fence to contain cattle or other livestock and deter predators. Generally poultry producers confine birds at night to protect them from nocturnal predators and the elements.

Moving the house at least once a week prevents the pasture underneath the house from dying. It recovers in about a month, depending on the climate. If the house stays in one location for longer than one week, the forage plants under the house may need to be re-seeded and it may take a couple of years to re-establish new pasture in that spot.

If a layer house has wheels (an "eggmobile"), it is usually moved often. Virginia producer Joel Salatin popularized the use of eggmobiles in the U.S. His layer houses moved through pasture every three to four days following grazing cattle. Old mobile-home trailer frames and old campers have also been used for eggmobiles. According to Salatin, significant acreage (50 acres) is needed in order to move the birds far enough that they do not return to the previous spot or identify a favourite spot such as a garden. He moves his eggmobile every few days. Skid housing is generally moved less often than wheeled housing, because it can be

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hard to drag. If wooden skids are used in organic production, they should not be pressure-treated with copper-chromium arsenate or other prohibited materials. Metal pipes are another option and are smoother to drag than wood.

The use of small shelters on skids is described in *Free-Range Poultry Production and Marketing* by Herman Beck-Chenoweth. His shelters have a roof and a wood floor covered with litter but only chicken wire instead of walls. He moves the shelters to fresh pasture every four weeks to prevent turf damage and maintains at least 100 feet between each house to keep flocks separate. Beck-Chenoweth's system is described on his Web site. Many attractive designs for small poultry houses used for free-range production in the United Kingdom are shown on the Forsham Cottage Arks Web site. Andy Lee pioneered the use of electronet for poultry in the U.S., using the term "day-range," in his book Day Range Poultry. The use of portable electrified netting as fencing allows bird activity to be placed where desired, reduces predation, and is easy to move. A 165-foot roll of netting encloses an area roughly 40 feet by 40 feet.

The electronet may completely encircle the house, or it can be looped off one section of the house. Temporary fencing makes many configurations of paddocks in conjunction with a mobile house. The electronet should be moved before the grass starts growing into the netting, which will short it out and make it hard to move. Putting the housing in the middle of the enclosure will reduce birds flying out.

Salatin has an egg production system using net fencing that he calls the "feathernet." Salatin moves his "feathernet" house and netting to a new site every three days, making a figure-eight with two 450-foot circles of netting (using three rolls each), so he can move the housing into a new circle without letting birds escape. Housing is sometimes designed to remain open at night in order to provide longer hours of outdoor access and eliminate the tasks of opening and closing doors. Birds forage actively at dusk. EU legislation allows a greater indoor stocking density if the house remains open at night. Flaps over the exits can deter predators such as owls from entering the house and help maintain temperatures in the house, and electronetting deters ground predators.

The housing design may impact portability. Portable houses usually have litter-covered floors to protect birds and keep them off wet ground. Floors increase the structural stability to keep the house from pulling apart when moved. However, houses without floors are less expensive to build and reduce potential habitat for rodents. If a portable house has no floor, it is important to keep rain water from seeping into the house through the ground. A trench above the house on a hillside can divert water flow from heavy rain, or ideally, the house is placed on ground that is higher than the surrounding ground or on a constructed pad of earth.

Colony Production

Colony production is a management system for free-range egg production described by Oregon producer Robert Plamondon on his Web site. Colony production uses many small houses along with a common nest house and feed area. It is based on a system that was popular in the early 1900s in the California poultry industry centred near Petaluma. It was designed to reduce labour in gathering eggs from small portable houses on range. "Colonies" of small roosting houses share a common nesting house and feed area. Plamondon moves his

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houses every few weeks to a new spot about 100 feet away. The producer visits only one house, the nest house, to collect eggs. The producer collects the eggs onto flats for pickup by truck or ATV (or, in the past, horse). According to Plamondon, when you have more eggs than you can carry by hand, you need a nest house. Plamondon's roost houses do not use floors or litter, although nesting houses have litter to clean birds' feet. When he moves the house, there is a 2 to 4-inch layer of manure left which he scrapes with his tractor and incorporates into the pasture. The houses should be kept 300 feet from barns, garages, and other places where you don't want birds to roost. He keeps 50 hens in each small house, and his colonies consist of 200 hens each.

Pasture Pens

Pasture pens are small floorless pens that are moved daily, usually by hand, to fresh pasture. These inexpensive shelters are set in a pasture, on a lawn, or in a garden. They are a favourite of small-scale producers due to their low cost and flexibility.

Pasture pens were popularized in the U.S. by Joel Salatin of Virginia. Salatin wrote a book called Pastured Poultry Profits which described his system to feed, provide care, market, etc. The pens have been so popular with small farmers that Salatin is credited with starting a "pastured poultry" movement in the U.S. He uses a 10-foot by 12-foot by 2-foot wooden pen. The top of the pen is flat, and partially covered by roofing. He stocks at a maximum density of about 1.5 birds per square foot for meat chickens. Producers following his book often have a high rate of success, but moving the pens daily is very labour-intensive.

No litter is used so birds can forage for grass and the pen is moved daily. The daily moves control coccidiosis, a parasitic disease that occurs if birds are in contact with their own manure. Salatin advises to return to the same plot of land only once per year.

Since the field pen is only a shelter, the birds are usually raised only in warm weather. On rainy days, producers put hay bedding on the ground under the covered section of the pen to help keep birds dry. One producer uses a "sled" under the pen; a good way to get the birds off the ground in rainy weather. The sled is smaller in dimensions than the pen. She lifts up one end of the pen and pushes the sled in. She uses a rectangle frame that is covered with hardware cloth so droppings still fall through to the ground. Although the birds are not free to roam in a pasture pen, they still have the advantages of fresh air and sunlight. However, the confined space of the pen is a welfare concern. Larger pens are needed for turkeys because of their wing spans. A field pen generally provides good predator control, but some predators (namely raccoons) can grab chickens through the wire. If there are low spots in the pasture, holes between the bottom of the pen and the ground need to be stopped up with scraps of wood or other materials. Some producers run an electric wire around the pen area a few inches off the ground to keep predators away or surround the pens with electronet fencing. Some producers use a combination of field pens and fencing, opening up field pens within a yard enclosed by electronet; the birds range in the entire enclosure during the day.

The pens are moved manually by putting a dolly on one end and lifting by a handle on the other. Birds learn to walk along with the pen as it is dragged across the field, but occasionally a bird will escape or be injured during a move.

The basic pen design can be modified in many ways. Plastic (PVC) pipe and rebar have been used in place of wood to lighten the structure. However, in areas with strong winds, light pens need to be staked down.

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Some producers peak the roof to allow more heat to escape, to keep rainwater from pooling, or to keep goats off. Skids or wheels can be mounted on the pen instead of a dolly to move the pen. The field pen can also be adapted for egg production by adding nestboxes. There are many other field pen designs that are flat, peaked, domed, or hooped. Building materials include wood, PVC, rebar, electrical conduit, and bamboo. Plamondon has a hoop design on his web site that uses cattle panels. In Europe, there are some fancy—and expensive—pens. Some have attached housing. These European "ark" houses are available through U.S. distributors, but there are also some similar pens in the U.S. The Henspa and the Eglu are available for urban poultry production. A booklet called Pastured Poultry, developed by the National Centre for Appropriate Technology (NCAT) for Heifer International, is available from ATTRA. It presents case studies from a Heifer project, describing the experiences of 19 producers in the South who each raised a batch of pastured poultry in field pens, and includes sections on mortality, weather, pen construction, economic analysis, and more.

Integrated Systems

Diversified farming is an important part of sustainable agriculture, and poultry can be integrated with livestock, crop, and vegetable production in "permaculture" systems that integrate principles of natural systems with agriculture. Some organic programs require that at least 50 percent of the poultry feed come from the farm where the birds are raised—or a nearby farm— in order to keep the nutrients cycling in the same region. Diversified farms allow nutrients to be recycled between plants and animals.

Diversified systems focus on services that poultry can provide, such as fertilization, tillage, and insect and weed control rather than only meat production. A permaculture concept called "stacking" combines several enterprises on the same piece of ground. Various species of domestic animals can be raised together to complement each other, creating mutually beneficial relationships.

Disease cycles can be broken when the same species does not occupy the same site all the time. For example, sheep on pasture can clean up parasites that affect poultry. However, poultry species (chicken, turkeys, ducks, etc.) should not be mixed, nor should flocks of different ages comingle. Some species are "carriers" of disease that can affect other species and older birds can also carry disease to younger birds. Salatin has a hoophouse mainly to overwinter small livestock. Rabbits are kept in hanging cages with chickens on the floor. Worm beds are kept underneath the rabbit cages and are covered with wire to keep chickens out. In the spring, after the animals are removed, the hoophouse is used for early vegetable production. Salatin uses double layers on the hoophouse—a shade cloth and a clear tarp. The shade cloth can be removed to capture solar energy during winter. Salatin makes his buildings multipurpose in order to rotate species in them.

Poultry may share pasture with cattle, sheep, and goats. The pasture soil is improved by the poultry's rich manure which helps revive fertility on a farm. Several species of animals may be grazed simultaneously, or the grazing may be staggered to allow only one species at a time in the paddock. Multispecies grazing can aid in protecting poultry from predators that respect large animals. Sheep in particular can help manage the forage for poultry. However, cattle and goats may disturb poultry housing and feed. Cattle may not have experience with poultry netting and may bring it down by accident. Exclude ruminants from poultry feeding areas to prevent foundering from overeating grains. Also, poultry feed may have additives not

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appropriate for ruminants.

Many cattle producers keep poultry to scratch apart larva-harbouring dung pats, which helps reduce fly and parasite problems on the cattle. Joel Salatin has said he would keep layers in his cattle pastures even if there were no eggs—just for the health benefits to the cattle.

Chicken Tractor

Some vegetable growers insist that in order to build a sustainable system, livestock or their manure must be incorporated into the farm for fertility.

A "chicken tractor" is a way to integrate poultry production with vegetable production. Andy Lee described his system in a popular book called *Chicken Tractor*. Birds are kept in small pens in a garden to provide fertility, tillage, and insect control. Lee uses a small floorless pen so the birds can forage and scratch. The pen is covered with wire and usually has a covered top or a small attached house. The pen is moved daily on fallow beds to add fertility and increase garden yields. The chickens also weed and till the beds and help control insects. Garden wastes are useful feed supplements. In addition to rotating the pen daily to a fresh spot, Lee suggests keeping the pen in one spot and adding fresh straw bedding daily to create a raised garden bed. Moving the pen after one month will leave a sheet-mulch on top of the beds to kill grass and weeds. According to producer Jean Nick, heavy broilers don't really till the soil. "They just poop and stomp on it." Layers are better at clearing weeds and bulbs and scratching the ground.

Scientific studies have examined the impact of poultry on fertility, integrating birds with vegetable and forage production. Jim McNitt, PhD, at Southern University and University of Illinois graduate student Ben Lubchansky have conducted such examinations.

Poultry can also be kept in gardens, fenced with portable electronetting. Chickens help prepare the ground for vegetable planting by tilling. After harvest, birds clean crop residues in market gardens in the fall— turkeys are especially useful for this purpose. According to Andy Lee, "from October through Thanksgiving the turkeys can clean every bit of weeds and spent plants from the garden and leave a rich load of manure behind." "Fold" houses in the United Kingdom allow flocks of chickens to help glean fields after crops are harvested. Chickens are not generally appropriate for a producing garden, because they scratch up seeds or eat crops. According to Vermont producer Walter Jefferies, "I don't let them in early in the season when the seedlings are getting started or late in the year when they'll peck ripe veggies. Chickens, guineas, and ducks all work with some plants such as potatoes, corn, tomatoes at the right states."

Poultry can also be kept in vineyards and orchards. Researchers at Michigan State University studied the use of chickens and geese in apple orchards. Chickens were found to control insect pests while geese aided in weed control. Poultry are kept in some California vineyards. Producers Greg and Jeff Kuntz in Iowa have raised poultry in a multicropping system: a vineyard system with sweet corn and poultry. The brothers use the corn and poultry as a way to add value to the vineyard while the grapes are being established. Young vines are encased in grow tubes that protect them from poultry and that can be removed later.

If poultry are kept in areas with growing crops that are certified organic, measures must be taken to ensure that the crop does not become contaminated with droppings to the extent that it presents a food safety hazard. USDA organic standards require that raw (uncomposted)

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manure be incorporated 120 days before harvest of a crop whose edible portion has contact with the soil (and 90 days for crops without direct contact). While there is an exception for grazing animals, it is still important to take appropriate measures to prevent the presence of manure on crops at harvest time. Other benefits offered by poultry:

- Some people keep chickens for tick control on their land.
- Turkeys were used in the past for insect control in crops, such as in tobacco during U.S. colonial times. Turkeys are more aggressive foragers than chickens.
- Weeder geese were used on a large scale in California in the '50s to weed cotton fields before the widespread use of herbicides. Geese have a strong preference for young grasses and have been used successfully to weed crops such as strawberries, potatoes, and onions.
- Ducks have been used to control aquatic plants in ponds, especially duckweed and pondweed. Muscovy ducks have been used for fly control on dairy farms. Ducks and geese provide insect, snail, and slug control.
- Guineafowl, considered luxury food in Europe, are good foragers, controlling insects in pastures and gardens. Because of the noisy calls they sound when alarmed, guinea fowl and geese can also act as "watchdogs."
- ATTRA can provide more information on turkeys, geese, weeder geese, ducks, guinea fowl, and gamebirds upon request.

Application of Outdoor Poultry Production to International Development Work

The production systems described in this publication are useful not only for alternative poultry production in the U.S. and other developed countries, but also for developing countries, where production systems rely heavily on integration with other farm activities. In many villages, poultry are kept loose in order to scavenge food waste. While large-scale indoor production system is used in many countries around the world, small-scale systems remain important. For example, small-scale growers produce 30 percent of the poultry in China.

Choosing a Production System

A producer's motivations will influence the size and type of production system chosen. Is the plan alternative poultry being a farm centrepiece or a part-time source of supplemental income? Is the plan year-round production or seasonal? Producers may choose one system for layers and another for meat birds.

Choosing a production system involves considerations such as the following:

- *Intensive vs. extensive:* Many large-scale operations use indoor production systems or semi-intensive systems with a yard. However, an extensive system is ideal for free-range poultry, especially combining poultry with other livestock grazing.
- *Fertility implications:* Does the producer want a light layer of manure spread over a large area or a heavy layer of manure over a small area? Is a goal fertility for a pasture? Or feedstock to compost for market garden or crops? Can a producer control excessive nutrients by rotating poultry land with crop production, grazing with ruminants, or making hay?

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- *Flexibility:* Many producers start with a pasture pen since it is an inexpensive system and flexible. They can try out one batch to see whether they like raising and processing poultry and whether they can build a market. Although it is labour-intensive, the entry costs for the enterprise are low. Many producers eventually switch to a different production system as their operations grow.
- *Labour and management:* A fixed house is easier to service, while moving portable houses obviously takes time. Ease of access is also an issue in small pens, so many producers make pens tall enough to stand in.
- *Bird welfare:* Some consider the pasture pen inhumane because it may expose birds to the elements, and submissive birds have no way to escape aggressive birds in the confining quarters. Active breeds are less able to forage in a pasture pen.

