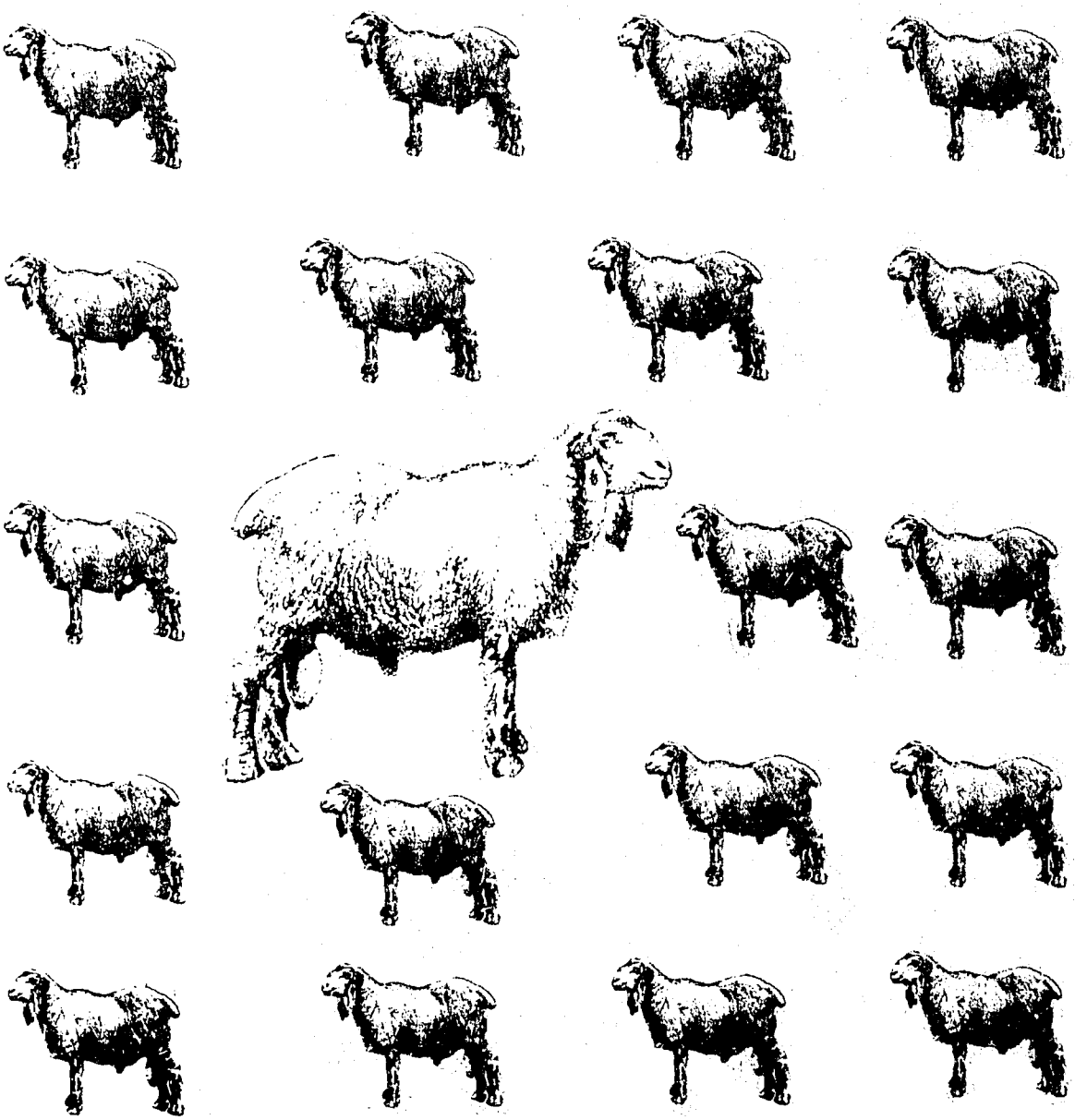
Development of feed resources and improvement of animal feeding methods in the CENTO region countries



Proceedings of the Conference on the development of feed resources and improvement of animal feeding methods in the CENTO region countries

Held at the
Turkish Ministry of Agriculture,
Ankara, Turkey
1st - 7th June, 1971

NEA
636.085
C397

Development of Feed Resources and Improvement...
Central Treaty Organization.
Conference on the Development of Feed Resources and Improvement of Animal Feeding Methods in the CENTO Region Countries, Ankara, June 1-7, 1971; Proceedings. 1972.
218 p.
Bibliography throughout.
Cover title: Development of Feed Resources and Improvement of Animal Feeding Methods...
1.Feeds - NEA.2.Animal nutrition - NEA.3.Livestock - Feeding and feeds - NEA.4.Range management - NEA.I. Title.II.Development of Feed Resources and Improvement..

Tropical Products Institute
56/62 Gray's Inn Road,
London, WC1X 8LU
1972

Foreign and Commonwealth Office
(Overseas Development Administration)

No responsibility is accepted by the editor or the Tropical Products Institute for the opinions expressed herein, or for the accuracy of factual information quoted.

When reference is made to material in this volume, the following shortened form of the title may be used: *Proc. CENTO Conf. devpt feed resources* (1971)

Tropical Products Institute

ISBN:O 85954 004 9

Contents

Pages

Introduction 5

List of Session Chairmen and Conference Officers 7

List of Conference participants 9

Addresses of welcome by: His Excellency Mr Suleyman Kara, Deputy Secretary of the Turkish Ministry of Agriculture 13

Mr Marcus J. Gordon, CENTO Deputy Secretary General (Economic) 13

First Session: Ruminant nutrition

Ruminant metabolism and productivity by D. Lewis 17

Ruminant nutrition, feed resources and their improvement in Turkey by A. Remzi Akyildez 23

Ruminant nutrition in Iran by R. D. Beheshti 29

Ruminant nutrition in Pakistan by Mohammed Akram 33

Report on Session 37

Second Session: Forage crop production

Forage crop production in the CENTO region by C. E. Johnson 41

Forage crop production in Turkey by Şahap Elçi 47

Forage crop production in Iran by M. B. Ghadaki 55

Forage crop production in West Pakistan by Mohammed Akram 59

Report on Session 63

Third Session: Range management

Range management in the CENTO region countries by D. F. Davidson 67

Pages

Range management in Turkey by Omer Bakir 69

A study of the improvement of dry-land ranges developed under the conditons of Erzurum (Eastern Anatolia) by Fahrettin Tosun, Ibrahim Manga and Mustafa Özyurt 79

Improvement of the rangelands and the problem of animal feeding in Iran by F. Arbabi 87

Range management in Pakistan by S. M. Ali 99

Report on Session 103

Fourth Session: Poultry nutrition

Aspects of poultry nutrition by W. Bolton 107

The main problems of poultry nutrition in Turkey by A. Kemal Göğüş 111

Increasing feed sources and improving feeding methods to achieve the development targets for poultry in Turkey by Nurettin Gürsoy 121

The poultry industry in Iran by Akbar Noormanesh 125

Poultry nutrition in Pakistan by M. Y. Bhatti 133

Report on Session 139

Fifth Session: Production and marketing of compounded feeds

Production and marketing of compounded animal feeds by R. K. Peberdy 143

The compound feed industry in Turkey by Orhan Üstunsoy 155

Industrial production of compounded feeds in Iran by M. Manouchehri 173

The industrial production of compounded feeds in Pakistan by M. Y. Bhatti 177

Changes in nutritive value of concentrate feedingstuffs during storage by I. Cockerell, B. Francis and D. Halliday 181

Report on Session 193

Sixth Session: Role of credit and co-operatives in livestock production

Livestock credit and its role in the livestock industry by J. M. Hill 197

Provision of agricultural credit especially for feed and livestock improvement in Turkey by Ergin Taşçioğlu 199

Agricultural and livestock credit in Iran by Mostafa Djirsarai 203

Credit and co-operatives in Pakistan by Anwar A. Qureshi 209

Report on Session 213

Final Session

Recommendations of Conference 217

Introduction

One of the major functions of the Central Treaty Organisation (CENTO) is to stimulate economic, scientific and technical co-operation between the member countries of the United States of America, United Kingdom, Turkey, Iran and Pakistan. Many of the economic and technological problems of the CENTO region countries are similar and the exchange of information and ideas has proved of great value, as has also the technical and economic assistance rendered by the two non-regional members.

It has long been recognised that improvements in livestock and poultry production have a vital and increasingly important role to play in the improvement of human nutrition in the developing world, and this is particularly so in the CENTO region, which possesses vast areas of natural rangelands supporting large numbers of livestock. In order to effect an exchange of ideas and information between CENTO member countries on this subject area, a symposium on 'National and regional livestock policy' was held at Islamabad in Pakistan during December 1969. One of the recommendations of the symposium was that a conference specifically devoted to animal feeding problems be held. The Government of the United Kingdom agreed to provide financial and organisational support for such a conference and the Government of Turkey offered to act as hosts. The conference was held at the Personnel Training Centre of the Turkish Ministry of Agriculture in Ankara from June 1 to June 7, 1971.

The Tropical Products Institute was given the task of organising the programme of the conference and editing and publishing the proceedings, and a member of staff was appointed as programme co-ordinator and editor of the proceedings. After a preliminary trip to CENTO region countries a programme was decided in consultation with the various interested parties. This programme included six subject sessions together with an opening ceremony and a final session to agree a series of conference recommendations. The six subject sessions were as follows:

1. Ruminant nutrition.
2. Forage crop production.
3. Range management.
4. Poultry nutrition.
5. Production and marketing of compounded feeds.
6. Role of credit and co-operatives in livestock production.

In the opening ceremony addresses of welcome were given by His Excellency Mr Suleyman Kara, Deputy Secretary of the Turkish Ministry of Agriculture and Mr Marcus J. Gordon, CENTO Deputy Secretary General (Economic), while heads of delegates made brief opening statements. The conference president was the leader of the Turkish delegation, Dr Celal Bilensoy, while specialists from the United Kingdom, from the United Kingdom Middle East Development Division, Beirut and from the United States of America were chairmen of the sessions.

At each subject session a paper was given by the chairman emphasising the points which he considered to be of greatest importance. This was followed by papers from each CENTO region country outlining the particular problems which existed and the measures considered necessary to overcome them. There were also several additional specialist papers on matters considered to be of especial importance. The delivery of the papers was followed by general discussions in which particular problems were identified and solutions suggested. Reports on each session were drafted by the session chairman and the programme co-ordinators, and these were used to formulate a number of conference recommendations. The draft session reports and conference recommendations were approved at the final session of the conference.

List of Session Chairmen and Conference Officers

Conference President	Dr Celal Bilensoy, Director Grassland and Animal Husbandry Research Institute, Ankara

Session Chairmen

First Session: Ruminant nutrition	Professor D. Lewis, Biochemistry and Nutrition Department, Nottingham University
Second Session: Forage crop production	Mr C. E. Johnson CBE, Adviser on Agriculture, Middle East Development Division, Beirut
Third Session: Range management	Mr D. F. Davidson OBE, Adviser on Forestry and Soil Conservation, Middle East Development Division, Beirut
Fourth Session: Poultry Nutrition	Dr W. Bolton OBE, Head of Nutrition Department, Poultry Research Centre, Edinburgh
Fifth Session: Production and marketing of compounded feeds	Mr R. K. Peberdy, Technical Manager, Messrs J. Bibby Agriculture Ltd, Liverpool
Sixth Session: Role of credit and co-operatives in livestock production	Mr J. M. Hill, Adviser on Fertilisers, USAID, Ankara
Final Session: Recommendations	Mr P Durran CBE, Veterinary and Animal Husbandry Adviser, Middle East Development Division, Beirut

Heads of Delegations

Iran	Eng Akbar Noormanesh
Pakistan	Dr M. Y. Bhatti
Turkey	Dr Celal Bilensoy
United Kingdom	Professor D. Lewis and Dr W. Bolton
USA	Mr J. M. Hill

Previous Page Blank

Conference Officers

Programme Co-ordinator and Editor of Conference Proceedings	Mr D. Halliday, Tropical Products Institute, London
Assistant Programme Co-ordinators	Miss B. R. Smith and Mr I. A. Cockerell, Tropical Products Institute, London
CENTO Conference Officer	Mr P. R. Holmes, CENTO Secretariat Ankara
Production Editor of Conference Proceedings	Miss D. H. Davis, Tropical Products Institute, London

List of Conference Participants

Iran

Dr Mostafa Djirsarai
Head, Sheep Department,
National Livestock Organization,
Tehran

Eng Akbar Noormanesh
Assistant Director,
Animal Husbandry Research Centre
National Livestock Organization,
Tehran

Pakistan

Dr M. Y. Bhatti
Director of Animal Husbandry,
Government of Baluchistan,
Quetta

Dr Anwar A. Qureshi
Director of Animal Husbandry,
Government of North West Frontier Province,
Peshawar

Turkey

Mr Razi Akay
General Directorate of the Project for Development of Animal Husbandry,
Ankara

Dr Mahmut Akkiliç,
Veterinary Faculty,
Ankara University

Dr Cemalettin Akpinar
Faculty of Agriculture,
Ankara University

Professor A. Remzi Akyildez
Faculty of Agriculture,
Ankara University

Mr Omer Akyüz
Director of Grassland,
Feed Plant Section,
General Directorate of Agricultural Affairs,
Ankara

Mr Nazmi Alinoğlu
Assistant Director,
Grassland and Animal Husbandry Research Institute,
Ankara

Mr Kamalettin Altay
Institute of Grassland,
Feed Plant,
Seed Production and Zootechnical Testing,
Kayseri

Mr Mehmet Apaydin
Grassland and Animal Husbandry Research Institute,
Ankara

Dr Doğan Atay
Faculty of Agriculture,
Ankara University

Mr Ismail Ayrim
Director of Technical Agriculture,
Sinop

Professor Omer Bakir
Faculty of Agriculture,
Ankara University

Dr Celal Bilensoy
Director,
Grassland and Animal Husbandry Research Institute,
Ankara

Mr Ahmet Can
Director of Animal Husbandry,
General Directorate of Agricultural Affairs,
Ankara

Mr Yilmaz Çevik
Director of Technical Agriculture,
Denizli

Mr Hüseyin Derman
General Directorate of the Project for Development of Animal Husbandry,
Veterinary Faculty,
Ankara University

Mr Sadi Dostoğlu
Director of Animal Husbandry Section,
Ankara

Professor Şahap Elçi
Faculty of Agriculture,
Ankara University

Professor A. Kemal Göğüş
Faculty of Agriculture,
Ankara University

Mr Muhittin Gök
Directorate of State Farms,
Ankara

Mr A. Riza Günday
Director of Technical Agriculture,
Aydin

Dr Nurettin Gürsoy
Expert on Poultry Production and Poultry Diseases,
General Veterinary Directorate,
Istanbul

Mr Şefik Iyibilgin
General Directorate of Agricultural Affairs,
Ministry of Agriculture,
Ankara

Mr Ozer Kurt
Grassland Animal Husbandry Research Institute,
Ankara

Mr Bahattin Tanci
Directorate of Technical Agriculture,
Amasya

Mr Ergin Taşçioğlu
Agricultural Bank of Turkey,
Ankara

Mr Fikri Tepe
Institute of Agricultural Research,
Antalya

Professor Fahrettin Tosun
Faculty of Agriculture,
Ataturk University,
Erzurum

Dr Servet Şener
Feed Plants and Animal Husbandry Desk,
Veterinary Faculty,
Ankara University

Mr Nevzat Uludağ
Institute of Zootechnical Research,
Lalahan,
Ankara

Mr Dursun Üresin
General Directorate of Agricultural Affairs,
Ministry of Agriculture

Mr N. Turhan Uslu
Institute of Grassland,
Feed Plant,
Seed Production and Zootechnical Testing,
Afyon

Mr Orhan Üstunsoy
Director of Nutrition and Production Corporation,
Turkish Feed Industry,
Ankara

Mr Mustafa Yaman
Director of Poultry,
General Directorate of Agricultural Affairs,
Ankara

Mr Şerafettin Yavuz
General Directorate of the Project for Development of Animal Husbandry,
Veterinary Faculty,
Ankara University

United Kingdom

Dr W. Bolton OBE
Agricultural Research Council,
Poultry Research Centre,
King's Buildings,
West Mains Road,
Edinburgh EH9 3JS

Mr I. A. Cockerell
Tropical Products Institute,
Overseas Development Administration,
56/62 Gray's Inn Road,
London WC1X 8LU

Mr D. F. Davidson OBE
Middle East Development Division,
Overseas Development Administration,
British Embassy,
Beirut

Mr P. Durran CBE
Middle East Development Division,
Overseas Development Administration,
British Embassy,
Beirut

Mr D. Halliday
Tropical Products Institute,
Overseas Development Administration,
56/62 Gray's Inn Road,
London WC1X 8LU

United Kingdom–continued

Mr C. E. Johnson CBE
Middle East Development Division,
Overseas Development Administration,
British Embassy,
Beirut

Professor D. Lewis
Department of Applied Biochemistry and Nutrition,
University of Nottingham,
School of Agriculture,
Sutton Bonington,
Nr Loughborough,
Leicestershire

Mr R. K. Peberdy
Messrs J Bibby Agriculture Ltd.,
57 Great Howard Street,
Liverpool L3 7AW

Miss B. R. Smith
Tropical Products Institute,
Overseas Development Administration,
56/62 Gray's Inn Road,
London WC1X 8LU

United States

Mr J. M. Hill
US Agency for International Development,
Dr Vali Resit Cad 16,
Ankara

FAO Observers

Mr Lloyd Schweitzer
UNDP/FAO Poultry Production Officer,
Ankara

Dr J. Sithinparanathan
FAO Forage Production and Utilisation Officer,
Ankara

Addresses of Welcome

by His Excellency Mr Suleyman Kara

Deputy Secretary of the Turkish Ministry of Agriculture

Distinguished Delegates of CENTO countries,

I am opening the CENTO Conference on 'The development of feed resources and improvement of animal feeding methods' held in Turkey this year. I am very pleased to extend to you all a most cordial welcome and to salute the valuable scientists of the friendly and brotherly countries. The presence of such distinguished guests in our country is a pleasure for us.

The special importance of feed and animal feeding problems in the development of agriculture and consequently to realize the better nutrition conditions of the people of our countries is known. The main solution to solve the problem of meeting the demands of rapidly increasing population for animal products is the improvement of feed resources and to use feed in the most rational way.

In recent years the importance of activities in the development of feed resources and feed production had been recognized very well. Consequently it is necessary to improve the grass lands and meadows and the per unit land yield should be more and better quality.

Programmes aiming at the increase of feed production and reaching the maximum use of feed had been prepared and implementation of them had been started. We still continue to look for the most proper solutions for the problems. This CENTO Conference, for this reason, will be fruitful for the solutions of the feed and animal feeding problems and enlighten us, I am sure.

I hope the impressions of our country will be positive on you during your short stay on the occasion of this Conference and it will be fruitful and I hope successfulness to you all.

by Mr Marcus J Gordon

CENTO Deputy Secretary General (Economic)

Your Excellency, Distinguished Delegates, Ladies and Gentlemen,

I wish first of all to extend warm personal greetings from His Excellency Mr Turgut Menemencioglu, the Secretary General of CENTO to the Delegates from the five CENTO countries, who have come to participate in this conference. The Secretary General also asked me to express thanks to the Government of Turkey for acting as hosts and providing such excellent facilities and to the Government of the United Kingdom for the financial and organizational support which they have provided. We know that a great deal of work has gone into the preparation of this meeting and feel confident that the outcome will fully justify the efforts.

The CENTO Economic Programme makes a modest but important contribution to a very wide range of economic activities in the CENTO region and the field of agriculture receives a very high priority. With a steadily rising population and a growing desire for higher standards of living it will require ingenuity, persistent effort and a large measure of international co-operation to succeed in producing the region's requirements for food in the years to come. Animal husbandry has a vital and increasingly important role to play in the improvement of the level of human nutrition. This is the third major conference which we have held on this subject in the last two years. In December 1969 a symposium was held on the general subject of 'National and regional livestock development policy', and in September

Previous Page Blank

 1970 we concentrated on animal health by calling a seminar on 'Veterinary investigational and diagnostic methods.

You now turn your attention to the question of improvement of animal feeding methods and the development of feed resources. We have only to compare the average yield of milk of a dairy cow in Western Europe or the United States with what is currently achieved in the CENTO region, or to compare the length of time required to bring a beef animal to market weight to see how much room there is for improvement in such matters as the production and utilization of forage crops, in better management of ranges and in the production and distribution of concentrated feeds.

We are particularly interested in the session of your seminar which will be devoted to the use of credit and co-operatives in the livestock industry. Agricultural development, particularly in an area with large numbers of subsistence farmers, can be greatly enhanced by co-operation between groups of farmers and the encouragement provided by outside finance, whether governmental or private, to progressively increase production and quality.

Gentlemen, I wish you success in your endeavours over the next few days and we look forward, with the greatest of interest to reading your report.

First Session

Ruminant nutrition

Chairman
Professor D. Lewis
Biochemistry and Nutrition Department
Nottingham University

Ruminant metabolism and productivity

D. Lewis

Biochemistry and Nutrition Department, Nottingham University, United Kingdom

It is especially important when considering the productivity of farm animals to keep the particular abilities of the ruminant in perspective. Full advantage must be taken of the fact that the ruminant has an exceptional ability to withdraw from refractory materials nitrogen containing fragments to yield protein, and carbon containing materials to yield energy. Under all production conditions, including extensive and intensive systems, this special ability deserves to be fully exploited. The magnitude of the ability to utilise fibrous and other refractory products can be exemplified by comparing the digestibility of the cellulose and hemicellulose fractions of different forages by the ruminant and other animals (see Table 1). It can be seen that the sheep shows a considerable advantage over the pig in this respect but in the case of the rat the coefficients of digestibility are much lower.

Table 1
Comparison of hemicellulose and cellulose digestibilities in ruminants and non-ruminants

		%Digestibility		
		Sheep	Pig	Rat
Alfalfa	: Hemicellulose	49	42	46
	Cellulose	53	38	23
Brome grass	: Hemicellulose	76	46	11
	Cellulose	72	38	4
Orchard grass	: Hemicellulose	76	46	8
	Cellulose	68	42	4
		65%	42%	15%

A comparison can be made of the differing abilities of ruminants and non-ruminants to obtain energy yielding nutrients from different ingredients by noting the metabolisable energy values for the different species (see Table 2). It is particularly noticeable that for high fibre materials, for example lucerne (alfalfa) or wheat, the metabolisable energy value for sheep is some 50 per cent higher than for the pig or fowl. On the other hand the metabolisable energy values for products at an intermediate level (around 2,800 Kcal/kg) are similar in the case of both classes of livestock whilst

Table 2
Comparative metabolisable energy values (Kcal/kg) for standard food ingredients in the case of the pig, fowl and ruminant

	Pig	Fowl	Sheep
Wheat	3,200	3,350	3,150
Maize	3,450	3,450	3,250
Barley	2,550	2,850	3,000
Oats	2,750	2,750	2,750
Milo (Sorghum)	3,250	3,400	2,900
Soyabean meal	2,850	2,550	2,950
Cottonseed meal	2,800	2,750	2,750
Groundnut meal	2,800	2,800	2,750
Fishmeal (White, 65% protein)	2,800	2,750	2,250
Meat meal (60% protein)	2,800	2,500	--
Alfalfa	1,600	1,200	2,100
Wheat bran	1,550	1,250	2,500

for wheat and maize the metabolisable energy in the case of the sheep is some five per cent lower. The particular features of the ruminant in relation to high fibre ingredients can be put on a quantitative basis by such procedures.

When considering the productivity of the ruminant under different conditions, whether they be differences in management or in environmental conditions, it is clear that the general principles are unchanged but that standards or levels of productivity will alter. It is particularly important for a specific circumstance to maintain an appropriate species or strain of animal, to aim for a realistic potential level of production, to take full advantage of the available dietary ingredients and to identify the objective clearly in terms of production or profitability. Within a balance of such determinants it is possible to define the most effective nutritional system: attention is therefore given primarily to taking advantage of current concepts in nutrition and applying them to the other determinants mentioned as they refer to conditions within the CENTO countries.

Nutrients

The first requirement in a nutritional programme is to accept a system for defining the nutrients that are

Previous Page Blank

required. The categories involved are water, vitamins, minerals, protein and energy: it is probably only in the case of the latter two that any uncertainty exists concerning systems of definition. Though it is generally recognised that the protein component serves primarily to supply essential amino acids and amino groups for the synthesis of non-essential amino acids, and though in the case of non-ruminants it is possible to identify the adequacy of the protein fraction in terms of its amino acid composition, this is not yet possible with ruminants. Since there is practically no information yet available on the amino acid needs of ruminants and since it is not possible directly to modify the supply of amino acids by altering the composition of the diet it is still only possible usefully to define the protein component in terms of total nitrogen. Circumstances of amino acid supplementation can hardly be identified for highly sophisticated intensive systems of ruminant production.

With regard to the energy-yielding fraction of the diet there is still considerable uncertainty concerning the use of either a metabolisable or nett energy system. Whilst the objective is to recognize the relative worth to the animal of available alternative ingredients a metabolisable energy system has considerable advantages since it does not include such a major component that is a function of the level of productivity. On the other hand when the objective is to define an appropriate diet for a particular level of production it is necessary to assess the diet at the nett energy level. The metabolisable energy system proposed by the Agricultural Research Council of the United Kingdom does to some extent take advantage of both situations in that the ingredients are evaluated in terms of metabolisable energy and a correction is then applied progressively for the factors influencing the efficiency of utilization. Within such a concept it is possible to devise a table indicating the nutritive values of the broad categories of ingredients that might be available. Such data (see Table 3) essentially represent the value in monetary terms of materials used in feeding.

Table 3
Protein (N x 6.25) and metabolisable energy values for ingredients in ruminant feeding (dry matter basis)

	Protein	M.E.
Sorghum (Milo)	12	3,400
Maize	10	3,400
Wheat	12	3,100
Rice	8	3,250
Rye	13	2,900
Barley	12	2,900
Oats	12	2,450
Wheat bran	18	2,500
Rice bran	15	2,200
Maize bran	8	2,650
Wheat straw	4	1,700
Oat straw	1	1,800
Barley straw	4	1,600
Maize husks	3	2,700
Herring meal	70	2,950
Meat and bone meal	47	2,500
Cottonseed meal	45	2,500
Groundnut meal	50	3,000
Soyabean meal	48	3,100
Alfalfa hay	12	2,000
Cottonseed hulls	4	1,500
Bermuda grass	12	1,500
Sugar beet pulp	10	2,450
Sugar beet tops	12	2,100

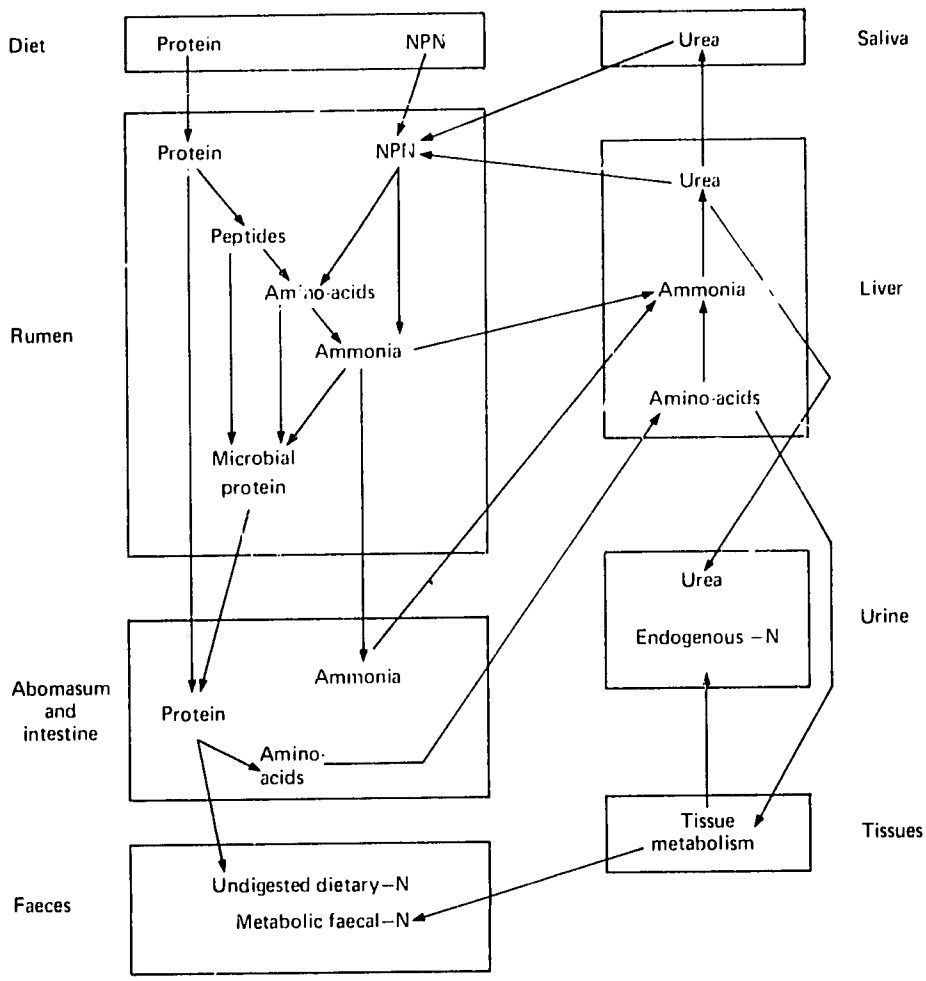
Intake

It is frequently considered that in the case of the ruminant intake is not primarily regulated by homeostatic mechanisms but essentially by physical factors concerned with the contents of the alimentary tract. Evidence has however become available that movement along the alimentary tract has a substantial effect upon intake and that an adequate medium for the development of a rumen micro-flora is important in this respect. Thus the proposal has been made that below a certain dietary protein level, around six per cent, food intake is restricted. Forage material under range conditions is often below this limit and it may then be desirable to introduce a nitrogen supplement. This is difficult under range conditions but certain blocks can be used, composed say of urea, molasses, vitamins, a forming material and perhaps a product to regulate intake. These could be spread in open conditions such that the animal could receive from these licks an effective nitrogen supplement. Various proprietary brands have been successfully used under conditions similar to those encountered in CENTO countries.

Urea

When contemplating such a dietary supplement of nitrogen the most obvious form to use is urea. It is necessary however to ensure that the supply is arranged to be at a level that is related to the needs. Excess can be both wasteful and potentially toxic. Concepts of avoiding ammonia toxicity and ensuring efficiency of utilization must be based on what might be regarded as nitrogen cycle in the ruminant (see Fig. 1). Urea is very rapidly broken down to ammonia but it must be remembered that this supplements any tendency to form ammonia from other sources, notably protein. Though some efforts have been made to regulate urea breakdown these have not as yet led to a procedure that can be successfully used in practice. It is more profitable in this respect to ensure that the ammonia formed is substantially directed to microbial protein synthesis and for this purpose a properly balanced supply of energy-yielding nutrients, for example starch or molasses, is essential. In order to synthesize microbial protein it is of course necessary to ensure that the supply of sulphur is adequate: there may be occasions when the branched chain substrates leading to certain amino acids are in short supply but it has not been possible to demonstrate this in terms of animal production.

Figure 1
Nitrogen metabolism in the ruminant



It is particularly important when devising a system of animal production that all the necessary contributory factors that can be said to come under the heading of management are borne in mind. It has already been mentioned that the determinants of the type of animal, feed and environment have a primary influence in establishing the pattern. Further details of the feeding programme are also important. When the basal roughage material requires to be supplemented it is often tempting to suggest, particularly under range conditions, the supplement might be offered infrequently. It is a potentially hazardous proposal to separate one part of the diet from another since effective microbial growth in the rumen or of tissue deposition in the animal requires that all necessary nutrients are simultaneously available. Since the half-life of a material in the rumen may be 12 hours there is probably a little more scope in this respect than for non-ruminants. But I am confident that any suggestion of offering supplements less frequently than daily must drastically reduce their effectiveness.