Outdoor Area

Outdoor access allows poultry to express natural behaviours. Birds scratch, pursue insects, eat forage, and dust-bathe outdoors. Outdoor access provides more space and is called "extensive," which may reduce stress because the birds are less crowded. Direct sunlight, fresh air, and the elements (frosts, heat, drying) can help reduce disease. Outdoor access can enrich the lives of poultry and incorporate their activity as part of biological cycles and nutrient cycles. However, if outdoor access is poorly done, it will be a detriment for the poultry rather than a benefit.

Land should drain well and should be mainly covered with vegetation. Land with low spots may be a problem in heavy rains, and poultry may be exposed to pathogens and parasites if they drink from dirty puddles. However, waterfowl need access to bathing water. For certified organic production, there should be no synthetic chemicals applied to the land for three years.

Birds need the same services outside the house as inside. They should have access to feed and water outside so they do not have to return inside. Feeders should be protected from rain and wildlife with a shield or cover and should be easy to move to a new location. Birds also need access to shade and shelter so they don't run back to the house every time something flies overhead.

The chicken evolved from a ground dwelling forest fowl that inhabited tropical forest clearings and woodland edges and roosted in trees at night. As flightless birds from the jungle, they need protection and shade outdoors, such as trees and bush plantings. In fact, they may not venture outdoors without it. Chickens do not like full sun, strong winds, or overhead predators. European research has shown that birds will forage in the open but prefer a covered area for resting. Some free-range programs in Europe require shade/shelter in outdoor areas. Trees and bushes are multipurpose, providing shade, roosts, overhead cover, and a wind break. Man-made constructions can also be used, including roof overhangs, walls, tarps and shade panels, portable "wigwams," and strawbales with pallets on top. Tarps on wheels provide portable shade and keep manure from collecting in concentrated areas. Tall crops such as corn or sunflowers can also be planted to provide shade and additional feed. Sometimes poultry are raised close to corn fields so birds can range among the tall plants.

Poultry can be combined with trees in an "agroforestry" setting, such as an orchard or woody ornamentals. A variety of trees, shrubs, understory plants and a pasture clearing will offer a wide range of nutrition, herbs, live protein, and shelter to the birds. Elm Farm

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Research Centre in the U.K. has planned a poultry agroforestry system with trees, shrubs, and health-promoting herbs.

Studies of large flocks of free-range meat birds in the U.K. showed that even in summer, the maximum number of birds that came outside the house was only about 15 percent of the flock. The number of birds outside was positively correlated with the amount of tree cover on range, as well as the time of day and season of the year. Specifically, more birds ventured outside if there was tree cover. Birds were less likely to go outside in the winter or during the middle of the day. Chickens prefer areas with trees, avoid bright sun, and either stay close to the house or seek tree cover. A wide open field is not preferred habitat. Encouraging birds to forage is important for the authenticity of free-range production and consumer confidence, and it begins with housing design. Keeping the buildings small or providing many exits enables birds to find their way outdoors. Bird-sized doorways may be used. Human doorways or opening an entire side provides additional access. Provide exits that are big enough that birds don't block the door. EU legislation requires 4 metres of pophole for every 100 square metres of house (13 feet of pophole per 1076 square feet). Maintaining vegetation or putting slat flooring by the popholes on the inside and outside helps reduce the amount of mud the birds track inside. Some programs like the Assured Chicken in the U.K. require a doormat.

Breed also plays a role in encouraging foraging. The fast-growing Cornish cross typically used for meat production in the U.S. is not as active as other breeds, especially as they get older and heavier. Some producers believe fast-growing birds in particular must be encouraged to graze by removing their concentrate feed temporarily. Sometimes fast-growing birds will go outside, but only to rest rather than forage. Slow-growing meat birds and layers are more active and may go outside and forage more. Usually birds return to the house at night due to their roosting instinct but some birds may need to be trained.

Some producers move outdoor feed and water stations away from the house to encourage foraging over a broader area and reduce stocking density near the house. The shade and shelter in the outdoor area will also encourage birds to move away from the house.

Birds go outside mainly in the morning and dusk. In hot weather, they may stay inside in the heat of the day or rest in the shade. Chickens are creatures of habit and use paths. Birds may range a considerable distance from the house depending on the production system and conditions. Active breeds may range about 100 metres (328 feet) from the house. Some producers believe that making forage available from an early age during brooding encourages birds to forage in the future.

Pasture

Chickens obtain limited nutrients from forage plants. Forage can be high in vitamins and protein; however, the nutrients in forage are not packaged well for chickens. Chickens were domesticated from wild, seed-eating jungle fowl, and have short digestive tracts. When chickens eat forage, their ceca develop microbes with the capacity to digest fibre and are much larger than the ceca of chickens that do not eat forage. Still, chickens cannot digest large quantities of fibre like ruminants can. Some other avian species, such as geese, can obtain more nutrients from forage, because they are better able to digest fibre. Poultry obtain high-quality nutrients from live protein such as worms and insects. On pasture, birds may eat enough nutrients to replace 5 to 10 percent of diet; however, when formulating rations, it may be best to assume zero contribution from pasture, because it is difficult to know what nutrients

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will be supplied and in what amount.

A key to pasture management for poultry is to keep the forage young and vegetative. Older plants are less digestible than young leafy plants. According to one producer, "chickens ignore vegetation over four inches high—all they will do is trample on it." In tall grass, they tend to make tunnels to feeders and not use the rest of the range. Tall grass holds moisture that may harbor parasites. Further, it can wet the birds' feathers and the moisture may be tracked into the house. Tall grass, especially when mowed, may become caught in the crop and cause digestive problems. Poultry yards should be laid out so it is easy to use a tractor to mow, plow, and plant. Ruminant grazing can help manage forage for poultry and avoid the need to mow or hay. In fact, combining sheep with poultry production is a best management practice to manage the pasture.

Pasture for free-range poultry is usually designed to be hard-wearing or is designed for ruminants. Many variables come into play in determining the "best forage" for your operation: soil type, pH, amount of rainfall, field fertility, type of tillage for seeding, size of pasture, and other planned uses of pasture, such as ruminant grazing or haying. Contact your local Extension service to discuss the best mix of cool season and warm season forages for your region. You may not need to add fertilizer because the poultry will add it in the form of manure, improving the pasture.

A perennial pasture with legumes and grasses is often suggested for ruminant pasture, because diverse species are the most reliable for a wide range of conditions, from high moisture in spring and fall to hot, dry days in summer. It may require a few years of intensive management by ruminant grazing to develop diverse pasture.

In the early part of the 1900s, scientific research examined forages and pasture management for poultry. Much of this research is still useful today; however, the modern broiler grows much faster than the meat birds of 100 years ago and needs more nutrients and feed supplementation. According to Plamondon, "Everything I've read points to oats as the ideal cool-season green feed, while ladino clover, alfalfa, and to a lesser extent other clovers are better summer feeds. My own experience with oats has been very favourable. Oats seem to do very well when broadcast by hand." According to Plamondon, the research showed that ladino clover and alfalfa remained palatable throughout the summer if mowed occasionally.

Legumes in the pasture may increase the omega-3 fatty acids in poultry meat and eggs. Chloroplast membranes of plants, where photosynthesis occurs, contain unsaturated fatty acids. The leafier the plant, the more omega-3 fatty acids it has. Clover, for example, is leafier than alfalfa, which has more stem. Research at Pennsylvania State University compared the amount of unsaturated fatty acids in three types of pasture: 1) alfalfa and grass, 2) red clover and white clover and grass, and 3) mixed grass. They found legumes had more unsaturated fatty acids. Eggs from hens raised on legumes and grass had more omega-3 fatty acids and vitamins than eggs from hens only raised on grass. Poultry can also be run on leguminous cover crops that are planted to increase nitrogen in the soil for crop production. Ruminant access to lush leguminous pasture should be restricted, especially in the spring, because they may overeat and founder (produce too much gas in the rumen). Special pastures may be designed for poultry, including seed mixes for poultry/sheep pasture. Peaceful Valley Farm Supply offers an Omega-3 Chicken Forage Blend seed mix. There is also interest in herbs that could be beneficial for poultry health maintenance or that could improve meat

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quality in terms of nutrient content or flavour.

Some plants may be poisonous to poultry, including the following: castor bean (*Ricinus communis*), corn cockle (*Argrostemma githago*), daubentonia (*Daubentonia longifoli*), death camas (*Zygadenus spp.*), glottidium (*Glottidium vesicarium*), milkweed (*Asclepias spp.*), nightshade (*Solanum nigrum*), oleander (*Nerium oleander*), pokeberry (*Phytolacca americana*), potato (*Solanum tuberosum*), vetch (*Vicia spp.*), and yew (*Taxus spp.*).

Fire ants on pasture can be a concern when using pastured pens in hot climates. Care should be taken not to place young birds on fire ant mounds. However, older birds may actually eat the ants and destroy mounds. ATTRA has a publication on sustainable fire ant control.

Major parts of the western U.S. are dryland where it is difficult to keep forage in a vegetative state. Drought-tolerant plants, such as perennial and annual ryegrass, sudan grass, millet, and sorghum, can stay green during the long dry summers, but poultry may not like them as much as other forages. Much western pasture is essentially standing hay and offers little nutrients for poultry; however, live protein and other benefits of outdoor access are still important. In fact, turkeys are native to dry areas of southern North America. Low moisture on dryland reduces the danger of poultry disease and parasites, and the fertility brought by poultry is welcome. Some producers in the West raise birds on irrigated pasture.

Pasture Rotation

Rotation allows pasture to recover from grazing and reduces the buildup of excessive nutrients and pathogens. To rotate pasture, birds are moved to new pasture by moving the house or moving the birds to a new yard. Pasture should be rotated at least every two to three months, although every month is better. Pasture can be rotated after flocks of meat birds are harvested, but a layer flock should not remain in the same pasture for the entire life of the flock. The pasture must be rotated.

Mobile houses that can be moved frequently are ideal to facilitate pasture rotation. Moving portable housing creates new environments for flocks, and birds may try to return to the old location if the house is not moved far enough. If a fixed house is used, subdivide the yards into at least 4 separate yards and rotate flocks among these. Plant trees or shrubs about 30 to 60-feet away to draw birds from the house.

Free-range poultry production should not add excessive nutrients to the ground. Soil samples taken as an initial baseline and annually will monitor how much nitrogen and phosphorus is added by outdoor access or application of litter to the ground. Legislation is increasing concerning the level of nutrients that can be applied to the land from animal waste. Regulations in the U.S. vary by state. The EU does not allow more than 170 kg/N/ha/year to be added to land from livestock manure, which would be the equivalent of 580 table chickens or the equivalent of 230 hens.

Where excessive nutrients build up in the soil, pathogens are also likely to build up as well, resulting in “fowl sick” land. Although many pathogens and parasites will die after their poultry hosts are removed, some are able to survive for a long period of time and re-infect birds when they are returned to the land. An additional consequence of not rotating pasture is that the vegetation is worn down to dirt. Mud from bare lots is tracked into the house and dirties eggs, greatly increasing egg cleaning costs and increasing moisture in the litter.

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Not rotating free-range yards will be a limiting factor on performance due to pathogens. If you have less than 50 birds, you probably do not need to rotate pasture. In the past, cultivation of crops or hay were rotated into poultry production to use up the nutrients and keep the soil from becoming compacted. According to Plamondon, "The old-fashioned method is to lime the pasture like mad, plow it, and replant it." The Soil Association recommends that pastures for laying flocks be rested for 12 months between flocks, with a requirement of at least 9 months rest. For meat chickens, the Soil Association makes the following distinctions:

- Clean pasture: no poultry for three years or new pasture after crops
- Relatively safe pasture: no poultry for one year; or no poultry for six months if land has been plowed and reseeded
- Dangerous pasture: pasture that has had poultry within six months.

Many producers permit outdoor access to improve not only bird welfare but also health; however, there are concerns about birds getting diseases from wildlife. In times of extreme heightened biosecurity, birds may be temporarily confined. At the time of this writing, avian influenza is a concern, and in Europe, many free-range flocks have been confined to prevent contact with wild birds. Take measures to reduce direct contact between domestic poultry and wildlife. Keep wild birds out of range feeders so they won't eat from them or defecate in them. The Soil Association suggests a container with small slits that allows poultry to pick out only a few grains or pellets at a time. Netting over range areas reduces contact with wildlife, and covered areas can eliminate contact. Biosecurity for the Birds is a USDA project that provides information for small poultry producers on how to maintain good biosecurity.

Seasonal Aspects of Alternative Poultry Production Systems

When poultry have outdoor access, there are seasonal aspects to production. The pasture composition in particular varies, and in the spring, forage grows quickly. The day length and light intensity varies in temperate areas and is more constant in tropical areas.

The U.S. has some regions that are very cold in winter. It is difficult to move portable housing in the winter in areas with snow or to insert electronet fencing poles in frozen ground. Any program that requires outdoor access should specify how birds can be handled in winter and still be considered free-range. In the USDA organic program, birds can be temporarily confined due to inclement weather.

Baled hay, such as alfalfa, and sprouted grains are useful during winter to maintain an intense yellow colour in egg yolks and provide enrichment for the birds. Verandas or "winter gardens" are also useful. In winter, some houses may not be heated. In insulated houses, body warmth may be sufficient to keep the house from freezing if there are enough birds. However, the welfare of the bird should be considered and avoid large temperature swings and cold, wet conditions. Many layers will go outside in snow, particularly if the snow has been packed down. Temperature has an impact on performance, particularly feed intake. Birds tend to eat less in hot weather and more in cold weather, when they need more energy to stay warm.

Predator Control

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Predators can cause a lot of damage to a flock and can also spread disease. A solid house is a good defence against predators when the birds are closed in at night. Most predators are nocturnal such as raccoon, opossum, weasel, and owls. Small flocks can be counted to monitor predation, but a producer must be able to recognise signs of predation in large flocks. Identifying the predator affecting your flock is essential to control. Use the following guide. Welp Hatchery also has information on predator diagnosis on its web site.

For daytime predators, such as dogs, an electronet fence around the poultry yard provides good protection from ground predators. Other predator controls include moving the house frequently to keep predators off guard, keeping housing away from wooded areas, keeping the housing close to a residence, grazing birds with cattle or other large animals, and grazing on shortgrass pasture, which predators do not like to cross in the daytime, Dispose of dead birds properly to avoid attracting predators.

Signs	***Predator***
Several birds killed	
Birds mauled not eaten	Dog
Small bites on body; neatly piled; some heads eaten	Mink or Weasel
Chicks killed; abdomen eaten; lingering smell	Skunk
Only 1-2 birds killed	
Birds mauled; abdomen eaten	Opossum
Deep marks on head and neck; some meat eaten	Owl
Only 1 bird gone; feathers remain	Fox or coyote

Adapted from Berry, J. 1999.

Reliable control for aerial predators such as hawks and other daytime raptors is difficult. In addition, birds of prey are protected by federal law from harassment or shooting. Some producers have a lot of hawk pressure and lose several birds per day to hawks; others lose only a few per year. Trees, tall crops, roof or window overhangs provide shelter so birds can run for cover. Use wide popholes so birds can quickly enter the house. Heavy broilers may not be as fast at escaping as more active breeds. Overhead bird netting excludes hawks, but this may be impractical for mobile production systems. Producers use scare tactics and alarms such as a fake owl or hanging reflective ribbons or CDs to reflect light. Scarecrows should be mobile and realistic with changes of clothing. One producer suggested rigging a radio to a motion detector light. According to another, “Here the guineas alert the dogs and the dogs alert us who get the gun.” One producer, having trouble with bears, hooked up a car alarm to a battery and put it on the poultry pen. It said “Step away from the car” and started sounding an alarm.

Since hawks are stealth hunters, interference slows them down and gives poultry a chance to escape. One producer uses long rectangular yards, because they are too narrow for hawks to glide in from the sides. Flight is disrupted on the shorter ends of the yard, with poles with surveyor’s’s ribbon. Other producers string fishing line over the paddocks above head height and spaced several feet apart.

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North America has some substantial predators, and guard animals can help. Dogs can be trained to guard poultry. Llamas and donkeys also make good guardian animals, especially since they can eat forage and stay with the poultry at all times. Often dogs come to the house to visit or sleep at night.

According to Vermont producer Walter Jefferies, "At issue is how many protectors are in the guardian pack. A single dog or llama, doesn't cut it with serious predation—several are much better as they can work as teams. A pair or pack of guardian dogs will successfully protect against almost anything short of the marine corps. Two do a bear. Three a cougar… Dogs alert us to threats, mark territory in ways that predators understand and respect…By their nature dogs are hunters at the same time of day that predators are at their greatest threat since the dogs are semi-nocturnal. Dogs are also useful for disposal of proteins (slaughter remnants) that I don't want to feed back to our various flocks (pigs, sheep, poultry). Likewise, dogs kill and eat the local pest and small predator populations from mice on up as high as the coyotes foolish enough to enter the pastures."

Some producers live trap predators and may then kill the animal humanely. Problem animals can be relocated, but they may become a problem for another producer.

Application of Modern Nutrition Principles in Poultry

All animals have a need for a certain amount of each nutrient every day in order to accomplish desired performance. Programs have been developed at the University of Florida to formulate feeds for commercial layers, broiler breeders, and replacement pullets for commercial egg production on an intake basis. A programme has been developed for broiler breeder replacements and some suggestions have been made for developing a similar programme for broilers. A brief review of each programme will be made and recommendations will be given for formulating feeds on this basis.

Commercial Laying Hens

For years it has been recognised that the nutrient composition of feeds for laying hens should be changed when temperature changes. This is necessary because the hen eats less feed in hot weather than in cold weather. In addition, there are other factors which control the amount of feed which the hen eats. Therefore, it was necessary to develop recommendations for daily intake of certain nutrients for the laying hen. A daily intake of 610 mg of sulfur amino acids and 730 mg of lysine was recommended. At this time recommendations were not made for any of the other amino acids.

Recommendations were also made for sodium and calcium. It was suggested that the level of phosphorus be reduced as the hen aged in order to improve eggshell quality. Since the level of phosphorus was changed for three different stages of life, it was decided that it would be appropriate to make other modifications (Harms, 1979) in order to feed the bird more efficiently.

Suggested daily intake of various nutrients when commercial layers are fed based on feed intake level of amino acids was recommended for 20-36 weeks of age with the lowest level of calcium and the highest level of phosphorus. The amino acid levels were reduced with age reducing the margin of safety and as a means of reducing the cost of the feed. This reduction was not made because the amino acid requirements of the hen decrease with age.

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The level of calcium was increased and the level of phosphorus decreased as the hen aged. These changes were made in an effort to get better eggshell quality.

In 1981 the recommendations (Harms, 1981) were again modified and specifications were made for six different age groups. The recommendations for 20-27 weeks were the same as had previously been recommended. The recommendations for 36-43 weeks were also the same as had previously been recommended for 37-52 weeks of age. The intermediate phase from 8 to 36 weeks was formulated by taking an average of these two. The basis for this was that if the requirements were to be changed at 36 weeks, why not make an intermediate change and save some money while improving the performance of the hen? The recommendations after 51 weeks were the same as those used previously. The 44-51 week recommendation was an average of the original phase 2 and phase 3. The sixth program was formulated to meet the bare minimum requirements of the hen and is to be fed six weeks before hens go to market or are force moulted. This change is again made primarily in an effort to save money, however, the programme includes an increase in calcium and a reduction in phosphorus which has been shown to give an improvement in eggshell quality.

The sulfur amino acid level ranges from a high of 0,789% when the hens are eating 17 lb per 100 birds per day to a low of 0,537070 when the hens are consuming 25 lb per day. The other amino acids follow the same pattern. A suggestion is given for protein. However, it is not necessary that this level be met if amino acids are adequate. The phosphorus level ranges from a high of 0,84% total phosphorus at the 17 lb' intake to a low of 0,57% for the 25 lb intake. The calcium and sodium are also phased down. However, a calcium level higher than 3,3% is not recommended regardless of feed intake. It is quite well established that if the feed contains more calcium than necessary, it will reduce feed intake. With young hens, it is desirable to get them to eat as much as they will in order to increase egg size as rapidly as possible. If the feed is formulated to meet the specifications for 22 lb intake, and the hen eats this amount, she will receive 15,5 g of protein per day, 610 mg of sulfur amino acids, 730 mg of lysine, 180 mg of tryptophan, and the other nutrients which are desired. However, if this same feed is used, and the hens only consume 20 lb per 100 birds per day, they will receive 10070 less of all nutrients than is desired. In other words, instead of getting an intake of 610 mg of sulfur amino acid, the hen would get 559 and all other nutrient intakes would be reduced proportionately.

On the other hand, if this same feed is given and the hen consumes 24 Ib/l00 birds/day, they will consume approximately 10% more of all nutrients than is necessary. This is very expensive and could possibly reduce performance of the hens.

This is the ingredient cost of feeds which meet the requirement when hens are consuming 22 or 25lb per day. Assumptions are that com costs US $100 per ton and soybean US $150 or 350. With the US $150 per ton cost for soybean meal, the ingredients for a ton of finished feed for the 22 lb intake would cost US $107,20. If the feed was formulated to meet the requirement of the hen, when she was consuming 25 lb per 100 birds per day, the cost would be US $103,83 or a difference of US $3,37. If the price of soybean meal increased to US $350 there would be a US $10,65 difference per ton in savings in ingredient cost. There would also be additional savings because the energy content of the feed would be increased.

When the protein level is decreased, soybean meal is replaced with com, and the energy level of the feed increases. If com and soybean meal were used to formulate a feed for 22 and

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25 lb intake, there would be a difference of 41 kcal per lb of feed. The hen reduces her feed intake by 1% for each 14 kcal increase, therefore, she would reduce the amount of feed consumed by 2,21% (2,21% of the $107,20 is $2,37). When this is added to the $3,37 for savings in ingredient cost there is a savings of $5,77, and at the $350/ton for soybean meal the savings would be $13,84. If feeds are to be formulated on these specifications, it is necessary to use the same nutrient profile for the ingredients. If different values are used it is necessary to adjust the nutrient recommendations accordingly.

Broiler Breeder Program

After developing a programme for feeding commercial layers based on the daily feed intake, a similar programme was developed for broiler breeders. Based on previous research, specifications for daily nutrient intake of broiler breeders were established. The original specifications were for 23 g of protein, 850 mg of sulfur amino acids, 4,5% of calcium, 750 mg phosphorus and 170 mg sodium. After conducting a series of two experiments it was found that these suggestions were approximately 20% higher than the requirement. The requirement for protein was no more than 18,6 g and the sulfur amino requirement was no more than 682 mg. A requirement for methionine, lysine, arginine and tryptophan was also established. The mineral requirements previously suggested were also higher than necessary. Based on these results, new specifications were established. The original requirements were reduced by 10% as shown in the right-hand column. The original requirements were much higher than the revised, and the revised recommendations were still much higher than the actual requirements.

These recommendations carried a 10% margin of safety and if the amount of feed broiler breeders get each day is actually measured, these recommendations could be reduced even further. The levels of amino acid decrease as feed allowance increases. For instance, the sulfur amino acid content of the feed at a 28 Ib daily allowance would be 0,584070 and is reduced to 0,416070 if 40 Ib of feed is given.

The other amino acids decrease in the same proportion. The calcium level is 3,21070 at the 28 Ib allowance and is reduced to 2,24070 at the 40 Ib intake. All these levels would result in the hen getting 4,07 g calcium per day which would meet the requirement. The vitamin, phosphorus and sodium levels also vary in the same manner.

These prices are based on US $100 per ton of corn and US $150 per ton of soybean meal. There would be a savings of US $2,73 per ton in ingredient cost if the feed were formulated on the specifications for a 32 Ib intake and we were actually giving them 36 lb. The energy level would also be increased when reformulating the feed. This would result in 2,7070 less feed being given each day, and would result in a US $2,96 per ton savings. The total savings would be US $5,69 with a cost difference of only $50 per ton for corn and soybean. If the difference is increased, the savings would be greater.

Commercial Egg Replacement Pullet

This was necessary to get the maximum bodymass on the pullet before placing it in the laying house in order to get the best production during the hot weather.

However, the general recommendation is to lower the level of protein at about 6 weeks, again at 12 and again at 16. If the requirement decreases in this manner it is more logical to

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decrease it in a linear fashion. Experiments using a stepwise reduction in protein were conducted at the University of Florida and it was found that this program resulted in maximum performance of the pullet.

Note that an eighth feed program is suggested for the pullet.

A sulfur amino acid level of 0,68070 is recommended for the first 5 weeks, and is gradually reduced to 0,42070 from 19 to 20 weeks. If the flock is large enough to necessitate the delivery of 16 loads of feed, formulations should be based on specifications for 16 feeds. These recommendations are for corn/soybean meal diets and the approximate energy level is shown in the right-hand column. To convert these values to the nutrient requirement per megacalorie, divide the requirement by this energy level and multiply by 1000. The requirement decreases as the pullet ages; however, sodium was left constant at 0,15070 of the diet. More research is needed on the sodium requirement of the pullet.

Factors Affecting Feed Intake

There are factors which affect feed intake and in turn will influence feed formulation and also nutrient level requirements of the feed expressed on a percentage basis. During the past 10-15 years, experiments have been conducted on the influence of copper on growth of broilers and turkeys as well as the influence of monensin on growth of broilers. Robbins & Baker (1980) studied the influence of increasing amino acids, minerals, and vitamins in a purified diet with and without added copper. Their conclusions were that this diet was adequate in vitamins, minerals, and amino acids in the presence or absence of added copper. However, close examination of the data indicated that this was not true.

The addition of amino acids to the basal diet containing no supplemental copper resulted in increasing bodymass by 8 g, which was not statistically significant (pooled error 4,2 g).

The addition of minerals and vitamins gave no further improvement in bodymass. However, there is a different pattern of performance of the chicks receiving the diet with and without added copper. With copper the addition of amino acids resulted in increasing growth rate by 11 g, which was statistically significant. The addition of minerals to the diet with added amino acids resulted in another numerical improvement in growth. Also when additional vitamins were added to the diet containing added amino acids and minerals a further significant increase in growth was obtained. These data indicate that the depression in body-mass gain from the addition of copper was partially due to depressed feed and nutrient intake.

In the same study, the addition of amino acids to the diet resulted in reducing feed intake when the basal diet was fed containing no added copper. The addition of vitamins and minerals did not influence this further. The addition of copper resulted in decreasing feed intake. When the amino acids were added to the copper-containing diet, a slight improvement in feed intake was noted. The addition of minerals did not affect feed intake, but a dramatic increase in feed intake was obtained when chicks received added vitamins, minerals and amino acids. It is obvious that a large portion of the growth depression from copper was due to decreased feed intake which resulted in the birds not receiving an adequate daily intake of vitamins, minerals, or amino acids.

Undoubtedly, there is a toxic effect from 500 J!g/g of copper in this diet. However, the majority of the growth depression was due to an inadequate intake of nutrients. With this in mind, an experiment was designed to determine if it is possible to overcome the growth

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depression from adding 500 J!g/g of copper supplied as copper sulfate to practical corn-soybean meal type diets. The approach was to increase the level of all nutrients that might be limiting when feed intake was decreased. Salt, phosphorus, calcium, and microingredients were increased by *20, 7%* over the levels in the basal diet. Lysine and methionine were increased and folic acid, pyridoxine, biotin, potassium, magnesium and sulfate were added. A diet was fed which contained 20,7% protein which has been shown to support near maximum growth especially with a low level of supplemental methionine.

When copper and the critical nutrients listed above were added, normal bodymass was obtained. When copper was added to the highprotein diet, depression in bodymass was obtained. However, the depression was not quite as great as noted in the diet containing the low level of protein. The addition of the critical nutrients restored bodymass gains. It is suggested that the growth depression from the addition of copper was primarily due to the depression of feed intake. The addition of copper to either diet resulted in decreasing feed intake.

However, when the critical nutrients were added, growth rate was restored and feed intake returned to normal. This indicated that the addition of critical nutrients, insuring that the birds were getting an adequate daily intake, resulted in overcoming the copper toxicity.

An experiment has been conducted with laying hens which indicates that the level of nutrients in the diet must be increased to overcome a copper toxicity. Three levels of copper were fed (0, 250, and 500 Jlg/g of copper). Nutrient density of 100% indicates the daily requirements as suggested by Harms (1981) are met and that a 14% margin of safety is possible.

The 118% indicates that all nutrients in the diet were increased by 18%. Therefore, the diets would have contained 32% more nutrients than would normally be needed. The addition of 500 Jlg/g copper to the diet containing 100% of the nutrient requirements resulted in a significant decrease in egg production, egg masses, and feed consumption. Increasing the level of nutrients in the diet by 18% did not affect egg production in diets containing 0 or 250 Jlg/g.

However, when 500 Jlg/g copper was included in the diet, a significant increase in egg production, egg masses and feed consumption was obtained at the high level of nutrient intake. These data indicate that copper is depressing feed intake of the birds and they do not obtain enough nutrients to support maximum egg production. However, there is an indication of a copper toxicity which is not totally overcome by increasing the nutrient level of the diet.

These results led us to conduct an experiment to determine whether increasing the nutrient content of the diet would overcome the growth depression from monensin. Two levels of protein were fed (21 and 25%), with and without monensin addition. The addition of monensin to either level of protein resulted in significantly decreased bodymasses. Addition of critical nutrients resulted in significantly increased bodymasses. When the critical nutrients were added to the diet containing 25% protein and monensin, a significant growth increase was obtained. The addition of monensin to the diet containing either level of protein resulted in decreased feed intake. However, the addition of critical nutrients resulted in restoring part of this reduced feed intake.

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Chapter 12 : Poultry Farming

Poultry farming is the practice of raising poultry, such as chickens, turkeys, ducks, and geese, as a subcategory of animal husbandry, for the purpose of farming meat or eggs for food. More than 50 billion chickens are reared annually as a source of food, for both their meat and their eggs. Chickens farmed for meat are called broilers, whilst those farmed for eggs are called egg-laying hens. In total, the UK alone consumes over 29 million eggs per day. Some hens can produce over 300 eggs a year. Chickens will naturally live for 6 or more years. After 12 months, the hen's productivity will start to decline. This is when most commercial laying hens are slaughtered. The vast majority of poultry are raised using intensive farming techniques. According to the Worldwatch Institute, 74 percent of the world's poultry meat, and 68 percent of eggs are produced this way. One alternative to intensive poultry farming is free range farming.

Friction between these two main methods has led to long term issues of ethical consumerism. Opponents of intensive farming argue that it harms the environment and creates health risks, as well as abusing the animals themselves. Advocates of intensive farming say that their highly efficient systems save land and food resources due to increased productivity, stating that the animals are looked after in state-of-the-art environmentally controlled facilities. A few countries have banned cage system housing, including Sweden and Switzerland. Consumers can still purchase lower cost eggs from other countries' intensive poultry farms.