It is also desirable to mention that efficiency of animal production is a feature very much linked with the level of production. Whilst an animal is kept at maintenance, production is totally inefficient. If two animals are maintained at survival or maintenance, with no production, it is generally desirable to reduce the stocking density such that one animal can achieve a certain level of productivity. Within this context of relating productivity to levels of dietary supply it is necessary to refer to standard values (see Tables 4 and 5) though it is extremely difficult to interpret these at what are essentially range conditions. They do however give such indication of what might be necessary to achieve chosen objectives.

Table 4
Requirements of available protein for maintenance and growth of cattle

Live weight (kg)	Rate of gain in live weight (kg/day)			
	0.0	0.4	0.8	1.2
	Available protein (g/day)			
100	50	135	220	310
200	60	145	230	320
300	80	165	250	340
400	100	185	270	360
500	115	200	290	370
600	135	220	300	390

Table 5
Metabolisable energy required by growing and fattening cattle

Live weight (kg)	Ration concentration (Mcal ME/kg dry matter)	Rate of gain (kg/day)						
		0	0.25	0.50	0.75	1.00	1.25	1.50
		(Mcal metabolisable energy/day)						
	1.8	8.6	10.5	12.9	15.8	–	–	–
200	2.6	8.0	9.2	10.6	12.3	14.3	16.7	19.7
	3.4	7.5	8.4	9.4	10.6	12.0	13.8	15.7
	1.8	10.5	12.8	15.3	18.8	–	–	–
300	2.6	9.8	11.2	12.8	14.7	17.2	20.3	–
	3.4	9.1	10.2	11.4	12.8	14.6	16.5	19.1
	1.8	12.4	15.1	18.0	22.1	–	–	–
400	2.6	11.5	13.2	15.0	17.4	20.2	23.9	–
	3.4	10.8	12.1	13.4	15.0	17.0	19.5	22.7

Though an extensive system seems to be unavoidable in certain areas it is always necessary to keep in mind the potential advantage of say a feedlot system of beef production. Within certain regions of CENTO countries there are noteworthy climatic advantages, it is possible to keep transport and labour costs to a defined level, it is possible to plan supply in relation to the market and the examples of the Arizona and Cuba systems have a lot to offer. The prevalent economic circumstances will however of course determine what advantage can be offered.

Whilst considering the level of production and the range of ingredients available, and also intensive circumstances, it might be as well to mention the issue of nutrient concentration. As a more concentrated diet is offered less food needs to be supplied per unit of weight gain i.e. the food conversion ratio improves. The comparative situation between ruminants and non-ruminants in this respect is shown in Table 6. A 50 per cent increase in the metabolisable energy level for the ruminant led to the food conversion ratio being halved but the advantage with non-ruminants is less marked. The particular case of

the ruminant for diets of low energy states is also demonstrated by these data.

Table 6
Relative efficiency of food utilization at different dietary levels for the young growing pig, chicken and ruminant.

[DE = Digestible Energy and ME = Metabolisable Energy both in Kcal/kg. FCR = Food Conversion Ratio (units food per unit liveweight gain)]

Pig (25–60 kg)		Chicken (0–56 days)		Steer (200 kg liveweight)	
DE	FCR	DE	FCR	ME	FCR
2,650	2.83	2,800	2.43	2,200	7.4
2,850	2.67	3,000	2.30	2,600	5.5
3,050	2.45	3,200	2.24	3,000	4.3
3,250	2.39	3,300	2.13	3,400	3.5
3,450	2.33	3,400	2.06		
3,650	2.31	3,500	1.99		

It must again be emphasised within this context of management that it is necessary to balance the determinant factors – the animal, the system and the food. Within the food it has been emphasised that nutrients must be balanced.

Roughages

The ruminant can utilize roughage materials like hulls and straws. Within CENTO countries all such products should avoid being wasted but they must be included in the diet to best advantage. My colleague, Dr. H. Swan, has in fact paid considerable attention to the issue of using barley straw to best advantage.

A study was conducted to examine the dilution of grain-based diets with ground barley straw on the growth rate and carcass characteristics of Friesian steers. Ground barley straw was used, as only in this form could the roughage be adequately mixed with the cereal and other supplements. In current work 20 per cent cane molasses further substituted the cereal component. The levels of straw inclusion used were 0, 10, 20, 30, 40, 50 and 70 per cent.

The relationship between the digestibility of dry matter and the percentage of crude fibre in the dry matter determined in this work for diets containing ground barley straw was similar to that for the digestibility of a range of diets. There was however no significant relationship between the apparent digestibility of dry matter and the dry matter intake of diets containing ground barley straw, although with each increment of straw there was a non-significant increase in dry matter intake. This is in direct contrast to the situation reported with long roughage.

The level of 30 per cent ground barley straw promoted the highest rate of liveweight gain and the most efficient conversion of the cereal portion of the diet into carcass gain.

Work is in progress to develop an automated farm system for the preparation of ruminant diets containing ground barley straw. It is therefore suggested that considerable attention be given to the exploitation of the use of all roughages but especially to the form in which they are included in the diet.

Nutritional status

It is difficult under range conditions to establish the nutritional status of individual animals and to identify those nutrients that might be limiting. Though some measure of adequacy can be obtained by noting survival and recording weight, such information can contribute little to concepts of increasing efficiency. There are however certain tests that can be carried out which give some useful information. It is possible for example by the collection of a blood sample and a determination of urea content to gain an index of the protein status; from blood glucose, volatile fatty acids and blood ketone values the status in terms of energy-yielding nutrients can be established; and blood mineral or vitamin analyses can give an index of the level of adequacy of individual nutrients in those categories. It is probably of particular interest when considering the adequacy of ruminant food in certain areas of CENTO countries to pay particular attention to the supply of protein, sulphur, carotene and vitamin A, magnesium and salt.

It is necessary in conclusion to emphasise again that developments in animal production are dependent on ensuring that all determinants that might be placing a barrier on production be recognised. Sophisticated and well balanced diets are of little value if offered to animals under conditions in which advantages cannot be shown. Nutrients need to be balanced in the diet and the overall factors regulating production must also be brought to a balanced state and limiting factors removed as far as possible.

Ruminant nutrition, feed resources and their improvement in Turkey

A. Remzi Akyildez
Nutrients and Animal Nutrition Department, Ankara University, Turkey

Introduction

Turkey is one of the richest countries with regard to animal numbers but, in the amount of animal production as a whole, productive capacity per unit and in consumption of animal products per capita, Turkey must be considered one of the less developed countries. All of the measures which have been taken up to now for improving animal production has been insufficient, and raising of animals in Turkey is still largely at a primitive stage. In spite of this the income from animal production has an important place in overall national income as shown in Table 1.

The percentage contribution of animal production to agricultural income in Turkey is higher than in Greece and Spain, but much lower than USA, Austria, West Germany, Belgium, Great Britain, Denmark, Italy and Holland.

Table 1
National income at current prices, agricultural income as percentage of national income and animal production as percentage of agricultural income

Year	National income (*Milliard TL*)	Agricultural income as percentage of national income *per cent*	Animal production as percentage of agricultural income *per cent*
1963	59.6	42.2	32.3
1964	63.9	40.4	32.3
1965	68.6	37.1	36.1
1966	80.2	37.6	33.8
1967	88.2	35.5	36.9
1968	97.0	34.6	37.5
1969	108.8	32.8	35.7

The species and numbers of ruminant animals in Turkey are shown in Table 2.

Table 2
Numbers of ruminant animals in Turkey

Year	Sheep	Ordinary goats	Angora goats	Cattle	Buffaloes	Camels
1950	23,082,521	14,498,268	3,966,336	10,113,185	947,731	110,305
1955	26,413,838	16,216,513	4,816,389	11,058,935	1,058,000	72,034
1960	34,463,200	18,636,700	5,995,500	12,435,000	1,140,000	65,390
1965	35,382,000	15,305,000	5,500,000	13,203,000	1,216,000	45,900
1966	34,663,000	15,315,000	5,617,000	13,769,000	1,253,000	43,000
1967	35,878,000	15,200,000	5,459,000	14,165,000	1,248,000	43,000
1968	36,587,000	15,187,000	5,450,000	13,761,000	1,257,000	42,000
1969	36,351,000	15,336,000	4,931,000	13,189,000	1,178,000	39,000

In addition to the above there are 1,110,000 horses, 1,938,000 donkeys, 291,000 mules, 18,000 pigs, 32,313,003 chickens, and 2,023,000 turkeys according to the statistics of December 1969. With the exception of camels and ordinary goats, animal numbers will be seen to have gradually increased. The rates of increase in animal numbers in the 1960–63 period were about seven per cent for sheep, 8.1 per cent for cattle, and 5.4 per cent for buffaloes, while numbers of camels and goats have been decreasing.

Amounts of products from these animals in Turkey have increased a little during this period, and this may be connected partly both with increasing numbers of animals and with the improvement of breeding and keeping conditions. The breeds of cattle in Turkey are shown in Table 3.

It will be seen in Table 3, that a great majority of cattle are of native breeds. Because of this and adverse

Previous Page Blank

Table 3
Numbers of different breeds of cattle in Turkey (1966)

Breed of cattle	Number (1,000 head)	Percentage of Total Cattle
Native black cattle	6,978	50.4
Native east-red	3,750	28.1
Native south-red	1,220	8.9
Grey cattle	1,200	8.8
Brown Swiss (from Alps) and their cross-breeds	300	2.4
Holstein-Friesian and their cross-breeds	200	1.2
Jersey and their cross-breeds	21	0.2

environmental conditions, the average production of milk and meat is very low as shown in Table 4.

Table 4
Average production of milk and meat per animal in Turkey (1968)

Kind of animal	Average milk production per animal per year, *kg*	Average carcass weight per animal, *kg*
Cattle	683.6	86.2
Sheep	33.6	15.7
Ordinary goat	42.0	14.9
Angora goat	21.0	17.5
Buffalo	839.0	101.6

Average yearly milk production per cow is, for example 1,380 kg in Spain and 4,480 kg in Israel while the average carcass weight in European countries is 173–292 kg for cattle, 10–25 kg for sheep and 13–24 kg for goats. So currently the productivity of all sectors of the livestock industry of Turkey is very low, but it is hoped that a special project for the improvement of animal raising and breeding sponsored by the State Planning Department will help to improve matters.

The reasons for this low productivity, in spite of large animal numbers, can be explained as follows:

1. The breeds of animals are of primitive kinds, that is their genotype productivities are very low.
2. Inadequate feed and poor feeding conditions, that is environmental conditions are adverse to high productivity.
3. Inadequate marketing facilities and lack of facilities for manufacturing animal products.

There three problems are interrelated with one another and have, therefore, to be solved together. To solve one or two of them alone would be insufficient for proper improvement of animal production.

For example, to raise high producing animals instead of primitive breeds, it is not enough to increase animal production without a knowledge of animal nutrition, management and marketing. For example a person imported 100 head of pregnant Holstein-Friesian heifers, but his men had insufficient knowledge of how to keep and manage cattle and many of the calves died because of this. In spite of the almost modern barn the owner could not take care of the animals. In the barn there was only low quality hay and two sacks of bran as feed, while daily milk productions was only 900 kg from 91 cows. The owner had money, 30 ha of fertile land and ten workers but no knowledge of organisation.

On the other hand, the animal products which are obtained will be valueless without proper handling, utilisation, transportation and favourable prices, i.e. marketing facilities. In recent years some animal feeding demonstrations were carried out by the Ministry of Agriculture to show the farmers the benefits and to teach the proper feeding of animals. But when farmers who observed the demonstration and saw the benefits of proper feeding were asked why they did not feed their animals in this way, the typical answer was as follows: 'At present, the product which I obtain from my animals is enough for my family. If I give more and better feed to my animals, I believe that I will get more product, but what will I do with the productions in excess of my family's requirements. There is no market and I do not know how to utilize them.' In these conditions generally speaking the farmers are unlikely to improve the nutrition of their animals.

The nutrition of our ruminating animals depends mostly on common pastures which are very low in capacity. Sheep and goats especially depend almost entirely on pastures. Beef fattening projects, which have recently been begun, have up to now been far from successful. Thus, to solve on of these problems alone will not be enough to improve our animal nutrition and to increase our animal production.

Present feed resources and pattern of utilization

1. Present feed resources

When the number of animals and their nutritional requirement is compared with the amount of feed available, a big feed deficiency is observed. Since there are little or no statistical figures on feed production or consumption, the figures given here depend on estimation or guessing. These estimates have been made through deductions of human consumption, amount of seed planted, amount of agricultural products used as industrial raw materials etc. in connection with agricultural products which can be used as feed. The remainder of these from the above purposes and their by-products are assumed as being available for feed. The amounts of available feeds according to these estimates are shown in Table 5.

In recent years there have been increases in production of cereals (about six per cent), oilseeds (60 per cent) and sugar beet, and a decrease of about two per cent in production of vegetables. It can be said that the increase of production is due mostly to the extension

Table 5
Estimated amounts of feed materials available for animal consumption in Turkey

	Metric tons
Cereals	3,781,157
Vegetables	182,574
Bran	270,780
Oil meals and oilseed cakes	154,061
Molasses (total production)	172,700
Sugar beet leaves	1,467,562
Sugar beet pulp	1,707,000
Hays (various kind)	15,504,668
Straw and stubble	25,634,294
Other feeds and by-products	859,900

of arable land rather than an increase of the yield per acre. Extension of arable land occurs at the expense of range or meadow land, and for this reason a decrease in the amount of hay produced is possible.

Production of mixed feed manufactured by the feed industry grows rapidly each year. Mixed production was about 60,000 tons in 1966, and had reached about 205,000 tons in 1969, 60 per cent of this latter amount being poultry feed and 35 per cent cattle feed.

In spite of the insufficiency of feeds to meet the needs for full animal production, some feedstuffs are exported from Turkey. The amounts of feedstuffs which are exported including seeds, grains and by products are shown in Table 6. (These amounts are not included in Table 5).

Table 6
Exports of feed materials from Turkey 1960–63 and 1966–68 expressed as annual averages

	1960–63	*1966–68*
Cereals	38,480	25,118 (+)
Vegetables	14,525	17,521 (+)
Bran (Various kinds)	43,206	23,120
Oilmeals and oilseed cakes (various kinds)	107,222	243,439
Other by-products	29,101	30,038

(+) for 1969

Some of the cereals and vegetables given in this table may be for human consumption. Until recently, there was no mixed feed export. But this year up to June, 10,000 tons of mixed feed will be exported according to contracts. It is said that there is more demand for compound feeds from several countries.

In regard to the figures given above, it can be said that there has been a considerable change in the feedingstuffs situation compared with animal numbers in the last eight to ten years. However, there is an important point to mention here in that mixed feed production has been growing very rapidly in Turkey. This is good because through the increasing use of mixed feed more and more animals can be fed better, but, if measures to increase feed resources are not taken as well, the deficiency of nutrients for animals will still remain.

Accepting this situation, the estimation of the needs of our animals (27,487,233 animal units, excluding poultry) and available feeding values are shown in Table 7.

Table 7
Calculated requirements for digestible protein and starch equivalent for current animal numbers (other than poultry) compared with current amounts available

	Starch equivalent	Digestible protein
	Metric tons	
Calculated need (for maintenance)	12,446,219	1,491,732
Available amounts	12,445,805	1,491,661
Difference	414	71

It can be seen from Table 7 that, while the need for maintenance is almost covered, that for production is not covered at all. When the requirements for poultry are also taken into account the shortage of feed for maintenance will be greater.

2. Present pattern of utilization of available feeds

As mentioned above, the feed resources currently available in Turkey are insufficient to satisfy the needs of the present animal population, but on the other hand Turkey exports some feedingstuffs. A considerable number of animals die each year but the exact number is not known precisely. The reason for such a great number of animal deaths, according to some ideas, is more due to nutritional insufficiency than insufficiency of vaccination or care of disease. This belief is true to some extent as in some years in certain areas the animals are exposed to shortage of feed due to drought. At such times it is difficult to find even straw to give the animals physical satisfaction. Measures (such as in feed transportation or in purchasing the animals) are taken by the government but these are becoming insufficient.

Despite disasters of the above type, animal numbers are increasing rather than decreasing. The reasons for this situation can be explained as follows:

1. The figures for either animal numbers or feed resources may not be reliable.
2. Most of the animals can survive by utilising body reserves built up during spring, summer and autumn.

This second situation occurs in most of the areas in almost every year due to lack of planned animal production practices. Most of the farmers (or feeders) do not anticipate the needs of animals for the whole year, and what must be prepared and purchased. The main reason for this is that there may be no incentive to make any plans or calculations because of poor

marketing conditions. However, in the absence of such planning, the present feed resources cannot be utilised properly.

Ranges and meadows, which are the main and cheapest feed resources, are used ignorantly but this subject will be discussed in detail in other papers. However, the proper utilization of meadow grass and forage crops must be strongly emphasised. According to analytical results and digestibility trials carried out in our department, the Turkish fresh forage crops have at least the same value and sometimes even better value as compared with those produced in other countries. In spite of this, the structure and feeding value of the hays, which are made from the same forages, is very poor compared with those of other countries. Because hay making is very primitive in Turkey, no attention or care is given to hay making in some districts and in some others it is not known how to make hay and what should be hay. Even in state farms, where it should be known how to make good quality hay, it is rare to find good hay because of negligence and lack of equipment.

After hay is made it is kept in simple open stacks. So the hay, which is poor in quality because of late cutting and bad handling, loses further nutritional value through rain, snow and other effects. During feeding the leafy parts of hay are lost and the hay resembles straw. Some of these leafy parts remain as litter. For all these reasons, it is likely that less than 50 per cent of the nutritional value of hay is utilized.

A small amount of forage especially alfalfa is artificially dried and utilized in Turkey. There are five small units with a capacity of about 300 tons each. Almost all of them work at below their installed capacity, the total amount of alfalfa meal produced being about 1,000 tons per year. In these units small amounts of other green forages are dried besides alfalfa. The operators of the driers do not grow the green forages themselves but generally buy them for cash. For this reason the farmers or contractors who sell the green forages cut them at a late stage to maximise the weight, and the end product is, therefore, low in quality and below standard. This results in a lower nutritional value compared with the original forage.

Utilization of forages through silage making also is not developed in Turkey. Material and technical assistance by the Ministry of Agriculture in the form of silage demonstrations have not improved silage making as would be expected. The reasons for this are almost always the same, being that the importance and the role of silage are not grasped sufficiently, the lack of planned forage crop cultivation and animal production, and the lack of marketing facilities for animal products. All of these factors are of importance either separately or together. In most of the state farms some silage is made, but the quality is very low and the nutrient losses are very high. Here also, carelessness and lack of technical knowledge can be observed.

The utilization of grains and other concentrates is also poor for the same reasons. These kinds of feeds are generally used in only very small quantities whether the need of animals is covered or not. The needs of animals in protein, energy, vitamins, minerals etc. are generally not considered according to feeding standards. The same situation also almost obtains in fattening projects which are sponsored and controlled by official organisations and which generally use only one kind of oil cake or oilmeal, bran, straw and sugar beet pulp in rations which are not well balanced.

It is necessary to mention with satisfaction here that mixed feed manufacturing has shown a rapid increase, and mixed feed production for cattle exceeded 70,000 tons last year. However, this amount is very low when compared with animal numbers, but it is valuable in supplying balanced rations to high producing animals.

There is a feed shortage in Turkey, when the feed resources and the needs of the livestock population are calculated. In practice, however, it can be said that there is not a feed shortage at present as feedingstuffs are exported from Turkey. The real feed shortage will arise when the current problems facing animal production in Turkey are overcome.

Nutritional problems encountered and measures considered necessary to overcome them

One of the problems in animal nutrition is the lack of technical knowledge. As has been mentioned above briefly in an example, owning high producing animals is not enough to produce high animal productivity. Some owners have high producing animals and enough capital but lack knowledge of animal keeping.

There are a considerable number of cattle feeders around the sugar factories. They feed their animals on rations consisting of sugar beet pulp, straw and some bran. It can be easily understood that the meat quality of those animals fed such a ration is very poor. Some of these feeders may know how to feed the animals properly, but they do not want to apply this knowledge.

Another important problem is the handling, utilization or marketing of the animal products. Animal products which are produced or will be produced can not necessarily find a market easily, or they may be sold at very low prices. So, the farmers do not get reasonable profit and they are prevented from improving themselves. In most districts, especially in East Anatolia, the animal producers obtain credits in advance from middlemen and enter into contracts to sell them their animal products at very low prices. Even though prices may be high at the time of sale, they cannot sell their products on the open market. Having only a small profit in this way, they find it difficult to supply their needs and are forced to try to obtain another credit.

Another problem in animal nutrition is that of most animals being low in productive potential and being

mostly owned by villagers. As well as the sheep and goats, each village family has only one, two or three cattle. Even though they feed their animals properly, production is only slightly increased. This does not satisfy the owners, while on the other hand most of the families obtain sufficient animal products for their family. Some families also need to keep animals for their manure.

The following measures should be taken to overcome these problems:

1. Firstly it is necessary to improve the animal rearer's knowledge of nutrition and management both in theoretical and practical terms by locally organised courses and field days. Also, practical and readily understandable bulletins must be prepared on each subject and distributed to the interested people. These and the other factors show that a better extension service is needed.
2. At the same time effective measures must be taken to increase the value of animal products, as otherwise the animal rearer who knows how to feed and keep animals will not be interested in adopting improved methods of feeding or trying to become more productive. The most effective measure to increase the value of animal products to the producers and to overcome nutritional problems, is the establishment of co-operatives, such as dairy co-operatives, meat and livestock trade co-operatives, co-operatives for selling wool, and co-operatives for the supply of animal feeds. The government must sponsor the establishment of such co-operatives and control them. On the other hand, the official organisations concerned with animal products, such as the Establishment of Meat and Fisheries and the Establishment of Dairy Industry, may help to increase the value of the products to the producer. These establishments could give credits, could have branched purchasing or collecting stations and could have better transportation facilities. The animal products also could be standardized and sold and bought according to established standards of quality. Some premium could be given to the people who produced better quality products.
3. If the number of high producing animals were increased and the above mentioned measures undertaken, animal production would be increased accordingly.

During this improvement programme the real shortage of feed supply would develop.

Future development of feed resources in Turkey

In solving the feeding problems in the future, the following factors must be taken into consideration:

1. The economic importance of home grown feeds, and among them more especially roughages in ruminant nutrition, is well known. For this reason effective measures must be taken to increase the cultivation and production of forage crops. In this way it would be possible to meet the complete maintenance requirement and part of that for production. Also more economical feeding and production would be possible.
2. All the feed conservation methods, which are applied today in Turkey, must be improved and taught to the private growers and in addition the proper utilization of conserved feeds must be clearly taught. Even though the production of forages is not increasing, their utilizable feed value could be increased. By applying better hay making methods and making silage from one-tenth of the green fodder, it is estimated that 200,000 tons of digestible protein and 1,200,000 tons of starch equivalent could be gained. As the production of forage crops increases, so the added feed value from better methods of conservation will be correspondingly increased.
3. At the five artificial drying units about 1,000 tons of alfalfa meal are currently produced, which constitutes about 0.007 per cent of the total hay production of Turkey. If only one per cent of forages were to be dried artificially, at least 450,000 tons of digestible protein and 2,500,000 tons of starch equivalent could be gained.
4. As mentioned above a great majority of ruminant animals in Turkey are of primitive and low producing breeds. Comparing their nutritional needs for maintenance and production, it will be seen that there is a considerable amount of feed wastage (or loss). If high producing animals were to be kept instead, there would be a saving of feeds according to the degree of change.

For example, the live weight of Brown-Swiss Cows (from the Alps) is about 450 kg and their annual milk production is about 2,000 kg in Turkish conditions (there are some farms where their average milk production is over 3,500 kg per cow). The Turkish native black cow has about 200 kg live weight and a production of about 400 kg milk per cow in a year, that is to say, five native black cows must be kept to produce 2,000 kg of milk under the same conditions. If one Brown-Swiss cow were to be kept instead of five native black cows to produce the same amount of milk, 177 kg of digestible protein and 1,741.5 kg of starch equivalent to cover the maintenance need of five native black cows would be saved.

The mean number of milking cows (for the last five years) was on average, 4,436,000 head, of which 2,235,000 head were native black cows. If there were cows of 450 kg live weight and 2,000 kg milk production instead of all the native black cows, 80,000 tons of digestible protein and 780,000 tons of starch equivalent could be saved. According to a programme drawn up by the Government 100,000 head of high producing cows will be imported each year. If this programme is realized, all of the native black cows could be discarded in five years and in this way, the annual saving of digestible protein and starch equivalent would be about 16,000 tons and 150,000 tons respectively, which would grow each year cumulatively, as the change from native cows proceeds.

5. The amounts of digestible protein and starch equivalent of exported feed are currently about 75,000 tons and 190,000 tons respectively.

Even without increasing the production of various feeds, we can gain a considerable amount of feed value, by taking measures in preparing, conserving and utilizing of our present feed resources as shown in Table 8.

It will be seen from Table 8 that the obtainable amount of digestible protein is almost equal to 50 per cent of the amount presently available (see Table 7), the position for the starch equivalent being 26 per cent. These amounts of digestible protein and starch equivalent are enough to increase milk production from 10.4 to 14.1 million tons (four per cent fat-corrected). That is more than double the present total annual milk production of Turkey.

As has been shown above, there is still potential for increasing animal production by feed improvement in Turkey, but animal rearers and feed producers have to be taught to realise this potential. On the other hand all measures necessary to increase animal production must be given equal and simultaneous consideration if progress is to be achieved.

Table 8
Obtainable feed values

Resources	Digestible protein	Starch equivalent
	(Metric Tons)	
Improving hay-making	188,000	1,120,000
Silage-making from 10% of green forages	12,200	72,200
Artificial drying of 1% of green forages	450,000	2,500,000
Exported feeding stuffs	75,000	190,000
Total	625,200	3,882,200

Ruminant nutrition in Iran with special reference to sheep and goats

R. D. Beheshti

Sheep and Goat Section, Animal Husbandry Research Centre, National Livestock Organisation, Tehran, Iran

Introduction

According to an estimate made in 1968 the numbers of livestock in Iran were as follows:

Sheep	30,000,000
Goats	14,000,000
Cattle	7,000,000
Buffaloes	330,000
Camels	234,000
Pigs	80,000
Total:	51,644,000

The above indicates that the major livestock industry in Iran is sheep and goat production. The estimated number of sheep and goats was about 44 million making up 86 per cent of all livestock in the country. Sheep alone accounted for about 58 per cent of Iran's livestock, but as in most cases sheep and goats are run together in the same flocks, for this and some other reasons sheep and goat production may be considered as a single industry.

Sheep and goats in Iran produce about 73 per cent of the red meat and 40 per cent of the milk and milk products. Apart from the Zel breed which is found near the Capsian Sea, the indigenous sheep breeds are of a fat-tailed and carpet wool type. The world famous Iranian carpets are made from the wool of indigenous sheep. In general the sheep of Iran are mainly bred for meat, wool, and milk production, with the exception of the southern and northern pelt breed of Karakul.

Sheep and goat by-products such as intestines, hides, hair and related products also are of special importance among the main items of the country's annual exports. For instance, during the six month period of 1970 (March 21st–September 22nd) the total export value of these items was about US $9,133,000. During the same period the total value of carpet exports was about US $26,309,720. Disregarding oil products, exports of sheep and goat by-products and carpets together were valued at 31.6 per cent of total exports for that six months period.

It will be seen that the sheep and goat industry in Iran is both the main source of animal protein for human nutrition and a major source of revenue through exportation.

Feed resources and pattern of utilization

Flocks of sheep and goats in Iran are managed under two different systems, namely, village and migratory. Like other parts of the Near and Middle-East, both systems are extensive and the animals are mostly kept on natural vegetation of the ranges and farm lands, with a little supplementary feeding. Intensive systems of sheep production are employed in only very rare cases.

About 70 per cent of the sheep and goats are kept under the migratory tribal system and 30 per cent under the village system. In the tribal migratory system the flocks migrate annually from the lower elevation winter ranges to the higher mountain grazing area in the summer. In the village system the flocks are allowed on the communal grazing area within daily defined limits. The so-called grazing area could be either natural pasture, irrigated farm lands or even mountain ranges in summer. With the above background information, it is evident that sheep and goat husbandry at the present time in Iran is very much dependent on natural vegetation.

There is some conflict of opinion about the estimated area of the natural ranges in Iran. The official estimated figure has not yet been released, but according to one estimate made in 1967, the area of natural ranges in Iran is about 106 million ha. Of this, forty million ha is very poor and semi-desert, while the remainder, namely 66 million ha, could be considered in poor to average to good condition. According to some estimates, the natural vegetation of the ranges provides 88 per cent of the animals' fodder requirement throughout the year.

Stocking rate on natural ranges is not controlled and depends on the seasonal rainfall and condition of the

pasture. Overgrazing is common, and the range specialists believe that the present stocking rate is twice the actual carrying capacity of the ranges, and in some cases it may be even as high as twelve times.

Irrigated farm fodder crops and cereal grains play only a small part in providing nutrients for sheep and goats. Cereal farms and some other farm lands are grazed by sheep and goats after harvesting the crops.

Hand feeding is practised only during winter, when little or no feed remains on the communal grazing lands of the villages. Fattening feed lot units, where sheep are intensively fed for a certain period, could also be included in the category of hand feeding. In this respect the industrial feed and commercially prepared pellet and concentrate mixture is of special importance. The concentrate mixtures in most cases consist of barley, dried sugar beet pulp (with or without molasses), cotton seed meal and minerals. Wheat and barley straws are also commonly-used roughages for sheep and goats.

Better availability of prepared concentrate mixtures and pellets, is rendering the intensive system of sheep and goat production a more practical proposition.

The estimated present production levels of barley, dried beet pulp and cotton seed meal, the main sources of concentrates for livestock, were reported to be 240,000 81,000 and 204,000 tons respectively, in 1968. Due to the shortage of supply, demands are great for these products, particularly during winter, and consequently the prices are very high.

Nutritional problems of the sheep industry and measures considered necessary to overcome them

As mentioned on the foregoing pages the basic system of sheep and goat production in Iran is the migratory extensive system. In this system the animals are dependent mainly on range land with its natural vegetation.

Over-grazing, drought, and lack of protection during many decades have decreased the grazing capacity of the ranges. At the present time the grazing animals all round the year are on a very low plane of nutrition. A sample survey made a few years ago by the personnel of the Sheep and Goat Section of the Animal Husbandry Research Institute (AHRI) with the collaboration of FAO experts, indicated that due to nutritional problems the production levels obtained from the indigenous breeds of sheep were very low. Lambing per cent of the tribal and village flocks was estimated to be between 67–88, while lamb mortality rates were high especially during the periods and years of feed shortage. The average carcass weight was very low. According to a survey made in 1967 for the whole country the estimated carcass weights were 20.6 kg for sheep and 14.0 kg for goats.

The results of research at the Sheep Section of the AHRI near Tehran during the last four years, have indicated that the production capabilities of the indigenous sheep are substantial if their normal nutritional requirements are met. In Table 1 the comparative production performance of Iranian sheep under extensive and intensive system of production is given. In the extensive system, animals depend on the available range grasses which may or may not be sufficient to meet their requirements for reproduction and general performance. In the intensive system, on the other hand these requirements are met by supplementary feeding during the periods when insufficient feed is present on the range.

Table 1
Production performance of indigenous sheep under intensive and extensive systems of husbandry

Production	Extensive system	Intensive system	Possible % increase in production
Lamb production per ewe	0.8	1.12	40
Carcass (meat production)	21.0 kg	Ewe 28 kg Ram 34 kg	33 60
Milk production	45.0 kg	59.5 kg	32
Wool production	1.3 kg	2.2 kg	68
Flock off-take	33%	42%	24

It may be seen from Table 1 that the present system of nutritional management which depends completely on natural vegetation is unsatifactory. Although the completely intensive production system gives satisfactory results, it is very costly and rather uneconomic at present due to the very high cost of feeding stuffs.

Recommendations for semi-intensive sheep production will be given later. However, as an urgent step, in order to overcome the present nutritional problems of the poor ranges, supplementary feed should be produced and made available to the tribal sheep breeders during the periods of breeding, lambing and lactation. This will compensate to some extent for the poor nutritional status of the flocks and will considerably increase production from these animals.

Future development of feed resources in relation to possible animal production plans and the difficulties

It has already been mentioned above that 70 per cent of the sheep population belongs to the tribes. Thus, the sheep industry's nutritional problems can only be solved if the nutritional problems of the tribal flocks are solved.

Pasture improvement, to many people, appears to be the major development plan for the future of the tribal sheep industry. With the present conditions of

over-grazing as a result of high stocking rates, there is little doubt that range improvement would be a very time-consuming programme and, perhaps, unsuccessful. To be successful, sheep should be taken off the ranges as much as possible to reduce the grazing pressure on the vegetation and to permit regeneration of the range species. So as to be able to take the sheep from the ranges, it is suggested that the present extensive system of production should be gradually changed to a semi-intensive system.

Semi-intensive sheep production could be practised by partial settlement of the tribes. In this paper it is not convenient to deal in depth with the problems of full or partial settlement of the tribes. It will only be mentioned that the permanent settlement of all tribal communities, as far as the livestock production is concerned, means losing the advantage of the natural fodder resources of million of hectares of the ranges. These now save the tribal livestock producers much money annually. Permanent settlement also requires large scale farm fodder production, which, for a semi arid country like Iran, is at present neither practical nor economic. By partial settlement of the tribes, only a part of their livestock fodder and feed requirements need be produced to supplement the insufficient feed obtained from the ranges.

The most suitable area, perhaps, for the partial settlement of the tribes would be near the newly established water dams. This would be a decided advantage in that they could easily produce crops under irrigation.

In partial settlement, one or several 'Family Groups' (Khanevar) of the tribe could be engaged permanently on farming and fodder production. If the settlement site is located on the migratory route the necessary facilities could be prepared and erected for the annual treatment of the flocks, such as dipping baths, shearing sheds etc. The settlement area could also be used as an animal breeding training centre for the whole tribe while they remain there. By this system of production the tribal flocks will benefit both from the natural vegetation of the ranges and from the fodder crops and other feeds produced on the irrigated farms. The productivity of the flocks may be increased through upgrading and more meat, milk, and wool will be produced. It will also stimulate the production of fodder crops and other feeds for the country. As a consequence, it will help to stabilise feed prices, the lack of which at present is a big problem encountered by livestock producers.

According to the FAO Indicative World Plan for Agricultural Development, the feed production requirements, to meet the 1975 and 1985 animal production targets in Iran, were as follows:

Requirement	Amount and years	
	1975	1985
Concentrate feed (Tons)	2,249,000	3,763,000
Legumes and oilseeds (Tons)	349,000	627,000

These estimated requirements far exceed present production levels. The available manpower, brought about by tribal settlement could perhaps do much to bridge the gap between estimated requirements for the years ahead and the present output.

Ruminant nutrition in Pakistan

Mohammed Akram
College of Animal Husbandry, Lahore, Pakistan

Ruminants play a vital role in the economy of Pakistan, providing high quality foods such as milk and meat and valuable by-products such as hides, skins, wool, hair, intestines, bones, etc. They also provide the motive power for many agricultural operations and maintain soil fertility through droppings rich in nitrogen and other soil nutrients.

There are about 80 million head of ruminants in Pakistan (see Table 1), and these include cattle, buffaloes, sheep, goats and camels. Cattle are kept primarily for agricultural operations and milk production alone. Sheep and goats are kept for meat, milk and wool, while camels are used for transport and conveyance of goods in the desert areas of Pakistan.

In spite of the large number of ruminants being kept in Pakistan, the per capita consumption for their products is small, and is inadequate for meeting national requirements. For example, the average national per capita consumption of milk is eight oz per day, while that of meat is about eight lb per year (Qureshi and Burque, 1969). Pakistan is, thus, consuming only one-third (10.7 g per head per day) of the minimum amount (31.3 g per head per day) of animal proteins considered to be desirable (Anon, 1968). It is considered that this low level of consumption of animal protein adversely affects national health and vigor to varying degrees, and the low availability of protective foods is due to poor performance of animals primarily because of low planes of nutrition.

The feeds and fodders available in Pakistan are not enough even for meeting the maintenance requirements of the present animal population and according to a recent estimate, hardly 11 lb of green roughages and 2.5 lb of dry roughages are available per animal unit

Table 1
Population of ruminants in Pakistan

Species	Class	East Pakistan	West Pakistan	Total
		1,000 head		
Oxen:	Breeding bulls	300	124	424
	Milch cows	4,516	5,122	9,638
	Work animals	10,351	8,485	18,836
	Youngstock up to 3 years	6,068	4,044	10,112
Buffaloes:	Breeding bulls	10	60	70
	Milch buffaloes	53	6,292	6,345
	Work animals	275	894	1,169
	Youngstock up to 3 years	117	2,627	2,744
Sheep:	Adult males	112	1,496	1,608
	Adult females	245	8,609	8,854
	Youngstock under 1 year	120	2,323	2,443
Goats:	Adult males	1,692	844	2,536
	Adult females	2,881	6,714	9,595
	Youngstock under 1 year	1,908	2,027	3,935
Camels:	Camels	–	763	763
	Total:–	28,648	50,424	79,072

Source: Haq and Masud (1966)

Previous Page Blank

 (Qureshi and Burque, 1965). Thus, it is evident that most of the livestock remain under-nourished and this accounts for their poor performance.

Conventional feeding systems

Cattle and buffaloes

Roughages (green and dry) are the major feeds on which cattle and buffaloes are raised. According to season two types of fodder crops are grown in a year, namely 'Kharif' or summer crops and 'Rabbi' or winter crops. The former include maize, jowar (sorghum), cowpeas, etc., while the latter include berseem (Egyptian clover), Persian clover, alfalfa, etc. These crops are grown in canal irrigated areas or in those places where there is facility of water provision through tube wells or Persian wells. Hardly ten to 12 per cent of arable land in such areas is brought under fodder crops because of competition from cash crops. During any one year about 5.6 acres per square (25 acres) are used for fodder production. The fodder produced from such a small area hardly satisfied the minimum requirements of livestock (five to six bullocks, one cow, one buffalo and two to three youngstock) maintained by a farmer tilling one square of land.

The main dry roughages available in the country are the by-products of cereal and legume production, including wheat straw, rice straw, oat straw, barley straw, gram straw, corn cobs, etc. However, the roughages available in greatest quantity are wheat and rice straw. These roughages are mostly fed mixed with chaffed green fodders or with concentrates.

In arid areas of the country, cattle and buffaloes are mostly grazed on marginal or range lands.

Milch animals

Supplemental feeding of milch animals with concentrates is seldom carried out and they are mainly maintained solely on green and dry roughages. When concentrates are supplied these normally consist of undecorticated cottonseed cake or more rarely cottonseed. The concentrates are fed both to increase milk production and to increase butter fat content.

Work animals (bullocks and male buffaloes)

These animals are maintained on roughages (green and dry) alone. Their feed is, however, supplemented during busy days of harvesting when they are worked for nearly eight to ten hours a day. Animals used to pull carts in big cities are fed on concentrates as well as roughages throughout the year.

Female young stock (calves)

These animals are always well fed and properly looked after. In the first few weeks of their life they are fed on milk liberally by allowing them to suckle two teats. When they grow a little older and start taking other solid feeds, the amount of milk is curtailed by restriction to one teat till they are weaned. In this system there is no control over feeding of these animals, and sometimes due to overfeeding of milk they suffer from scours.

Male young stock (calves)

The feeding situation with regard to male young stock is quite alarming. Buffalo male calves particularly and Sahiwal calves in general because of their unsuitability for draft purposes are either killed just after birth or starved to death. According to a conservative estimate 75 per cent of male calves (buffaloes and Sahiwal) are lost annually in these ways, thus resulting in a huge economic loss.

Heifers and dry animals

The heifers and dry animals are raised on roughage which is usually refuse left by milch and work animals. They thus remain underfed resulting in late maturity in heifers and poor performance in the succeeding lactation by dry cows and buffaloes.

Sheep, goats and camels

These animals are not fed at all in ordinary sense of the word 'feeding' in Pakistan, but are allowed to roam at large over whatever grazing areas are available and get little more food than they find in their wanderings. The camels are usually maintained on tree leaves and weeds, and sometimes on dry roughages such as gram straw or wheat straw mixed with a little concentrate. The flocks of milch goats maintained in or around big cities are fed on green fodders in addition to grazing on marginal lands.

Feeding practices in urban areas

In and around big cities the feeding practices are different to those followed in rural areas. In cities the prices of roughages are higher than those prevailing in villages, and the animals (cattle and buffaloes) are maintained on a minimum quantity of fodders and dry roughages with supplemental feeding. The usual concentrates used are cottonseed cake (undecorticated) fed alone or mixed with wheat bran, but feeding of concentrates is never carried out in accordance with any feeding standard and the animals are fed below their requirements. The dry animals in cities are either sold to butchers or are kept on poor quality roughages.

Feed industry

There are already a number of feed manufacturing concerns in Pakistan (the industry was started in the late 1950s), and more feed mills are expected to come into operation in the near future. At present all the plants are producing only poultry feeds but one company (Messrs Lever Bros Ltd) did at one time produce dairy concentrates. Production of dairy concentrates by this firm was, however, terminated due to lack of demand.

Research in ruminant nutrition

A programme of feeding experiments has been carried out to determine the nutritional requirements of milch animals (cows, buffaloes and goats), dry animals, work animals (buffaloes), meat animals (beef and mutton) and youngstock (calves and heifers).

Economical and efficient rations have been evolved by conducting feeding trials extending over a number of years using commonly available feed ingredients unfit for human consumption such as agricultural and industrial wastes and by-products like wheat straw, rice straw, corn cobs, bagasse, maize and sorghum stovers, molasses (cane and beet) cottonseed hulls, oil cakes, brans (wheat, maize and rice bran) and husks.

Investigations were also carried out to study the feasibility of using fertilizer grade urea as livestock feed. The findings of these studies revealed that the urea can be efficiently utilized by ruminants (cattle, buffaloes, sheep, goats and youngstock) when used up to 1.5 per cent in a mixed ration without adversely affecting their performance (milk production and growth). The results further indicated that 1 lb of urea can replace up to 12.5 lb of conventional sources of proteins such as cottonseed cake (undecorticated) in livestock rations. However its proper utilization is only possible if readily available sources of energy preferably grains are available in the mixed rations. Undoubtedly urea is a partial protein replacer, but its use in livestock rations cannot be advocated presently to Pakistani farmers because of the risk of its toxicity especially when they are not well versed in its proper use (Akram, 1971).

It is heartening to see that the livestock farmers in Pakistan have started realizing the importance of scientific feeding and are now becoming interested in following modern feeding practices.

Future line of action

The following ways and means are suggested, which if followed would go a long way towards improving ruminant nutrition, thus, enhancing their production:

1. Curtailing the existing number of animals by culling and getting rid of those which are uneconomical.
2. Enhancing fodder production through judicious use of fertilizers.
3. Conducting research on fodder production to evolve high yielding varieties with higher nutritive value.
4. Encouraging farmers to make hays and silage from fodders at times of the year when they are surplus to the requirement of their animals.
5. Developing and conserving range lands.
6. Restricting export of feed ingredients especially oil cakes, etc., etc., needed for home use as livestock feed.
7. Encouraging the manufacture of compounded ruminant concentrate feeds and advocating their use among farmers.
8. Devising some means to prevent the envisaged huge wastage of wheat bhoosa through the use of harvesters and combines.
9. Discouraging the use of straws in the manufacture of packing materials and saving them for livestock feeding.
10. Establishing an independant Institute of Animal Nutrition, one in each wing of Pakistan for conducting research on different aspects of livestock feeding.

References

ANON. 1968. *The protein problems of Pakistan.* Karachi: National Science Council.

AKRAM, Mohammad. 1971. Personal communication.

HAQ, I. and MASUD, M. 1966. *Livestock, poultry and their products.* West Pakistan Agricultural University, Lyallpur.

QURESHI, S. R. and BURQUE, A.R. 1965. Production of animal fodders and feeds. *Food production and consumption in Pakistan,* 2, 69.

QURESHI, S. R. and BURQUE, A. R. 1969. *Production trends and future production potential for livestock and poultry in West Pakistan.* West Pakistan Agricultural University, Lyallpur.

Report on First Session: Ruminant nutrition

Chairman, Professor D. Lewis

Feed supplies in relation to animal numbers

1. The Conference recognised that at present in CENTO countries there were too many animals in relation to the feed supplies available. This was due both to overstocking of rangeland and a shortage of forage crops.

2. There was some discussion as to the ways of overcoming the problem of excessive livestock numbers in relation to feed supplies. There were two basic approaches to solving this, namely either to reduce livestock numbers so that feed supplies would be adequate to satisfy the requirements of the remainder or to increase forage supplies.

3. It was emphasised however, that increasing forage supplies without controlling stock numbers would not in effect prevent the basic problem of imbalance of stock and feed. It was further emphasised that the most promising approach might be to regulate stock numbers as the prerequisite for improving a particular forage situation.

4. The method of controlling stock numbers was discussed and a number of problems were identified. These included the reluctance of those keeping livestock on communal grazing lands to reduce numbers when their neighbours might do otherwise. There was also the desire of livestock keepers to insure themselves against mortality among their stock by keeping as large a number of units as possible. There was also the problem of lack of marketing facilities and incentives to slaughter their stock. Other areas of the world such as Australia and the United States with large rangelands have not had the same problems to overcome to utilise them effectively.

5. It was, however, essential to increase forage crop production, and one example of how this could be achieved was given with respect to the Anatolian plateau of Turkey. Work carried out at the Grassland and Animal Husbandry Research Institute, Ankara, has shown that replacement of the existing wheat-fallow system of cultivation by a rotation including leguminous forage crops resulted in increased wheat production as well as production of a forage crop.

6. The potential for great utilisation of by-products from the production of economic crops as stockfeed was mentioned. Sugar beet pulp was widely used already in Turkey and Iran, while there was potential for the greater use of molasses. It was mentioned that residues from crop production were fully utilised at present in Pakistan and were fully utilised in Turkey. There might also be a greater role for other concentrates to play in livestock feeding.

Livestock production efficiency

7. There was some discussion as to the relative merits of using imported breeds in place of the existing local breeds of cattle. It was emphasised that although the ceiling of production of imported breeds would be higher, they were not necessarily more efficient as production units than the local breeds at lower levels of production. However, evidence was presented which indicated under good management, imported breeds were highly productive in Turkey.

8. Imported breeds would be less resistant to disease than the local breeds and would initially only survive with very careful management. It was unlikely that they would either be suited to local management practices or fit into the current environmental scene. They would after a long period of time adapt to the local environment, but could lose some of their productive potential in the process.

9. The possibility of nutrient deficiency was discussed. It was considered that nitrogen would commonly be deficient in many diets and could be a limiting factor in productive efficiency. For example it was stated that feed intake fell when crude protein intake was below six per cent of the total ration. There was some discussion as to how low protein intakes could be supplemented. One material which could be used might be urea, which could be fed either as a liquid supplement or in the form of a block which could be licked

Previous Page Blank

by animals. The former approach was more suited to intensive production, while the latter could be used for animals kept in a range environment.

10. Urea was best used as an ingredient of a balanced supplement supplying all nutrients which might be limiting. Care would be needed to ensure that urea was fed in such a way that it was not toxic. Toxicity was associated with inefficient utilisation by the rumen flora, and it was essential to feed it together with molasses to avoid this. Work recently carried out at the Veterinary Faculty, Ankara University had also suggested that urea might have some undesirable effect on fatty acid production by the rumen flora.

11. It was clear that despite the potential for improving the efficiency of livestock production, the most important problems were still those of excessive livestock numbers in relation to feed supplies. These problems were to be discussed further in the two following sessions dealing with forage production and range management respectively.

Second Session

Forage crop production

Chairman
Mr. C. E. Johnson CBE,
Adviser on Agriculture,
Middle East Development Division,
Beirut

Forage crop production in the CENTO region

C. E. Johnson
Middle East Development Division, Beirut, Lebanon

Introduction

Extensive grazing on natural pastures is the predominant source of food for many millions of sheep, goats and cattle in the three countries of the region. Cultivated land supplies supplementary feed in the form of crop residues, grazing on stubbles and a limited production of forage crops. The natural pastures vary greatly in climate, soil and topography, but their productivity is generally severely restricted by various factors and animal production is limited by the low total availability of feed and by seasonal shortages which result in a 'stop-go' cycle of nutrition. The purpose of the present paper is to introduce a discussion of the prospects and problems of supplementing the feed supply with forages to meet both the overall inadequacy and seasonal shortages.

Forages are distinguished from concentrated feeds such as cereal and pulse grains and the high-protein residues derived from oilseeds by their bulk. They exploit the special ability of ruminants and certain other animals with large stomachs to digest bulky feeds that cannot be assimilated by animals with smaller stomachs including man. As one authority has put it, what is roughage to us is 'smoothage' to them (Commonwealth Agricultural Bureaux, 1964). The case for forage crops rests on the capacity of the animals to utilize materials that have no value as human food and can be produced on the farm at a lower cost in terms of digestible nutrients than the more concentrated foods, which also have their place in ruminant nutrition. Forages have their limitations. Their cheapness depends on suitable choice of crops and methods of cultivation and their bulk can make them expensive and laborious to handle and transport. There is a limit to the amount of bulk that even a ruminant can ingest, and high producing animals in particular may be unable to consume sufficient, if fed exclusively on roughages with a low content of digestible nutrients, to meet their nutritional needs. But balancing their advantages and limitation forage crops have a value which makes them a crucial factor in the economics of ruminant animal production.

Feeding value

The natural food for ruminants is grass, which varies widely in feeding value. Close-grazed good quality fresh green grass may have a dry-matter content of 20 per cent including three per cent of digestible crude protein and 14 per cent of starch equivalent, and this is equal to 15 per cent protein and 70 per cent starch equivalent on a dry-matter basis. Most grass on range grazings in the region will be of less feeding value than this. When fully mature and dry its nutrient content approaches that of cereal straw, with about 85 per cent dry matter, 20 per cent starch equivalent and less than one per cent protein. Average hay cut before the grass is fully mature might have a dry matter content of about 85 per cent a starch equivalent of perhaps 30 per cent and about three per cent protein. Hay is cut on the natural pastures in some parts of the region during the season of flush growth, when it grows faster than the animals can eat it, to be kept for feeding during the scarce season. There is very little production of cultivated grass, though highly productive species have been developed in various parts of the world for a diversity of natural conditions and some of these have been tried out on experiment stations in the region.

Cereal straw and other crop residues, including the green tops of sugarbeet and sweet potatoes, the dry stalks of pulse crops, sunflower and groundnut tops, etc. are widely used as forages in the region. They are of low feeding value but they are a cheap and useful supplement to over-wintering animals and in limited quantities as part of the ration for fattening or milk production. Of much higher value is legume hay, which if properly made at the right stage of maturity (usually when the plant is in early flower) can have a dry-matter content of 85 per cent, a starch equivalent of about 30 per cent and a protein content of eight per cent or more. Alfalfa (*Medicago sativa*) is far the best known in the region and is widely grown under irrigation and also to some extent in dryland farming. Sainfoin (*Onobrychis viciifolia*) is another perennial of similar habit which has given good results in dryland cultivation on the Anatolian Plateau (Bilensoy, 1970). Berseem (*Trifolium alexandrinum*), vetches (*Vicia sativa* and V.

Previous Page Blank

ervilia) and forage peas (*Pisum sativum*) are annual forage legumes suited to sub-tropical conditions and grown in some parts of the region and adjoining areas. Subterranean clover (*Trifolium subterraneum*) is another annual which seeds itself each year and has been successfully cultivated in Mediterranean areas including parts of Turkey. Among species adapted to tropical conditions are forage varieties of cowpeas (*Vigna* spp.) and lubia (*Lablab niger*) and there are various others that have been developed for pasture and forage production in the tropical and sub-tropical regions of Australia, the United States, India and elsewhere (Commonwealth Agricultural Bureaux, 1964).

Forage cereals are widely grown for feeding green or for conservation as hay or silage in many countries and to some extent in the region. They include green barley, oats and rye for cool growing conditions and maize, sorghum and millets for warmer climates. Yields can be high, as has been shown by the experiments of Karadj in Iran where one plot of irrigated sorghum reached 40 tons of dry matter per ha (Kernick, 1967) and experiments in Iraq demonstrated that hybrid forage maize under irrigation was (under the conditions there existing) the cheapest producer of starch equivalent (Anon, 1968). Root crops and leafy brassicas such as mangels or forage beet, swedes, kale, cabbage, rape etc. are extensively used in European countries, and of these forage beet has proved its value in the Mediterranean area and given interesting results in the Mesaoria dryland farming region of Cyprus where under preliminary trials it has produced over seven tons of dry matter per ha with a winter rainfall as low as 250 mm. In tropical areas pumpkins and sweet potatoes are useful forages.

All these succulent crops are very bulky and have a high labour demand. In composition they are similar to sugarbeet tops with a dry-matter content of round about 15 per cent, a starch equivalent of seven to nine per cent and a protein content from under one per cent to nearly two per cent.

While the range of forage crops is very wide the choice for any particular locality is usually rather restricted. Yields and feeding value vary greatly according to local conditions of climate and soil and whether the crops are to be irrigated or dryland. Legume hay may be the highest-yielding and cheapest source of protein at present available in the region. Irrigated alfalfa has been shown under suitable conditions to yield 25 tons or more of dry matter per ha in successive cuts over the year containing some 2.5 tons digestible crude protein and seven tons of starch equivalent. But it uses a lot of water. In dryland cultivation 2.5 tons of hay per ha have been obtained on the Anatolian plateau from alfalfa and sainfoin grown in rotation with cereals, and this is equivalent to over 200 kg of protein per ha compared with about 80 kg from an average cereal crop yielding under these conditions about 1,000 kg of grain and the same amount of straw. While legumes are valuable as a source of protein, higher yields of energy food may be obtained at lower cost from forage cereals and root crops. In Britain average crops of mangels (also known as forage beet) and kale yield over five tons of starch equivalent per ha compared with about three tons from an average grain crop of about 3.5 tons per ha plus about the same amount of straw and two tons from an average hay crop yielding two cuts of three to four tons each per ha. Yields of forage beet obtained in dryland cultivation in Cyprus with 250 mm rainfall per year are equivalent to about 3.5 tons of starch equivalent, and this may be compared with 750 kg from dryland alfalfa yielding 2.5 tons of hay per ha at 30 per cent starch equivalent on, under similar rainfall conditions, the Anatolian plateau. Under warm conditions forage maize or sorghum may be the most economical producer of energy food and sweet potatoes and pumpkins have considerable possibilities. Mixtures of grasses or cereals with legumes, such as grass with subterranean clover, oats or barley with vetches or forage peas, may also find a place in some areas, as experiments by Tosun at Erzerum in North-East Anatolia are showing.

Legume hay is likely to remain one of the most useful forages for the region. Legumes are well adapted to many parts of it, and their ability to fix nitrogen and to be readily convertible in the climatic conditions usually prevailing to hay with a high protein content, gives them a particular value for supplementing the low-protein diet available over most of the year from the natural grazing plus cereal straw and rather mature grass hay. In some situations where soil moisture is favourable from rainfall or irrigation and nitrogen fertilizers are used more freely than in the drier areas, forage cereals cut at an early stage in grain formation can be attractive, and in some dry areas where grain production is hazardous through lack of soil moisture in the later stages of growth, a cereal cut before maturity for forage may give a higher yield of animal feed than if left to produce an indifferent grain crop.

More experiments are necessary at different places to determine the potential for high-producing grasses, which like high yielding cereals generally require plenty of nitrogen and soil moisture to give their best yields. In all experiments with forages, once the preliminary screening phase of finding out what will grow well enough to be worth further examination has been completed, the importance of feeding value must be emphasized. What is of interest to the livestock feeder is the yield and cost of digestible nutrients.

Potential for forage production

Dryland farming is extensive in all three countries, and soil moisture is a major limiting factor to crop growth. Irrigation has been most highly developed in West Pakistan, where about 60 per cent of the total cultivated area is irrigated. There is a considerable potential in both Iran and Turkey which is now being developed. East Pakistan generally gets more than enough water in summer but is turning to irrigation for winter crop production. A very large proportion of

the cultivated land in the region is devoted to food production, which is somewhat delicately balanced between supply and demand. Turkey and Pakistan rely heavily on crop exports to provide their foreign exchange requirements, and Iran's dependence on agricultural exports, if less exclusive, is important. Much of the land not used for growing food for local consumption is therefore taken up with export crops. Any significant increase in animal feed production poses the question of where the feed crops are to be grown.

In fact there is a considerable potential. The question is how to develop it. New irrigable land is constantly being created but does not always add very much to the production formerly obtained from that land by dryland farming. However progress is beginning to be apparent in the intensification of irrigated cropping, both the using irrigation to grow two crops a year instead of one and by pushing up crop yields through the use of higher-yielding varieties and increased use of fertilizers and crop protection measures. The 'green revolution' is already a reality in some of the irrigated and high rainfall areas. Once the shadow of food shortage has been lifted there will be more interest in and indeed a search for other crops that can be profitably grown. High value cash crops for export will of course be strong candidates, but the scope for these is not unlimited and in many areas there will be room for forage crops if animal production develops to provide a profitable market for them.

The dryland areas present a different problem because of the limitations on cropping imposed by soil moisture considerations. However, there are two significant developments that could, though perhaps slowly, change the picture. There is much controversy among scientists about the functions of the year-long fallow that is extensively employed in dryland farming in the interior of Turkey and north-western Iran, where at least ten million ha are left fallow each year, partly perhaps because it is believed necessary to accumulate moisture for the succeeding grain crop, partly it may be to accumulate available nitrogen through the action of soil micro-organisms, partly to facilitate weed control, partly no doubt because with simple implements and animal draught it is impracticable to plough the stubbles and clean up the weeds in the time between harvest and the beginning of the following rains. Experiments in various places have shown that under the conditions of a Mediterranean climate, of which a continental variant extends over much of Anatolia and north-western Iran, the fallow can be used for growing forage crops (Perrin de Buchambaut, 1969). Bilensoy (1970) demonstrated at the Grasslands Research Station near Ankara that part of the fallow can be used for alfalfa and sainfoin with benefit to the succeeding wheat crop, making it possible to produce the same amount of wheat, or even more, from the reduced area under cereals and to get forage as well. Further investigation is necessary to identify the conditions of soil and climate in which this result holds and to find whether with the use of fertilizers and moisture-conserving methods of cultivation the fallow could be completely eliminated and used for short-term forage crops in rotation with cereals. In some dry areas it has been found that vetches planted in place of the fallow increase the yield of the following cereal as well as providing animal feed. For more intensive use of the dryland areas to be practicable, quicker and more effective methods of tillage and seeding are needed. Methods and implements suitable for this purpose have been developed and a demonstration of these in the Campbellpur district of West Pakistan gave spectacular results, increasing the yield of wheat from about six maunds per acre (550 kg per ha) on the control plots cultivated in the traditional way to 16 maunds per acre (1,450 kg per ha) under a seasonal rainfall of 300 mm (Rana Tractors and Equipment Ltd). The equipment, consisting basically of a chisel plough and a mulch hoe grain drill to place the seed in moist soil below the surface layer requires a 60 hp tractor to draw it and its general adoption in this region of predominantly small farms presents obvious problems. The experiment was carried out by a commercial firm which clearly has an interest in demonstrating a favourable result with the equipment it sells, but in fact the technique has been well proven in dry areas in other parts of the world. However, it does need testing on a wider scale to establish where in this region conditions of soil and climate are suitable for its introduction. Any system which depends on conserving the season's rainfall in the soil can work only if sufficient rain falls and can be held in the rooting zone for the use of the crop.

Problems of development

Given the potential that exists for increased forage production, many problems are involved in its development. It is not proposed here to deal with the general problems of agricultural development which apply to any kind of crop, but only those of special relevance to forages. Surveys are necessary for all agricultural development but a specific need exists to identify areas which have a potential for dryland forage production in rotation with cereals, making use of fallows and suitable tillage and seeding methods. Here there is a need for short cuts, because the usual methods of soil survey are costly and laborious and generally appropriate for more intensive development requirements. Quick methods are needed of assessing whether there is likely to be enough rain for more intensive production and whether it can be absorbed and stored in the root zone of the soil. The reliability of rainfall is as important as the average amount, and statistical techniques have been developed for calculating from scarce data the probable water requirement of a crop week by week through the season and the probability of that amount being available (Manning, 1956). Sampling techniques for classifying soils according to their capacity for absorbing and storing moisture might be used to make a cheap and rapid land classification that would be adequate for this purpose (Robertson and Stoner, 1970).

The importance of some degree of mechanization has been mentioned as a requirement for more intensive

dryland cultivation and is also likely to be important in the harvesting and conservation of forage crops, which because of their bulk may stretch the labour and animal power of many of the farmers. Mechanization presents serious economic problems to small farmers and is more likely to succeed if its use can be spread over more than one farm. A useful FAO booklet in the multifarm use of agricultural machinery (Lonnemark, 1967) deals with this subject.

Fertilizers are likely to be of great importance in the expansion of forage crops. More intensive cropping, with utilization of fallows for forage production on dry land and growing two crops a year on irrigated land, increases the drain of plant nutrients from the soil and eliminates any restorative functions the yearly or seasonal fallows may have. Legumes require a sufficiency of phosphates and potash if they are to develop their nitrogen-fixing capacity and will need nitrogen fertilizers in places where modulation for some reason does not develop, as for instance under hot arid conditions in the Persian Gulf. High yielding and nutritious varieties of grass and forage cereal require plenty of nitrogen in order to realize their full potential, and root crops and leafy brassicas cannot produce the great bulk of animal feed of which they are capable without fairly heavy feeding themselves in the form of balanced fertilizers.

Special attention will be needed to secure supplies of reliable and weed-free seed of forage crops. In Turkey the State Increasing Farms have the land, equipment and skill for seed production and to supervise and assist seed multiplication under approved conditions on private farms. Extension of this type of activity and provision of services for obtaining good seed and for supervising its production and certification will be as vital for the development of forage production as they have proved to be for the spread of the new cereal varieties.

Forage conservation

Hay is the most important conserved forage (along with straw and chaff) and its feeding value is greatly influenced by the stage of maturity at which it is cut and the subsequent handling. Feeding value declines sharply after the plant has flowered and begun to form seed. Careful and quick handling is needed in the field after cutting to save the crop without excessive drying, which causes the leaves to break off, or too much moisture in the stems which would cause deterioration in storage. A process known as 'crimping' is sometimes advocated to assist the stems to dry at the same rate as the leaves by slightly crushing them, but it requires a rather expensive machine and its value is as yet uncertain. In storage, hay should be protected from the weather, either by putting it in a simple shed or barn, or covering with a polythene sheet or by building it up into a stack which can be thatched as was the common practice in Britain before the age of polythene. Other methods of conservation of which there is little experience in the region at present may be briefly mentioned. Silage is much used in Britain, where it has been largely and somewhat expensively mechanized and is perhaps more suited to the moist climate than hay. Artificial drying of young green grass is also suited to a moist climate conducive to a continuous flush of grass and produces a concentrated feed having much less fibre than most forages. Sugarbeet pulp, as well as being carted away from the factory in the wet state as is common in the region, can be dried with or without the addition of molasses. A process known as 'cobbing' has been developed in parts of Europe and North America to improve coarse roughages such as straw or inferior hay by chopping them up and adding molasses, sugarbeet,pulp, grain, etc., together with a binding material. Urea in solution can be sprayed on straw or other low protein feeds for feeding to ruminants, which have the capacity to utilize urea in part place of protein. However, urea must always be fed with care as unskilfully used it can be fatal to animals. It must always be fed in conjunction with a supply of soluble carbohydrates such as molasses, to ensure its efficient conversion to microbial protein.