Techniques

Organic

In organic systems, chickens are also free-range. Organic chickens are slower growing, more traditional breeds and live typically for around 81 days. They grow at half the rate of intensive chickens. They have a larger space allowance outside (at least 2 square metres and sometimes up to 10 square metres per bird).

Indoor with Higher Welfare

Chickens are kept indoors but with more space (around 12 to 14 birds per square metre). They have a richer environment for example with natural light or straw bales that encourage foraging and perching. The chickens grow more slowly and live for up to two weeks longer than intensively farmed birds. The benefits of higher welfare indoor systems are the reduced growth rate, less crowding and more opportunities for natural behaviour.

Free-range

Free range poultry farming consists of poultry permitted to roam freely instead of being contained in any manner. In the UK, the Department for Environment, Food and Rural Affairs says that a free range chicken must have daytime access to open-air runs during at least half of their life. Unlike in the United States, this definition also applies to eggs. The European Union regulates marketing standards for egg farming which specifies a minimum condition for Free Range Eggs states that "hens have continuous daytime access to open-air runs, except in the case of temporary restrictions imposed by veterinary authorities". In free-range broiler

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systems, the chickens are given continuous access to an outdoor range during the daytime and sheds where they are housed at night. Free-range chickens grow more slowly than intensive chickens. They live at least 56 days. In the EU each chicken must have one square metre of outdoor space.

Free range poultry production requires that the poultry have access to the outside. In some cases this means the poultry are raised on pasture, enabling the poultry to move around, forage for their natural diet and live in cleaner conditions than those in batteries. In some farms, the manure from free range poultry can be used to benefit crops.

The benefits are also a reduced growth rate and opportunities for natural behaviour such as pecking, scratching, foraging and exercise outdoors, as well as fresh air and daylight. Because they grow slower and have opportunities for exercise free-range chickens have better leg and heart health and a much higher quality of life.

Finding suitable land with adequate drainage to minimise worms and coccidial oocysts, suitable protection from prevailing winds, good ventilation, access and protection from predators can be difficult. Excess heat, cold or damp can have a harmful effect on the animals and their productivity. Unlike battery farms, free range farmers have little control over the food their animals come across which can lead to unreliable productivity.

Some free range farming in the UK, which accounts for 26% of production, has also come under criticism concerning animal welfare. This is due to some large scale free range farms where social abnormalities arise due to having large numbers of birds in an outdoor space. Beak trimming due to cannibalism and infighting is common in this form of poultry farming as well as in batteries. Diseases are common and the animals are vulnerable to predators. In South-East Asia, a lack of disease control in free range farming has been associated with outbreaks of Avian influenza.

Yarding

While often confused with free-range farming, yarding is actually a separate method of poultry culture by which chickens and cows are raised together. The distinction is that free-range poultry are either totally unfenced, or the fence is so distant that it has little influence on their freedom of movement. Yarding is common technique used by small farms in the Northeastern US.

Daily releases out of hutches or coops allows for instinctual nature for the chickens with protections from predators. The hens usually lay eggs either on the ground of the coop or in baskets if provided by the farmer. This technique can be complicated if used with roosters though, mostly because of difficulty getting them into the coop and to clean the coop while it is inside. This territorial nature is apparent while outside in which they have a brood of hens and sometimes even informal land claims. This can endanger people unaware of the existence of the territories who are attacked by the larger birds.

Intensive Chicken Farming

In egg-producing farms, birds are typically housed in rows of battery cages. Environmental conditions are automatically controlled, including light duration, which mimics summer daylength. This stimulates the birds to continue to lay eggs all year round. Normally, significant egg production only occurs in the warmer months. Critics argue that year-round egg production stresses the birds more than normal seasonal production.

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Meat chickens, commonly called broilers, are floor-raised on litter such as wood shavings or rice hulls, indoors in climate-controlled housing. Poultry producers routinely use nationally-approved medications, such as antibiotics, in feed or drinking water, to treat disease or to prevent disease outbreaks arising from overcrowded or unsanitary conditions. In the U.S., the national organisation overseeing chicken production is the Food and Drug Administration (F.D.A.). Some F.D.A.-approved medications are also approved for improved feed utilisation. In the U.S., federal law prohibits the use of hormones or steroids in poultry production.

In egg-producing farms, cages allow for more birds per unit area, and this allows for greater productivity and lower space and food costs, with more efforts put into egg-laying. In the U.S., for example, the current recommendation by the United Egg Producers is 67 to 86 in^2 (430 to 560 cm^2) per bird, which is about 9 inches by 9 inches. Modern poultry farming is very efficient and allows meat and eggs to be available to the consumer in all seasons at a lower cost than free range production, and the poultry have no exposure to predators. The cage environment of egg producing does not permit birds to roam. The closeness of chickens to one another frequently causes cannibalism. Cannibalism is controlled by de-beaking (removing a portion of the bird's beak with a hot blade so the bird cannot effectively peck). Another condition that can occur in prolific egg laying breeds is osteoporosis. This is caused from year-round rather than seasonal egg production, and results in chickens whose legs cannot support them and so can no longer walk. During egg production, large amounts of calcium are transferred from bones to create eggshell. Although dietary calcium levels are adequate, absorption of dietary calcium is not always sufficient, given the intensity of production, to fully replenish bone calcium.

Under intensive farming methods, a meat chicken will live less than six weeks before slaughter. This is half the time it would take traditionally. This compares with free-range chickens which will usually be slaughtered at 8 weeks, and organic ones at around 12 weeks.

In intensive broiler sheds, the air can become highly polluted with ammonia from the droppings. This can damage the chickens' eyes and respiratory systems and can cause painful burns on their legs (called hock burns) and feet. Chickens bred for fast growth have a high rate of leg deformities because they cannot support their increased body weight. Because they cannot move easily, the chickens are not able to adjust their environment to avoid heat, cold or dirt as they would in natural conditions. The added weight and overcrowding also puts a strain on their hearts and lungs. In the U.K., up to 19 million chickens die in their sheds from heart failure each year.

Issues with Poultry Farming

Humane Treatment

Animal welfare groups have frequently criticized the poultry industry for engaging in practices which they believe to be inhumane. Many animal rights advocates object to killing chickens for food, the "factory farm conditions" under which they are raised, methods of transport, and slaughter. Compassion Over Killing and other groups have repeatedly conducted undercover investigations at chicken farms and slaughterhouses which they allege confirm their claims of cruelty.

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Figure: *Battery cages*

Conditions in intensive chicken farms may be unsanitary, allowing the proliferation of diseases such as salmonella and E coli. Chickens may be raised in total darkness; hens are most often kept in crowded wire battery cages with space less than that of a sheet of paper per hen, as opposed to cage-free or free range. Rough handling and crowded transport during various weather conditions and the failure of existing stunning systems to render the birds unconscious before slaughter have also been cited as welfare concerns. Another animal welfare concern is the use of selective breeding to create heavy, large-breasted birds, which can lead to crippling leg disorders and heart failure for some of the birds. Concerns have been raised that companies growing single varieties of birds for eggs or meat are increasing their susceptibility to disease.

A common practice among hatcheries is the mass-slaughter of newly-born male chicks of egg laying breeds, since they don't lay eggs, and do not grow fast enough to be profitable for meat. Once separated from the females, the male chicks are dropped into grinding machines.

Debeaking

Laying hens are routinely de-beaked when young to prevent fighting. Because beaks are sensitive, the usual practice of trimming them without anaesthesia is considered inhumane by some. De-beaked chickens will peck much less than chickens with beaks, which animal behaviourist Temple Grandin attributes to guarding against pain. The United Egg Producers says that de-beaking is not painful. It is also argued that the procedure causes life-long chronic pain and discomfort and decreased ability to eat or drink. De-beaking is described as being as painful as for a human's fingertips, rather than nails, being cut off.

Intelligence

Some groups which advocate for more humane treatment of chickens claim that they are intelligent. Dr. Chris Evans of Macquarie University claims that their range of 20 calls, problem solving skills, use of representational signalling, and the ability to recognise each other by facial features demonstrate the intelligence of chickens.

Antibiotics

Antibiotics have been used on poultry in large quantities since the 1940s, when it was found that the by-products of antibiotic production, fed because the antibiotic-producing mold had a high level of vitamin B12 after the antibiotics were removed, produced higher growth than could be accounted for by the vitamin B12 alone. Eventually it was discovered that the trace amounts of antibiotics remaining in the by-products accounted for this growth.

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The mechanism is apparently the adjustment of intestinal flora, favouring "good" bacteria while suppressing "bad" bacteria, and thus the goal of antibiotics as a growth promoter is the same as for probiotics. Because the antibiotics used are not absorbed by the gut, they do not put antibiotics into the meat or eggs.

Antibiotics are used routinely in poultry for this reason, and also to prevent and treat disease. Many contend that this puts humans at risk as bacterial strains develop stronger and stronger resistances. Critics point out that, after six decades of heavy agricultural use of antibiotics, opponents of antibiotics must still make arguments about theoretical risks, since actual examples are hard to come by. Those antibiotic-resistant strains of human diseases whose origin is known originated in hospitals rather than farms. A proposed bill in the United States Congress would make the use of antibiotics in animal feed legal only for therapeutic (rather than preventative) use, but it has not been passed. However, this may present the risk of slaughtered chickens harbouring pathogenic bacteria and passing them on to humans that consume them.

In October 2000, the U.S. Food and Drug Administration (FDA) discovered that two antibiotics were no longer effective in treating diseases found in factory-farmed chickens; one antibiotic was swiftly pulled from the market, but the other, Baytril, was not. Bayer, the company which produced it, contested the claim and as a result, Baytril remained in use until July 2005.

Arsenic

Chicken feed can also include Roxarsone, an antimicrobial drug that also promotes growth. The drug has generated controversy because it contains the element arsenic, which can cause cancer, dementia, and neurological problems in humans. A Consumer Reports study in 2004 reported finding "no detectable arsenic in our samples of muscle" but found "A few of our chicken-liver samples has an amount that according to EPA standards could cause neurological problems in a child who ate 2 ounces of cooked liver per week or in an adult who ate 5.5 ounces per week." However, the Food and Drug Administration (FDA) is the organisation responsible for the regulation of foods in America, and all samples tested were "far less than the... amount allowed in a food product."

Growth Hormones

Chickens grow much more rapidly than they once did and some consumers have concluded that this rapid growth is due to the use of hormones in these animals. Some consumers believe that the increasingly earlier onset of puberty in humans is the result of the liberal use of such hormones. However, hormone use in poultry production is illegal in the United States. Similarly, no chicken meat for sale in Australia is fed hormones. Furthermore, several scientific studies have documented the fact that chickens grow rapidly because they are bred to do so. A small producer of natural and organic chickens confirmed this assumption:

If this were 1948, you might have something to worry about. Using hormones to boost egg production was a brief fad in the Forties, but was abandoned because it didn't work. Using hormones to produce soft-meated roasters was used to some extent in the Forties and Fifties, but the increased growth rates of broilers made the practice irrelevant—the broilers got as big as anyone wanted them to get when they were still young enough to be soft-meated without chemicals. The only hormone that was ever used in any quantity on poultry (DES) was banned

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in 1959, after everyone but a few die-hard farmers had given them up as a silly idea. Hormones are now illegal in poultry and eggs. The people who advertise "No hormones" are either woefully ignorant or are indulging in cynical fear-mongering, maybe both.

E. Coli

According to Consumer Reports, "1.1 million or more Americans [are] sickened each year by undercooked, tainted chicken." A USDA study discovered *E. coli* in 99% of supermarket chicken, the result of chicken butchering not being a sterile process. Feces tend to leak from the carcass until the evisceration stage, and the evisceration stage itself gives an opportunity for the interior of the carcass to receive intestinal bacteria. (So does the skin of the carcass, but the skin presents a better barrier to bacteria and reaches higher temperatures during cooking). Before 1950, this was contained largely by not eviscerating the carcass at the time of butchering, deferring this until the time of retail sale or in the home. This gave the intestinal bacteria less opportunity to colonize the edible meat. The development of the "ready-to-cook broiler" in the 1950s added convenience while introducing risk, under the assumption that end-to-end refrigeration and thorough cooking would provide adequate protection. *E. coli* can be killed by proper cooking times, but there is still some risk associated with it, and its near-ubiquity in commercially-farmed chicken is troubling to some. Irradiation has been proposed as a means of sterilizing chicken meat after butchering.

Avian Influenza

There is also a risk that crowded conditions in chicken farms will allow avian influenza (bird flu) to spread quickly. A United Nations press release states: "Governments, local authorities and international agencies need to take a greatly increased role in combating the role of factory-farming, commerce in live poultry, and wildlife markets which provide ideal conditions for the virus to spread and mutate into a more dangerous form..."

Efficiency

Farming of chickens on an industrial scale relies largely on high protein feeds derived from soybeans; in the European Union the soybean dominates the protein supply for animal feed, and the poultry industry is the largest consumer of such feed. Two kilograms of grain must be fed to poultry to produce 1 kg of weight gain. However, for every gram of protein consumed, chickens yield only 0.33 g of edible protein.

World Chicken Population

The Food and Agriculture Organisation of the United Nations estimated that in 2002 there were nearly sixteen billion chickens in the world, counting a total population of 15,853,900,000. The figures from the *Global Livestock Production and Health Atlas* for 2004 were as follows:

1. China (8,860,000,000)
2. United States (1,970,000,000)
3. Indonesia (1,200,000,000)
4. Brazil (1,100,000,000)
5. Mexico (540,000,000)
6. India (425,000,000)
7. Russia (340,000,000)
8. Japan (286,000,000)

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9. Iran (280,000,000)
10. Turkey (250,000,000).

The Poultry Industry

Facts about the Poultry Industry

The average consumer may not be aware of the suffering of billions of birds raised for meat and egg production in the United States each year. The U.S. Department of Agriculture (USDA)'s National Statistics Service reported that 7.07 billion "broiler" chickens, 67 billion "egg" chickens, and 321 million turkeys were killed in 1998 for food. In addition, millions of birds die as a result of disease, injury, and during transportation.

Egg Production

Egg-laying hens in the United States number more than 459 million. Of these millions of birds, 97% are confined to "battery" cages, tiny cages roughly 16 by 18 inches wide. Five or 6 birds are crammed into each cage, and the cages are stacked in tall tiers. As many as 50,000 to 125,000 battery hens, in sheds with minimal light, strain to produce 250 eggs per year, ten times the number of eggs they would produce in the wild.

Battery cage confinement does not allow birds to turn around or take part in any other natural behaviour, such as preening, dust bathing, and foraging for food. Prolonged forced confinement causes unnatural behaviours such as cannibalism and increases the incidence of disease and injury. Laying hens are also forced to live in a polluted environment due to toxic feed ingredients, accumulated feces, and excretory ammonia fumes. A successful battery system relies heavily on antibiotics that are routinely administered to laying hens to decrease the incidence of disease among these immune-repressed birds.

Battery hens often die in their cages as the result of disease or injury. Those who survive but stop producing adequately are considered "spent" hens and are sent to slaughter to be used for human and animal food. Male chicks are of no value to egg producers. Each year more than 200 million male chicks are killed or left to die after hatching. Egg-producing birds that are not confined to battery cages seldom fare much better. Eggs labelled "Cage Free" or "Free Range" simply mean that the birds are not confined to battery cages, not necessarily that the hens are allowed a more natural existence. Neither guarantees that they have adequate space to move around, or that they are allowed outdoors to roam about and forage or dust bathe.