Economic considerations

With so great a variety of conditions in the region there is wide scope for different crops and different practices. Forage crop production is ancillary to animal production. Its market is the ruminating stomach. The development of animal production is essential to the development of forages, and forages are only a part of the feed resources required by animal production. Their particular value is their capacity to provide digestible nutrients cheaply in a form that ruminants can use. Cheap production depends on suitable choice of crops and methods of growing and conservation adapted to the conditions of the locality. Once produced, they must be got as cheaply as possible to their market in the animal's stomach. Handling and transport can add greatly to the cost of the bulkier forages and these are best fed as near as possible to where they are produced, the animals being brought to the feed rather than the feed to the animals. Where forage is sparse and the stock are dependent mainly on range grazing supplemented in winter and during drought by cereal straw and by grass and legume hay, conditions are suitable for rearing but not for fattening. Once reared, the animals are best moved for finishing to more fertile areas where a more ample supply of feeds can be cheaply produced. Waste in storage and feeding can add to the cost of the feed the animals actually consume. Simple feeding racks and troughs, arranged for convenient filling from farm cart or trailer or by hand, will reduce waste from trampling and soiling. The more valuable forages such as good legume hay can be tranported, especially if they are baled, and a market in forages between places where supluses can be cheaply produced to where they are scarce is a necessity for the rational development of the livestock industry.

Conclusion

This paper attempts to present in general terms the potential that exists in the region for forage production in terms of land and crops, and the problems of developing it in terms of agronomic techniques. The country papers will no doubt deal more specifically with possibilities and problems in the individual countries. There is a great field and a great need for increased forage production, and its importance will grow as animal production develops. New trends in crop production will bring both opportunities and problems opportunities through the improvement of agronomic practice, problems from changes in land use such as reduction of fallow and stubble grazing and replacement of local cereals with a long straw by improved varieties with a short straw, thus reducing the availability of crop residues for animal feeding. Other feed resources will be developed by improvement of pastures and expansion of the agricultural feed industry. Increased production of forages to use in conjunction with these offers real prospects of improving the nutrition of the great numbers of sheep, goats and cattle and of working donkeys, mules, camels and horses in the region.

References

ANON. 1968. Some economic aspects of mechanised fodder production on irrigated lands. *Animal Husbandry Research and Training Project, Baghdad, Iraq, Technical Report No.20.*

BILENSOY, M. C. 1970. Crop productivity as affected by rotation in dry-farming areas of Turkey. *3rd FAO Seminar for Plant Breeders trained in Mexico under joint FAO/Rockefeller Foundation Training Programme 1961 1968, Ankara, Turkey.*

COMMONWEALTH AGRICULTURAL BUREAUX 1964. Some concepts and methods in sub-tropical pasture research by the staff of the Cunningham Laboratory, CSIRO, Brisbane, Australia. *Commonwealth Bureau of Pastures and Field Crops, Hurley, England, Bulletin No.47.*

KERNICK, M. D. 1967. Results of tests on forage crops under irrigation at Karadj, 1960 1966. *Pasture and Forage Crop Investigation Project, Iran, Technical Progress Report No.2.*

LONNEMARK, H. 1967. Multifarm use of agricultural machinery. *FAO Agricultural Development Paper.*

MANNING, H. L. 1956. The statistical assessment of rainfall probability and its application in Uganda agriculture. *Empire Cotton Growing Corporation Research Memoirs, No.23.*

PERRIN de BUCHAMBAUT, G. 1969. Similarities and differences in world-wide dryland farming. *Proc. Int. Conf. on Mechanised Dryland Farming sponsored by Deere & Co. under the auspices of FAO.*

ROBERTSON, V. C. and STONER, R. F. 1970. Land use surveying: a case for reducing the costs: new possibilities and techniques for land use and related surveys. *World Land Use Survey, Occasional Papers No.9.*

RANA TRACTORS & EQUIPMENT LTD. Date not known. Dryland Farming project in Pakistan. *Rana Tractors & Equipment Ltd, Lahore, Pakistan, Report.*

Forage crop production in Turkey

Şahap Elçi
Forage, Crops and Pastures Department, Ankara University, Turkey

Present pattern of utilization

The utilization of the cultivated land in Turkey is shown in Table 1. According to these figures about 32,474,000 ha of land are used for agricultural production and 18,273,000 ha are forest. The objectives of Turkish agricultural technology and economics are to manage this land properly so as to obtain maximum production per unit area.

Table 1
Utilization of cultivated land in Turkey. (According to the statistics of agriculture, 1969)

	ha
Fields : sown	15,907,000
fallow	8,824,000
Vegetables	500,000
Vineyards	838,000
Orchards (citrus plantations excluded)	951,000
Olive trees	723,000
Forests	18,273,000
Total	46,016,000

Table 2 shows the percentage of land used for forage crop production in Turkey. It will be seen that the percentage of land used for forage crop production is low and in fact the 31,329 ha devoted to forage production constitutes only 0.197 per cent of the total area devoted to arable crops.

Table 2
Area devoted to forage crop production in Turkey

	ha
Total sown fields	15,907,000
Alfalfa (*Medicago sativa*)	8,941,000
Sainfoin (*Onobrychis arenaria*)	3,688,000
Vetch (*Vicia sativa*)	10,600,000
Bitter Vetch (*Vicia ervilia*)	8,100,000
Total	31,329,000

The pattern of land utilisation in France is given in Table 3, from which it will be seen that France has 13,062,700 ha under permanent pasture and 5,944,900 ha devoted to forage crop production. In Germany (see Table 4) 41 per cent of the land devoted to agriculture is meadow or pasture, while there are also wide areas used for the production of good quality forage crops (Anon., 1966). In this latter connection Simon (1969) estimated that grasses and legumes were grown on 1,141,151 ha of land in Germany of which alfalfa covered 141,724 ha and clovers 381,028 ha. The forage crop situation in Germany and France contrasts strongly with that in Turkey today.

Table 3
Utilization of land in France (Anon., 1962)

	ha
Permanent pastures	13,062,700
Cereals	9,195,500
Forage crops	5,944,900
Forests	11,435,000
Sugar beet, sunflowers, etc.	2,630,700
Vegetables and others	585,110
Fallow	650,600

Table 4
Utilization of land in Germany
(Percentages of total land devoted to agriculture)

	per cent
Fields	54.4
Green meadows and pastures	41.3
Orchards and vineyards	4.3

Vavilov (1949/50) stated that Asia Minor was the gene center of *Vicia ervilia, Medicago sativa, Trifolium resupinatum, Trigonella foenum-graecum, Onobrychis altissima, Onobrychis transcaucasica, Lathyrus cicera, Vicia sativa, Vicia villosa* var. *perennis* and *Vicia pannonica*. Also according to Vavilov, the following forage plants belonged to the Mediterranean center of origin of cultivated plants (this includes the southern

Previous Page Blank

part of Turkey): *Vicia ervilia, Phalaris canariensis, Lathyrus sativus* var. *macrospermus, Vicia faba* var. *major, Lupinus albus, Hedysarum coronarium, Trifolium alexandrinum, Trifolium repens, Trifolium incarnatum, Vicia sativa, Lathyrus gorgoni, Lathyrus ochrus, Lathyrus cicera* and *Ornithopus sativus*. Vavilov stated 'Many of the old varieties of forage plants have originated in the Mediterranean countries. It is interesting to note that each civilization in this center has introduced its own forage plants into cultivation.'

Wilsie (1967) stated 'The original home of red clover is thought to be in Asia Minor and Southern Europe.' Hanson, Tysdal and Davis (1967) wrote 'Alfalfa (*Medicago sativa*) originated in south west Asia, although forms of it and related species are found as wild plants scattered over central Asia and even into Siberia' and Tarman (1960) stated that Turkey was located in the region of the alfalfa gene center. Fergus (1967) stated that Kentucky bluegrass (*Poa pratensis*) was considered to be a native of Eurasia.

Schoth et al (1967) wrote that Italian ryegrass (*Lolium multiflorum*) is native to the Mediterranean regions of southern Europe, Northern Africa, and Asia Minor.

Hollowell et al (1967) stated as follows: 'There are three *Trifolium* spp. commonly known as hop clovers, namely *Trifolium dubium* (small hop clover), *Trifolium campestre* (*T. procumbens*) (large hop clover) and *Trifolium agrarium* (hop clover). The large and small hop clovers are widely distributed and adapted as winter annuals in the southern and Pacific Coast states . . . . . All three species are of European and Asia Minor origin'. It is also stated that Persian clover (*Trifolium resupinatum*), a native of Asia Minor and widely used in Iraq, Iran, India and Egypt is a winter annual. The delegates from Portugal at the Seventh Mediterranean meeting on forage crops and pasture development in October 1963 stated that in Portugal there were about 50,000 ha of Persian clover.

Hollowell et al (1967) also gave the following information about clovers: 'Bigflower clover (*Trifolium michelianum*) is a tall growing weak stemmed winter annual, recently introduced from Turkey, while ball clover (*Trifolium nigrescens*), a recently introduced winter annual from Turkey, has been successfully established in many location in the South'. Also according to Hollowell et al (1967): 'White clover (*Trifolim repens*) is a native of Europe. It probably originated in the eastern Mediterranean countries or in western Asia Minor'. Hollowell and Knight (1967) also stated as follows: 'Crimson clover, (*Trifolium incarnatum*) sometimes called scarlet Italian, or incarnate clover, is native to south-eastern Europe and south-western Asia Minor'.

Hartley and Williams (1956), reviewing the available information on pasture grasses with special reference to those from the Mediterranean region and of great importance in the pastoral economy of Australia, wrote as follows: 'The outstanding importance of the Eurasian region as a center of origin of the cultivated pasture grasses is shown by the fact that 24 of the 40 species are indigenous there . . . . . These relationships suggest that the Mediterranean Region should be regarded as a sub-region of the Eurasian center of pasture plants rather than as one of independent status.

Observations by ourselves confirm those of the above authors and abundant native plant material has been obtained on different plant collection trips in Turkey. For example, autochthonal material of strawberry clover (*Trifolium fragiferum*) has been collected in the following regions: the eastern frontier of Turkey, near Erzurum, in the west on the coast of the Aegean Sea, just 100 m from the sea coast on very sandy soil, in the central plateau in Ankara Ataturk Farm and in our college garden, on the soils which have high percentage of salt near Konya-Aksaray, and in the southern part of the country in the Mediterranean region near Adana. Kipcak and Nouruzhan (1951) stated that this species is native to Maras. Davis (1969) stated that *Trifolium fragiferum* var. *fragiferum* was found in Istanbul (Silivri, Goksu), Bolu (Aladağ, Karacasu), Eskişehir (Çifteler) Konya (Çumra, Kuçükkoy), İzmir (Efes), and Tarsus, while *Trifolium fragiferum* var. *pulchellum* was found in Istanbul (Şişli, Kâgithane) Balikesir, Niğde (Aksaray, Sultanhani), Van (Gevaş), Diyarbakir, Bitlis, the western part of Gaziantep Amanos, and Adana. The material collected by ourselves has a wide variation in size and colour of leaves, habit, etc.

The same experience has been obtained for alfalfa, vetch and sainfoin while working with these materials for different breeding purposes. This is an opportunity for us to find the best available material for selection in different breeding programmes. It is considered that these materials can answer to the need of the Turkish agriculture, provided that the importance of these crops in different regions of the country is realised. It is a very rich natural resource for plant breeders.

In Turkey there is a wide variation in climatic conditions. In the central plateau there are very suitable environmental factors for growing seed crops of forage plants. During the flowering period of most leguminuous forage plants the weather is bright and sunny, while the humidity of the air is never very high, giving an opportunity for the insects to pollinate the allogam legume flowers, and wind pollination can occur so easily in grasses and legumes that the other autogam plants are also pollinated and set seed easily. This is advantageous for Turkish agriculture to obtain good quality and prolific seeds from forage grasses and legumes. In the coastal areas seeds obtained under the conditions of the central plateau should be used and the vegetative parts of the plants should be utilized either for feeding or as green manure. There is a good capacity to grow forage plants all over Turkey.

Problems arising from the present pattern of utilization

Before going into the details of problems arising from the present pattern of utilization of forage crops in

Turkey, it will be convenient to review the beneficial effects of these crops when used in Turkish agriculture.

1. Use of forage crops as a source of livestock feed

These crops are a very important source of livestock feed, and leguminous forage plants and grasses supply feeds with a high nutritive value to livestock. There are also some other crops which can be used for livestock feeding besides these two big families.

It is clear that, if it is desired to produce animal products in large amounts, an adequate supply of good quality livestock feed is necessary. However, in Turkey the present pattern of crop production in most cases does not indicate that forage crops are important in every unit of agricultural production. Forage crop production in Turkey is presently limited to only a few species such as alfalfa, vetch, *Vicia ervilia*, and sainfoin, and the acreages of these crops are not sufficient to meet the needs of the country. The best cultivation practices for these crops are not well known to the producers, and it is necessary to impart more knowledge to the producers in order to produce higher quality hay and seed.

In all stages of forage crop production there is a need for extension work on matters such as seeding, harvesting, parasitology, storage practices, etc. Farmers must be taught to obtain the maximum benefit from forage crops especially when they are used on their own farms for their own livestock. Suitable forage plant strains have been selected by us to feed livestock in Turkey, but these selected materials are not all used on a large scale. The following strains have been selected by our Department:

a. *Selections made by Tarman*
   Vicia narbonensis
   Vicia villosa
   Lolium perenne
   Medicago sativa (creeping type)
   Pisum arvense
   Festuca ovina

b. *Selections made by Elçi*
   Kara elçi figi, *Vicia sativa* (ERZ-1-147 black seeded)
   Sari elçi, *Vicia sativa* (yellow seeded)
   Yeşim çilek uçgülü, *Trifolium fragiferum*
   Trifolium resupinatum
   Lotus corniculatus (prostrate type)
   Lotus corniculatus (erect type)
   Agropyron cristatum (tetraploid type)

There is some selected material in a few other Institutions as well.

2. Use of forage crops in erosion control

In Turkey wind and water erosion is very important and in the coastal areas, where the annual rainfall is high, severe water erosion has been observed. In the central plateau and the other regions where the vegetation is scarce, heavy and uncontrolled grazing is practiced, the crop production method is monoculture and no cover crop is used. For these reasons heavy wind erosion occurs. Forage crops (both annuals and perennials) could control this erosion by covering the surface of the soil like a carpet. Forage crops can also be used on the banks of the highways to protect the roads from runoff.

There are different types of these crops available for erosion control. Some of them are suitable for one region while others have a good adaptability to other environmental conditions. Forage crops such as tall wheatgrass (*Agropyron elongatum*) and other *Agropyron* spp. may be used for erosion control under dryland conditions.

Some of the leguminous forage plants may be used for erosion control under more humid conditions, and a strain of strawberry clover (*Trifolium fragiferum*) has been selected by us as being suitable for covering the soil and controlling erosion under such conditions. The plant is useful in the same way as cover crops, because of its tillering habit on the surface of the ground.

Strains of bird's foot trefoil (*Lotus corniculatus*) have also been selected by us. The plant is fully prostrate in type. It spreads over the surface of the soil, one single plant covering an area of 1.2 m diameter. This plant has very bright yellow flowers up to late November and seems very suitable for pasture land and erosion control both under humid and dryland conditions.

These are just examples of the selected forage crops which can reduce erosion under different soil and climatic conditions, and it will be possible to discover and add more to this group.

3. Influence of forage crops on soil organic matter and physical structure

The organic matter content of the soil is very important from the view point of plant production. Very many forage crops are soil builders; in other words they accumulate organic matter in the soil by their abundant roots. For example the selected strain of strawberry clover (*Trifolium fragiferum*) mentioned above is a good soil builder. This plant gives many secondary roots on the nodes of the stems and makes a network in the soil, and is therefore a good sod forming plant. Stoddart and Smith (1955) stated that 'Pauly-Chenko found a three-year-old plant of crested wheatgrass had a total root length of 315.4 miles (504 km), bromegrass of 65.2 miles (104.9 km) and slender wheatgrass of 9.9 miles (15.8 km)'. It is well known that hairy vetch and rye can supply even more organic matter to the soil, and this mixture is advisable for sandy and dry soils before these plots are used for production of other cultivated crops. Forage plants affect the structure of the soil by their roots, which go down to the deeper layers of the soil. When these roots, die and decay the soil layers obtain a loose crumby structure.

In the central plateau of Turkey and under similar climatic conditions growth of vegetation is slow and accumulation of organic matter in the soil is one of the limiting factors for plant production. There is a tendency to use most of the acreage for wheat production in these areas and, as a result of this, the production per unit area is too low. An infertile field of wheat can be improved by rotating forage crop strains which supply more organic matter to the soil. Following such crops it is obvious that we can get more yield per unit area.

4. Importance of forage crops as green manure and cover crops

This is not a very widely used practice in Turkey, but some legumes can be grown as green manure crops, particularly in the coastal areas. Commenting on a preliminary experiment on the effects of leguminous and non-leguminous green manures on sugar beet production Williams et al (1954) stated as follows: 'The harvest data show that the vetch green manure increased the root yield by 8.5 tons per acre with no appreciable drop in sucrose concentration, while the barley and vetch mixture increased root yield by 5.4 tons and the barley 1.5 tons. Fertilization of fallow plots with 120 pounds of nitrogen per acre (approximately the same amount of nitrogen as was turned under in the vetch crop) increased the yield but did not increase it as much as the vetch green manure'. We have 102,637 ha of sugar beet in Turkey and, if not on all of this land at least on some of it, vetch could be used for green manure and bigger yields obtained.

Today, cotton is grown on the coastal areas as a monoculture, and from October till April about (6 months of the year) the soil is bare ground and nothing is grown on it. Cotton occupies the soil only from April till October. Cotton occupies an area of about 638,520 ha in Turkey. It is necessary to develop a method of growing a legume during the winter time on these cotton lands. For example, an early growing vetch is a very suitable crop for this purpose if planted in early autumn just after the harvesting of cotton. This will give enough time to grow vetch and to cut it for hay or plough it under as green manure. By this method the cotton land in Turkey could either supply more hay for farmers during the winter time or add more nitrogen and some organic matter to the soil for cotton production.

Another possibility for green manure application in Turkey is the olive plantations which cover 723,000 ha. On this land different legumes for green manure such as vetch could again be used for this purpose.

Forage crops can also be grown in orange groves. In April 1971 two orange gardens were observed on the Adana-Tarsus highway, 15 km from Adana. One of the gardens had broad beans 120 cm in height. The other garden had nothing but weeds. At that time of the year 1 kg of green broad bean was selling for TL 9. During this time in the central plateau behind the Taurus mountains just 200 km from Adana there was no green plant more than a few cm in height. It is quite obvious that certain legumes, such as vetch, beans and clover, could be used for green manure under citrus plantations in Turkey. It is always possible to cut some of this material as a feed for livestock and plough the rest of it under for soil organic matter.

Citrus plantations currently occupy 41,300 ha in Turkey and on at least half of this land legumes could be grown. It is also possible to seed legumes for green manure and cut some part of it for livestock in peach and apple orchards. In fact, before the establishment of any kind of orchard it is advisable to grow legumes and plough them under for nitrogen and organic matter.

In fact a total of about 875,000 ha of land could be seeded for green manure cover crop and some part of it cut for hay or grazed by livestock.

5. Importance of legumes in crop rotations

There are many experimental results that show legumes as being important in crop rotations. Rotations assist greatly in controlling fungi and other diseases and pests. They also regulate the use of labour on the farm, and production can be better arranged according to the demand pattern. After legume crops the soil has a better structure, increased fertility and higher organic matter content, and makes a good seed bed for succeeding crops in the rotation. In most farms in Turkey a suitable rotation plan is not used, a monoculture system of cropping being fairly general. There are very wide differences in climatic conditions in Turkey but it is possible to find one or more suitable legumes from those available for use in crop rotations under the various conditions.

Wheat and other cereals, sugar beet and cotton are important field crops in Turkey, and we need a good rotation plan for these crops. Although we do not have sufficient experimental data from all over the country, at least we have some results obtained in several places including Ankara and Erzurum. There are also very many rotation experiments in different countries which have proved successful. There is a proverb on the beneficial effects of rotation which says 'The grain of a cereal crop sown after alfalfa cannot be swallowed by birds nor can its stems be cut by the threshing machine'. Another proverb on this subject states 'The residue of vetch acts like fertilizer'. We should conduct research in this field and on the basis of the results obtained, the farmers could be advised on possible alternatives to their present monocultural systems. Tosun (1969) in an experiment conducted at Erzurum obtained the figures shown in Table 5.

Table 5
Rotation experiment at Erzurum

Plots	Wheat yield
	kg/decare
Fallow – wheat, 30 kg/decare of 20 per cent ammonium sulphate	200
Fallow – wheat, 30 kg/decare of 20 per cent ammonium sulphate with 30 kg/decare of 18 per cent superphosphate	190
Vetch – fallow – wheat	186.6
(on vetch plots average dry hay yield was 159.7 kg/decare)	

It will be seen that wheat yields from the vetch – fallow – wheat rotation, were only slightly below those of the fertilized fallow wheat rotations.

Kennedy and Mackie (1925) stated: 'Berseem (*Trifolium alexandrinum*) occupies an important role in the agriculture of Egypt where it is the foundation of the dairy and beef stock industry. Without the use of berseem or some leguminous crop the high yields and excellent quality of cotton could not have been maintained'. It is advisable to test this clover on the cotton area of Turkey under different methods of utilization such as hay production, grazing green manure, etc. Kiesselbach and Lyness (1952) stated: 'Need for the rotation of crops has been recognised since the pioneer days of the previous century. This is an important principle involved in agricultural diversification, maintenance and restoration of soil productivity, field sanitation with respect to the control of harmful insects, plant diseases and weeds, and the economic distribution of farm labour'.

These are all important points: extensive rotations would be beneficial to the agriculture of Turkey. Finally, as Whyte, Nilsson-Leissner and Trumble (1953) stated, 'There are in all parts of the world examples of field rotations in which crops that remove fertility from the soil alternate with those restoring fertility in the form of nitrogen, organic matter, crumb structure, microbiology and general soil health'.

It is not necessary to give more examples on this subject. Suitable rotation systems must be used in Turkish agriculture.

6. Use of forage crops on ground unsuitable for other cultivated crops

There are soils in Turkey which are flooded for long periods of time and there is no possibility of using such land for other crops. On these lands forage crops like Persian clover (*Trifolium resupinatum*) and strawberry clover (*Trifolium fragiferum*) can be grown. There are also quite large areas of saline and alkaline soils scattered around the country which cannot be used for growing crops, except forage plants like *Agropyron* spp., *Puccinellia* sp., *Lotus* sp. and *Trifolium fragiferum*.

Weed control is another area where forage crops can be used with success. In the East of Turkey the Mus Valley is well known for its high crop production. Today most of this valley is covered with *Glycyrrhiza* sp., and according to preliminary tests alfalfa is the only crop that can control this weed. Because of the deep and strong tap root of alfalfa, the weed cannot compete with it and after several years of alfalfa cultivation the land can be successfully used for other crops like cereals. On high plateaus which are only suitable for grazing, for example near Oltu, Şenkaya and Kağizman, we have found native lands covered with *Andropogon ischaemum;* these lands are heavily grazed. There are some other lands which are also only suitable for use as pasture or meadow but 'People want to obtain their bread from their own land'. In other words the farmers want to produce their wheat so as to avoid any risk of experiencing difficulties in purchasing wheat in the market. The farmer has no guarantee that he will be able to buy the wheat that he needs at any time of the year, so he ploughs under his meadow or pasture land to produce wheat. The area, for example, around Şenkaya is characteristic range and meadow land but is not suitable for cereal production from the stand points of both yield and quality. A field of wheat was observed on 30th September 1967 which was in the blooming stage. There was no chance of obtaining a crop from this field at that time of the year in that region. The farmers around Kastamonu seed *Triticum monococcum* in the very late fall, but this region again is more suitable for forage crop production. Farmers, as in the East, are not sure if they will be able to buy wheat in the market any time of the year at stable prices so they think it is wise to produce their own requirement of wheat.

This shows that the cropping pattern of Turkey is not planned according to technological considerations but that economic and social factors play the more important role. Turkey can obtain good quality seed from forage plants because it has good seed stock material and because ecological factors are very suitable for the production of high quality seeds. It is obvious that forage seeds are needed for use within Turkey first, but if a good programme of seed production is established it may even be possible to sell some seed to other countries as well if good prices can be obtained.

Current needs for conservation and improved methods of utilization

It is not necessary to wait a long period of time in order to have at least forage plant material to multiply; good quality material of the main forage plants is already available to multiply and to offer to the farmers.

It is believed that there are very many experiments which have to be conducted in order to establish the materials most suitable for forage crop cultivation in

Turkey, but the material that is already in hand is enough to start the programme of forage crop production which the country urgently needs. If this programme is realized and is extended to the farmers as soon as possible Turkish agriculture will benefit greatly.

The agricultural extension service can do very good work in this field. In Turkey there are forage crop seed producers who do not know where they can sell their seed. There are also a large number of farmers who want to buy forage crop seeds for their farms but cannot find the right place to buy them. Most farmers have not considered whether they can produce forage crops on their farms or not, and it is necessary to teach these farmers why and how they should produce better forage crops. Extension work is, therefore, very necessary and useful for forage crop production in Turkey. Extension services together with other means of propaganda such as radio, periodicals, newspapers, television, etc. should help this programme effectively. Selection of available land for special forage crops, using good quality seed, application of suitable fertilizer, using the right equipment for different kinds of land preparation, seeding, fertilizer application, harvesting and seed processing of forage crops, etc. all need to be taught to farmers.

In Turkey there are very wide differences in climatic conditions, rainfall distribution in the country being very different from one part to the other. For instance, there is a corner at the Black sea coast which receives about 2,000 mm of rainfall annually, while there is another point in the central plateau which has only 250 mm of annual rainfall: the other regions have annual rainfalls between these two extremes. In the eastern part of the country snow covers the soil for more than six months of the year, while in the southwest there is no snow at all. The temperature of the other regions is in between these two extremes.

There are characteristic acid, calcerous, saline and alkaline, sandy, heavy clay soils and areas of flooding. Irrigation and drainage are necessary on some soils. There are topographical and geographical differences also, and all these factors and their combinations are found in different parts of Turkey. It is generally possible, however, to find one or more forage crop plants to adapt to the specific conditions. Research on forage crops can answer questions such as which species are suitable for which climate, when to grow them on which soils, how to use them and for which livestock they are advisable.

Although at present we are not completely in the dark with regard to these questions, as there are several centers carrying out research with these plants, it is necessary to establish more research points and carry out more work on introduction, adaptation and selection in order to find out better varieties for specific regions. Drought resistance, salt tolerance, flood tolerance, winter hardiness, better quality, nutritive value, ease of establishment, disease and insect resistance, suitable maturity, earliness, competition with other species and seed and hay production all need to be investigated.

There is also a need to improve the methods of forage crop cultivation and seed and hay production, to introduce rotation systems with other crops, to investigate the possibilities of green manure application, etc.

To produce the good quality of improved seed needed a special programme, initially on state farms, could help and special seed producers under contract should also co-operate in this programme. Through this programme forage crop seeds which are needed in the country could be obtained.

National programmes and an assessment of the extent to which they meet requirements

1. There are several national programmes for seed multiplication of improved forage crop material. At present these are confined mainly to state institutions, but these programmes should extend to special seed producers. It is believed that, without the co-operation of producers in different regions, the programmes necessary on this item cannot be realised.

2. There are some programmes for the breeding of forage crops in a few centers but it is considered that more effort is needed to answer to the needs of different regions.

3. There are programmes for encouraging animal production in the form of milk and meat, etc. and, if these are successful, forage crop production will inevitably increase very quickly.

4. Research on seed, hay production and grazing capacity of forage crops should be planned in different regions. Green manuring and crop rotations are also important subjects for research.

5. An efficient extension service is needed to work on most aspects of forage crop production.

6. It is necessary to train experts and technicians to work on some of the programmes mentioned above.

References

ANON. 1963. *France Agriculture.* Paris: Ministère de l'agriculture.

DAVIS, P. H. 1969. *Flora of Turkey,* **3.** Edinburgh: University Press.

ELÇI, S. 1964. The role of forage crops as green manure in the development of agricultural production. *Turkish association for the conservation of natural resources, Publication No. 9.*

FERGUS, E. N. 1967. The Bluegrass. *Forages* (ed. H. D. Hughes *et al*), pp. 220–228. Ames, Iowa: Iowa State University Press.

HANSON, C. H., TYSDAL, H. M. and DAVIS, L. R. 1967. Alfalfa. *Forages* (ed. H. D. Hughes *et al*), pp. 127–138. Ames, Iowa: Iowa State University Press.

HARTLEY, N. and WILLIAMS, R. J. 1956. Centre of distribution of cultivated pasture grasses and their significance for plant introduction. *7th Int. Grassland Congress, New Zealand*, pp. 190–201.

HOLLOWELL, E. A. 1967. Ladino and other white clovers. *Forages* (ed. H. D. Hughes *et al*), pp. 161–168. Ames, Iowa: Iowa State University Press.

HOLLOWELL, E. A., HENSON, P. R. and McKEE, R. 1967. Other legumes. *Forages* (ed. H. D. Hughes *et al*), pp. 211–219. Ames, Iowa: Iowa State University Press

HOLLOWELL, E. A. and KNIGHT, W. E. 1967. Crimson clover. *Forages* (ed. H. D. Hughes *et al*), pp. 180–186. Ames, Iowa: Iowa State University Press.

KENNEDY, P. D. and MACKIE, W. W. 1925. Berseem or Egyptian clover (*Trifolium alexandrinum*). *Univ. Calif. College, Agric. Expt. Station Bulletin, 389.*

KIESSELBACH, T. A. and LYNERSS, W. E. 1952. Crop rotation experiments. *Agric. Expt. Sta. Univ. Nebr. College Agric. Bulletin, 416.*

KIPCAK, C. and NOURUZHAN, H. 1951. Turkiyenin Zirai Bunyesi (Agricultural structure of Turkey). *Türkiye Seker Fabrikalari A.S. (Sugar Company of Turkey), Publication No. 20.*

SCHOTH, H. A. *et al.* 1967. The ryegrasses. *Forages* (ed. H. D. Hughes *et al*). Ames, Iowa: Iowa State University Press.

SIMON, U. 1969. Saatgut und Sortenwert Kleeartiger Acerfutterpflanzen Sonder. *Landwirtschaftliches Jahrbuch.* Bayer.

STODDART, L. A. and SMITH, A. D. 1955. *Range Management.* New York: McGraw Hill.

TARMAN, O. 1960. How we should work in order to improve forage crops, meadow and pasture cultivation in Turkey. *Univ. of Ankara College of Agric., No. 165.*

TOSUN, F. 1969 Legumes and wheat rotation trial on dryland. *Univ. of Ataturk, Agric. Research Inst., Erzurum, Publication.*

VAVILOV, N. I. 1950. The origin, variation, immunity and breeding of cultivated plants. *Chron. Bot.*, **13**, 1–364.

WHYTE, R. O., NILSSON-LEISSNER, G. and TRUMBLE, J. H. C. 1953. Legumes in agriculture. *FAO Agricultural Studies, No. 21.*

WILLIAMS, W. A., RIRIE, D., HALL, H. L. and HILLS, F. J. 1954. Preliminary comparison of the effects of leguminous and non-leguminous green manures on sugar beet production. *Proc. Am. Soc. Sug. Beet Technol.* 8 (1).

WILSIE, C. P. 1967. Red clover and alsike clover. *Forages* (ed. H. D. Hughes *et al*), pp. 139–149. Ames, Iowa: Iowa State University Press.

Forage crop production in Iran

M. B. Ghadaki
Animal Husbandry Research Centre, National Livestock Organisation, Tehran, Iran

Introduction

According to the National Statistical Bureau the rate of population growth is about 2.6 per cent per year in Iran. The population growth is particularly high in the cities following industralization of the country and mechanization of agriculture. The demand for milk and meat has therefore increased during the last few years but, as the local production is inadequate to satisfy the increasing demand, these products are imported at a high annual foreign exchange cost.

Ruminants are the main producers of meat as well as being the producers of milk in Iran. Their rations consist mostly of forage, and the main difficulty in increasing meat and milk production in Iran is that of fodder shortage. It is important therefore that attention be paid to this problem.

In this paper there will be a short description of the current status of the pastures of Iran followed by an outline of the present situation with regard to fodder crops and the problems associated with their production.

Background

Iran's native forage producing lands stretch from the sub-tropical coast of the Persian Gulf to the arid deserts of the interior plateau, the subalpine meadows of the high mountains and the humid Caspian littoral. These vast rangelands have been grazed by domestic livestock ever since animals were first domesticated and over most of the area a stable ecological balance was long maintained. Palatable and nutritious grasses and other plants provided ample sustenance for the herds and, because they were not continually overgrazed, these desirable forage species continued to flourish and reproduce themselves. Evidence indicates that until recent times the feed requirements of man's animals were generally within the forage producing ability of the land.

Probably within the last century, with a stabilization of human populations, the numbers of domestic livestock began to build up rapidly and the grazing pressure on native ranges increased. The numbers of grazing animals soon reached the point where in many places the better forage plants were overgrazed and the ecological balance was upset. This build-up of livestock numbers and the pressure on the land has greatly accelerated during the past two decades. It is estimated that the number of sheep, goats and other domestic livestock now grazing Iran's ranges amount to at least three times the forage producing capacity.

Experts first studied the range and pasture situation in the early 1950s. They recognized the need for range management and improvement and for the control of grazing. Largely as a result of their recommendations the Range and Fodder Organization was established as a small unit of the Forest Service in the Ministry of Agriculture in 1954.

In 1960 an FAO ecologist under the Expanded Programme of Technical Assistance was appointed to advise and assist the Range and Fodder Organization. His ecological surveys and studies described the serious range depletion which he found and stressed the need for a continuing programme of research. He recognized the difficulty of reducing livestock numbers to the present grazing capacity of the native ranges and, accordingly, emphasized the importance of restoring the depleted ranges through reseeding and of producing supplemental forage on cultivated lands. He recommended that the Range and Fodder Organization be strengthened and given the full support of the Government.

Present situation of fodder crops in Iran

Irrigated forage legumes have been grown on a small scale for many years in Iran. In recent years the increased need for milk and meat in Tehran and other big cities has resulted in the setting up of large dairies and livestock finishing yards. Consequently the need for forage has increased on a large scale.

Previous Page Blank

The former Range and Fodder Crop Organization, under the Ministry of Agriculture, has put some effort into producing much more forage by introducing improved forage species. They provided good seed and assisted the farmers with advice on the many aspects of fodder crop production. In recent years the cultivation of alfalfa has increased and in 1970–1971 the Fodder Organization Project has assisted in the production of about 10,000 ha.

The Seed Improvement Institute and in particular the Maize Project are making great efforts to introduce high-yielding varieties of forage corn such as Yugoslavian hybrids and Israeli cultivars. Demonstration plots in selected areas and on private farms are made to show where maize production fits into the crop rotation, and the area under maize for fodder has increased. Sorghum and Sudan grass are also grown but only on a small scale. Currently in Iran, alfalfa is the most important forage crop from the quantitative point of view, followed by maize, sainfoin, clovers, sorghum and Sudan grass.

Due to the different climatic conditions in different parts of the country the yield per ha varies considerably: for example, alfalfa yields in different areas are as follows:

Karadj area	8–9 tons/ha
Varamin area	12 tons/ha
Khozestan area	12–18 tons/ha

The range of yields for alfalfa is six to 18 tons per ha. The large variations in yields indicate the need for and possibilities of improved cultivation practices.

In the Karadj area, where farming operations are comparatively large, alfalfa represents 26 per cent, maize 11 per cent and other forages 13 per cent of the fodder crops and cereals grown. In the villages there is less alfalfa but more sainfoin and clover and no maize is grown. Green cereal forage is usually grazed around the villages during winter and spring when a shortage of feed occurs.

Forage legumes are generally sown in early spring or late summer/early autumn and then irrigated. Spring seeding is preferable for alfalfa because there is no risk of frost as with late summer sowing. Forage maize is planted about mid spring in the central part of Iran and in the south of the country there are two sowing times, namely winter and late summer.

Farmyard manure and artificial fertilizers are widely used for alfalfa and maize. The quantities used per ha are 20–50 tons of farmyard manure and 150–300 kg of triple super-phosphate. Urea is used at the rate of 50–100 kg and 400 kg for alfalfa and maize, respectively.

The four main methods of forage irrigation in Iran are as follows:

1. Flood-irrigation.
2. Basin-irrigation.
3. Furrow-irrigation.
4. Sprinkler irrigation.

Harvesting of fodder crops is done by hand in the villages and by machinery on the large farms. The optimum harvesting time for alfalfa is at the ten per cent inflorescence stage. In general, however, farmers harvest alfalfa at a much later stage. The protein and fibre contents of green alfalfa and alfalfa hay (analysed by the Nutrition Section of the Animal Husbandry Research Institute (AHRI), Heidarabad) expressed on a dry matter basis are as follows:

	Crude protein	Crude fibre	No. of samples
Alfalfa hay	12.3	32.0	9
Green alfalfa	23.5	20.7	8

The difference in composition between alfalfa hay and green alfalfa is due to two factors. Firstly, the stage of harvesting is important; the protein decreases and the fibre increases with advancing maturity, and secondly, during hay-making a lot of leaves may be lost, thereby decreasing the protein and the overall quality of the alfalfa.

The main limiting factor in increasing fodder crop orduction is water availability. It is only around the Caspian Sea area that the precipitation is enough and forage can be grown without irrigation. Occasionally, in this area the precipitation is so high that harvesting operations are made difficult. In the other parts of the country it is practically impossible to grow forage without irrigation.

Land preparation cost and the cost of irrigation equipment are the two principal expenditures in fodder crop production. Due to the dry climate of Iran with long hours of subshine in summer, the rate of evaporation is high and the quantity of water required for forage production is high. For example, it is about 16,000 m^3/ha for alfalfa in Karadj and 24,000 m^3/ha in Khazestan.

As mentioned above, the irrigation water supply in Iran constitutes an important limiting factor in agricultural production. The farmers are, however, unable to use the available water supply and until a few years ago the surface water ran into the sea throughout the existing rivers and ghanats, especially in winter and spring. In the last decade, however, a lot of work has been done to conserve the water during winter and spring time. For this purpose ten great dams have been constructed in different parts of the country and now much of the water supply is used in agriculture. Some large farms of up to 20,000 ha are now in operation near these dams and are producing forage and other products. But still the canalization of all these dams is not complete and their water reserve is not currently totally used for agriculture.

According to a comparison made of the costs and returns from two popular fodder crops, alfalfa and maize as against those of two basic cash crops, sugar beet and wheat, the net income and costs of wheat are

less than the other crops. Alfalfa has the highest estimated net income per ha followed by maize and sugar beet. The current high price of alfalfa may be the most significant figure in this comparison but the good yields also help. Unfortunately even with this high net income compared with other economic crops forage production has not really improved, because of the high requirement for investment finance, technology and machinery.

The establishment of a strong programme to encourage forage and fodder production on cultivated lands is a further urgent task. In fact this is the key to the solution of the range problems of Iran. As the present available knowledge of forage and fodder production is far from being fully applied extension techniques are urgently needed. With good planning and proper direction, a forage and fodder extension programme could be undertaken with much of the field work done by technicians.

Unfortunately, the importance of cultivated forage and fodder production seems to have been lost in the reorganization of the Ministry of Agriculture; it urgently needs to be re-established and, for this reason, in 1971 the Forage Bank under the Ministry of Natural Resources was set up. This bank with 12.5 million dollars at its disposal will help the fodder crop producers by extending credits and fixing prices.

As mentioned above the rates of return on investment are larger and more quickly realized from programmes in cultivated forage and fodder development than from range management. In Iran, because of the great and urgent need for such development, commercial financing holds a good deal of promise. This is especially true in connection with commercial dairy herds and feed lots for growing out and finishing range-bred sheep. Some lending institutions, notably the Agriculture Development Fund of Iran with the help of International Bank for Reconstruction and Development (IBRD), are actively engaged in or are considering financing various dairy and finishing enterprises in widely scattered sections of Iran. Another hopeful development is that the Fodder Crop Organization under the Ministry of Agriculture provides a subsidy of $40 per ha plus 150 kg of chemical fertilizer to all farmers planting fodder crops.

Further development of feed resources

Demand for agricultural products generally and in particular livestock products is increasing due to the growth of the population and the increased purchasing power of people, resulting from an improvement in the standard of living.

Consequently the Government is promoting various aspects of livestock production and their main activities are as follows:

1. Research work is in progress at the AHRI, Heidarabad to solve some of the problems related to livestock production. Research is also being carried out at the Razi Institute, Seed Improvement Institute and Soil Institute, while training and demonstrations in agricultural engineering are also being conducted.
2. Agricultural co-operatives have been started in different parts of Iran. They are contributing to higher crop yields per ha and are also putting into practice improved methods of crop cultivation which are raising the yields.
3. Agro-industrial companies are now in operation in Iran and some large ones are operating on areas of up to 20,000 ha. Their activities include fodder crop production and livestock production, and related aspects of these.
4. Specialist committees appointed by the government are involved in certain areas of development. They help with crop production, harvesting and the use of agricultural machinery.
5. Special development projects are being undertaken. Examples of these are fodder crop production, agricultural mechanization and crop irrigation projects.
6. Regional development projects including the Moghan plain, the Dasht Ghazvin area and the Jiroft region are now being undertaken.

These areas of agricultural development should result in increased output per ha in the years ahead provided that the Government continues to control, guide and support them.

References

BENHAM, A. A. 1971. Personal communication.

FAO. 1970. *Pasture and Fodder Crop Investigation, Iran.* Rome: FAO.

SHOMMA, M. and MANOUCHEHRI, M. A. 1969. Varieties of forage cereals and grasses, cultivating techniques, harvesting cost of and income from the cultivation of fodder in Iran.

Forage crop production in West Pakistan

Mohammed Akram
College of Animal Husbandry, Lahore, Pakistan

For all classes of livestock good forage is the foundation of efficient production. The importance of forage is shown by the fact that in the United States forage, including pasture, hay, silage and stovers, forms about 55 per cent of all feeds consumed by livestock (74 per cent for dairy cattle, 82 per cent for beef cattle, 94 per cent for sheep and goats and 68 per cent for horses and mules), (Morrison, 1959).

The sources of forage in West Pakistan are as follows:

1. Cultivated fodders.
2. Cultivated grasses.
3. Pastures (natural grazing).

1. Cultivated fodders

According to season two types of fodder crops, namely 'Kharif' or summer crops and 'Rabbi' or winter crops, are grown in the areas of West Pakistan where canal water or other water resources are available. The summer crops are sown during the months of March to August and cutting continues during October and December, while the winter crops are sown from September to December and fodder is available from April to May. Both crops are ready for harvesting two to three months after sowing. The early or late sown crops yield less fodder because their growth is greatly affected by climatic conditions. The scarcity of green fodder in these areas is experienced at two periods of the year, firstly in the months of May and June and secondly in November and December.

Leguminous and non-leguminous crops differ in their nutritional value, the leguminous crops being comparatively richer in protein but lower in carbohydrates. Thus mixed sowing of these crops is a common practice among farmers and the resulting fodders are relatively balanced in their essential nutrient content.

The most commonly cultivated fodder crops in West Pakistan are as follows:

Kharif (summer) crops

a. Leguminous
   - Cowpeas (*Vigna spp.*)
   - Guara (*Cyamopsis tetragonoloba*)
   - Moth (*Phaseolus aconitifolius*)

b. Non-leguminous
   - Sorghum
   - Maize
   - Millets or bajra
   - Swank (*Panicum colonum*)

Rabbi (winter) crops

a. Leguminous
   - Egyptian clover (*Trifolium alexandrinum*)
   - Persian clover (*Trifolium resupinatum*)
   - Indian clover
   - Alfalfa (*Medicago sativa*)

b. Non-leguminous
   - Oats
   - Barley
   - Turnips
   - Rape (*Brassica campestris*)

2. Cultivated grasses

Some particularly useful grasses for forage production are as follows:

Elephant or Napier grass (*Pennisetum purpureum*)
Guinea grass (*Panicum maximum*)
Sudan grass (*Sorghum sudanense*)
Rhodes grass (*Chloris gayana*)
Teosinte (*Euchlaena mexicana*)

The areas in which the above-mentioned grasses are grown are very small and mostly at Government Experimental Stations.

3. Pastures (natural grazing)

During the monsoon in West Pakistan, grass, both on the hills and on the plains, makes prolific growth and furnishes grazing for livestock. With the onset of cold weather, however, the amount of grass available decreases

Pastures Page Blank

Table 1

Livestock population of West Pakistan[1]

Cattle				Buffaloes				Sheep			Goats			Others[2]	Grand Total
Milch animals	Work animals	Young stock and bulls	Total	Milch animals	Work animals	Young stock and bulls	Total	Adult	Young stock	Total	Adult	Young stock	Total	Total	
Thousands															
2,881	4,772	2,345	9,998	5,150	732	2,198	8,080	10,186	2,341	12,527	6,980	1,871	8,851	2,389	41,845

[1] Planning Commission, Government of Pakistan, Islamabad.

[2] Haq and Masud (1966).

in amount and in quality, until the majority of grazing grounds in the more arid areas provide very little natural grazing of any great value. Certain forest lands are available for grazing but only about five per cent of the animal population of the country can obtain access to them (Lander, 1949).

In some of the Government forests controlled grazing is practiced over limited areas which are closed periodically.

Table 2
Land and livestock resources of West Pakistan

Human population (1,000)	Per 100 persons				
	Adult cows	Adult buffaloes	Sheep and goats	Cropped area	Livestock grazing area
51,958	9.0	10.9	37.2	74.2 acres (30.05 ha)	167.6 acres (67.88 ha)

Source: Qureshi and Burque (1969)

Forage supply contrasted with requirement

There are 41.8 million head of animals being pastured by West Pakistan. These include cattle (oxen), buffaloes, sheep, goats, horses, donkeys, mules and camels (Table 1). According to recent estimates the daily per capita availability of foods of high biological values like milk and meat in West Pakistan is as follows:

Milk	12.00 oz
Beef	0.28 oz
Mutton and goat meat	0.12 oz

This low availability of protective foods is due to low yield and poor performance of our dairy and meat animals, primarily due to poor feeding. This is evident from the fact that hardly 11 lb of green roughage is available per day per animal unit (Qureshi and Burque, 1965). According to a recent Report compiled at the West Pakistan Agricultural University (Qureshi and Burque, 1969) the cropped area per person in 0.74 acres (.300 ha) from which 0.20 cows and buffaloes and 0.37 sheep and goats derive their feed (see Table 2). From the data given in Table 3 it is evident that there are too many breeding oxen, buffaloes and work animals on the fodder area and far too many cattle, sheep and goats on the grazing area available. A sound land livestock relationship demands that the land should provide sufficient forage and straw to meet the maintenance TDN (total digestible nutrients) requirements of livestock on the land. The fodder or grazing area available per animal unit is much too low considering the fodder and grass yield, and under these circumstances it is impossible to utilize even the existing genetic potential of livestock. The amount of nutrients available for production above maintenance is non-existent and only a small percentage of animals get this allowance at the cost of others. Due to lack of adequate fertilizers and water resources the land is not producing enough fodder, and it is impossible to increase the area under fodder in the present situation where land is needed for food and cash crops. In addition a million acres (405,000 ha) of land are being lost due to salinity every year. Thus it is very essential that concerted efforts should be made to enhance forage production.

Table 3
Relationship between livestock numbers and land area

Fodder area per Bovine Unit	Grazing area per Animal Unit	Cropped area per work animal	Fodder per Bovine Unit per year	Fodder Yield per acre
0.194 acres (0.079 ha)	2.206 acres (0.893 ha)	3.820 acres (1.547 ha)	32.79 maunds	167 maunds

Source: Qureshi and Burque (1969)

Future line of action

The main objective behind the recommended programmes is a rationalization of livestock numbers and improvement of their production efficiency in relation to the available forage in different area. The general policy to achieve this involves (a) effective control of epizootics to avoid the necessity of keeping large numbers of livestock for fear of mortality through diseases, (b) efforts to increase fodders and forage per acres, (c) development of grazing area and (d) development of breeds and strains of livestock which have greater efficiency of conversion of feed into products.

To achieve these objectives the following programmes are recommended:

1. Fertilizer Subsidy

The subsidy on fertilizers for growing fodder should be higher than that for growing cash crops, as since the land and water resources are limited much higher fodder yields will have to be obtained from the same area through the use of fertilizers.

2. Improved Seeds for Fodder Crops

A separate and independent project should be launched to produce and distribute improved seeds for good fodder.

3. Development of Range Areas

As more than two thirds of the land area of West Pakistan is range land a Range Development Authority should be established to (a) improve forage and water resources in the area and (b) to demarcate range areas and settle nomadic graziers on the land.

References

HAQ, I. and MASUD, M. 1966. *Livestock, poultry and their products.* West Pakistan Agricultural University, Lyallpur.

LANDER, P. E. 1949. *The feeding of farm animals in India.* London: Macmillan.

MORRISON, F. B. 1959. *Feeds and feeding.* Clinton, Iowa: Morrison Publishing Company.

QURESHI, S. R. and BURQUE, A. R. 1965. Production of animal fodders and feeding. *Food production and consumption in Pakistan,* 2, 69.

QURESHI, S. R. and BURQUE, A. R. 1969. *Production trends and future production potential for livestock and poultry in West Pakistan.* West Pakistan Agricultural University, Lyallpur.

Report on Second Session: Forage crop production

Chairman, Mr C. E. Johnson

1. The Conference recognized that forages would play a dominant part in meeting the requirement for feed to maintain the increasing numbers of ruminant animals in the region and lift the feed supply above the present maintenance level. There was a great need to increase production of forage crops throughout the region, and this would call for a major effort in agricultural extension.

Varieties of forage crops

2. It was clear that the great diversity of conditions in the region made it necessary to consider a wide range of different forages adapted to the varying soils and climates.

3. Research had been carried out in some parts of the region to find the most suitable crops, varieties and farm practices for the different areas. It was pointed out that many of the forage crops most widely cultivated in other parts of the world had their origins in the Middle East and Mediterranean region and there was no lack of genetic material adapted to local conditions.

Cultivation and harvesting methods

4. There was some discussion on the use of fallows for forage production and on growing forages in rotation with other crops. Experiments at the Grassland Research Station near Ankara had shown that on the Anatolian Plateau the fallow could be at least partly replaced by forage crops without reducing cereal grain production, and in the coastal areas of Turkey forage crops could be grown in rotation with cotton.

5. It was recognised that the simple wooden ploughs traditionally used in the area had many virtues and that where mechanization was introduced it was important to obtain the right kind of implement for tillage and seeding. The chisel plough, which did not invert the furrow, appeared to give better results in the drier parts of the Region than the mouldboard or disc type of plough, and the importance of placing the seed at the correct depth was emphasised.

6. Where forage crops were grown in rotation with food and cash crops, speed was essential both in harvesting and in land preparation since time was more limited than when a fallow was taken between the crops.

7. There was discussion on the development of mechanical methods of harvesting in order to save hay at the right stage of maturity and to remove it from the land so that preparation for the next crop could begin. In the case of forage crops harvested for seed, quick harvesting at the correct stage was necessary to avoid undue losses by shedding.

Conservation of forage

8. In the course of a discussion on methods of conservation of hay, it was noted that in the cool highlands of Eastern Turkey and North-western Iran considerable quantities of hay were conserved by traditional methods which though laborious seem to be well adapted to the conditions. A simple method of baling had been evolved. It was suggested that some of these might be demonstrated in other areas and that simple methods of mechanical baling, especially for crops like alfalfa where leaf-shedding was a problem, should be investigated.

9. Baling had a special importance where hay was produced on arable farms and had to be transported to the livestock areas. It was pointed out that, while care was necessary not to over-dry hay as this resulted in undue shedding of leaves, bales should not be so moist as to cause a risk of deterioration in storage.

Incorporation of additional nitrogen

10. Following the previous day's discussion on the use of urea in livestock feeding, it was suggested that one method of incorporating urea in livestock rations might

be through the use of 'cobbing'. In this process coarse roughages such as straw or inferior hay were improved by chopping them up and adding molasses, sugar beet pulp, etc. together with a binding material and urea could perhaps be added also.

Straw as forage

11. It was mentioned that wheat straw was extensively used as forage in the region and that the new Mexican wheats had a short, stiff, straw which was much less acceptable to livestock. It was recognised that this development was inevitable if food production was to be increased through the use of high-yielding dwarf varieties and that it would be necessary to devote more attention to the production of forage crops to replace wheat straw.

12. With the use of high-yielding cereal varieties and rotational cropping with forages it was considered feasible to increase the production of cereals and forages at the same time. The point was made that wheat straw was, in any case, of low nutritive value and its replacement by more nutritious and higher yielding forages would in many respects be an advantage.

Third Session

Range management

Chairman
Mr D. F. Davidson OBE,
Adviser on Forestry and Soil Conservation,
Middle East Development Division, Beirut

Range management in the CENTO region countries

D. F. Davidson
Middle East Development Division Beirut, Lebanon

Introduction

Turkey, Iran and Pakistan together cover an area of about 300 million ha. Approximately half of this vast area is thought to be utilised as range. It includes a great variety of vegetation types – highland, lowland, humid and arid: almost every variation of ecosystem from alpine meadow to climatic desert.

Much of this range land is situated within relatively low rainfall areas with an annual precipitation of less than 300 mm falling mainly in the winter months. In some parts of the area however, notably in Pakistan, monsoon conditions produce a summer rainfall.

Grazing patterns of all types occur – nomadic, transhumance and sedentary. Many of the livestock have access to feed from crop residues for part of the year. Sheep, cattle and goats are the main domestic species involved.

In this attempt to summarise the problems which beset range management in the three regional CENTO countries I have largely relied on the findings and recommendations of the CENTO Travelling Workshop on Range Management which visited Pakistan, Iran and Turkey from 17th September to 15th October 1970.

Current problems with regard to range management and improvement

Most of the ranges are in poor condition and produce well below their potential as a result of a number of factors, most important of which are uncontrolled and excessive grazing, encroachment by low grade subsistence farming and indiscriminate cutting or uprooting of trees and shrubs for fuel and small timber.

In general the governments of the region have no unified, central agencies for the integrated control of all the factors affecting range utilisation and development. This is particularly so in Turkey and Pakistan. In Iran, however, overall responsibility for range management and development throughout the country is vested in the Ministry of Natural Resources – but, even so, co-ordination between policies and personnel concerned with land use allocation, animal health, livestock and livestock products, marketing and range utilisation do not appear to be either clear or effective.

For many parts of the region information concerning range characteristics, methods of range improvement and utilisation together with the many associated socio-economic factors, which is necessary for planning the management of range is largely incomplete. Adequate comprehension of the social and economic circumstances of grazing communities in relation to their utilisation of the range is particularly lacking.

A shortage of trained staff is an important constraint to progress in both basic research and the field application of range management practice.

Inadequate facilities for the organisation of the marketing of livestock and livestock products often limit the development of full potential offtake from the range. This situation is probably a greater contributary factor to the general overgrazed condition of the range than is commonly appreciated.

Solutions to current problems

The CENTO Travelling Workshop which visited the region in 1970 and which I have already referred to came to the following conclusions concerning the best way of solving all these problems:

1. Continuing deterioration in the quality of the range can only be corrected by comprehensive national range development programmes that will integrate range improvement with grazing management, supplementary fodder production, livestock marketing, animal improvement, judicious water development and the rationalisation of existing land rights and patterns of flock movement.

Previous Page Blank

2. It is essential for the implementation and development of comprehensive range programmes that national governments should set up executive agencies charged with responsibility for the conservation, management and development of the range area and with specific authority for co-ordinating existing government effort in this sector. Whereas some success in this field might be expected to follow simply from the exercise of government controls, the greater long term benefit will come from the active participation of the livestock owners themselves through the creation of local organisations, holding corporate and legal responsibility for the land, to which increasing responsibility can be transferred by governments and within the framework of which range improvement can be effected.
3. In the allocation and training of staff for these programmes, priority should be given to integrated resource surveys for the collection of the ecological, social and economic data on which all development planning should be based. Although these surveys should take priority over other research activities, there remains a general need for quantitative assessment of proper livestock carrying capacity and for research into sundry problems of more local importance.

In what I have just said there is one point which I think deserves particular emphasis — a reference was made to the need to comprehend the human factors involved in trying to introduce improved range management practice. In our region range management is not really an exercise in the control of animals; it is rather an exercise in the control of men and their use of animals.

If we are to succeed in persuading the herdsmen of the region to change their time honoured practices we can only do so if we can demonstrate to them that the improvements we advocate are worthwhile in terms which are relevant to their own standards of values. And, unhappily, here exists a vast gulf in communication. On the one hand we have the pastoralists who are mostly uneducated and live under relatively primitive conditions so that they are unable to assimilate what appear to them to be incomprehensible, uneconomic and revolutionary ideas of grazing practice. On the other hand we have the technicians of the various governments who have some theoretical knowledge of what is to be done but have not yet carried out the essential surveys and pilot experimental work which are necessary to arrive at well tested and demonstrably sound solutions to the problems with which they are faced.

No short term improvement in the situation can therefore be expected, but the need to press on with the education of the rural population, build up the necessary extension services and expedite surveys and pilot experimental work in the range management sector is very clear and deserves most urgent attention by the authority concerned.

Range management in Turkey

Omer Bakir
Forage Crops and Pastures Department, Ankara University, Turkey

Introduction

Rangelands which have been grazed by livestock for thousands of years are the basic source of forage in Turkey. At the beginning of the 20th century, when ten to 12 million people were living in Turkey, a relatively small number of livestock were grazed on extensive rangelands and there was not a serious range management problem. After the first world war the numbers of livestock began to increase to meet the demands for various animal products of a growing population. This trend was very slow at the beginning. For example, in 1935 when there were 44 million ha of rangeland which occupied 58 per cent of the country, there were 20 million animal units grazing on this vast area. At the end of the second world war, when the numbers of animal units were the same, the rangeland area of the nation was reduced to 43 million ha.

Since the second world war, the numbers of livestock have rapidly increased, while very many productive meadows and rangelands have been ploughed under as a result of the introduction of mechanised farming. Thus in 20 years between 1940 and 1960 some 14–15 million ha of rangelands were ploughed under while in the same period the numbers of livestock have increased by about 6.5 million animal units. In this period the equilibrium between the numbers of livestock and the area of rangelands which was already not very well balanced, became worse. In 1940 more than two ha of grazing land were allotted per animal unit, but this area has been reduced to one ha per animal unit today. This trend has stopped since 1960, and in the last ten years there has been no very significant reduction in the area of rangelands nor any important increase in the numbers of livestock.

Today there are 26 million ha of grazing land in Turkey and 26 million animal units (each animal unit is assumed to have a weight of 250 kg). The reduction of grazing lands and the increasing numbers of livestock are shown in Table 1.

Table 1
Grazing lands and numbers of livestock in Turkey

Years	Rangeland *Million ha*	Livestock *Million AU*	Area per AU *ha*
1935	44.3	20.3	2.18
1940	44.2	20.4	2.16
1945	43.0	20.0	2.14
1950	37.8	21.0	1.79
1955	31.0	23.2	1.34
1960	28.6	26.4	1.08
1965	28.0	26.4	1.07
1970	26.1	26.4	1.07

N.B. One animal unit (AU) is assumed to have a weight of 250 kg.

Production and utilisation of rangelands in various regions of Turkey

It is best to study the present condition, production and utilisation of Turkish grazing lands by geographic regions.

1. *Grazing lands of Black Sea region:* The most productive rangelands of Turkey are located in this region. The annual precipitation increases from 600 mm to 2,000 mm from west to east. The climate is very efficient for growing pasture plants especially from the stand-point of rainfall, but rangeland area is not very large, only 11 per cent of the rangelands of Turkey being located in this region. The most productive rangelands are found in the western part of the region where rainfall is very high, these productive rangelands being mostly located on high mountains. Alpine pastures are frequently seen in this region. The average hay production of rangelands is around 900 kg per ha. The main advantage of these rangelands over the grazing lands of the other region is, that they produce green forage for a longer period.

 10.6 million head of various livestock equivalent to 5.3 million animal units are grazed on the 3.2 million ha rangelands of this region. In this region 0.59 ha of rangeland is allotted per animal unit while 1.2 ha of range area per animal unit has been calculated as being necessary on these kinds of grazing lands. All of the rangelands of this region are, therefore, grazed heavily. Animals are grazed in the national forests situated in the region, tree leaves and tree branches being used as forage causing heavy damage to the forests.

2. *Rangelands of Marmara region:* Only 5.7 per cent of the rangelands of Turkey are located in this region in which intensive farming is practiced. Environmental conditions are well suited for growing range plants and rangelands of this region are, therefore, fairly productive. Grazing lands of this region produce about 600 kg hay per ha all of which is made during hot dry summer months. On the 1.6 million ha of grazing land 8.5 million head of various kinds of livestock (equal to a about three million animal units) are grazed, the majority of grazing animals being cattle and sheep. Although ideally two ha of grazing land should be allotted to each animal unit for a grazing period of 200 days, only 0.55 ha of land can in fact be allotted in this region and overgrazing is, therefore, widespread. However, concentrated feeds are used more than in the other regions, milk cows found around big cities being especially well fed.

3. *Rangelands of Egeon region:* This region resembles the Marmara region except that the Makies which is the characteristic shrub vegetation of the Mediterranean region occupies large parts of the coastal areas. 8.5 per cent of the Turkish rangelands are located here.

On the 2.4 million ha of grazing lands 8.1 million head of various kinds of livestock (equal to 2.9 million animal units) are grazed. On rangelands in this condition about two ha of grazing land should ideally be allotted per animal unit, but in practice only 0.8 ha of land is available per animal unit.

4. *Grazing lands of Mediterranean region:* About nine per cent of the grazing lands of Turkey are located in this region. Although in Antalya and Adana plains there is intensive farming, in the other parts of the region farming is extensive in character. Almost all of the coastal areas up to 500 m are covered with makies, maki vegetation being composed of shrubs and small trees which have no economic value except as fuel and for soil protection. For this reason in most of the Mediterranean countries maki vegetation has been destroyed and replaced by either field crops or pastures. The dominant species of makies in this region is *Quercus coccifera*, a small shrub one to two m in height. Only goats can graze this shrub together with the other constituents of the vegetation, there being a sparse herbaceous cover in the openings between shrubs. Maki vegetation is not suited for grazing cattle and more especially sheep and for this reason most goats are raised in this region. The other rangelands of this region, which are mostly located in the Toros mountains, are not generally as productive as the rangelands of Ege and Marmara regions. On average the grazing lands of the region produce only about 450 kg hay per ha. 7.5 million head of various kinds of livestock are grazed on the 2.3 million ha of rangeland but, because the rangelands are insufficient for so many animals, forested areas are also grazed. Grazing livestock on native rangelands, on maki vegetation and on forested areas has resulted in a type of nomadic animal husbandry. Livestock in most of the villages are taken out from the barn in the early spring, grazed on the three types of vegetation mentioned above and after seven to eight months returned to the village.

5. *Rangelands of Central Anatolia:* The most unproductive rangelands of Turkey are found in this region because of the unsuitable climatic conditions. Annual precipitation varies between 200 mm and 500 mm from place to place. Because of the hot and dry summers the rangelands are completely dried out for two to 2.5 months of the grazing season which lasts for six months. The climax vegetation of the region is so severely degenerated that the plant cover in some places cannot even protect the soil, and for this reason, in the southern part of the region around Karapinar severe wind erosion occurs. Accelerated water and wind erosion are also seen frequently in most parts of the region.

Central Anatolian rangelands have a steppe character, but as in the true steppes grasses are not dominant. The most important plants of these grazing lands are *Thymus squarrosus, Festuca ovina* and *Poa bulbosa* var. *vivipara*. In some parts of the region *Thymus squarrosus* is replaced by *Artemisia fragrans*, and thus in Central Anatolia *Thymus* and *Artemisia* steppes are developed. In these grazing lands grasses constitute about 40 per cent of the vegetation.

In general, 15 per cent of the plant cover is legumes, the other 45 per cent of the vegetation being constituted by weeds, shrubs and very many herbaceous plants which animals graze very little or not at all.