Forced Molting

Molting is the natural process of shedding old feathers and the growth of new feathers. Molting initiates a new egg-laying cycle. The natural molting process takes about four months to complete. However, on factory farms, poultry producers induce starvation to control egg production in laying hens (eggs for human consumption) and breeding hens (eggs that hatch into birds used for meat or egg production) to reduce the molting period to one to two months. Performed to increase farm profits, this "forced molting" is extremely stressful to hens. Forced molting methods include food and water deprivation, medications, and simulated light and dark cycles. A 1992 *Poultry Science* report found that forced molting in combination with a Salmonella infection created an actual disease state in tested hens. Salmonella infection can be passed on to consumers through egg consumption.

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Debeaking and Toe Clipping

Debeaking is a painful procedure whereby the bird's sensitive beak is sliced off with a hot blade. Poultry meat and egg producers that use battery cages and crowded floor systems remove one-half to two-thirds of the birds' beaks to discourage cannibalistic pecking, a behaviour that occurs when birds are kept in close confinement with no regard for their natural behaviours. Behavioural studies indicate that debeaked birds are often unable to eat, drink, and preen properly. They also exhibit behaviours associated with chronic pain and depression.

Toe-clipping is the amputation of a bird's toes just behind the claw. This painful procedure is performed to reduce claw-related injuries on factory farms.

Meat Production

Genetic engineering of broiler chickens and turkeys often results in a bird too heavy to stand or walk. They suffer from pain in their legs and sores on their feet that are induced by their extreme, unnatural size. Kept in polluted dark sheds with as many as 25,000 birds per shed, these birds suffer many of the same ailments as battery hens, such as being debeaked and being forced to live in a toxic environment. Thousands of these birds never make it to slaughter — they will die while still on the farm from injuries, disease, or their inability to reach food and water.

Transport and Slaughter

Millions of birds die during the loading of trucks and while en route to slaughter. These sensitive birds, often in very poor physical condition, are grabbed by their legs and thrown into densely packed cages to be transported by truck to slaughterhouses that are sometimes hundreds of miles away. Many die from shock, injury, and suffocation in the process.

The U.S. Federal Humane Slaughter Act does not apply to poultry, meaning that there is no federal law that requires birds to be stunned prior to slaughter. This allows for diversity in commercial poultry slaughter approaches and stunning equipment. When slaughterhouses do use stunning equipment, lack of regulation often results in birds allowed to raise their heads prior to reaching the water bath stunner and therefore not adequately stunned. Problems also exist in neck-cutting equipment, which may result in prolonged and extreme pain caused by necks improperly cut during the killing process.

Poultry Industry in India

Poultry is one of the fastest growing segments of the agricultural sector in India today. While the production of agricultural crops has been rising at a rate of 1.5 to 2 percent per annum, that of eggs and broilers has been rising at a rate of 8 to 10 percent per annum. As a result, India is now the world's fifth largest egg producer and the eighteenth largest producer of broilers. Driving this expansion are a combination of factors-growth in per capita income, a growing urban population and falling real poultry prices.

India is the fifth largest producer of eggs and ninth largest producer of poultry meat in the world, producing over 34 billion eggs and about 600,000 tons of poultry meat in 2004. In the overall market for poultry products, India was positioned 17 in World Poultry Production. And analysts estimate that the poultry sector in India has been growing at a much faster rate, along with other industries such as BPO and Securities market. Over the past decade the

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poultry industry in India has contributed approximately US $229 million, to the Gross National Product (GNP).

Several breakthroughs in poultry science and technology have led to the development of genetically superior breeds capable of higher production, even under adverse climatic conditions that offer opportunities for overseas entrepreneurs to expand export and import of poultry products on a large scale. The average per capita poultry meat consumption is also estimated to increase from 0.69 to 1.28 kilograms, during the 2000-2004. Overall, analysts studies that the total egg consumption is estimated to increase from 34 billion in 2000 and to 106 billion in 2020, while poultry meat consumption is predicted to increase from 687 million kilograms to 1,674 million kilograms.

In the context of this emerging scenario, questions are being raised about the impact of the scaling up of production-through structural factors, externalities and policies-on small-scale producers. Do the transaction costs, policy distortion and environment externalities place the small-scale producer at a disadvantage? Why do some poultry farms have higher income than others? Do large farms earn more profit per unit of output than small ones? What explains the differentials in profitability? This report, which forms part of an ongoing international comparison study on poultry, seeks to address these questions. It attempts to assess the impact of policy and environmental factors on the scale of poultry operations in India as well as the implications of that impact for small-scale production. The study aims to collect and analyse consistent data.

Transformation from a Backyard Activity to a Major Commercial Activity

The poultry sector in India has undergone a paradigm shift in structure and operation. A significant feature of India's poultry industry has been its transformation from a mere backyard activity into a major commercial activity in just about four decades. This transformation has involved sizeable investments in breeding, hatching, rearing and processing. Farmers in India have moved from rearing non-descript birds to today rearing hybrids such as is Hyaline, it is Shaver, ll and in Babcock, it which ensure faster growth, good liveability, excellent feed conversion and high profits to the rearers. The industry has grown largely due to the initiative of private enterprise, minimal government intervention, considerable indigenous poultry genetics capabilities, and considerable support from the complementary veterinary health, poultry feed, poultry equipment, and poultry processing sectors. India is one of the few countries in the world that has put into place a sustained Specific Pathogen Free (SPF) egg production project.

Regional Variation in Poultry Development

Another important aspect of poultry development in India is the significant variation in the industry across regions. The four southern states-Andhra Pradesh, Karnataka, Kerala and Tamil Nadu-account for about 45 percent of the country's egg production, with a per capita consumption of 57 eggs and 0.5 kg. of broiler meat. The eastern and central regions of India account for about 20 percent of egg production, with a per capita consumption of 18 eggs and 0.13 kg. of broiler meat. The northern and western regions of the country record much higher figures than the eastern and central regions with respect to per capita availability of eggs and broiler meat.

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Growing Production of Eggs and Broilers

Presently production of eggs is estimated to number about 37 billion, that of broilers 895 million, and that of poultry meat 735,000 tonnes. In addition, organised facilities have been set up over the years for the manufacture of egg powder and frozen, processed broiler meat essentially to cater to export markets and markets in the metropolitan areas of India.

Increasing Scale of Operation

The growth of the poultry sector in India is also marked by an increase in the size of the poultry farm. In earlier years broiler farms had produced on average a few hundred birds (200-500 chicks) per cycle. Today units with fewer than 5,000 birds are becoming rare, and units with 5,000 to 50,000 birds per week cycle are common. Similarly, in layer farms, units with a flock size of 10,000 to 50,000 birds have become common. Small units are probably finding themselves at a disadvantage because of high feed and transport costs, expensive vaccines, and veterinary care services and the non-availability of credit. Some small units are reported to be shifting from layer to broiler production because output in broiler units can be realised in six weeks.

Structure of the Poultry Industry

The structure of India's poultry industry varies from region to region. While independent and relatively small-scale producers account for the bulk of production, integrated large-scale producers do account for a growing share of output in some regions. Integrators include large regional firms that incorporate all aspects of production, including the raising of grandparent and parent flocks, rearing DOCs, contracting production, compounding feed, providing veterinary services, and wholesaling.

Concentration of Poultry Units Around Cities and Urban Centres

There has also been a growing tendency for poultry units to be concentrated around urban areas because of the existence of ready markets for the end products of poultry production.

Low Per Capita Consumption

Even though India is the world's fifth largest egg producer and the eighteenth largest producer of broilers, its per capita consumption of these products is poor-37 eggs and 1 kg. of poultry meat per capita per annum. Here, again, there is considerable variation in per capita consumption between rural and urban areas and also across the region. Per capita consumption of eggs is only 7.7 per annum in rural areas compared with 17.8 per annum in urban areas. In seven states, per capita consumption is less than 3.5 per annum. Similarly, per capita consumption of poultry meat is 0.24 kg. in rural areas and 1.08 kg. in urban areas.

Slow Changes in Consumption Habits

An analysis of consumption data originating from National Sample Survey (NSS) rounds reveals many interesting facts. First, 42 percent of households are vegetarian in that they do not eat fish, meat or eggs. The remaining 68 percent of households are non-vegetarians. Over time there has been a gradual shift from vegetarianism to non-vegetarianism. The change is more visible in rural areas than in urban areas. For instance, between 1987-88 and 1999-2000, the proportion of households consuming only one of the three items-fish, meat or eggs-increased by only one percent in urban areas, while in rural areas this proportion increased by four percent. Second, calculation of income elasticity of demand for different commodity groups shows that the commodity group that includes meat, fish or eggs ranks second in the quantity of commodities consumed in rural areas (milk and milk products rank first), while in urban areas consumption of the meat, fish, or egg commodity group ranks third. The estimated

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income elasticity is 1.01 in rural areas and 0.66 in urban areas. Third, the price elasticity also follows the same order. Meat, fish or eggs have the high price elasticity of 0.75 in rural areas and 0.68 in urban areas.

Fourth, estimates of income and price elasticities calculated for each of the four expenditure groups show that those elasticities tend to decline as one moves from the poor to the non-poor and the wealthy. The income elasticity is low for the wealthy-0.5 in rural areas and 0.6 in urban areas. The other two income groups in rural areas have high-income elasticity-greater than unity. Price elasticities are greater than unity for the very poor and the poor in rural areas, and for the very poor in urban areas. A significant policy implication of these consumption habits is that there is lot of scope in raising the demand for poultry products in rural areas.

Exports

Exports of poultry products from India comprise table eggs, meat, live birds and value-added products such as egg powder and frozen yolk. The value of aggregated exports was Rs. 1,683 million in 1996-97. Exports were expected to reach the level of Rs. 5 billion by the year 2000.

Employment

Three decades ago, when egg and broiler production was 10 billion and 30 million, respectively, the total employment numbers in the poultry sector were not so encouraging. As income and employment in the crop sector started diminishing, the non-crop sector, which includes dairy and poultry, underwent a significant shift. With the demand for poultry increasing and production reaching 37 billion eggs and 1 billion broilers, this sector now employs around 1.6 million people. At least 80 percent of employment in the poultry sector is generated directly by these farmers, while 20 percent is engaged in feed, pharmaceuticals, equipment and other services required by the poultry sector. Additionally, there may be a similar number of people roughly 1.6 million who are engaged in marketing and other channels servicing the poultry sector.

Issues Relating to Animal Welfare and Environmental Pollution

Issues relating to animal welfare and environmental pollution by poultry units have been of increasing concern in developed countries such as the U.S. and the European Union (E.U.). But in India these issues have not yet emerged as critical although they are discussed at length in various seminars and forums on poultry production. Considering globalization and the international trade in poultry products, however, these issues may assume significance in a few years because of pressures from importing countries such as those in the E.U.

Constraints on the growth of the Poultry Industry

A major constraint affecting the growth of the poultry industry in India is the lack of basic infrastructure such as storage and transportation, including cold chain. As a result, there are wild price fluctuations in the prices of poultry products, i.e., eggs and broilers. Another constraint to growth is an inefficient marketing system. The presence of so many market intermediaries harms both the producer and the consumer. A third problem relates to the price availability of feed resources. Maize or corn plays a major role in broiler production, as it constitutes 50 to 55 percent of broiler feed. As the broiler industry is growing at the rate of 15 percent per annum, the demand for maize is thus likely to increase. Presently India grows only 11 million tonnes of maize and only 5 million tonnes are available for poultry, which is

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not sufficient if the current growth rate of the industry is to be maintained.

Policy Measures

The policy measures that are required to improve the poultry industry must involve: (a) improving infrastructure facilities, which will help not only to stabilize the price of poultry products in the domestic market, but will also make them available in remote areas; (b) creating an efficient marketing channel that will help provide remunerative prices to producers (in other words, India's marketing set-up should also grow along professional lines); and (c) increasing maize production, which will involve using GM (genetically modified) seed varieties or, alternatively, will necessitate finding other sources of feed ingredients that can replace maize.

The Breeds of Chicken

Breeds of Poultry and their Availability

Cari Nirbheek (Aseel Cross):

- The literal meaning of *Aseel* is real or pure. Aseel is well known for its pugnacity, high stamina, majestic gait and dogged fighting qualities. The name Aseel appears to have been given to this indigenous breed because of its inherent qualities of fighting.
- Andhra Pradesh is said to be the home of this important breed. The best specimen of this breed, although rare, are encountered with the fanciers and the people engaged in cock-fighting show through out the country.
- seel is larger inbuilt with noble looking and dignified appearance.
- The standard weight varies from 3 to 4 kg for cocks and 2 to 3 kg for hens.
- Age at sexual maturity (days) 196 days
- Annual egg production (number) 92
- Egg weight at 40 week (g) 50.Cari Shyama (Kadakanath Cross):
- It is locally known as "Kalamasi" meaning the fowl having black flesh. Jhabua and Dhar districts of Madhya Pradesh and the adjoining districts of Rajasthan and Gujarat spreading over an area of about 800sq. miles is considered to be its home tract.
- These are mostly reared by tribals, adivasis and rural poor. It is considered to be a sacred bird and offered as sacrifice to Goddess after Diwali.
- The colour of the day old chicks is bluish to black with irregular dark stripes over the back.
- The flesh of this breed though black and repulsive to look at, is considered not only a delicacy but also of medicinal value.
- The tribal uses Kadakanath blood in the treatment of chronic disease in human beings and its meat as aphrodisiac.
- The meat and eggs are reckoned to be a rich source of protein (25.47% in flesh) and iron.
- Body weight at 20 weeks (g) 920
- Age at sexual maturity (days) 180
- Annual egg production (number) 105
- Egg weight at 40 week (g) 49

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- Fertility (%) 55
- Hatchability FES (%) 52.

Hitcari (Naked Neck Cross);

- Naked neck is relatively larger in built with long cylindrical neck. As the name indicates, neck of the birds is fully naked or only a tuft of feathers is seen on the front of the neck above crop.
- The resulting bare skin becomes reddish particularly in males as they approach sexual maturity.
- Trivundrum region of Kerala is considered to be the homeland of Naked neck
- Body weight at 20 weeks (g) 1005
- Age at sexual maturity (days) 201
- Annual egg production (number) 99
- Egg weight at 40 week (g) 54
- Fertility (%) 66
- Hatchability FES (%) 71.

Upcari (Frizzle Cross)";

- Unique scavenging type birds developed with native breed base, having typical desi fowl look, better tropical adaptability and disease resistance, exceptional growth and production performance.
- Best suited for backyard system of poultry production.
- Four varieties of UPCARI birds suitable for different agro-climatic conditions are available.
  1. Kadakanath x Dehlam Red
  2. Aseel x Dehlam Red
  3. Naked Neck x Dehlam Red
  4. Frizzle x Dehlam Red.

Performance Profile:

- Age at sexual maturity 170-180 days
- Annual egg production 165-180 eggs Egg size 52-55 g
- Egg colour Brown
- Egg quality Excellent Internal quality
- Livability Above 95%
- Temperament Active and good forager.