Though Central Anatolia is a high plateau, there are not very many high mountain pastures which can be grazed in hot and dry summer months as in the Black Sea, Mediterranean and Eastern Anatolian regions. In summer months during which the rangelands are completely dry, animals are grazed on stubble and fallow lands. Forests which do not occupy much land are also grazed by hungry animals.

26 per cent of national grazing lands are located in this region. 18 million heads of various kinds of livestock (equal to 6.1 million animal units) are grazed on 7.4 million ha of rangelands. Although the potential carrying capacity of the Central Anatolian rangelands is 3.6 ha per animal unit, each 1.2 ha of grazing land carries one animal unit. This is one of the most important reasons of range degeneration in the region the climatic conditions of which are already not suited for forage production. Because of this heavy grazing

the forage output of the rangelands has been reduced to an average of 300 kg hay per ha.

6. *Rangelands of Eastern Anatolia:* There are 9.6 million ha of grazing lands in this region, roughly 34 per cent of the grazing lands of Turkey being located in Eastern Anatolia. On these grazing lands 12.1 million heads of various kinds of livestock, (equal to four to six million animal units) are grazed. Although the rangeland area is large the numbers of grazing animals are not as large as the other regions. For this reason the potential and actual carrying capacities of the grazing lands are almost equal to one another. More than half of the animals are cattle.

Because of the relatively small number of animals grazed on the rangelands of the region the condition of grazing lands is better than in the other regions. The climate is also more suited to forage production than the other regions, excluding the Eastern Black Sea Region, and overgrazing is not so severe as in the other regions.

Eastern Anatolia is essentially an animal husbandry region, as successful farming cannot be practiced because of the high elevation. Most of the productive meadows are also located in Eastern Anatolia. This region has a great capacity for animal husbandry and forage production and most of the efforts of the villagers have been directed towards animal husbandry.

7. *Rangelands of South Eastern Anatolia:* The rangelands of this region resemble the Central Anatolian grazing lands, because, of the dry climate. However, the condition of the ranges is only a little better than those of Central Anatolia. Because of the higher temperature range forage dries out quickly, and the livestock are taken to the Eastern Anatolian rangelands and high mountain pastures on the South Eastern Toros Mountains. 5.9 per cent of the rangelands of Turkey are located in the region. On 1.7 million ha of grazing land about six million heads of various kinds of livestock (equal to two million animal units) are grazed. While ideally around three ha of grazing land is necessary per animal unit, only 0.85 ha can be given per animal unit. The rangelands of this region are, therefore, also heavily grazed. Overgrazing in fact occurs all over Turkey, except perhaps Eastern Anatolia.

Feedstuff production in Turkey

The amounts and feeding value of the various feedstuffs produced in Turkey are shown in Table 2. As shown in this table about half of the fodders consumed by livestock in one year are obtained from various straws. The feeding value of straw is very low, and in most of the progressive countries straw is not considered as a feed.

Table 2
Feedstuffs production in Turkey and feeding values

Feedstuff	Production *Tons*	Feeding Value: Digestible Protein *Tons*	Feeding Value: Starch Equivalent *Tons*
1. Range and meadow hay	14,794,648	739,732	5,326,072
2. Barley	3,361,996	252,150	2,666,063
3. Straw	25,374,000	157,708	2,755,553
4. Alfalfa hay	615,948	80,072	307,974
5. Sugar beet leaves	1,467,562	29,351	161,432
6. Oats	397,705	31,419	260,497
7. Stubble	260,294	25,944	203,497
8. Bran	270,780	32,494	135,390
9. Vetch seed	84,608	20,306	60,749
10. *Vicia ervilia*	97,965	19,457	95,603
11. Brewery by-products	8,557	321	855
12. Sugar beet pulp	1,707,000	5,121	25,350
13. Industrial feeds	77,900	13,087	56,088
14. Cottonseed	20,900	3,135	7,106
15. Sainfoin hay	94,072	12,229	47,036
16. Maize	21,456	1,416	17,187
17. Molasses	28,180	1,239	15,781
18. Various cakes	154,061	46,218	92,437
19. Other feeds	837,000	20,262	151,135
Total		1,491,661	12,445,805

The crude protein content of straw is very low and in fact straw supplies only ten per cent of the total crude protein consumed by ruminants in Turkey. Hay production from meadows and rangelands constitutes about one third of fodder supplies and more than one half of crude protein consumed by ruminants, while the balance of 12 per cent is obtained from other miscellaneous feedstuffs.

From this annual production of feeding materials, the digestible protein share of one animal unit per day is about 148.7 g and the share of starch equivalent is about 1240.7 g. However, an animal unit weighing 250 kg needs 150 g crude protein and 1,500 g starch equivalent daily for maintenance only and it is clear, therefore, that Turkisk livestock are on average fed only at a maintenance level. One of the most important reasons for the low productivity of Turkish livestock is of course this insufficient feeding.

As is clearly shown in Table 2, ranges and meadows play a very important role in animal feeding and they produce more than half of the feeding value consumed by livestock annually. In fact, the forage production capacity of grazing lands in Turkey is undoubtedly higher than today's actual level, but under the present conditions of utilisation it is impossible to obtain benefit from this higher production capacity.

As previously indicated all of the grazing lands in Turkey excluding the Eastern Anatolian Region are grazed very heavily. The hay produced from them in one year is just enough for 15 million animal units for a six month grazing period, while the number of animal units owned today is 26 million. Under these circumstances overgrazing of the rangelands of Turkey cannot be prevented without taking radical measures. As a matter of fact in a 1964 study of a village pasture near Ankara it was found that 90–92 per cent of the annual forage production was consumed by village animals. The utilization percentages of all the rangelands of Turkey are around these figures.

Perhaps the utilization pattern of the grazing lands of Turkey should now be examined.

Utilization of grazing lands in Turkey

Almost all of the grazing lands of Turkey are common ranges, although there are a few private pastures in Eastern Anatolia. The owner of these common grazing lands is the government but the utilization right has been given to the villages and towns. Every man who lives in a village has a right, therefore, to graze all of his animals on the common pasture.

When the government granted the grazing right of these pastures to the villages, it was not mentioned how they should be grazed, how many animals should be grazed on them, how they should be kept in good condition and how they should be improved. When these grants were made the number of animals was low and the grazing area was large and for this reason the government did not take these matters into the consideration. This omission is a very severe disadvantage today and no law regulating the grazing on these common pastures has been accepted by the government yet. For this reason uncontrolled grazing is practised all over the common pastures in Turkey. Because the grazing on common pastures is completely free, everybody has the right of grazing his animals without any restriction. Very many examples of misuse of common pastures can be given, but early and heavy grazing are the most important reasons of range deterioration in Turkey.

Early grazing is widespread in Turkey. Animal raisers who do not have enough feedstuffs to feed their animals in winter take their livestock on the common pasture when the first green leaves of range plants are seen. The range readiness concept is not known by the villagers and very early grazing starts on the pastures which are already heavily grazed up to the winter in the previous season. Range plants which are grazed in the early days of their annual life cycle cannot produce normal amounts of forage.

Although it differs widely from year to year the length of grazing season in Central Anatolia is about six months. Cool season grasses start to grow at the end of February or at the beginning of March but this first growth is very slow and it can be stopped frequently by cold weather. In April range plants grow more rapidly and most of the important ones reach the range readiness phase of growth at the beginning of May, when most of the range plants are 7.5–10 cm in height. Improved range plants such as *Agropyron* spp. and *Bromus* spp. develop more rapidly and reach the range readiness phase of growth two weeks earlier than the native range plants.

On native ranges, grazing by sheep starts in February and March when the snow disappears. When the temperature becomes a little higher grazing by cattle starts, while goats stay almost the whole year round on the pasture in some regions. Grazing on native ranges continues up to the time of harvesting cereals and by the beginning of July 90 per cent of the current year's forage is consumed by animals.

At this time all of the range plants are completely utilised and animals are taken to the stubble and fallow lands. Animals pick the cereal heads which fall down on the soil during harvesting up and graze the weeds, dry cereal leaves and straw. In Central Anatolia stubble and fallow lands are also considered as pasture. This fallow land grazing is especially important in western parts of Black Sea Region, where considerable amounts of forage are obtained by grazing fallow lands. The forage growing on fallow lands is sometimes so abundant that they can be cut.

The high mountain pastures have a special importance from the stand-point of meeting the seasonal green forage requirements of livestock, but most of these pastures are located on the mountainous regions of the

country such as the eastern Black Sea Region, Eastern Anatolia and the Toros mountains.

Most grazing lands in Turkey are of the springfall range character, but grazing in the fall on the Central Anatolian rangelands cannot be guaranteed for every year and is not important. In some years the fall rains begin late and there is not very much forage on the ranges. Fall grazing continues up to the time that the weather becomes dangerously cold for the grazing animals. Thus, range plants cannot have an opportunity to store reserve food in their roots and stem bases to survive during winter months and especially in the early spring for new growth. This prolonged grazing is of course another reason of range degradation.

Problems arising from the present pattern of production and utilisation

Forage production and utilization conditions in Turkey have been reviewed and more emphasis is being given to the native ranges. The problems arising from this production and utilization pattern can be grouped into two categories:

1. A great deficiency in forage production

Continuous reduction of grazing lands in Turkey, as indicated above, has resulted in a great deficiency in forage production. As grazing lands have been ploughed under for field crop production, so forage production has declined. The amount of hay produced by native meadows and ranges is shown in Table 3, from which it will be seen that hay production has been reduced from 26.1 million tons to 14.5 million tons in the last thirty five years. This great reduction has not been offset by the production of other forage crops and miscellaneous feeding stuffs. The production of barley, oats, vetch, alfalfa and sainfoin and the other feedings stuffs has shown a continuous increase from year to year, but this increase has been so slow that it has not changed the general trend sufficiently. This deficiency in meadow and range hay has been met by continuously increasing straw production. As a matter of fact, straw production increased from 11.3 million tons in 1950 to 26 million tons in 1970.

Table 3
Hay production of native meadows and ranges in Turkey

Years	Production *Million Tons*
1935	26.1
1940	26.0
1945	25.4
1950	22.3
1955	18.3
1960	16.8
1965	16.0
1970	14.5

This great deficiency in forage production is one of the most important problems to be solved in the near future, if maximum benefit is to be gained from our livestock. The annual fodder requirement of our animals is between 40–50 million tons, while the amount of actual production is only around 20 million tons, including the other fodder material listed in Table 2. According to these figures there is 20–30 million tons of fodder deficiency. This means, that we cannot produce even one half of the fodder requirement of our animals. This deficiency results of course in a low yield of milk and meat.

It is impossible, without improving the feeding condition of livestock, to meet the animal production requirements of the rapidly increasing population. To increase forage and feed production is one of the most important means of increasing animal production.

2. Range deterioration

Because of the uncontrolled grazing which is practiced all over Turkey our rangelands are getting poorer from year to year. The destructive effects of extremely heavy and completely uncontrolled grazing on the range vegetation is very well known. Under these grazing conditions range deterioration is a natural result which cannot be stopped easily. As a matter of fact range vegetation is so weakened by uncontrolled grazing that it cannot protect even the soil. On deteriorated rangelands severe wind and water erosion has already begun.

Erosion causes great damage especially in dry regions, and the wind erosion occurring in Karapinar county of Konya province has been a real disaster in recent years. Although the amount of annual precipitation is low in dry regions it occurs as storms. For this reason, water erosion has also become a serious problem in dry regions. Water erosion has been increased by ploughing the sloping rangelands.

The amount of desirable range plants has been greatly reduced because of the heavy and uncontrolled grazing. The studies which we conducted on the dryland ranges around Ankara have indicated that the percentage of desirable range plants in the vegetation was around 25 per cent. This percentage was lower on the south slopes which are normally drier than the other range sites. Thus, a tremendous range improvement problem has arisen because of the heavy grazing during the last decades The original vegetation of the rangelands has deteriorated badly and grazing lands have become covered with secondary grasses and weeds. As a result of this change in plant cover the grazing capacity of rangelands has been greatly reduced.

The amount of desirable range plants on more than half of the rangelands is so much reduced, that there is almost no possibility of natural reseeding. The remaining desirable range plants cannot produce enough seed and vegetative reproductive organs to give rise to a new generation. Range improvement through natural re-

seeding will take a very long time on these depleted rangelands, because secondary succession is a very long time-consuming process, especially in dry regions.

Here, the results of an experiment to investigate the effects of various rest treatments on the botanical composition of a native range vegetation should be mentioned. In this study it was clearly demonstrated that complete rest treatments up to eight years did not improve the botanical composition of the vegetation significantly. The percentages of the desirable grasses and legumes were so little that they could not rapidly increase and cover considerable areas in eight years. However, the basal cover and especially the hay production increased with eight years of complete rest.

Current need of increased production and improved methods of utilisation

In order to increase production and decrease the deficiency of forage, all forage resources must be fully developed. The main forage resources are various forage crops, meadows and native ranges.

1. *Growing forage crops:* In order to meet the hay requirements of livestock rapidly, forage crops must be the first choice, and there is the possibility of rapid and plentiful forage production in fields. As has been previously indicated, 18 million ha of grazing lands have been ploughed under during the last thirty five years in Turkey. Ploughing under of grazing lands has occurred in other countries as well and in fact this is a natural trend, because it is generally considered that the grazing lands are reserve fields. As the population and consequently the demand for field crop production increases, some of the grazing lands are ploughed under and allotted to field crop production, but in most progressive countries a new agricultural system, namely 'Grassland agriculture, grassland farming or ley farming' also develops rapidly. Thus, the total forage production does not decrease, but increases by giving more emphasis to the growing of forage crops and establishing various kinds of seeded pastures in or outside normal crop rotation. This has not happened in Turkey and, as a result of ploughing under the grazing lands and although field crop production has increased, forage production has decreased tremendously. It is considered that the time has come to correct this past mistake by growing more forage crops in the rotation.

Growing forage crops is not new in Turkey. Some important forage crops such as alfalfa, sainfoin and vetch have been grown in Turkey for thousands of years, but the production of hay obtained from these crops has not yet achieved a level which could influence animal feeding. Besides these traditional forage crops new forage crops which will meet the requirements of modern feeding techniques must be grown in sufficient amounts. From this stand point forage crops for silage and to meet seasonal green forage requirements are especially important.

Forage crops can be grown in or outside normal crop rotation. Growing forage crops in rotation is especially important from the stand point of both increasing the soil productivity and preventing soil erosion. Very promising results have been obtained from rotation experiments with alfalfa, sainfoin and winter wheat at the Grassland and Animal Husbandry Research Institute; experiments conducted for many years have proved that growing alfalfa and sainfoin in crop rotation not only increases forage production but at the same time increases wheat production from the same area. Thus, it is clearly understood that without decreasing the wheat production, which is the main crop in the rotation, important amounts of forage can be produced by putting these two legumes into the crop rotation. There is no doubt that important contributions will be made to the forage production of Turkey by using this rotation system.

Developing forage crop production will decrease the intensity of grazing on native ranges. At least the early grazing will be decreased by providing sufficient amounts of hay for winter feeding. In fact it is almost impossible to work on the range improvement subject without preventing early and heavy grazing of rangelands. From this point of view increasing forage crop production is an essential preliminary to efficient range improvement studies.

2. *Range improvement:* This subject can be divided into two, namely the establishment of seeded pastures and other range improvement methods.

The greatest potential in meeting the forage deficiency in Turkey lies undoubtedly in native rangelands. As has been previously indicated the forage production capacity of Turkish native ranges is higher but, under the current utilization circumstances, it is almost impossible to benefit from this potential capacity.

There is no possibility of improvement through natural reseeding on most of the native ranges, because the percentage of the desirable range plants in the vegetation is very low. For this reason establishing seeded pastures on relatively flat rangelands is one of the quickest ways of range improvement.

Very promising results have been obtained from seeded pasture experiments. An experiment conducted at the Grassland and Animal Husbandry Research Institute has clearly shown the importance of seeded pastures for Central Anatolia. On a seeded pasture established with a mixture of *Agropyron intermedium, A. cristatum, Bromus inermis, Elymus junceus, Medicago sativa* and *Onobrychis viciifolia* one year old sheep were grazed for six months. Sheep grazing on 0.225 ha of seeded pasture could not consume even half of the forage during six months. Thus, it was concluded that the carrying capacity of this type of seeded pasture was about 0.2 ha of land per sheep for a six months grazing season or five sheep could be grazed on one ha. Sheep grazing on the seeded pasture gained live weight continuously up to the middle of July. In August and

September when the grasses were almost completely dry and alfalfa in a dormant condition the sheep lost some of the weight they previously gained. In October, when this plant growth started due to the fall rains animals gained some more body weight. Sheep grazing on various grass and legume mixtures had live weight gains of between 16.3 and 19.1 kg per head. The maximum live weight gains were by sheep grazing on *Bromus inermis* + *Medicago sativa* and *Agropyron intermedium* + *Medicago sativa* mixtures.

Sheep lost 1.1 kg of live weight in August and 3.0 kg in September when grasses were completely dry and alfalfa was in a dormant condition.

In order to prevent these important losses in live weight concentrated feeds need to be used. Perhaps 100 g of cotton seed cake per sheep per day would be enough to prevent this loss. This much cake would also afford the more efficient utilization of dry pasture forage. If this supplementary feed cannot be obtained easily or it would not be economically feasible to provide it, animals must be taken to high mountain pastures or to the other seasonal pastures.

When the results obtained from this experiment are compared with the results of experiments conducted on native ranges, the importance of seeded pastures in Central Anatolia can be clearly indicated. A study conducted on the native ranges of the Middle East Technical University around Ankara indicated that 0.6 ha of grazing land must be given per sheep for six months of grazing season. Other studies in some counties of Ankara obtained the same results. The grazing capacity of seeded pastures, as clearly understood from these figures, is at least three times higher than that of native ranges.

Seeded pastures give us more animal products because the feeding value of the forage produced on these pastures is higher than native range hay. This fact has also been proved by grazing experiments. A sheep grazing experiment conducted on a native range of Ataturk Park near Ankara showed that sheep grazing each on 1.5 ha of land gave only wool and they did not gain appreciably in body weight in five months. In fact, animals lost all of the body weight they gained in the spring months, when the range forage was green, in the following summer and winter months. A grazing experiment with sheep and goats at Lalahan Animal Husbandry Research Institute obtained only 8 kg of live weight gain per animal, while in the grazing experiment on seeded pasture mentioned above each sheep gained 17.8 kg of live weight as the experimental average.

As these grazing experiments clearly indicate seeded pastures are more productive than native ranges. However, there is no possibility of converting all of the native ranges of Turkey to seeded pastures because most of them are located in mountainous regions. There is no possibility of establishing seeded pastures on steep and stoney areas on which farming machines cannot easily work. On these types of lands other reseeding possibilities without seed bed preparation must be tried.

Good results could not be obtained from the reseeding studies conducted in Central Anatolia without seedbed preparation. The seeds broadcasted in the vegetation could not find any possibility of germination. Seeds drilled into the soil without any seed bed preparation showed a relatively higher germination, but seedlings could not compete with the existing vegetation and died before maturing. However, further research is needed in reseeding without seed bed preparation. It is considered that this method will give satisfactory results in sparse vegetation and where the soil condition is relatively better. This type of reseeding will be more successful in more humid regions of the country than Central Anatolia. In these regions reseeding without seed bed preparation must be investigated thoroughly because it is more economical than establishing seeded pastures.

3. *The other method of range improvement:* In order to improve the rangelands where establishment of seeded pastures is impossible, controlled grazing must be practiced before anything else. There is no possibility of increasing the range yield without regulating the utilisation pattern. In order to make controlled grazing in Turkey possible, the early grazing must first be prevented. We must have sufficient amounts of winter forage to keep the animals in the barn up to the time when range vegetation can be grazed safely. From this stand-point establishing seasonal pastures which can be grazed early in spring are very important. For this early grazing some cool season grasses, for example *Poterium sanguisorba* and even barley and rye, can be used. During summer months, when the range forage is dry, summer pastures are needed in order to meet the green forage requirements of animals and to prevent the decrease of milk and meat yields. For these summer pastures some native warm season grasses such as *Andropogon gryllus*, *A. ischaemum* and *Kochia prostrata*, sudangrass, forage sorghums and *Panicum* spp. can be used.

Following the establishment of these seasonal pastures overgrazing problems will be solved to a large extent. The range plants which will be saved from the pressure of the heavy grazing will have the possibility of producing more forage by making a normal growth and development. In order to prevent overgrazing a reduction in the number of animals is also necessary, a great number of poor yielding animals being raised in Turkey. More milk and meat can be produced from this limited amount of feed if more productive animals are obtained by introduction and effective animal breeding in Turkey. The wealth of a ranch or an animal rearer is still measured by the number of animals he owns rather than the amount of animal products he produces. This is true for almost all of the underdeveloped countries.

There is no law regulating the grazing on common pastures in Turkey, grazing being completely free. Under these circumstances it is impossible to solve the feed problem thoroughly by improving the native ranges or establishing seeded pastures. Controlled grazing is more necessary on seeded or improved pastures than native ranges, as seeded pastures cannot withstand uncontrolled grazing as much as the native ranges. Seeded pastures degrade in a very short period of time and become poorer than the native range under uncontrolled grazing conditions. Controlled grazing concepts must be taught to the villagers by an effective extension service.

Other improvement methods may also be used to increase the forage yield of native ranges. In European and American countries commercial fertilizers come first in the range improvement and very many grazing lands have been improved by this means, forage production being increased tremendously by fertilization. However, range improvement by fertilization in the dry regions of Turkey is less promising. Fertilizers must be accompanied by adequate soil moisture in order to give the maximum benefit, but in dry regions like Central Anatolia moisture is the most important limiting factor for plant growth.

However, some promising results have been obtained by fertilization in Central Anatolian rangelands. Fertilization of native meadow and range vegetation has given good results, especially where the soil moisture condition was not so critical. Some increase in forage production has been obtained by fertilization of native ranges in Central Anatolia, but the economics of range fertilization have not been studied thoroughly.

Besides this, the proportion of weeds and low value plants is so high in the dry land range vegetation that it is very difficult to promote the increase of desirable grasses and legumes. In general, these weeds and low value range plants utilize the fertilizers better than the desirable range species and much of the given fertilizers is used by weeds. For these reasons only seeded lowland pastures, natural meadows and those pastures containing appreciable amounts of desirable grasses and legumes should be fertilized in the Central and South Eastern Anatolian regions.

It is natural that range fertilization in the more humid regions of Turkey will give better and more economic results. Fertilization of range lands containing adequate numbers of desirable species will increase the forage yield in some of the Eastern Anatolian range lands. In all regions, except maybe Central and South Eastern Anatolia, the greatest emphasis must be given to range fertilization in order to improve the range condition and to increase the forage production of those grazing lands with a satisfactory botanical composition.

The fertilization problem of the rangelands of Turkey can be solved in future as the commercial fertilizer production of the country increases. At the present time even the efficient fertilization of the other field crops including the high value cash crops is a very big problem. For this reason the possibilities of range fertilization in Turkey are, of course, limited. It is considered that it would be better to fertilize all the natural meadows first and only then take the fertilization of rangelands into consideration. As the soil moisture condition and the botanical composition of natural meadows are suitable for fertilization, great increases in forage production could be obtained from these areas.

Weed control in meadows and rangelands has not yet begun even in research institutions. Our rangelands contain considerable amounts of weeds, especially in rainy spring months when all of the ranges are covered with many flowering weeds. Some of these weeds are willingly eaten by livestock. Annual legumes such as *Trigonella* and some *Astragalus* spp. are especially abundant in the range vegetation, but these are very short lived plants. They dry out quickly, fall down on the soil and lose all of their feeding value in a very short period of time. These very short lived annual legumes can be considered as weeds also. Weed control in all of the regions and brush control in coastal regions of the country are important range improvement problems.

Another thing which must be considered to increase forage production is the drainage problem of native meadows. Most native meadows are located on areas which are poorly drained. The soil under the meadow vegetation is so wet most of the time, that *Juncus* and *Carex* spp. are in the dominant position in some meadows. These areas are frequently flooded and all the vegetation remains under water for some time. For this reason the hay production which is badly needed is low and the quality is poor. Draining excess water from these areas will undoubtedly double the hay production in terms of both amount and the quality.

National programmes for increasing production and improving utilisation

1. *Programme for growing forage crops.* The problems of feeds and feeding were first recognised by the Turkish Government in the early 1950s, although some efforts were made to promote forage crop production and to enlarge the acreage before 1950. For example, five to six tons of alfalfa and a few tons of beet seeds were customarily distributed to the needy farmers every year. In 1952, after the importance of growing forage crops had been thoroughly recognised, a big demonstration programme was prepared by the Ministry of Agriculture to develop alfalfa and sainfoin growing in Turkey. This demonstration project which was applied in all regions of Turkey has been to some extent very beneficial in developing forage crop production. Thousands of ha of alfalfa and sainfoin fields were established and a few hundred tons of seed was distributed annually for 15 years. However, this big demonstration project did not promote forage crop growing in every part of Turkey. Farmers who did not have many high yielding animals preferred to

feed their animals with straw which is cheaper than hay. Most of the farmers did not want to grow forage crops on their land which was already too small even to grow field crops in adequate quantities.

It is considered that there are two main reasons for the lack of development of forage crop growing in Turkey in spite of this very big effort made by the government. First of all, the marketing and price policy of animal products has not been efficiently regulated. Every farmer can sell his field crop production easily, but it is not always so easy and the price is not so satisfactory for animal products such as milk. Therefore, animal raising and production of meat and especially milk has not yet been a dependable source of income in some regions of the country. Also, no one wants to invest money in the marketing and industrial processing of animal products in places which are far from big cities or consumption centers.

Secondly, most of our farmers have only a small area of land and they do not want to grow forage crops for their few unproductive animals. The number of big animal rearers is low and some of them are nomadic people. The main occupation on these small farms is field crop production and animal rearing is considered as a side occupation.

In order to feed these animals from small farms efficiently the necessary forage must be grown in rotation. Especially in regions in which a fallow system is practiced, growing forage crops in rotation is the shortest way to solve this problem. Putting the forage crops into the crop rotation will be easier in humid regions. The rotation experiments conducted at the Grassland and Animal Husbandry Research Institute have clearly indicated that it is possible to produce as much as 4.9 tons of alfalfa or 5.4 tons of sainfoin hay per ha from the same area without any decrease in the wheat production. The rotation reduces the percentage of fallow from 50 to 28 per cent and thus 1.7 million ha of fallow land can be saved to produce either forage crops or field crops, simply by putting legumes into the crop rotation.

2. *Programme for the establishment of seeded pastures.* In most of the regions of Turkey very many seeded pastures have been established in villages with the aid of the Ministry of Agriculture. In some places all and in other places a considerable part of the establishment costs of these pastures have been met by the government. These seeded pasture demonstrations have been accepted by the villages with great interest and in many places villagers actually applied to the local extension services for the establishment of a seeded pasture in their village. The establishment of seeded pastures was well conducted in some provinces such as Ankara, Kayseri, Eskisehir and Kars, where the extension service was more active than in the other provinces. Local government also allocated money in their budgets to be spent on the establishment of seeded pastures in these provinces. The establishment of seeded pastures which was started as demonstration projects has had a satisfactory development over the ten or 12 year period.

However, the relatively high cost of seeded pasture establishment has prevented great development in all of the regions of the country. The contribution of these pastures to the total hay production of the country has not been very great, because the funds were not sufficient to establish a demonstration pasture in every village. In most places the contribution of villagers to the establishment costs of seeded pasture has soon been obtained and thus the share of the government has been decreased. However, villagers who are faced with very many problems in field crops production cannot finance the cost of establishing the seeded pastures needed in the future. Besides this, it is rather difficult to obtain the contribution of all of the villagers for the establishment of a common pasture.

Another limiting factor is technical knowledge. Because seeded pastures are new in Turkey, the farmers do not know the technical details of establishing seeded pastures and even the growing techniques of new forage crops. For this reason they need the technical assistance of very well trained range specialists.

In order to promote the establishment of seeded pastures and to make the greatest contribution to the national hay production, a series of measures must be taken. Before anything else, politicians must be convinced that the establishment of seeded pastures is a productive investment and that, without establishing seeded pastures and improving the native ranges, it will be impossible to ensure progressive animal husbandry in the country. After the politicians are convinced of the importance of the subject it will be easier to obtain necessary funds from the national budget. In order to enlarge the acreage of seeded pastures, it is necessary, that some of the establishment expenses be borne by the government. As the financial condition and the level of the technical knowledge of the farmers are raised government support could be gradually decreased.

The number of well trained range and pasture specialists must be increased rapidly. Today there are more than six thousand agronomists in Turkey, but the number of satisfactorily trained range and pasture specialists is very low. After a sufficient number of specialists have been trained, the lack of technical knowledge of farmers can be rectified in a short period of time and the trained farmers can establish seeded pastures themselves. Thus government support through technical assistance could be also gradually reduced.

At the present time the seed bed is usually prepared by the villages and the government supplies only the necessary seed and technical assistance. This collaboration between the government agencies and the villagers is going very well in most places.

The necessary seed is produced only in government institutions at the present time. The seeds of conventional forage crops such as alfalfa, sainfoin and vetches

are grown by the villagers, but they do not yet produce the seeds of pasture grasses such as *Agropyron* spp. and *Bromus* spp. Seed production of pasture grasses and legumes has not yet been developed as a farming branch in Turkey, and this is why the production of seed for pasture grasses will be a duty of the governme it institutions. At the presen' time the seed production of these institutions is barely enough for the current limited demand, but for the increased demand in the future necessary measures must be taken today. This problem can be easily solved by training some of the better educated farmers to produce pasture grass seed.

Grazing on seeded pastures is also a problem. Unfortunately, it cannot be said that the established pastures are grazed according to the technical basis of range management.

Seeded pastures are grazed as heavily as the native ranges in some places. For this reason some of the seeded pastures, even those established in the government farms, are becoming unproductive in a very short period of time. Seeded pastures cannot withstand as much overgrazing as the native ranges and it is vital, therefore, that they be grazed properly. Otherwise, seeded pastures become very short lived and it becomes necessary to establish another pasture on the same area by renewing all of the expense and effort. This, of course, is not an economical method of operation.

The proper grazing of seeded pastures must be obtained through effective extension because no law regulating grazing on common and seeded pastures exists in Turkey today. This can only be achieved by very well trained range and pasture experts.

3. *Range improvement in Turkey.* Range improvement studies began in Turkey in 1952-53. The first improvement works were range fertilization, control of some spiny plants and clearing out the stones in the area. Satisfactory results from range fertilization demonstrations could not be obtained, especially in dry regions, because no range fertilization research was conducted before.

Reliable information on range fertilization is not available for every region of the country and this is why further research is needed in order to make possible recommendations concerning efficient range fertilization. There is no doubt that range fertilization affects the forage production more or less everywhere but the economy of the fertilization is a very important problem. The native ranges have been so depleted by uncontrolled grazing in some regions that it is almost impossible to improve the botanical composition by fertilization. The danger of promoting weeds and brushes exists on most of the grazing lands. The success of range fertilization is limited both by the soil moisture and the amount of the weeds. Therefore, only seeded pastures, lowland pastures and meadows must be fertilized in dry regions. At the present time the amount of fertilizer used on grazing lands is very little and much more fertilizer must be used to increase the forage yield, where the botanical composition and the soil moisture condition are suitable. However, the fertilization of grazing lands is dependent on the development of the fertilizer industry in Turkey. The efficient fertilization of grazing lands of the country will be possible only after cheap and plentiful quantities of fertilizers are produced in Turkey. Very many range and meadow fertilization experiments must be conducted in every region. All of the technical details of range fertilization for every region must be in hand for those days when we will have plenty of fertilizers produced in Turkey.

It is considered that there is not much possibility of weed control in grazing lands at present because this problem cannot be solved even for crop lands. However, weed control on seeded pastures is very important and all efforts must be made to make the seeded pastures longer lived and more productive. Weed control on seeded pastures is especially important during the establishment years. Brush control in the coastal regions of the country is another important problem and shrub vegetation located on relatively flat areas must be destroyed. Thus, large areas can be won to produce more forage and possibly even field crops. In order to replace this brush vegetation with productive pasture vegetation a national programme must be prepared.

The drainage problem of natural meadow and ranges must be solved in a short period of time to obtain the maximum benefit from these areas.

One of the most important range improvement works may be the establishment of stock watering facilities in Turkey. Obtaining drinking water for animals in most of the regions is a very important problem. Grazing animals often have to walk for great distances to drink water, which is a useless energy loss. Animals cannot utilize the range forage efficiently without drinking sufficient amounts of water. Sometimes all of the drinking water resources dry out and in these dry years grazing lands are left in spite of plenty of forage being present. Thus considerable amounts of forage are lost and the animals are taken to those grazing lands with drinking water, no matter whether or not enough forage is present. This is true especially for the high mountain pastures of Eastern Anatolia.

Since 1952 very many stock watering facilities have been established by the Ministry of Agriculture. These facilities are not enough, however, and the natural resources of stock drinking water must be developed to obtain enough water especially during the summer months.

A study of the improvement of dry-land ranges developed under the conditions of Erzurum (Eastern Anatolia)

Fahrettin Tosun, Ibrahim Manga and Mustafa Özyurt

Crop Science Department, Ataturk University, Erzurum, Turkey

Introduction

According to the agricultural statistics of 1969 there are about 28 million ha of native range land in Turkey. More than 75 per cent of this land is in poor condition mainly because of heavy grazing. The optimal carrying capacity of the total ranges in Turkey has been estimated at nine million animal units of 250 kg of live-weight per season. In fact there are 74 million head of animals of all kinds and ages in Turkey which, if converted into animal units of 250 kg live-weight, give about 28 million animal units to graze on 28 million ha of range land. This means a three-fold extra load over estimated carrying capacity of these ranges. As the acreage of range lands decreases by being taken up for crop production and the number of animals increases, the remaining ranges are subjected to much heavier grazing every year.

Livestock production of Eastern Anatolia depends more upon the range grazing than any other region of Turkey. All ranges in Eastern Anatolia excluding pastures developed on the bottom land are in poor condition and it is, therefore, an important problem to find methods of improving and increasing grazing capacity of these dry ranges developed on the lower slopes of mountain ranges in Eastern Anatolia. This study was conducted to establish a successful method for the improvement of these depleted ranges under the climatic and soil conditions of Erzurum.

General information about the experimental area

The experiment was established on a dry range of the Ataturk University farm developed on the foot of the Palandoken Mountain Range. The experimental area is about 2,000 m above the sea level.

1. Climate

The long-term average of total yearly precipitation of Erzurum is 470.8 mm; about 40 per cent of which falls in April, May, and June. The lowest rainfall is in August and September and about 35 per cent of the yearly precipitation comes as snow. The yearly average temperature is 5.9°C, the monthly temperature average of December, January, and February being below zero. The warmest months of the year are July and August, and the frost free period is only about 160 days.

2. Soil

The texture of the range soils has been named by Baykan (1970) as Palandoken gravely-loam. The texture of the surface soil is sandy-loam, and that of the deep soil gravely-sand, containing about 50–60 per cent of gravel (Table 1). Organic matter content (about one to two per cent) is very low. The infiltration rate is very high, consequently water holding capacity is very low (Ertugrul, 1969 and Baykan, 1970).

Table 1
The texture, organic matter content and water holding capacity of range soils[1]

Soil characteristics	Depth of profile cm			
	0–38	38–59	59–109	109–150
	Texture per cent			
Gravel	49.4	64.1	63.4	68.6
Sand	45.4	56.6	67.2	85.9
Loam	31.1	25.0	19.7	14.1
Clay	23.5	18.4	13.1	0.0
Organic matter	2.12	1.55	0.98	0.31
	Water holding capacity, per cent			
Field capacity	22.50	23.48	15.75	7.98
Wilting point	12.26	13.25	9.36	4.96
Available water	10.24	10.23	6.39	3.02

[1]Source: Baykan (1970)

3. Plant cover

The native plant cover of the experimental range has deteriorated due to heavy grazing over a period of many

years. The botanical composition of the range vegetation determined on dry weight base and by the line interception method is shown in Table 2 (Tosun, 1968). The two dominating species are spiny astragalus (*Astragalus* sp.) and sheep fescue (*Festuca ovina*) consisting of about 58 per cent of the native vegetation. The vegetation also contains in small amounts *Koeleria cristata, Bromus tomentellus, Agropyron trichophorum* and *Poa* spp. from the grass family; wild alfalfa (*Medicago* spp.) and wild sainfoin (*Onobrychis* spp.) from the legume family, and sage (*Artemisia* sp.) and thyme (*Thymus* sp.), species from other families. The spiny astragalus which is not readily grazed by the sheep constitutes 31.24 per cent of the vegetation. The sheep obtain their diet from the other legumes and grasses.

The vegetation covers only about 15 20 per cent of the soil surface. The remaining bare surface of the soil is partly covered by annual plants only during the early spring.

Table 2
Botanical composition of the range vegetation determined on a dry weight basis and by line interception method[1]

Plant species	Botanical composition	
	Dry weight	Line interception method
	per cent	*per cent*
Gramineae:		
Festuca ovina	27.34	29.64
Koeleria cristata	3.26	7.05
Bromus tomentalus	2.53	9.22
Agropyron trichophorum	1.61	2.63
Poa bulbosa	1.99	0.89
Poa annua	3.62	4.27
Other grasses	4.66	6.15
Total	45.01	59.85
Leguminosae:		
Astragalus sp. (Spiny astragalus)	31.24	2.34
Astragalus sp. (Spineless astragalus)	1.45	1.86
Medicago spp. (Wild alfalfa species)	7.42	3.89
Onobrychis spp. (Wild sainfoin species)	3.22	0.34
Other legumes	1.10	0.00
Total	44.43	8.43
Other families:		
Arthemisia sp. (Sage)	5.64	9.64
Thymus sp. (Thyme)	2.00	4.71
Anthemis sp. (Yellow daisy)	0.32	4.71
Other plants	2.60	12.66
Total	10.56	31.72
GRAND TOTAL	100.00	100.00

Source: Tosun (1968)

Materials and methods

Four treatments, control (native range), broadcasting (overseeding), and two artificial pasture establishments were applied in the experiment.

1. Control

In the control plots, the native vegetation was kept in its natural condition without any treatment application.

2. Broadcasting (overseeding)

For broadcasting, in addition to the native vegetation that was kept as in the control plots, the following treatment was applied: the surface of the range was tilled by a field tiller with teeth 30 cm apart. Thus, furrows about five to six cm deep were obtained in the plots. Then a mixture of alfalfa (*Medicago sativa*), sainfoin (*Onobrychis viciifolia*), intermediate wheatgrass (*Agropyron intermedium*), crested wheatgrass (*A. cristatum*), smooth bromegrass (*Bromus inermis*), and sheep fescue (*Festuca ovina*) was scattered over the surface of the soil in April, 1967. The seeds scattered on the surface of the soil were partly covered by a brushwood harrow in the furrows. The seeding rate of the mixture was 4.75 kg per decare. The ratio of alfalfa, sainfoin, and bromegrass in the mixture was 15 per cent for each; 25 per cent for intermediate wheatgrass, 20 per cent for crested wheatgrass and ten per cent for sheep fescue.

3. Artificial pasture establishment

In order to establish artificial pastures the native vegetation of the range was completely killed by plowing and several cultivations. In the fall of 1965 the gullies in the area were levelled and the soil was deeply plowed. In the spring and summer of 1966 the plots were cultivated several times until all of the weeds and the native vegetation were killed and a good seedbed was prepared. In April of 1967 two different mixtures of seeds were prepared and seeded by a grass drill (Massey Ferguson No. 732) using both fertilizer and seed boxes.

The plant species included in the mixtures were those recommended by Tosun (1968). The same grasses, intermediate wheatgrass, crested wheatgrass, smooth bromegrass, and sheep fescue were included in both mixtures, the seed ratios of these species in the mixtures being 30, 25, 15, and 5 per cent, respectively. In addition to these grasses, one of the mixtures contained 25 per cent alfalfa and the other, 25 per cent sainfoin. The first one was named '*alfalfa-grass mixture*', and the second one '*sainfoin-grass mixture*'. The rate of seeding was 4.35 kg per decare for 'alfalfa-grass mixture' and 7.15 kg per per decare for 'sainfoin-grass mixture'.

A plot of 50 decares (five ha) was assigned to each treatment and the experiment was replicated four

times. Ammonium sulphate (21 per cent) and super phosphate (16 per cent) fertilizers were applied to all plots including control at a rate of 30 kg per decare.

The plots were fenced and the grazing was started in the spring of 1968, one-year old lambs of Morkaraman and Merino sheep of Ataturk University Farm being used for grazing. During a grazing season the number of sheep grazed in each 50-decare plot was eight, 12, 24, and 24; and thus a grazing area of 6.25, 4.17, 2.08, and 2.08 decares was allotted to each sheep in the treatment of native range, broadcasting, 'alfalfa-grass mixture' and 'sainfoin-grass mixture' respectively.

The number of sheep per plot was arranged on the basis of 'take half and leave half' of total forage produced in each plot per season. To do this 10 cages of 1.2 m by 1.2 m were randomly located in each plot. At the end of each month, when the sheep were weighed, forage was clipped from an area of one m^2 under and out of the cages. The difference between the weights of forages clipped from under and out of cages was considered to be consumed by sheep during that month. The grazing was started at about the end of May when the plants had attained a height of about ten to 15 cm and continued for 92 days in each year.

The live weight increase of sheep was determined by weighing them at the end of each month during the grazing season. The sheep were taken into paddocks at 5 pm. on the previous day and kept there without any feeding and watering until the next morning, when they were weighed.

Results and discussion

1. Hay yield and the amount of consumption

Hay yields, amounts of consumed hay from various pastures and their analyses of variance are shown in Table 3. Highly significant differences in hay yield among treatments and years were found, the hay yields of artificial pastures established with the two mixtures

Table 3
Hay yield and amount of hay consumed under various pasture improvement treatments

Treatments	Years			Average[1]
	1968	1969	1970	
	Hay yield per decare, kg			
Native range (control)	132.0	135.5	101.2	122.9 b
Broadcasting (over-seeding)	199.2	135.8	107.7	147.6 b
Artificial pastures:				
'Alfalfa-grass mixture'	431.[illegible]	273.5	236.2	313.6 a
'Sainfoin-grass mixture'	555.0	260.0	229.5	348.2 a
Average[1]	329.3 a	201.2 b	168.7 b	
	Amount of hay consumed per decare, kg			
Native range (control)	45.2	70.0	28.5	47.9 b
Broadcasting (over-seeding)	89.8	67.2	39.2	65.4 b
Artificial pastures:				
'Alfalfa-grass mixture'	193.5	164.0	109.8	155.8 a
'Sainfoin-grass mixture'	281.5	128.8	121.5	177.2 a
Average[1]	152.5 a	107.5 b	74.8 b	

[1] Averages indicated with the same letter are not significantly different.

Analyses of variance

Source of variation	Degrees of freedom	F values	
		Hay yield	Amount of hay consumed
Total	47		
Blocks	3	0.63	0.26
Treatments (T)	3	34.87**	16.78**
Error (a)	9		
Years (Y)	2	61.47**	13.83**
TXY interaction	6	11.81**	3.74**
Error (b)	24		
LSD	Among treatments	88.9	72.3
	Among years	42.9	41.5

** indicates one per cent level of significance.
LSD = Least significant difference.

being about three times that of the native range. As an average of three years' data, annual hay yield of native range was 122.9 kg per decare, whereas it was 313.6 and 348.2 kg per decare for the 'alfalfa-grass mixture' and the 'sainfoin-grass mixture', respectively. In fact, since the spiny astragalus was included in the clippings, the amounts of available forage in native range and overseeded plots were lower than those shown in Table 3. No significant difference in hay yield between native range and overseeded plots was found. Although the overseeding of native pastures and ranges is encouraged because of its cheapness and easiness, it was unsuccessful in this experiment. Tarman (1964) and Calder and Warren (1967) also indicated that overseeding was not a successful procedure to improve depleted ranges under dry land conditions. In this experiment a poor seedbed preparation and heavy competition between planted seedlings and native vegetation resulted in the failure of overseeding.

On the other hand, since a good seedbed was prepared and all of the native vegetation was killed in the artificial pastures, a satisfactory germination and survival of seedlings were obtained. The necessity of a good seedbed preparation and the removal of competitive native plants for a good pasture establishment was indicated by Ranzi *et al.* (1962), Bement *et al.* (1965), Rumbaugh and Thorn (1965), and Kay (1966).

In the artificial pastures the hay yield of 'sainfoin-grass mixture' was greater than that of 'alfalfa-grass mixture' in 1968, but it was lower in 1969 and 1970. This was probably due to the short-lived growth habit of sainfoin as compared to alfalfa, sainfoin lasting for only four years while alfalfa is a long-lived perennial. However, as an average of three years, there was no significant difference in hay yield between alfalfa-grass and sainfoin-grass mixtures.

Highly significant differences in annual hay consumption were observed among the treatments (Table 3), the greatest amount of hay being consumed from the artificial pastures. The amount of consumption from the 'alfalfa-grass mixture' and the 'sainfoin-grass mixture' was 155.8 and 177.2 kg per decare, respectively. The difference in hay consumption between the two mixtures was not significant. The amount of hay consumed from the native range and overseeded plots was 47.9 and 65.4 kg per decare, respectively: these were about one third of those consumed from the artificial pastures.

As is shown in Table 4, about half of the forage produced annually in the artifical pastures was consumed by the sheep. The consumption ratio was 49.7 per cent for the 'alfalfa-grass mixture' and 50.9 per cent for the 'sainfoin-grass mixture'. This shows that the artificial pastures were grazed according to the principle of '*take half and leave half*'. On the other hand the consumption ratio was 39.0 and 44.3 per cent for the native range and over seeded plots, respectively. However, this does not indicate that the native range and the overseeded plots were lightly grazed because, as is shown in Table 2, 31.24 per cent of the native vegetation of the range is constituted by spiny astragalus which cannot be grazed by sheep. Therefore, the consumption ratios of the available forage of these plots would be higher than those shown in Table 4.

Table 4
The hay yield, the amount of hay consumed and the consumption ratio under various pasture improvement treatments.[1]

	Hay yield *kg/decare*	Consumed hay *kg/decare*	Ratio of consumption *percentage*
Native range (control)	122.9	47.9	39.0
Broadcasting (overseeding)	146.6	65.4	44.3
Artificial Pastures:			
'Alfalfa-grass mixture'	313.6	155.8	49.7
'Sainfoin-grass mixture'	348.3	177.2	50.9

[1] Each figure is the average of three years (1968, 1969, and 1970).

Highly significant differences in both hay yield and the amount of consumption were observed between years. The greatest hay yield and consumption was obtained in 1968. This was followed, in decreasing order, by 1969 and 1970. Since the hay yield of native range also showed the same decreasing order, this was at least partly due to the climatic differences between years. Age of the established pastures may be considered as another factor for the decrease in the hay yield in successive years.

2. Live-weight gain

The live-weight gains per decare, per sheep, and their analyses of variance are shown in Table 5. Highly significant differences among treatments and years in live-weight gain per decare were observed. The greatest live-weight gain per decare was obtained from the 'sainfoin-grass mixture'. This was followed, in decreasing order, by 'alfalfa-grass mixture', overseeded and native range plots. As an average of three years data, live-weight gains of 6.83, 6.24, 3.13, and 2.13 kg per decare were obtained from the mixtures containing sainfoin and alfalfa, overseeded, and native range plots, respectively. More than a three-fold increase in live-weight per decare was obtained from the artificial pastures over the control.

The mixture containing sainfoin produced more live-weight gain than alfalfa-grass mixture, and the difference between the two was significant. This was due to the fact that sheep-grazing on the 'alfalfa-grass mixture' was adversely affected by bloating especially in the early period of the grazing season, whereas no bloating

Table 5
Live-weight gain per decare and per sheep under various pasture improvement treatments

Treatments	Years 1968	1969	1970	Average[1]
	Live weight gain per decare, kg			
Native range (control)	1.47	2.57	2.37	2.13 d
Broadcasting (over-seeding)	2.10	3.91	3.38	3.13 c
Artificial pastures:				
'Alfalfa-grass mixture'	3.85	7.86	7.00	6.24 b
'Sainfoin-grass mixture'	5.04	8.66	6.78	6.83 a
Average[1]	3.11 c	5.75 a	4.88 b	
	Live weight gain per sheep, kg			
Native range (control)	6.68	16.00	14.78	12.48 a
Broadcasting (over-seeding)	7.50	16.30	14.10	12.64 a
Artificial pastures:				
'Alfalfa-grass mixture'	5.76	16.35	14.62	12.24 a
'Sainfoin-grass mixture'	7.84	18.05	14.12	13.34 a
Average[1]	6.95 c	16.68 a	14.41 b	

[1] Averages indicated with the same letter are not significantly different.

Analyses of variance

Source of variation	Degrees of freedom	F values for live-weight gain: Per decare	Per sheep
Total	47		
Blocks	3	4.50^{x}	5.22^{x}
Treatments (T)	3	396.75^{xx}	2.94
Error (a)	9		
Years (Y)	2	288.40^{xx}	98.68^{xx}
TXY interaction	6	23.30^{xx}	5.64^{x}
Error (b)	24		
LSD	Among treatments	0.53	1.26
	Among years	0.31	0.64

^{xx} indicates one per cent level of significance
^{x} indicates five per cent level of significance.
LSD = Least significant difference.

occurred on the sheep grazed on the 'sainfoin-grass mixture'.

The live-weight increase was faster in the first two months than the last month of the grazing season in all treatments (Figure 1), about 80 to 85 per cent of the total live-weight gain occurring in the first two months. In the course of the grazing season the greatest cumulative live-weight gain was obtained from the 'sainfoin-grass mixture'. It was followed, in decreasing order, by alfalfa-grass mixture, overseeded, and native range plots. On the other hand no significant differences in the live-weight gain per sheep were observed among treatments (Table 5). As the average of three years data, the live-weight gain per sheep varied from 12.34 to 13.34 kg among treatments. Like the live-weight increase per decare, the live-weight increase per sheep was faster in the first two months than the last month of the grazing period in all treatments (Figure 2). The live-weight gain per sheep showed the same accumulative progress in all treatments during the grazing period. This indicated that all of the pastures under various treatments were grazed within their moderate grazing capacity. Highly significant differences in the live-weight gain both per decare and per sheep were found among the years (Table 5). The greatest live-weight gain both per decare and per sheep in all treatments were obtained in 1969. This was followed, in decreasing order, by 1970 and 1968. In spite of the highest hay yield and consumption, the live-weight gain both per decare and per sheep was lowest in 1968 (Tables 3 and 5). This was mainly due to the higher initial live-weight of the sheep grazed in 1968 than the other years (Table 6). The average initial live-weight of the sheep grazed in all treatments in 1968 was 42.9 kg, whereas it was 31.9 and 31.0 kg in 1969 and 1970 respectively. Because of the different winter feeding at the farm the sheep used in 1968 were ten to 12 kg heavier than those used in 1969 and 1970.

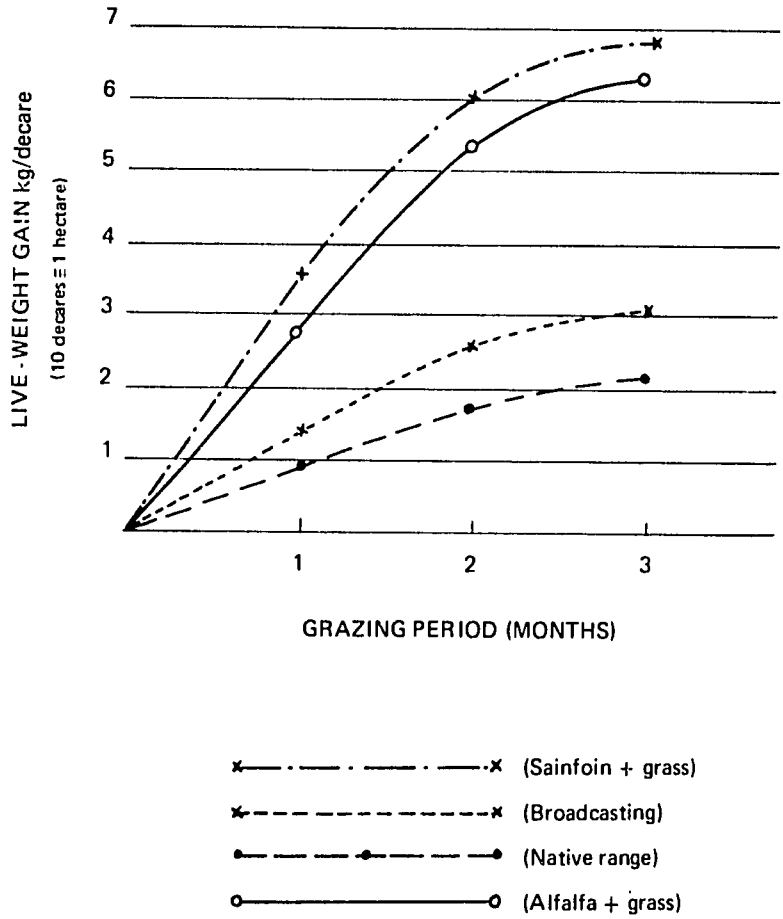


Figure 1
The cumulative live-weight gain per decare during the grazing period under various range improvement treatments. (The curves are based on the average of three years' data).

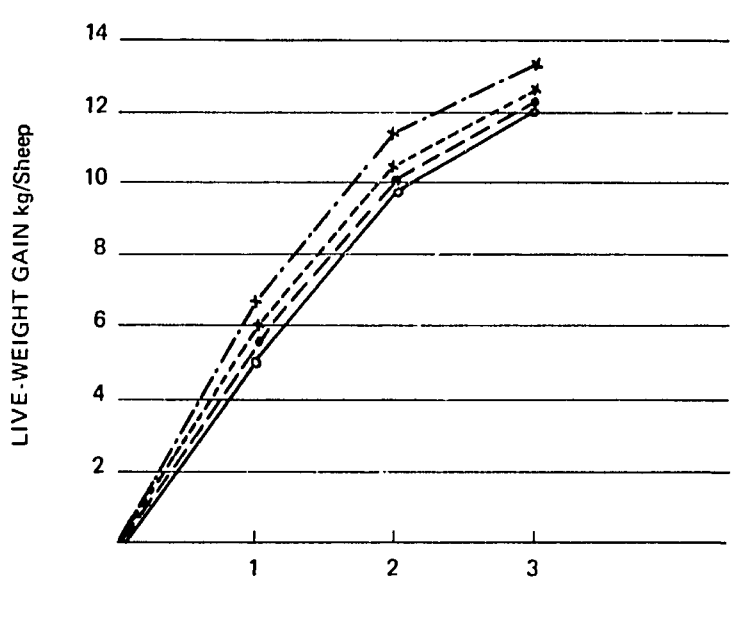


Figure 2
The cumulative live-weight gain per sheep during the grazing period under various range improvement treatments. (The curves are based on the average of three years' data).

Table 6
Initial and final live-weights of sheep grazed on the pastures under various improvement treatments

Treatments	Average live weight per sheep, *kg*					
	Initial			Final		
	1968	1969	1970	1968	1969	1970
Native range (control)	41.9	32.2	31.7	48.6	48.2	46.5
Broadcasting (over-seeding)	43.1	31.9	30.6	50.6	48.2	44.7
Artificial Pastures:						
'Alfalfa-grass mixture'	43.1	31.9	30.8	48.9	48.3	45.4
'Sainfoin-grass mixture'	43.4	31.7	30.8	51.2	49.7	44.9
Average	42.9	31.9	31.0	49.8	48.6	45.4

Conclusions

The results obtained from the experiment conducted for only three years can be summarized as follows:

1. Over-seeding was not a successful procedure of range improvement under the climatic and soil conditions of Erzurum and with the natural vegetation of the experimental range. Absence of a good seedbed preparation and the heavy competition from the native vegetation resulted in failure of overseeding.

2. Preparation of a good seedbed, a complete elimination of the native vegetation to prevent competition and drilling in the seed of 'alfalfa-grass mixture' or 'sainfoin-grass mixture' are necessary for a successful establishment of an artificial pasture under the climatic and soil conditions of the experimental area.

3. About a three-fold increase in hay yield, amount of hay consumption and live-weight gain per decare were obtained from the artificial pastures over the control.

4. It is too early to make an economical evaluation of the artificial pastures, by taking into consideration the establishment cost and the live-weight increase over the control. Therefore, the experiment should be continued for some more years.

References

BAYKAN, O. 1970. Ataturk Universitesi Erzurum Ciftligi topraklarinin bazi ozellikleri, tasnifi ve haritalanmasi. *Atatürk Universitesi Basimevi, Erzurum, Ataturk Uni Yayinlari No. 87.*

BEMENT, R. E., BARMINGTON, R. D., EVERSON, A. C., HYLTON, L. D. and REMMENGA, E. E. 1965. Seeding of abandoned croplands in the Central Plains. *J. Range Mgmt,* **18** (2), 53–58.

CALDER, F. W. and WARREN, F. S. 1967. Pasture renovation in the Maritime Provinces. *Canada Dept. of Agric., Publication No. 1024.*

ERTUGRUL, H. 1966. Erzurum Ovasi Topraklarinda Toprak-Su Munasebetleri ve Ovanin Sulama Suyu Ihtiyaci Uzerinde Bir Arastirma. (Docentlik tezi basilmamistir).

KAY, B. L. 1966. Range seeding without cultivation. *Calif. Agric.* **20**,(10), 2–4.

RAUZI, F., LAN, R. L. and BECKER. C. F. 1962. Mechanical treatments on short-grass rangeland. *Wyoming Agric. Expt. Station Bulletin No. 396.*

RUMBAUGH, M. D. and THORN, T. 1965. Initial stands of interseeded alfalfa. *J. Range Mgmt,* **18** (5), 258–261.

TARMAN, Ö. 1964. Turkiyede yem ve mer'a problemleri. *Turkiye Tabiatini Koruma Cemiyeti Yayinlari No. 9, Sayfa 73–78.*

TOSUN, F. 1968. Dogu Anadolu Kirac Mer'alarinin islahinda uygulanacak teknik metodlarin tesbiti uzerinde bir arastirma. *Atatürk Universitesi Basimevi, Erzurum, Arastirma Bulteni No. 29.*

Improvement of the rangelands and the problem of animal feeding in Iran

F. Arbabi
Ministy of Agriculture, Tehran, Iran

General considerations

Most of the regions of the Middle East whose climates are marked by a long period of summer drought are in varying degrees characterized by: overgrazing of all natural vegetation, deforestation and the uprooting of all combustible species; rapid exhaustion of cultivated lands – manure is used mostly to fertilise soils; loss of water by run-off or by direct evaporation; and finally the extension of desert or semi-desert areas.

This deplorable situation is the result of an abusive and uncontrolled exploitation of all the natural resources by traditionally oriented populations practising agriculture or animal raising – but rarely both at the same time. These populations follow methods of little rationality. Their standard of living is generally very low and, in their daily fight for survival under unfavourable climatic conditions, they are almost precluded from any thoughts for the future.

The administrative and technical problems relating to range improvement and management, and more generally the problem of feeding the animals, cannot be resolved without a marked raising of their living standards and the creation of new sources of income.

With the exception of certain small privileged regions it is mostly the *lack of forage* and the *lack of fuel* which impedes the development of a balanced agricultural production, limits the production per ha and leads to the exhaustion of natural resources (vegetation, soils and water).

This wastage of natural resources can only be reduced by endeavouring to develop fodder production outside the existing rangelands and by the production of fuel outside the residual forests, and this under the most economic conditions possible.

This situation will not be modified solely by the development of irrigation (95 per cent of Iranian territory can never be irrigated) nor by the generalized use of chemical fertilizers (in dry climates the soils require primarily organic matter). Irrigation and the use of chemical fertilizers will result in a marked increase of the national production, but only on the most favoured lands. If no simultaneous effort is made to stop the impoverishment of immense regions which cannot be irrigated, there is a risk of arriving at a rich and modern agriculture concentrated on isolated units, distinctly separated from a relatively primitive and shifting agriculture which will become progressively poorer. The consequences of such an evolution on the social structure could be very serious.

In addition, the improvement of forage production natural or artificial – can only be fully effective if special measures are taken to rationalize breeding methods, organize the market in animal products (firstly that of meat), reduce the number of livestock during seasons of scarcity, etc. Such measures will vary according to the regions, but they should first and foremost aim to reduce the limiting factors at the different production stages as well as at consumption stages (transport, storage, sale).

Attempts to overcome the numerous problems posed in the organization of rational animal breeding must be focused on the search for two kinds of balance between production and consumption. These balances are between forage production and animal consumption, requiring mainly technical solutions; and between animal production and human consumption, requiring economic measures.

An integration of animal husbandry with agriculture should be one of the essential objectives of significant progress is to be realized. It is necessary to re-establish the normal biological cycle, soils – animals – manure – soils, as much on dry-farming lands as on irrigated ones.

It would seem urgent to establish a list of the traditional practices which are detrimental to the conservation of natural plant resources and of the soil-water capital, and a list of the practices which should be introduced or considerably developed. The agricultural planners should bear well in mind those practices which must be eliminated or developed; they should also become more conscious of the interdependence of all the agricultural problems before even trying to develop

separately each of the different branches of the production. The improvement of forage production (rangelands, artificial pastures and fodder crops) has been much too neglected for many reasons. These reasons include the practical impossibility of controlling the number of animals and their movements over the rangelands (at least under the present conditions), lack of organization in the fodder market, disbelief of breeders and farmers in the financial profitability of irrigated fodder cultivation, ignorance of rotation practices, considerable technical difficulties encountered in the creation of non-irrigated artificial pastures, the entrenched habit of considering that the raising of small livestock is no longer profitable if the animals are fed with something other than natural vegetation or cereal stubble and the lack of interest in long term investment.

Because of their considerable extent (approximately 60 per cent of the area of Iran), the natural rangelands must be utilized to the maximum but they are generally in such a bad state that they are no longer sufficient to ensure normal feeding of the livestock. In agricultural regions natural pastures are so depleted and reduced in area that the animals obtain most of their nourishment from the weeds of the wasteland and fields.

The number of animals should be significantly reduced so that the natural vegetation has a chance to improve. However, as a voluntary reduction of the livestock is practically impossible, it will be necessary to augment forage production. This will entail the extensive development of irrigated fodder crops, replacement of a part of the fallow period of dry farming systems with forage crops and the creation of permanent or semi-permanent pastures under dry-farming conditions on waste and marginal lands.

The development of irrigated fodder crops (high return cultivation) presents only few technical problems, but it might be too costly for small livestock. Irrigated lands in any case represent only two to three per cent of the country's surface. In reality it would be a mistake to assume that the problem of livestock feeding (bearing in mind the regular increase in the demand for animal products) could be solved without massive forage production in dry-farming systems.

Thus, in Iran the necessity is to create a *fodder and pasture agronomy based on modern dry-farming methods.* This poses serious technical problems, but the experiments conducted in the last few years are extremely encouraging and millions of ha of abandoned lands with a rainfall of over 250 or 300 mm could be reclaimed by reseeding methods. It is only by the rapid extension of artificial pastures that a reduction in the grazing pressure on the rangelands can be achieved, as well as an improvement in the natural plant cover.

Improvement of the rangelands

In the dry or arid countries of the Middle East all kinds of spontaneous vegetation, herbaceous or bushy, whatever its density and whatever its forage potentialities, can be considered as rangeland. Such a definition excludes only dense and protected forests, steep cliffs, absolute deserts and the lands cultivated permanently (without forgetting that after the harvest these lands are grazed heavily and for many months).

Theoretically, any type of vegetation can be improved by quite costly and prolonged human intervention. In practice the only interventions which can be considered are those which offer a fairly strong probability of technical success and can be justified economically.