Cari Sonali Layer(Golden-92):

- First egg at 17 to 18 weeks
- 50% production at 150 days
- Peak production at 26 to 28 weeks
- Liveability of grower (96%) and layer (94%)
- Egg production peak 92%
- Hen Housed to 72 wk. more than 270 eggs

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- Egg size Average
- Egg weight 54 g
- First egg at 18 to 19 weeks
- 50% production at 155 days
- Peak production at 27 to 29 weeks
- Livability of grower (96%) and layer (94%)
- Egg production Peak 90%
- Hen Housed to 72 wk. more than 265 eggs
- Egg size Average
- Egg weight 54 g.

Cari-devendra:

- A medium-sized dual-purpose bird
- Efficient feed conversion-High positive return over feed cost
- Superiority over other stocks-Low laying house mortality
- Body weight at 8th week-1700-1800g
- Age at sexual maturity-155-160 days
- Annual egg production-190-200.

Caribro-vishal (Caribro-91):

- Weight at day old : 43g
- Weight at 6 weeks : 1650 to 1700g
- Weight at 7 weeks : 2100 to 2200g
- Dressing percentage : 75%
- Livability percentage : 97-98%
- Feed conversion ratio at 6 weeks : 1.94 to 2.20.

Cari-rainbro (B-77):

- Weight at day old : 41g
- Weight at 6 weeks : 1300 g
- Weight at 7 weeks : 1600 g
- Dressing percentage : 73%
- Livability percentage : 98-99%
- Feed conversion ratio at 6 weeks : 2.3.

Caribro-dhanraja (Multi-Coloured):

- Weight at day old : 46g
- Weight at 6 weeks : 1600 to 1650g
- Weight at 7 weeks : 2000 to 2150g
- Dressing percentage : 73%
- Livability percentage : 97-98%
- Feed conversion ratio at 6 weeks : 1.90 to 2.10.

Caribro-mritunjai (Cari Naked Neck):

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- Weight at day old : 42g
- Weight at 6 weeks : 1650 to 1700g
- Weight at 7 weeks : 2000 to 2150g
- Dressing percentage : 77%
- Livability percentage : 97-98%
- Feed conversion ratio at 6 weeks : 1.9 to 2.0.

Breeds from Project Directorate on Poultry (ICAR), Hyderabad

Vanaraja:

- Suitable bird for backyard farming in rural and tribal areas, developed by the Project Directorate on Poultry (ICAR), Hyderabad.
- It is a multi-coloured dual purpose bird with attractive plumage.
- It has better immune status against common poultry diseases and is adaptable to the free range rearing.
- Vanaraja males attain moderate body weight at 8 weeks of age under regular feeding system
- The hen lays 160-180 eggs in a laying cycle
- Due to their relatively light weight and long shanks, these birds are capable to protect themselves from predators which are otherwise a major problem observed in birds reared in backyards.

Krishibro:

- Developed by the Project Directorate on Poultry (ICAR), Hydereabad.
- Multi-coloured commercial broiler chicks
- Attain body weight by 6 weeks of age with less than 2.2 feed conversion ratio.
- The survivability of this bird upto 6 weeks of age is around 97%.
- These birds have attractive colour plumage and are well adapted to tropical weather conditions.
- The commercial Krishibro has highly resistance against the common poultry diseases like Ranikhet and Infectious bursal disease.
- Advantages : Hardy, Well adapted and Better survivability.

Breeds from Karnataka Veterinary Animal Fishery Science and University, Bangalore

Developed by Department of Poultry Science, University of Agricultural Sciences, Bangalore, presently Karnataka Veterinary Animal Fishery Sciences University, Hebbal, Bangalore:

- This breed yields 15-20 eggs in a year more than Giriraja chicken breed and was released by the Karnataka Veterinary Animal Fishery Sciences University, Bangalore in 2005. Swarnadhara chickens have a high egg production potential along with better growth compared to other local varieties and are suited for mixed and backyard farming
- Compared to Giriraja breed, Swarnadhara breed are smaller in size with a lighter body weight, which makes them easier to escape attacks from predators such as jungle cats and foxes

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- The bird can be reared for its eggs and meat.
- It attains maturity from the 22-23rd week after hatching.
- Hens attain a body weight of about 3 kg and the cocks about 4 kg.
- Swarnadhara hens lay about 180-190 eggs in a year.

Other Native Breeds

Breed	***Home Tract***
Ankaleshwar	Gujarat
Aseel	Andhra Pradesh and Madhya Pradesh
Busra	Gujarat and Maharashtra
Chittagong	Meghalaya and Tripura
4Danki	Andhra Pradesh
Daothigir	Assam
Ghagus	Andhra Pradesh and Karnataka
Harringhata Black	West Bengal
Kadaknath	Madhya Pradesh
Kalasthi	Andhra Pradesh
Kashmir Faverolla	Jammu and Kashmir
Miri	Assam
Nicobari	Andaman & Nicobar
Punjab Brown	Punjab and Haryana
Tellichery	Kerala

Broiler Production

Broilers are the most preferred ones under poultry meat category. Many Private companies are involved with farmers in contract farming for boiler production. So marketing is no longer a problem. A broiler is a young chicken of below eight weeks of age, weighing 1.5 to 2 kgs body weight, with tender and soft meat.

Best Management Practices:

- Poultry house temperature: 1st week 95^0F is quite comfortable and reduced at the arte of 5^0F weekly until 70^0F in 6^{th} week.
- Ventilation: Maintain good aeration, remove the ammonia (bird droppings) regularly to avoid suffocation to birds
- Lighting: 60 watt bulb for 200 sq. ft floor space
- Floor space: 1 sq. ft. per bird
- De-beaking: debeaked when 1-day old.

Broiler Health Care:

- Start with disease free chicks
- Vaccine against Marek's disease at the hatchery
- RDVF1 at 4-5 days

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- Drugs in feed to prevent coccidiosis
- Keep feed free from aflotoxin
- Cover floor with clean litter at least 3 inch deep after eachcycle.

Marketing:

- Market at 6-8 weeks old
- Feeders and waterers removed to prevent bruises during catching
- Protect the in-transit birds from extreme weather.

Some of the private companies involved in contract faring of broilers are Suguna, Coimbatore, VHL, Pune, Pioneer, Bromark etc.

Bird Flu in India

About Bird-Flu

Birds, just like people, get the flu. Bird flu, also called *Avian flu, Avian influenza, H5N1* viruses infect birds, including chickens, other poultry and wild birds such as ducks. Most bird flu viruses can only infect other birds.

However, bird flu can pose health risks to people. The first case of a bird flu virus infecting a person directly, H5N1, was in Hong Kong in 1997. Since then, the bird flu virus has spread to birds in countries in Asia, Africa and Europe. Deadly H5N1 strain hit India in January.

More than 3.9 million chickens and ducks were culled to prevent the spread of the virus across the country, Food and Agriculture Organisations said in a statement on Wednesday. No new disease outbreaks have been discovered since Feb. 2, 2008, FAO said. Avian influenza hits mostly birds but its H5N1 strain has killed 234 people since 2003 when it began in Asia, according to the World Health Organisation (WHO).

During an outbreak of bird flu, people who have contact with infected birds can become sick. It may also be possible to catch bird flu by eating poultry that is not well cooked or through contact with a person who has it. Bird flu can make people very sick or even cause death. There is currently no vaccine.

Table: *Distance Norms*

Purpose Activity	*Minimum Distance*
Layer shed to layer shed	50 ft.
Brooding *I* growing to layer shed	150 ft
Feed mill/store	150 ft.
Labour Quarters/Office, etc.	150 ft.
Disposal Pit *I* Incinerator	500 ft.
Between two Poultry units	200 to 300 metres

Poultry Development

Site Selection:

1. Farm should be located at an elevated and well-ventilated site, away, from water ways, existing poultry farm/village poultry

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2. Shed direction should preferably be East-West. Construction :

- Separate sheds for brooding-cum-growing and laying operations for smaller units.
- Separate sheds for brooding, growing and laying operations for larger units.
- Avoid multi-storied shed construction.
- Provide fencing, foot dips and roof overhand (at least 3 ft.).
- Maximum width of shed-33.5 ft. for Cage System and 30 ft. for Deep Litter System (DLS).
- Rat proofing provision.
- DLS shed should be minimum 2 ft. above ground level.
- Platform height (Cage System) should be around 6 ft.

Operation :

- Procure day old chicks from reputed hatcheries
- Prefer cage system over DLS for hygienic and cost-effective production performance
- Prefer automated system with minimum manual handling.
- Maintain utmost hygienic condition during feed handling.
- Vaccination, litter management, etc. as per the advise of competent authority.
- Vehicle movement should be restricted and disinfectants to be used to avoid disease out break
- Free movement of visitors as well as manpower should be restricted for utmost hygienic environment.

Poultry Layer Farming

Why do Poultry Farming for Eggs?

Poultry egg and meat are important sources of high quality proteins, minerals and vitamins to balance the human diet. Specially developed breeds of egg type chicken are now available with an ability of quick growth and high feed conversion efficiency. Depending on the farm-size, layer (for eggs) farming can be main source of family income or can provide subsidiary income and gainful employment to farmers throughout the year. Poultry manure has high fertilizer value and can be used for increasing yield of all crops.

Scope for Layer Farming and its National Importance

India has made considerable progress in egg production in the last three decades. High quality chicks, equipments, vaccines and medicines are available. Technically and professionally competent guidance is available to the farmers. The management practices have improved and disease and mortality incidences are much reduced. Many institutions are providing training to entrepreneurs. The improved layer population has increased from 35 million in 1961 to 115 million in 1996. The egg production in the same period has increased from 2,340 million to 34380 million. The egg production registered compound growth rate of 6.83% during eighth plan period (1992-97). The per capita egg availability at present is 41 eggs; while as per ICMR recommendations about 182 eggs per person per year are required to balance the common vegetarian diet. Increasing assistance from the Central/State governments and poultry corporations is being given to create infrastructural facilities so that new entrepreneurs take up this business. Layer farming has been given considerable

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importance in the national policy and has a good scope for further development.

Financial Assistance Available from Banks/NABARD

NABARD is an apex institution for all matters relating to policy, planning and operations in the field of agricultural credit. It serves as an apex refinancing agency for the institutions providing investment and production credit. It promotes development through formulation and appraisal of projects through a well organised Technical Service Department at the Head Office and Technical Cells at each of the Regional Offices. Loan from banks with refinance facility from NABARD is available for starting poultry farming. For obtaining bank loan the farmers should apply to the nearest branch of a Commercial or Cooperative or Regional Rural Banks in their area in the prescribed application forms which is available in the branches of financing banks. The technical officers attached to or the manager of the bank can help/give guidance to the farmers in preparing the project report to obtain bank loan. For poultry farming schemes with very large outlays, detailed reports will have to be prepared. Banks provide financial assistance for the following purposes :

a. For construction of brooder/grower and layer sheds, feed store,quarters etc.
b. For purchase of poultry equipment such as feeders, waterers,brooders etc.
c. For creating infrastructure items for supply of electricity, feed,water etc.
d. For purchase of day old chicks or ready to lay pullets.
e. For meeting working capital requirement in respect of feed,medicines and veterinary aid etc. for the first 5 to 6 months(i.e. till the stage of income generation).

The Cost of land is not considered for loan. However, if land is purchased for establishing a poultry farm, land cost can be treated as party's margin upto a maximum of 10% of total cost of project.

Scheme Formulation for Bank Loan

A scheme can be prepared by the beneficiary after consulting local technical persons of State Veterinary department, poultry corporation or private commercial hatcheries. If possible, they should also visit the progressive layer farms in the area and discuss the profitability of farming. A good practical training and experience on a layer farm will be highly desirable, before starting a farm. A regular and constant demand for eggs and nearness of the farm to the market should be ensured.

The scheme should include information on land, water and electricity facility, marketing aspects, training facilities and experience of entrepreneurs and the type of assistance available from State government, poultry corporation, local hatcheries. It should also include data on proposed capacity of the farm, total cost of the project, margin money to be provided by the beneficiary, requirement of bank loan, estimated annual expenditure, income and profit and the period for repayment of loan and interest. A format developed for formulation of layer poultry scheme is given in Annexure-I.

Requirements of a Good Project

After the scheme is submitted to the bank it is examined for technical feasibility and economic viability.

Technical Feasibility : This would briefly include :-

a. Suitability of climate and potentiality of the area
b. Availability of inputs such as chicks, feed, medicines etc.

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c. Technical norms

d. Infrastructure available for veterinary aid, marketing, trainingand experience of the beneficiary.

Financial Viability : This would briefly include :-

a. Unit cost and loan requirement.

b. Input costs for chicks, feed, veterinary aid, labour and otheroverheads.

c. Output costs i.e. sale of eggs, culled birds, for meat, manure,empty gunny bags etc.

d. Income-expenditure statement and annual gross surplus.

e. Cash flow analysis.

f. Repayment schedule i.e. repayment of principal loan amountand interest.

Other documents such as loan application forms, security aspects, margin money requirement etc. are also examined. A field visit to scheme area is undertaken for conducting techno economic feasibility study for appraisal of the scheme. The model economics of layer farming unit of 1500 birds is given in annextures IIa to IIf.

Sanction of Bank Loan and its Disbursement

After ensuring technical feasibility and financial viability the scheme is sanctioned by the bank. The loan is disbursed in kind in 2 or 3 stages against the creation of specific assets such as construction of sheds, purchase of equipment and machinery, recurring cost during growing period on purchase of chicks, feed, medicines and vaccines, electricity and water, labour expenses etc. For first cycle. Constant follow up and supervision of the scheme is done by the bank.

Lending Terms-General *Unit Cost*

Each Regional Office (RO) of NABARD has constituted a State Level Unit Cost Committee under the Chairmanship of RO in charges and with the members from developmental agencies, commercial banks and cooperative banks to review the unit cost of various investments once in six months. The same is circulated among the banks for their guidance. These costs are only indicative in nature and banks are free to finance any amount depending upon the quality of investment.

Margin Money: Nabard has defined farmers into three different categories and where subsidy is not available the minimum down payment as shown below is collected from the beneficiaries

Sr. No.	*Category of Farmer*	*Beneficiary's contribution %*
a)	Small farmers	5
b)	Medium farmers	10
c)	Large farmers	15

Interest Rate for ultimate borrower: Banks are free to decide the rates of interest within the overall guidelines. However, for working out the financial viability and bankability of the model projects we have assumed the rate of interest as 12 % p.a.

Security

Security will be as per NABARD/RBI guidelines issued from time to time.

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Repayment Period of Loan

Repayment period depends upon the gross surplus in the scheme. The loan will be repaid in suitable monthly/quarterly instalments usually within a period of seven to eight years with first year as grace period.

Insurance

The birds and other assets (poultry sheds, equipments) may be insured. Wherever necessary the risk/mortality fund may be considered in view of insurance.

Package of Common Management Practices Recommended for Poultry Farmers

Modern and well established scientific practices should be used to obtain maximum economic benefits from poultry farming. Some of the major norms and recommended practices are given below :

Poultry Housing:

1. Select well raised land for poultry sheds. Land with hard rock or murram is more suitable. Avoid water logging and flooding near the sheds. Provide separate sheds for growers and layers.
2. Ensure adequate facility for water, electricity, approach road, supply of chicks, feed, veterinary aid and nearness to market for sale of cull birds and eggs.
3. Obtain training/experience in layer farming before starting a farm. You should be prepared to stay on the farm and have constant supervision.
4. Provide adequate floor space per bird. BIS specifications for construction of poultry sheds are available.
5. Construct sheds in such a way that the end walls face East-West direction and the side walls face North-South direction, so that rain water will not enter the sheds.
6. Provide strong roof and hard flooring. Raise plinth of the shed at least one feet above the outside ground level.
7. Provide 3 to 4 feet overhang of the roof to avoid entry of rainwater inside the shed.
8. Provide at least 50 feet distance between two sheds in the same sector and about 150 ft between growing and laying sector.
9. Provide adequate light and ventilation and comfortable housing conditions during all seasons (cool in summer and warm in winter).
10. Construct sheds in such a way that predators (cats/dogs/snakes) will not enter the shed. Avoid entry of rats by constructing rat proof civil structures.
11. Keep the shed clean and free from flies/mosquitoes etc.
12. After every batch of growers/culled birds is disposed off, the dirty litter material and manure should be removed, walls and floors should be cleaned, white washed with lime and disinfected with 0.5% malathion or DDT insecticide spray.
13. If deep litter system is followed, always use dry and clean litter material (sawdust, paddy husk, etc.). Spread 4" layer of litter on the floor, keep clean/disinfect brooding, feeding and watering equipment and then introduce chicks in the house.
14. The litter material should be always kept loose and dry. Stir the litter twice a week. Any wet litter/droppings etc. should be removed and replaced with fresh/clean dry litter.

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15. If cage system is followed, ensure that droppings are spread with lime powder or 10% malathion spray twice a month to prevent menace of flies. The droppings under the cage can be removed after 6 months.
16. Use scientifically designed cages and equipment for brooding, feeding and watering purposes. BIS specifications for equipment are available. A good design can be shown and manufactured locally, so that cost can be reduced.
17. Purchase improved strain of one day old healthy egger type chicks from a reputed hatchery. Usually 2-5% extra chicks are supplied.
18. If cages are used for housing of birds ensure proper cage space i.e. half of the recommended floor space on deep litter.
19. Clean, wash and disinfect all equipments with 0.5% malathion spray after every batch of birds is disposed off.
20. Use high quality balanced feeds. Starter feed (upto 8 weeks of age), grower feed (9 to 16 weeks of age) and layer feed (17 to 72 weeks of age) manufactured by reputed institutions/ companies should be used. BIS feed formulae and specifications are available. With proper knowledge/experience, the feed can be prepared on the farm. Feed requirements of birds are shown in Annexure IV and V.
21. Store the feed in clean, dry, well ventilated room. A wet feed may bring fungus infection.
22. Use properly designed feeders and control the rats to avoid feed wastage.
23. Provide adequate feeding space per bird. More space is required as the bird grows in age.
24. Keep proper records on feed consumption per bird for each batch. About 7 kg. feed upto 20 weeks and 38 kg. feed from 21 to 72 weeks of age is required. Excess consumption may be due to feed wastage, rats, low temperature of shed or poor feed quality (low energy feed). Too low feed consumption may be due to disease condition, low quality/unpalatability of feed, high temperature in poultry shed.
25. Always give fresh and clean drinking water. Water should be always available at birds.
26. Use properly designed watering equipment. Provide adequate watering space per bird.
27. Always keep water-pots clean. Avoid birds entering inside pots.
28. Provide cool water during summer. Store the water in tanks that are not exposed to hot sun in summer.
28. Clean sanitary conditions of poultry sheds and equipment, balanced feed, fresh clean water, healthy chicks are essential to prevent diseases.
29. Avoid entry of visitors to farm, especially inside the sheds. If visitors come, ask them to dip their feet in a disinfectant solution, wash and clean hands and to wear apron/boots provided by the farm.
30. Use proper vaccination schedule.
31. Use high quality vaccines purchased from reputed manufacturers. Keep vaccines in cool, dry conditions away from sunlight.
32. Any left-over vaccine should be properly disposed off. Vaccines should not be used after their expiry date is over.

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33. Any dead bird should be immediately removed from the shed and sent to laboratory for post-mortem examination or buried/ burnt suitably away from the poultry sheds.
34. The waste of farm should be suitably disposed off. Different workers should be employed in brooding and laying sheds.
35. Any bird showing advanced signs of a disease, should be removed from the shed and culled. It can be sent to laboratory for diagnosis.
36. Birds showing advanced signs of a disease should be shown to a qualified veterinarian and suitable medication/treatment be given as per his/drug manufacturers recommendations.
37. Poultry manure, if infected, can spread disease, from one batch to another. Keep the litter dry, remove it after flock is sold and dispose the manure properly and quickly.
38. Keep proper records on mortality and its causes and the treatment given to birds. Dates of vaccination for each flock should be properly recorded.
39. Rats are important carriers of poultry disease. Avoid rats. Use suitable rat poisons/rat traps.
40. Many poultry medicines can be given in drinking water. When medication is to be given, remove the waterers in poultry sheds on the previous evening. Next morning give medicine in measured quantity of water, so that entire medicine will be quickly consumed and there will be no wastage of medicines.
41. Mild infection of disease may not cause mortality but it will reduce growth. Keep sample record of body weight for growers, mortality rate and egg production. Study the possible causes, if weight is low or egg production is low and take steps to improve the management of the subsequent batches. A Constant vigil and analysis of records/results is necessary to keep up the efficiency in farming.
42. The guidelines for integrated bio security in poultry production are given in Annexure VII.
43. Ensure the constant and steady demand for eggs is available and the market is nearer to the farm.
44. Study the market demand for particular egg weight. Provide one nest box for every 5 birds. Collect eggs from the shed 4 times a day. Store them in a cool dry place and market them quickly.
45. Birds should not be kept on the farm beyond 18 months of age, as their egg production will go down considerably and their efficiency of feed conversion will reduce progressively as they grow older.
46. If live culled birds are sold after dressing (processing) use clean dressing hall and processing equipment. Dressed birds should be chilled in the ice-cold water for 3-4 hours and excess water removed. Birds should then be packed in clean plastic bags and the mouth of bag sealed.
47. Processed birds should be marketed as early as possible. If they have to be preserved, deep freezing equipment (-10 to-200C) be used. Refrigerated vans may be required for long distance transportation.

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Chapter 13 : Live Bird Marketing

Layers start a second year of egg production usually after 71 to 78 weeks of age; however, the eggs produced are inferior in number and quality to those produced in the first year. The birds should be culled at the end of their first year of production and sold for meat. In the tropics and in dry areas, slaughtered layer meat deteriorates very quickly if refrigeration is not available. For this reason, layer meat is purchased either live or just slaughtered. Unless carcasses can be chilled rapidly and kept below a temperature of 4° C, they should be sold within a few hours after slaughter.

Quality Criteria

Composition and Attributes of Layer Meat

Weight is a determinant characteristic in the marketing of live birds. The type of feed, the breed of the bird and how it has been treated will define the weight of each layer. The main constituents of layer meat are water, protein, and fat. Increases in collagen and elastin, the proteins forming the connective muscle tissues, are related to the toughness of the meat of layer birds. Variations in the amount of deposited fat are associated with quality. The age and sex of a bird influence the fat content, as does a high caloric diet. Layer meat provides a good source of high quality protein, iron and phosphates and the B vitamins riboflavin and niacin. The vitamin content of the meat is influenced to a very large degree by the vitamin content of the feed consumed.

Eating Quality

Meat varies in acceptability to consumers according to its tenderness, juiciness and flavour when cooked. Age and sex are the primary characteristics distinguished in commercial poultry handling. Broilers, which are birds reared specifically for meat, can be marketed from the age of 8 weeks up to 20 weeks. Birds under 12 weeks of age, of either sex, have very tender meat. Birds between 12 and 16 weeks of age, of either sex, also have relatively tender meat and can be cooked by roasting. Birds that are marketed between 16 and 20 weeks have meat that is less tender but which can also be cooked by roasting. The meat of mature layers (over 20 weeks old at the time of culling) is less tender than that of a roaster and therefore is best cooked by steaming or simmering in water.

Appearance

Layer birds must be sound, healthy, clean and fit for human consumption. The birds must have a healthy appearance. Missing or displaced feathers, bare skin in evidence and broken bones or cuts detract from the appearance of a carcass. If the bird is not in good condition, the consumer will not buy the bird even though it has been slaughtered, as the carcass will show the defects.

Measures to Prevent Deterioration During Marketing

In tropical and dry climates, the most common form of marketing poultry meat is to sell the birds live. The quality of birds is affected greatly by the methods employed in transporting them from the farm. Considerable death losses, broken wings and legs, and bruises result if birds are handled roughly or carried in unsuitable or overcrowded containers. Live birds

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must be transported in a manner that allows for plenty of air ventilation to protect the birds from heat. Birds should be transported in crates, constructed so that the birds' legs cannot pass through the bars yet air can circulate easily. Crates of wire netting on a wood frame are safe, light in weight, and suitable for handling and transport. The entrance of the crate should be easy to open and close and centrally situated so that all parts of the crate are within reach.

The bird should be approached from behind, the crook should be placed just above the foot and the bird picked up gently with care. Under tropical and subtropical conditions, this operation should be carried out at the end of the day in dim light or darkness, when the birds are more docile.

Placing Birds in a Crate

The bird should be lowered gently into the crate, head first, the wings held close to the body with one hand, with the other hand gently holding the legs. Overcrowding in each crate must be avoided. For example, a crate that has dimensions of 80 ´ 60 ´ 30 cm will hold a maximum of ten birds. Crates must be handled with great care and fastened safely when they are loaded onto transport vehicles. Transport must take place during the cooler part of the day in order to avoid the birds being exposed to sunlight and heat. They must not be shaken or jolted excessively when being transported and the time spent travelling must not be excessive. Weight losses ranging from one to three percent during transport from farm to market or processing plant are common.

Marketing Slaughtered Birds

Birds to be marketed should be fasted before being slaughtered. If birds are fed mash, they should be fasted four to six hours before slaughter; if fed grain, ten hours of fasting will be required. But if feed and water are withheld from the birds for fourteen hours or longer, there is a high risk of the guts breaking during slaughter, which would enable organisms such as salmonella to infect the meat, the slaughtering tools and the slaughtering area during processing. When refrigeration is available it is possible to market the birds in the following manner:

- dressed (slaughtered, bled and plucked);
- eviscerated/ready to cook (the carcass minus head and feet but including liver, heart, and the gizzard less its contents and lining);
- poultry parts (legs, thighs, wings, breast, back, neck and giblets); and
- boned (muscle, fat and skin only).

The rate of quality deterioration or spoilage depends very much on the form in which the carcass is marketed. A bird with only feathers and blood removed will spoil much more slowly than eviscerated, cut-up or boned carcasses. Spoilage bacteria are confined largely to the intestinal tract and skin. These organisms are rapidly dispersed in the tissues of eviscerated, cut-up or boned carcasses and there are few or no natural defences to prevent their multiplication. The cold temperatures found in refrigeration slow down contamination.

Grading and Standardization

Grading of live poultry is generally informal. Buyers note the breed, age, weight and general condition of the birds on offer. Because the feathers obscure the proportion of flesh to bones, they usually catch a few birds and feel the breasts to see how much meat they carry. Price negotiations will then proceed on the basis of market price. Broad standards, such as weight, appearance and ease in processing, are used to distinguish first and second quality

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grades, but essentially this is difficult and subjective. Formal standards and grades can be adapted more easily to carcasses because the quality features can be seen more clearly. The following factors are usually considered:

- *conformation* (the shape of the carcass);
- *fleshing* (leg, wing and breast muscles are full and well developed, assuring a good proportion of meat to bone);
- *fat* (fat under skin is important because it gives the carcass a pleasing light appearance by covering up the pink or red muscles underneath);
- *skin dislocations, tears* and *cuts*; and
- *bruises*.All these features are appraised in relation to species, sex and age.

Conditions for Standardized Grading

The feasibility of applying uniform quality standards depends very much on how birds are marketed. Because of the difficulty of classifying live birds by more than broad age, sex and type categories, standardized grading in most countries relates only to the marketing of birds already in carcass form. Consumer interest in standardized grading is also related closely to the form in which the bird is sold. If the consumers can see and handle the live birds, they are able to form their own conclusions regarding quality. The greater the degree of processing undertaken during marketing the more difficult this becomes. Age and condition are difficult to judge in cut-up and packaged meat and a grade label becomes the buyers' main guide. Trading must be on a constant and large scale if grading is to be undertaken systematically and accurately. Ease in the adoption of uniform grading procedures is also related to the degree of standardization that has been reached in the production process.

Where substantial quantities of meat are wholesaled and retailed as carcasses, and proper refrigeration is available during handling and marketing, there are many advantages in standardized grading. For example, transactions between distant markets can take place without personal inspection by the buyer.

Processing

The degree of processing undergone during marketing varies greatly both between and within countries. It depends primarily on the form in which the consumer wishes to take delivery of the bird and, secondly, on the equipment available to enterprises and distributors. Some consumers buy live birds and slaughter them when needed, particularly if refrigeration is not available. Many consumers do not want to kill the birds themselves, however, they may wish to see the birds alive before buying them. This is very important in areas where production is not specialised. In these areas sellers usually hold stocks of live birds in cages so that consumers can see them. Once a sale has been made, the seller slaughters and dresses the bird according to consumer desires. A bird can be slaughtered by dislocating its neck or by cutting its throat. The blood must be completely drained out and then the feathers can be plucked. Dry plucking involves plucking feathers by hand when the body is still warm. Usually four to ten birds can be plucked per hour. Once feathers have been removed the carcass can be prepared accordingly: dressed, eviscerated/ready to cook, poultry parts or boned. In countries where consumers prefer ready-to-cook birds and refrigeration is widely available for processing, transportation, selling and storing, mechanized processing is widely

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used).

Marketing Organisation for Live Birds

It is important to gather information first to see if there is a market for culled birds. Sales would be on an occasional basis, therefore, it is advisable to ascertain whether consumers and retailers would want to buy live birds at such irregular intervals. Producers usually have a marketing system developed to sell eggs and it may be possible to sell culled birds using the same system. Direct marketing includes door-to-door sales, street hawking, selling at a producer's local market and selling to local retailers. Some consumers prefer to have the birds slaughtered after they have inspected them alive. This would involve learning how to slaughter and pluck birds properly. An easy and practical method to slaughter live birds at a customer's home, on the street or at a producer's market would be necessary. Provision must be made for transportation of the birds in cages. A larger vehicle may be required so the cages can be transported along with the eggs. When transporting live birds and eggs together it is important that the quality of eggs does not deteriorate because of bird manure.

A careful evaluation of the costs involved and the income obtained from the direct sale of live birds must be made to see if this method of marketing is worthwhile. Furthermore, the time spent by the producer attending to clients, slaughtering birds and cleaning up after the slaughter must be taken into consideration.

Farm-gate sales also involve slaughtering the birds for the consumers. It is important to know how to slaughter a bird and how to pluck and prepare the carcass. It is necessary to buy proper utensils and to have a location where the birds can be slaughtered. Before slaughtering, the birds must be checked for disease and other problems such as cuts, broken bones, etc. The slaughtering and processing procedures shown below must be carried out in a covered area that is well ventilated and clean. All utensils and equipment used for slaughtering must be kept clean.

Slaughtering. Birds can be slaughtered by dislocation of the neck, cutting of the jugular vein, stunning and cutting, piercing of the brain and decapitation. The most common used are dislocation of the neck, cutting the jugular vein and stunning;

- *Neck dislocation.* The bird has to be held by its feet. The neck must be pulled downwards and then bent sharply backwards. Considerable force is required to break the neck.
- *Cutting of jugular vein.* The bird must be held by the feet and an incision has to be made in the jugular vein just under the head of the bird at the beginning of the neck.
- *Stunning.* Birds are stunned with an electric stunner applying 90 V for one-half a second and then the jugular vein is cut. Stunning will keep the bird from struggling.

Bleeding: All the blood must be removed from the bird. This can be done by placing the slaughtered bird in a bleeding cone or holding the bird above a bucket for one and one-half to two minutes. For hygienic reasons it is important that the blood is not allowed to spread in the slaughtering areas.

Plucking: Dry plucking consists of removing the feathers from the bird when it is still warm by hand or by machine. Scalding makes plucking easier. It involves placing the bird in hot water (between 50° and 55° C) for about two minutes and then plucking the feathers by hand or machine. A common plucking machine has two drums with rubber fingers that revolve

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in opposite directions pulling the feathers off the body in a downward motion.

Evisceration: At this point the bird can be processed to fit the consumers' requirements. The carcasses can be dressed, boned and cut into pieces. The feet, head, neck and giblets, heart, liver and gizzard can be removed. Careful attention must be paid not to break or cut the intestines of the bird because this would release many harmful organisms into the meat.

Chilling: (This is possible only where refrigeration is available.) Before chilling, the meat and the giblets have to be washed thoroughly and left to drain. The meat and giblets can be chilled in cold water, slush ice, crushed ice or solid carbon dioxide. To chill to the optimum cold storage temperature of between 2° and 4° C will take about 45 minutes.

Packaging: The selection of materials for packaging depends on needs such as physical strength, permeability to water vapour and other gases, transparency, cold resistance and heat sealing properties. The bird can be packed with the giblets, which are packed in a clean plastic bag and placed inside the bird or packed separately. The carcass can be placed in a plastic bag, from which as much air as possible has been drawn, and firmly sealed.

Storage: Meat can be kept for seven days at a temperature of 2° C; however, if storage is required for a longer period it is best to store at a temperature of-5° C or even to-18° C.

Collectors, who regularly visit production facilities to collect eggs, may be interested in buying the culled hens. Processor-packers, wholesalers and retailers may also be interested. Alternatively, producers can market the culled birds separately from existing egg marketing arrangements. They will have to determine whether it is more feasible to market the birds directly or to use channel members for their marketing. The producer will have to evaluate costs against income obtained from the sale of birds. For example, a producer could dispatch the entire lot of birds to an abattoir, where they would be slaughtered, processed and packed. This may be feasible in terms of costs and income. Yet, alternatively there could be a higher income in selling the birds separately at a local producers' market. South African egg producers sell their culled birds to entrepreneurs who run spent hen depots, and who in turn may sell them to street hawkers.

Economics of Production

The agricultural subsector of animal production is part of a complex interdependent farming system. Analysis of livestock production cannot be based solely on input and output, but must also take into consideration other farming activities. The interaction between animal production and other subsectors can be complementary, as in the use of manure; or competitive, as in the allocation of land to crops or livestock grazing.

The farming system as a whole, and animal production in particular, is influenced by external factors (including government policy on rural development, livestock development programmes and marketing), which must be considered in any analysis or evaluation.

Definition and Analysis of Production Costs

The farming system is defined as the combination of all farm enterprises/subsystems, management and farmer objectives and the interaction between them. It is a decision-making and land-use unit, comprising the farming household and the crop and livestock systems, which transforms land, labour, management and capital into products that can be consumed or

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sold.

Enterprises/subsystems are defined as the different subdivisions of the farming system, each producing one kind of crop or livestock product. In the case of family poultry, the products are poultry meat and eggs, with manure as a by-product. The harvesting of family poultry for home consumption and sale can be considered as the management of a standing resource for economic yield. In this respect, the economic principles applying to the management of fauna, parklands, fisheries, wood and timber forests and rangelands are more appropriate than the economic concepts more commonly applied to the labour and capital-dependent livestock production and other commercial farming industries.

Methods and Criteria for Cost Calculation

The cost of production can be seen from various angles. The inputs may be external (Non-Factor costs) or internal (Factor costs). Internal input is under the control of the farming household, and includes land, labour, management and capital. The cash involved in production represents either Cash (Paid) Costs or Non-Cash (Calculated) Costs. Another way to categorize the costs is to distinguish Variable Costs from Fixed Costs. Variable costs rise and fall with the size of the output and the level of the operation. Variable costs (for items such as feed, vaccine and casual labour) can be controlled to some extent and are not incurred when there is no production. Fixed costs (for items such as taxes, insurance, interest, and depreciation on buildings and equipment), are incurred whether or not there is any output.

The Opportunity Cost principle is applied in farm cost accounting. Opportunity costs can be defined as the "income that would have been generated if the production resource/input/factor were put to the next best alternative use". Many farm enterprises/subsystems yield more than one product. Poultry produce eggs, meat and manure. When calculating the cost-price per unit of production, the cash value of the by-products (sold externally or used as a substitute in another enterprise/subsystem of the farm), must be subtracted from the Total Gross Costs. This will result in the Total Net Costs. For the cost-price per unit of production, the Total Net Costs must be divided by the total number of units of production.

The cost-price calculation model splits production costs into two categories: Paid Costs and Calculated Costs. Paid costs involve actual payment in cash or kind for inputs or services used. Calculated costs are determined using mathematical formulae, and include the following:

- depreciation on the poultry house and equipment;
- interest on cash in hand and personal capital used to construct the poultry house and purchase equipment, birds and feed;
- maintenance of the poultry house and equipment; and
- labour supplied by the farm family.

Calculated Costs include Opportunity Costs as related to the national economy: for example, unemployment (including hidden unemployment) and high rates of devaluation of the national currency. These form a part of the socio-economic reality for the smallholder, and influence the Opportunity Cost of labour (reduced by high unemployment) and of capital (which tends to move towards zero when the rate of currency devaluation is higher than the interest rate). By making use of locally available and renewable materials for poultry housing and equipment, family poultry producers minimize the introduction of external capital into

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their enterprise.

Large-scale poultry production cannot really be compared with smallholder family poultry, because smallholders often face such constraints as the absence of organised marketing systems and the lack of price rewards for produce quality and uniformity. Therefore, the cost-price calculation for large-scale poultry production (and also that for free-range commercial poultry production) may not be applicable to smallholder family poultry systems without modifications.

Elson (1992) showed that for layers, production costs (per dozen eggs produced) increased with space allowance (stock density) per hen. The minimum stock density allowed in the EC (under EEC Council directive 1988/66) is 22 birds/m (450 cm^2/bird). The production cost for birds housed in laying cages at this density is used as a baseline. The percent increases in cost over this baseline (each with their associated management system) are:

- 5 percent for aviaries;
- 7-12 percent for percheries (tiered wire floor aviaries) at 20 birds/m^2;
- 15 percent for cages at 20 birds/m^2 (750 cm^2/bird);
- 21 percent for deep litter systems at 7 birds/m^2;
- 30 percent for straw yards at 3 birds/m^2;
- 35 percent for semi-intensive systems at 0.1 birds/m^2 (1000 birds/ha);
- 50 percent for free-range systems at 0.04 birds/m^2 (400 birds/ha).

A Broader Economic Framework for Analysis

All economic activity consists of transforming resources (land, labour and capital) into goods and services which serve the needs and desires of people. Much of the quantitative assessment in cost-benefit analysis is simple accountancy: assigning monetary values to various measured or estimated physical quantities, categorizing them under a cost or benefit heading, adding them up, and finally comparing the totals. Proper economic analysis should provide a framework by which the benefits of production are shown in the economic system, and how these benefits are valued by society. This can only be done with a "before and after" or "with or without" analysis.

Benefits can be measured in two ways:

- by a technical component which represents the higher productivity of resources used (and hence reduced unit costs) in supplying poultry products; and
- an economic component which reflects the value placed by society on those supplies.

The technical effects are demonstrated in an economic analysis as a shift of the supply curve-the basic relationship showing the minimum price at which different levels of production can be made available to the market. The value placed on this change in potential availability is then entirely dependent on the demand for poultry products. With rising demand for these products, additional supplies become expensive, and therefore the extra production translates into a substantial gain in benefits to the community.

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It can be argued that this usually happens in developing countries where, compared to the staple diet, poultry products are a luxury commodity with a relatively higher value. Hence, the demand curve D shows that the quantity demanded is highly responsive to price and income changes, with additional consumption causing little decrease in value. The demand for poultry products is price/income elastic.

This simple model highlights the overall economic impact of higher poultry production as manifested on the market for poultry products. Production and consumption rise from Q_0 to Q_1 but the average price paid by consumers (and received by producers) falls from P_0 to P_1. Consumers gain significantly, reaping the benefits of both greater supplies and lower prices. Producers also gain. Although unit costs fall, the increase in production compensates for the price reduction and, as evident from the diagram, total revenue received by producers, (P_1Q_1) is greater than the previous P_0Q_0.

The overall net economic benefit from improved family poultry production technology is represented by the size of the shaded area. It is this net economic benefit that an economic analysis of family poultry development schemes and programmes should be seeking to estimate.

Economic Feasibility of Restricted Feeding in Broiler Breeders

An experiment was conducted in which the effects of economic feasibility of restricted feeding in broiler breeders was studied during the breeding periods. Broiler breeders were reared from 0 to 6 weeks on ad lib feeding, 6 to 20 weeks on restricted feeding to maintain required body weights at 20 weeks. At 20 weeks of age, the following four treatments were imposed: T1, fed ad lib; T2, 10% restriction of ad lib feeding; T3, 20% restriction of ad lib feeding; T4, 30% restriction of ad lib feeding. Cost of one kg feed was calculated by taking market rate of each ingredient in different treatments. Data were recorded on total feed cost per bird, number of chicks per bird during breeding period. All the weekly data during breeding period were converted into 28 days period. The results indicated that the saving/chick from restricted feeding varied from Rs. 1.95 to 2.31. The day old broiler chicks costed lower in T2 (Rs. 1.95), T2 (Rs. 2.02) and T4 (Rs. 2.31) than the adlib fed group. The higher returns through feed restriction mainly based on total egg production, hatch able egg production, hatchability percentage on total eggs, and mainly on lower feed consumption in restricted feeding. The higher returns in 30 per cent restriction were due to higher production of hatch able eggs (%) and lower feed consumption. It may be concluded that by restricting the feed during breeding period, cost of production of chicks can be reduced and it was lowest when feed restriction was 30 per cent of ad lib feeding.

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Bibliography

Aho, M. and J. Hirn. : *Prevalence of Campylobacteria in the Finnish Broiler Chicken Chain from the Producer to the Consumer*, Acta Veterinaira Scandinavica, 1988.

Blank, G. and C. Powell. : *Microbiological and Hydraulic Evaluation of Immersion Chilling for Poultry*, Journal of Food Protection, 1995.

Chandra, Rajesh: *Diseases of Poultry and Their Control*, IBDCO, Delhi, 2001.

Conner, K. C. and D. E. Conner.: *Bactericidal Activity of Organic Acids Against Salmonella Typhimurium Attached to Broiler Chicken Skin*, Journal of Food Protection, 1997.

David Halvorson, Donna Hill *: Biosecurity in the Poultry Industry*, International Book, 2006.

Huang, T. C. and A. M. Pearson. : *Control of the Dehydration Process in Production of Intermediate-Moisture Meat Products: A Review*. Advances in Food and Nutrition Research, 1996.

Kobe, A. and R. Fries.: *Air Chilling and Evaporation Technique in Poultry Meat Production- A Microbiological Survey II. Differentiation*, Fleishwirtschart,1997.

Kumar, Rakesh Shukla *: Handbook of Poultry Diseases : A Bedside-Guide*, International Book Dist, Delhi, 2006.

Lesiak, C.A. and D.U. Ahn. : *Effects of Post-Mortem Time Before Chilling and Chilling Temperatures on Water Holding Capacity and Texture of Turkey Breast Muscle*, Poultry Science, 1997.

Mahapatra, C. M.; N. K. Pandey and S. S. Verma. : *Microbiological Changes on Chicken Carcasses During Processing*, Indian Journal of Poultry Science, 1989.

Mandal, A.B.; A.S. Yadav, T.S. Johri and N.N. Pathak *: Nutrition and Disease Management of Poultry*, International Book Distributing Co, Delhi, 2004.

Moguilevsky, M.A.: *Drug Resistance of Enterobacteriacaea Isolated from Chicken Carcasses*, Journal of Food Protection, 1997.

Morley A. Jull *: Successful Poultry Management*, Biotech, Delhi, 2001.

Oye, Y. K. Niiya, T. Kawata, T. Tsushima. : *Survey of Bacterial Contimanation and Microbiological Control at a Poultry Slaughterhouse*. Journal of the Japan Veterinary Medical Association, 1996.

Panda; A. K.; Rama, S V Rao and Reddy, M R *: Growth Promoters in Poultry : Novel Concepts*, International Book Dist, Delhi, 2008.

Prasad, L. N.*: Advanced Pathology and Treatment of Diseases of Poultry : With Special Reference to Etiology Signs*, International Book Dist, Delhi, 2006.

Ramasubba, V. Reddy and Dinesh T. Bhosale *: Handbook of Poultry Nutrition*, International Book, 2004.

Randall, V .: *Mutagenicity of Poultry Chiller Water Treated With Either Chlorine Dioxide*

Vet-ebooks.com

or Chlorine, Journal of Agricultural and Food Chemistry, 1997.

Saxena, H.C.: *Poultry Feed Technology : Feed Formulation and Manufacturing*, International Book, Delhi, 2006.

Sharma, R.P. R.N. Chatterjee, S.V. Rama Rao and S.R. Sharma *: Poultry Production in India*, Indian Council of Agricultural Research, 2008.

Sharma, R.N.*: Poultry Management*, Vista International Publishing House, Delhi, 2008.

Sonaiya, E. B. and S E J Swan *: Small-Scale Poultry Production : Technical Guide*, Daya, 2007.

Sreenivasaiah, P. V.*: Scientific Poultry Production : A Unique Encyclopaedia*, International Book Dist, Delhi, 2006.

Sylvester, N.; D. Barbut and M. W. Griffiths. : *The Determination of Efficacy of Anitmicrobial Rinses on Turkey Carcasses Using Response Surface Designs*, International Journal of Food Microbiological, 1997.

Tsukahara, T.; J. Kusunoki, C. Kaneuchi : *Serotypes and Drug Resistance of Salmonella Isolates from Poultry Processing Plants*, Journal of the Japan Veterinary Medical Association, 1997.

Vegad, J. L.*: Poultry Diseases : A Guide for Farmers and Poultry Professionals*, International Book Dist, Delhi, 2008.

Walker, J.T. Slavik, M. F. , Wang Hong. : *Electrical Treatment of Poultry Chiller Water to Destroy Campylobacter Jejuni*, Journal of Food Protection, 1995.

Whittemore, A. D. and N. A. Cox : *Relationship Between Aerobic Bacteria, Salmonella, And Campylobacter on Broiler Carcasses*, Journal of Food Protection, 1997.

Wong, R .Y. L. A. Harden, R. E .Wilson, M. Benson, K .L. Steven. : *Potent Bacterial Mutagens Produced by Chlorination of Simulated Poultry Chiller Water*, Journal of Agricultural and Food Chemistry, 1996.

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