1. Types of intervention

Starting with the most simple and finishing with the most complex, these varous types of intervention can be classified as follows:

a. By simple production:
   - simple seasonal grazing control.
   - prohibited grazing of short duration (two to three years).
   - prohibited grazing of long duration.

b. Short or long period of prohibited grazing with broadcast surface seeding of forage or soil-fixing species.

c. With mechanized working of the soil:
   - prohibited grazing of short duration after subsoiling (to increase the infiltration and aeration of the soil).
   - prohibited grazing of short duration with surface mechanical work on a part of the soil and, if possible, broadcast seeding of herbaceous species.
   - surface work in spaced strips with seeding or planting of herbs, shrubs or trees, grazing prohibited for a period determined principally by the species introduced.
   - complete transformation of the vegetation by total ploughing followed by seeding or planting.

These latter types of intervention are based upon agronomy but they must be entirely subordinate to ecological tenets. There is, in fact, little relationship between the cultivation of a field through the introduction of a single species of rapid growth (generally annual) and the restoration of a permanent natural (or semi-natural) vegetation, as this means the achievement of a delicate balance between the environmental factors, the species of which it is composed and the most remunerative human exploitation possible.

The more arid the climate the more eroded are the soils, the more depleted is the initial vegetation and the more difficult it is to improve the rangelands. The useful perennial species must pass through several critical phases during several consecutive seasons:– reproduction (in some years the percentage of viable seeds is very small); dissemination; conservation and

fixation of the seeds (the great majority are generally lost in natural conditions, and this loss is often total in arid climates or on too compact soils); germination (fairly precise conditions of humidity and temperature must be present simultaneously and over a number of consecutive days); first growing season (as the young seedlings must develop their root system rather rapidly before the soil dries up, severe competition between the seedlings and the previously established species); first dry season (in certain years all the young plants may be eliminated); finally, first cold season (frost-lifting of weakly rooted plants).

It is rare that native species, even protected, can benefit from optimum conditions at each stage of their development; it is sufficient for one limiting factor to be unfavourable for the entire process of multiplication to be checked. In arid climates many species only succeed in reproducing themselves during exceptionally favourable years, for instance one year in ten.

With artificially introduced exotic species a defect in adaptation can manifest itself at any stage of development and, even if the plants succeed in maintaining themselves over the first year, they may be completely eliminated later due to the severe competition of local species. Finally, even if the introduced species can resist this competition it is rare that they can maintain themselves for long because of badly controlled human exploitation.

The various methods of range improvement must therefore take into account, above all the limiting factors, and it is to minimize their influence that a type of intervention best adapted to each particular case must be carefully chosen.

Protection alone can only give good results if the initial vegetation contains a sufficient percentage of good species which multiply easily and not too many undesirable species. A single undesirable plant because of its active multiplication can sometimes invade the entire protected territory. In addition, the more arid and continental the climate is the slower the natural regeneration will be.

Certain perennial forage grasses end up by degenerating and disappearing unless they are grazed on from time to time, for example *Aristida plumosa;* the suppression of stems – at least after seed maturation – generally conditions the enlargement of the tufts. It is therefore necessary to pass from total protection to controlled grazing as soon as the grasses become significant: grazing prohibited up to the time of seed dissemination and then grazing on dry hay will contribute to the settling of the seeds in the ground.

Too often the vital importance of microclimates as degrading or degenerating factors in countries with dry or arid climates is not appreciated. Technicians with little knowledge of ecology have too often recommended the uprooting of all woody species, in the belief that they were encouraging the growth of herbaceous forage species. This is generally a serious mistake and experience has shown that in enclosures such an operation has been detrimental to the best species (*Bromus*) and to the benefit of the more xerophilous species (*Stipa*). Bushy species not only fix the soils in depth but they also lessen the action of the wind thus reducing direct evaporation and decreasing aridity. They also reduce trampling of the soil by animals, stop erosion by the wind, often produce very appreciable quantities of leaves and protect the young herbaceous plants in various ways. When there is severe overgrazing the last good grasses can be found inside woody or spring shrubs which allow them to bear seeds and to regain lost ground when placed under protection. In certain cases natural regeneration of herbaceous cover could be speeded up by acting on the microclimate with spaced plantations of inexpensive shrubs and bushes (preferably native and fairly drought resistant).

Very often on reasonably level lands, the principal limiting factor is the compactness of the topsoil, which prevents normal infiltration of rainwater, and favours the extension of undesirable species with superficial rooting (*Carex stenophylla*, lichens and mosses). In these cases all intervention should be subordinate to the re-establishment of a normal infiltration, but the most efficient and economical mechanical process for each particular case remains to be found (subsoiling or scarification). In many cases a mechanical operation of this kind could bring about an improvement of the vegetation from the very first year even under arid conditions. In ranges where the infiltration is normal it is generally the scarcity of good species which constitutes the principal limiting factor. Human intervention must, therefore, tend either to multiply one or several perfectly adapted natural species or to introduce one or several exotic species which are as well adapted as possible. Direct sowing without land preparation can only lead to failure except perhaps in certain humid climates or on very sandy soils. The seed must at least be lightly covered, for example in furrows several metres apart. It has sometimes been recommended to plant mother-plants or cuttings of tufts capable of producing seed from the first year. The best time to do this sowing or planting must be chosen carefully, but failures are always to be feared due to important climatic variations from one year to the next. Regions with cold winters, where the spring rains are scanty and the dry season starts early, present the greatest difficulties for reseeding.

When competition from the natural vegetation is feared one can first try to eliminate certain undesirable species with the aid of hormones or by other means. Instead of merely making spaced furrows, it would seem better to cultivate and seed in strips (two to five m wide), alternating with unworked or simply subsoiled strips, generally wider. The introduced species would in this way have a better chance to maintain themselves and even to multiply later in the strips left in their natural state. In the case of failure the remaining vegetation can recolonize the ploughed strips, thus reducing the risk of erosion.

In many cases range improvement should aim not only at increasing the forage potential but also at the fixation and conservation of the soils. This second objective must even have priority when erosion is particularly active or when the soils are too skeletal. It is only when the pedological and microclimatic conditions have appreciably improved that the introduction of species, which are more palatable but also more demanding from the ecological viewpoint, can be attempted. Finally, if the residual vegetation of a rangeland is really very poor or constituted only of undesirable species and the climatic edaphic and topographic conditions are relatively favourable (rather deep, level ground, more than 250 or 300 mm rainfall), it is surely preferable and more economic to use classic dry-farming methods and create an artificial pasture or a crop of reapable forage plants.

Research and experiments in connection with range improvement should therefore be divided into three different groups:

a. natural regeneration with eventual intervention concerning the soil or the undesirable species.
b. artificial improvement by sowing or planting to enrich the pre-existing vegetation.
c. the creation of permanent or semi-permanent artificial pastures or the seeding of reapable fodder crops under dry-farming conditions.

Natural regeneration can in certain cases be relatively easy and inexpensive, but the results are not at all rapid and it will not be possible to extend it to large territories until such forage can be produced outside rangelands.

Artificial improvement of the existing vegetation raises complex technical problems which will not be solved for many years; success is dependent on the discovery of species which are easy to multiply, with rapid germination and growth, perfectly adapted and capable of withstanding the competition of local species. It is not surprising that no experiment of this kind has yet succeeded in the Middle East. The creation of unirrigated artificial pastures also presents serious technical problems but, since competition with native species is practically eliminated, good agronomists aided by ecologists can often solve these problems quite quickly. Numerous native or foreign species have already been introduced at the experimental stations. This is the field in which the quickest and most advantageous achievements can be made in particular on marginal or formerly cultivated lands.

Once conclusive experiments have been carried out and, when it seems that a particular problem of certain ecological conditions has been solved, the next step is to try to estimate approximately:

a. the extension which can be given to this new technique (territories where it is applicable).
b. the cost per ha.
c. the anticipated profit.

The estimate of the profit can be however only very approximate. In addition to the productivity increase in forage or head of livestock other advantages can be obtained, namely soil fixation and improvement, better economy of natural water resources, less risk of flooding in the lower parts of the improved areas and better use of other associated grazing lands.

Before any work is undertaken on rangelands it must be ensured that control over the exploitation of the new vegetation can be maintained. In the absence of this certainty, which presupposes the education of the users of the ranges and competent and respected control services, it would be useless to commit the expenditure of large sums.

2. Choice of the plant species

The species used for reseeding or planting must be carefully chosen. It must have as good an adaptation as possible to the climate and soil, easy germination, rapid growth of the seedlings, strong rooting and good seed production. The degrees of palatability and digestibility, although important, are not the principal criteria; it is more worthwhile to cultivate a species which is perfectly adapted, multiplies easily, is undemanding for its soil requirements and gives a good yield of acceptable forage, than a species of superior nutritional value but more demanding, less strong and more sensitive to certain ecological factors.

Besides, it should not be forgotten that the notion of species is rather imprecise and that many species comprise a great number of ecological varieties or 'ecotypes', each ecotype being adapted to a complex of particular ecological conditions; practical results can vary a great deal depending on whether this or that ecotype of the same species is used.

Apart from special cases when it is desired to introduce woody species, almost all the forage or soil-fixing species tested for introduction are grasses or legumes. There are also several interesting Chenopodiaceae, especially usable for the rather arid regions and saline lands; these Chenopodiaceae (*Salsola, Atriplex, Kochia*) often have the advantage of being both woody and forage plants, their seed production is prolific and their germination often very easy. Also *Poterium* spp. (Rosaceae) are excellent forage species, and certain Compositae are very easy to multiply and have an appreciable forage value (*Artemisia, Taraxacum*).

A curious fact has come to light during the experiments carried out in Iran with native species. It has become apparent that the easiest species to cultivate and multiply are often those which in nature do not make up part of the typical pastoral vegetation, but are present preferentially on waste and fallow lands, by the roadside or on very depleted rangelands[1]. They have in

[1] This is the case of *Medicago* cf. *sativa, Melilotus* sp., certain *Onobrychis* spp., *Lolium* sp., *Phalaris* sp., *Hordeum bulbosum, Secale montanum*, certain *Agropyron* spp. and many of the forage species introduced in cultivation. It is also the case of wheat, barley, rye and no doubt most of man's food species, their primitive forms having been in some way 'preadapted' to cultivation.

some respects an ecology of 'weeds' and therefore can be cultivated more easily. On the other hand the typical species of natural rangelands, although they reproduce well in their wild state even under very severe ecological conditions, are often difficult to introduce in cultivation, at least by sowing. However, within the limits of our present knowledge it would be unwise to envisage the utilization of many of these species for the improvement of large areas, although they contain some of the best adapted species. This is particularly the case with the perennial *Stipa* and *Aristida*, basic grasses of the Middle East steppes. Fortunately exceptions do exist, for example *Bromus tomentellus* which while being the best grass of semi-arid mountain pastures is very easy to cultivate.

One is therefore led to consider the native forage and soil-fixing species – and no doubt the woody species too – according to a criterion which seems to have been little recognized up to now. This is the extent of their ability to be manipulated by man. Very roughly, it is possible to distinguish between 'domesticable' species, which are easy to multiply artificially but hardly capable of permanently integrating with the flora of a natural pasture, and the 'resolutely wild' species, existing and able to multiply in moderately exploited natural pastures but reluctant to respond to artificial multiplication processes at least at the present state of our techniques.

The practical consequences of these distinctions are of great importance; to increase forage production under dry or arid conditions we have at our disposal only two types of intervention, radically different from each other:

a. natural regeneration by protection and management, with or without mechanical intervention. However, this is generally very slow and is almost impossible when the initial vegetation is severely depleted (which is generally the case in Iran).
b. cultivation of 'domesticable' (or already 'domesticated') species, either to create permanent or semi-permanent artificial pastures or to produce fodder reserves for use in periods of scarcity.

The types of intervention intermediate between these two extreme solutions (reseeding within an existing vegetation) generally come up against great difficulties, either in the handling of the 'wild' species or in the practical impossibility of integrating the 'domesticated' species within a pre-existing natural vegetation.

3. *Introduction and multiplication nurseries*

Before undertaking any reseeding project over large areas it is essential to establish introduction nurseries in which to observe the behaviour of various species, varieties and ecotypes (either of exotic or native origin) under particular ecological conditions, and where it is possible to produce seeds or cuttings in order to make trials in small areas.

A big effort has been made over the last few years to provide most of the dry and arid countries of the Middle East with samples of various kinds of forage seed and even large quantities of some species utilized in the United States, Europe, Australia, etc. Unfortunately the ecological factors have often been neglected and too many seeds have been imported with no indication of the conditions in which they can grow and often even without precise scientific names. Often all these species or varieties are placed side by side in nurseries (generally irrigated); certain of them develop well, others grow with difficulty or fail completely. But it is difficult to come to practical conclusions when one does not know the degree of adaptation of each species or variety in relation to the various limiting factors – drought, extreme temperatures, soils, overgrazing – nor what those limiting factors are locally. Finally, it is an error to give too much water to species chosen for their drought resistance, as many of them develop poorly or are even destroyed by excess humidity.

In each regional nursery the species introduced should be classified according to their ecological requirements, especially water needs, and consequently the way in which they could be utilized, for example:

a. high yielding species requiring much water – regular irrigation or humid climate without dry season:
   - for seasonal fodder crops (maize, sorghum, vetches, annual clovers, etc.).
   - for semi-permanent fodder crops (alfalfa, perennial clovers, sainfoin, etc.).
   - for semi-permanent pastures (highly palatable perennial legumes and grasses: clovers, birdsfoot, orchard-grass, fescues, rye-grasses, timothy, etc.).
   - for green manure (sweet clovers, vetches, etc.).

These species, well known to agronomists, are mostly of interest for cattle and generally cannot be utilized for the improvement of rangelands or the reclamation of dry waste and marginal lands; they should be grouped in special irrigated nurseries, the purpose of which should be a methodical selection of the best adapted and most productive varieties for each climatic region.

b. fodder and forage species which are less demanding in their water requirements, of rapid growth, capable of being cultivated in rotation with cereals in dry-farming zones, sometimes with one or two irrigations if needed:
   - for seasonal fodder crops (special vetches and other annual legumes).
   - for perennial fodder crops (adapted varieties of alfalfa, sainfoin, etc.).
   - for semi-permanent pastures (various legumes, grasses, etc. with rapid growth).
c. forage or soil-fixing species withstanding well a long summer drought but generally with a slower growth:
   - for the establishment of permanent artificial pastures on waste and marginal lands (perennial grasses, legumes, Chenopodiaceae, etc., which are fairly palatable).

– for forage improvement of depleted rangelands (various shrubby or bushy species, easy to multiply – *Artemisia*, certain Chenopodiaceae etc.).

It is necessary to distinguish those species which do not tolerate – or tolerate badly – irrigation and those which, while being well adapted to the arid climates, develop much better in the irrigated nurseries, thus producing much more seed.

d. species insufficiently known as regards their practical usage, but which later might prove to have some use on a particular soil or under a particular climate.

In this field of the introduction of fodder and pasture species Iran is significantly advanced in comparison to most Middle East countries, but it has not yet been possible because of the lack of funds and technical personnel to establish well organized nurseries in each large ecological region. The only major nurseries are those of Karaj (irrigation) and Homand (dry farming), both of which are in the Tehran Province. This is quite insufficient for so vast a country with such varied climates. Nevertheless, these two nurseries contain a great number of native and exotic species and several hundred varieties or ecotypes on which many observations have been made or are being made with a view to selecting those meriting multiplication. It is urgent to make a serious choice among all these plants which have been introduced, often somewhat by chance (see samples received from abroad). The selected varieties for multiplication should:

- either give valid economic returns under irrigated cultivation (intensive fodder productivity).
- or be easy to cultivate under dry-farming conditions in place of fallow lands or even in the place of cereals with a higher economic return (extensive fodder production).
- or be able to establish themselves and develop without too many technical difficulties on marginal lands or where cereal cultivation is not profitable – or even impossible – due to certain ecological factors (permanent artificial pastures).
- or be able easily to integrate into a depleted natural vegetation (improvement of rangelands).
- or be fit for successful introduction to soils which are eroding (soil fixation).

Therefore, it appears to be without utility to multiply species or varieties which are both too little productive and much too demanding ecologically, or still more those which while being perfectly adapted on the ecological side present too many difficulties in manipulation and establishment.

In brief, the choice of the species or varieties for multiplication should be based on an accurate appraisal of their ecological adaptability and of their agronomic qualities; the economic point of view (net cost and probable profit) is also important, and particularly so for fodder crops.

For the present it is on the ecological plane that the species already introduced are best known, but a big effort remains to be made on the agronomical side (techniques and utilization) and on the estimation of basic costs before being able to pass to the stage of practical accomplishments over areas large enough to permit real progress in animal feeding and a significant improvement of the rangelands.

Management and control of the rangelands

For many years international conferences on the various aspects of the improvement of animal husbandry and of the vegetation and soils have been held periodically in semi-arid countries, but it has to be admitted that these have not as yet had many practical results, at least in Middle East countries. In particular, problems of range management are discussed too often by specialists foreign to the interested countries and the methods which are usually recommended are those applicable to economically developed countries with generally less rigorous climates. These recommendations vary little from one conference to another and there is little concern to find out how far they are technically applicable and economically justifiable.

It is true that all over the world there is hardly any agricultural problem as complex as that of the rationalization of animal husbandry, but in the semi-arid climatic zones of the Middle East this complexity reaches its maximum. More particularly the problem of grazing control on the rangelands has so far resisted the best efforts for solution.

Methods inapplicable under present conditions

Of the solutions recommended for the management of rangelands some must be eliminated at the outset. For example it will never be economic to irrigate or artificially fertilize rangelands outside humid climates. Water is too precious to be used for anything other than the most profitable cultivation. Manure and chemical fertilizer should first be used on the best irrigated lands, although this is far from being practised in most countries. Thus the rangelands have to manage with the droppings of animals and the residue of the natural vegetation. Also, chemical fertilization might modify this vegetation and could lead to the extension of undesirable species, for example *Peganum harmala*, encouraged by nitrates and phosphates.

The creation of new watering places is a very questionable measure besides being quite costly. It is very often the scarcity of water which has allowed the conservation of certain grazing regions; digging new wells would in the absence of strict control lead to the formation of large overgrazed areas and the disappearance of the remaining good steppe rangelands. For the present watering places should be created only when absolutely necessary for facilitating the movement of migratory flocks from one region to another, but not to enable them to remain in the locality.

The adoption of rotational grazing is often advised, but for some years now the efficacy of this method outside artificial pastures has come to be doubted, in particular in the dry regions of the United States where the most modern techniques have been experimented with. The only type of rotation which could be useful should be extended to cover several years, grazing not being authorized except in spring, in summer or in autumn in the course of the succeeding years.

Any method of permanent control of grazing presupposes a fairly precise delimitation of the rangelands and their division into grazing units capable of receiving a predetermined number of animals over a well defined period.

Unfortunately, there is no precise information available on the productivity, nutritive value, seasonal development and geographical distribution of the most important types of vegetation (and in Iran there are hundreds, all at varying stages of depletion!). Further, these types of vegetation are much inter-mixed and, except in the sub-desert zones, the plant cover is rarely sufficiently homogeneous for an approximate estimation to be made of the forage resources available for animals, more so because at a given locality these resources vary very much at identical dates depending upon the year. Finally, in a very large part of non-desertic Iran there are no precise limits between occasionally dry-farmed lands and permanent rangelands. The permanent rangelands are mostly situated on steep and stony slopes to such an extent that, between the areas which are too arid to be cultivated and the mountains which are too eroded and too cold, grazing areas of sufficient size and topographically smooth enough to justify regulations and grazing control can rarely be found. Theoretically, it is probably possible to arrive at a reasonable estimate of the grazing capacity, seasonal development and geographical distribution of the main types of range vegetation in Iran. But this would necessitate long years of research, a large establishment of qualified technicians and above all considerable financial and material means. Such research would be extremely costly and the uncertainty of arriving at really applicable and remunerative results would certainly cause the government to hesitate before authorizing such expenses, the benefits in other agricultural fields being much more immediate and assured, e.g. increasing production on the best irrigable lands.

It is equally important to know if the enforcement of any system for a permanent grazing control might not occasion considerable organization and inspection expenses, and if this might not also provoke in its turn profound dissatisfaction on the part of the rural populations considering themselves deprived of their traditional rights. It is always dangerous to displace a socio-biological order which has been established for centuries and which in spite of its very low economic standard nevertheless constitutes a certain equilibrium. Finally, should there be too many technical or statistical mistakes or if unforseen factors should occur, the remedy might be worse than the disease.

It is necessary to have the courage to admit once and for all that a system of methodical grazing regulation, such as is recommended and sometimes adopted in certain economically developed countries, is for the present inapplicable to the rangelands of the arid or semi-arid developing countries. Theoretically there is no single factor which by itself constitutes an insuperable obstacle but, if a sum is made of all the problems – ecological, technical, geographical, administrative, budgetary, legislative, economic, social and even psychological – which would have to be solved, one can only conclude that this is completely impossible. Only after admitting this can we do some useful work and find some realistic solutions, not so much for the management of the rangelands but for the general improvement of animal feeding, this being the real crux of the problem.

When endeavouring to analyse this problem as a whole and in its various aspects one comes quickly to the conclusion that nothing can be attempted in the regulation of the use of rangelands as long as the herdsmen, mostly of sheep and goats, do not make use of large amounts of supplementary foods at the lowest possible prices. The only alternative would be a brutal and authoritarian diminution of the livestock, an impractical solution as the consumption of animal products tends to increase regularly with the economic and demographic development of the country and the rapid growth of urban agglomerations.

Nomadism and semi-nomadism

A large part of the Iranian population is constituted of more or less nomadic tribal groupings, very attached to their entrenched customs and depending for their existence almost exclusively on the breeding of small livestock on rangelands.

The nomadic tribes are often blamed for the damage caused to the natural vegetation. However, it is evident when travelling through the various provinces that, outside the sub-desert areas, the poorest vegetation from the forage viewpoint is to be found on the outskirts of towns and villages even in relatively favoured climates. It is even certain that the nomadic tribes, better organized for resistance than the villagers, have for a long time succeeded in preventing the abusive extension of dry land cultivation on their traditional grazing lands. It is probably the weakening of the tribal unity or their slow transformation into settled peasantry which has permitted an almost total tillage on certain substeppic or forest regions, the principal cause of the depletion of the residual rangelands.

In fact, the nomads have thousands of years of experience behind them; they know how to get the best out of the existing vegetation and they organize their movements according to quite precise rules, reserving certain pastures for the bad season, leaving others before they are exhausted, speeding up or slowing down their movements depending on whether the vegetation becomes richer or poorer, sending observers off over

large distances to reconnoitre the condition of the watering places and to make forecasts as to the condition of pastures during the next season, sometimes leaving pregnant ewes in more favoured places in order to collect them later with their lambs, dispersing or concentrating their flocks according to the forage resources available, etc.

Is not all this a kind of range management — the most economic and without doubt the only one adapted at present to the severe conditions, harsh topography and unforeseeable climatic changes of the immense steppic and substeppic areas of Iran? However, when several dry years follow one another, when strategically important pastures are brought under cultivation by settled populations, when tribal conflicts erupt, there is no longer any question of taking care of the natural resources but only of living from day to day. This leads to the disruption of the biological equilibrium (plants, animals, man) and it is the vegetation which bears the consequences.

Instead of wishing to settle the nomads at any price, when we are still far from having solved the problems raised by settled breeding, it would probably be wiser to try to benefit from their long pastoral experience, at the same time looking for the weak points in their practices and the causes of their difficulties.

They could be helped through the hardest seasons by contributions of supplementary feed, by boring wells on locations where it seems really necessary, by increasing health facilities for animals as well as man, by purchasing animals when they are in the best condition and by rapidly transporting them to the areas of consumption in order to avoid the exhaustion of long journeys, etc.

Later, when social and economic relations become more harmonious between the nomad herdsmen and the farmers — in particular through the provision of supplementary feed, but also through the education of their children at the same schools — it should be possible to try progressively to integrate nomand husbandry into agriculture in regions where it appears to be technically possible. Alliances between nomadic and sedentary families would much facilitate this integration.

In regions where there are still vast steppes or mountain summer rangelands there would be a seasonal nomadism (transhumance), the sole economic means of drawing most profit from the rangelands which are too far from the villages, but only the indispensable personnel would accompany the flocks. The remainder of the population would be settled and would be occupied with farming activities including, in particular, the provision of fodder crops and artificial pastures, which would help in the regrouping, feeding and even fattening of the animals in the vicinity of the villages during the bad seasons. This would also in many cases permit the avoidance of long and arduous journeys in search of problematical winter pastures.

Search for realistic solutions

Any far-reaching reforms of the breeding systems now in use should be implanted on a socio-economic infrastructure with a geographical basis and including all agricultural activities. This infrastructure can be found only in villages and small towns.

It is only with the agricultural support furnished by the villages and with the economic support furnished by the towns that the best methods for the management of grazing lands (limiting as much as possible seasonal migration) can be experimented with and later applied to large regions. The geographical basis must first be established by taking into account communication facilities, local climatic and pedological variations and, of course, the watersheds, thus integrating 'range management' within 'watershed management'.

Therefore the first concern would be to divide the country — at least the provinces where animal husbandry is important — into geographical units, the shape and extent of which would vary greatly according to local conditions, but as heterogeneous as possible as far as natural resources are concerned. Each unit — or district — would comprise a certain number of villages (from a very few to as many as thirty or forty), a plain or a group of cultivable and partially irrigable valleys and natural rangelands reaching to the summit of the nearest mountains or, in the absence of mountains, extending over steppic or saline zones. In the region where there is some remnant of forest each district would include a forest area where special regulations would be enforced. Regions without villages (high mountains, large arid areas) could be commonly shared by several neighbouring districts or attributed to a remoter district having insufficient rangelands. There would remain certain districts of an essentially agricultural nature in the large plains where animal husbandry would be completely integrated with agriculture (fodder crops, artificial pastures, grazing on fallowlands).

In each 'agro-pastoral' district (or in specific instances 'agro-sylvo-pastoral' district), the simplest possible methods[1] should lead to a provisional and global evaluation of the maximum grazing pressure that could be borne by the ensemble of the grazing lands.

The control applicable to these grazing lands should not be too complicated in order to avoid costly inspection procedures. It could include for example total protection of a portion of a district during a certain period, deferred grazing (prohibition of grazing outside cultivated areas before a certain date), prohibition of bringing new lands under cultivation without authorization, prohibition of the felling of trees or uprooting of woody plants for fuel, global limitation of the number of animals per village and obligation to sell certain

[1] Global estimation of the vegetation state, enquiries into the present use of grazing lands (number, place of origin of animals, grazing periods, movement of flocks), interpretation of aerial photographs, etc.

animals at a given time. Outside the temporarily protected zones it would be necessary to leave to the shepherds a large margin of initiative during the periods when they migrate far from the villages; the number of animals of a district being globally limited overgrazing could only occur in isolated instances.

During the season thought to be the most critical, either for the vegetation or for the animals, flocks should be settled near to agricultural agglomerations or even towns (meat markets) and an inexpensive method should be found to ensure adequate feeding of the flocks.

Each district organized on a highly co-operative basis would have at its disposal a 'technical study group' consisting of farmers and husbandrymen chosen for their competence, their progressive attitude, their dynamism and hopefully for a certain community spirit. This 'technical study group',[1] in liaison with the relevant local governmental authorities who would provide them with the necessary technical documentation, would study the local problems of organization, production and improvement of natural resources as well as the possibilities for the introduction of new techniques, especially those concerning animal husbandry, fodder crops and rangeland management, not forgetting firewood production[2]. The suggestions of the 'technical study group' would be submitted for the approval of the relevant agricultural service and the local authorities would subsequently assure their execution.

In principle each district should feed its own animals in its own territory without encroaching upon the lands of neighbouring districts. In the beginning the authorized number of animals will depend on the fodder and forage resources of the district and could only be increased by an improvement of the rangelands and mostly by the extension of fodder crops and artificial pastures.

The rangelands could be the common property of the district (under government control), the artificial pastures reseeded on marginal lands would preferably be the property of the villages and the fodder crops – irrigated or not – should remain the property of individual farmers.

In each district it would be necessary to organize a co-operative of husbandrymen including as often as possible a first aid veterinary service. This co-operative could help the husbandrymen to purchase their equipment, to procure fodder and to sell their animals and products under the best conditions.

It is hardly possible at present to go into more details. On the technical plane each problem should be the subject of particular studies in which economists should collaborate with animal husbandry and agricultural technicians. On the extension level the agricultural authorities should make an exceptional and sustained effort to inform and document the elite of the farmers and husbandrymen, thus generating amongst themselves discussions resulting in the formation of 'technical study groups' able to make realistic proposals and to judge how far and in what forms the proposed reforms might be applied in their particular district. On the financial level government grants should be allocated on a priority basis to groups of villages manifesting a real desire to co-operate and to organize themselves for technical progress.

The principal obstacle to any structural reform and to any attempt at reorganizing the use of natural resources lies in the fact that most villagers and tribesmen are still illiterate and thus incapable of making an account of their resources, of organizing their work programmes, of documenting themselves, etc. Thus, agricultural progress is entirely conditioned by the development and spread of education, firstly at a primary level and then at the technical level. Iran is resolutely committed to this road to progress, thus preparing a new generation of farmers and husbandrymen who, wishing to live better than their parents, will be capable of organizing and rationalizing their production methods.

The elaboration of any kind of 'agro-sylvo-pastoral' planning will undoubtedly bring forth a host of problems and in putting it into effect there will be innumerable difficulties, as the complete transformation of traditional socio-economic structures will require some decades and will probably extend over several generations. However, the technical research, the enquiries and the experiments, without which no development project can take root, must be started *now*. The accelerated evolution of the towns and the rapid expansion of industrial production increasingly require energetic measures to safeguard and improve natural resources, the fundamental conditions for a general and harmonious increase in agricultural production.

Outline of a range and forage policy proposed for Iran

1. With the dry and arid climates of the Middle East, especially in Iran, and under the present agricultural social and political conditions it is neither technically possible nor economically profitable to impose a strict control over animal grazing on wide areas of rangeland.

2. The nomadic and semi-nomadic shepherds are at present the best qualified people to take greatest advantage of the immense steppic, substeppic and mountainous grazing lands. However, the accelerating deterioration of natural resources and the excessive spread of cultivated lands make their position more and more precarious.

---

[1] CETA: Centres d'etudes de techniques agricoles (Centres for the study of agricultural techniques) which were spontaneously organized in France amongst the elite of the agricultural producers could give an indication as to how these 'technical study groups' might function.

[2] This is in complete conformity with the policy of the Government who welcome the fact that local groups come together for matters of mutual interest and make a conscientious effort to overcome by themselves a large part of their problems.

3. A degree of control in the use of rangelands is only conceivable if the nomadic and semi-nomadic stock-breeders have confidence in the competence of the people representing the government and respect their authority. The stock breeders must also be provided with facilities to help them get through critical seasons, better medical and veterinary assistance and the means to sell their animals under the most profitable conditions.

4. Such control could only aim at determining globally the approximate number of animals which could be allowed to graze during a certain period of time inside a geographical territory, well delineated but sufficiently large to allow the shepherds fairly wide freedom of movements; whenever possible watersheds should be taken into account as units of rangeland.

5. This control should remain flexible enough to take into consideration certain unforeseeable factors such as exceptional drought, the drying-up of watering points, abnormally cold winters and even sometimes locust invasions.

6. Before establishing a system of control over a limited region it is essential to study the seasonal movement of the flocks to find out the approximate number of animals and the temporary fluctuation in number. An attempt should also be made to identify, classify and map the most common types of rangeland and estimate the average carrying capacity of each. In this way a global and seasonal estimate of the forage resources within each geographical unit can be reached. This would seem possible only if speedy and economic methods of survey and enquiry can be found.

7. Provisionally, an attempt should be made to reduce globally the grazing pressure on the rangelands by restricting the movement of a large proportion of the animals during the seasons which are the most critical for themselves and for the vegetation. This would be possible only if inexpensive forage and fodder were produced for them outside the natural grazing lands.

8. In many cases the present state of plant cover would justify total protection for a short or long period, especially on the badly eroded watersheds which are the cause of catastrophic flooding. Moreover, it is more feasible to forbid completely range grazing over certain areas than to control the number and movement of the animals.

9. A considerable increase of fodder and forage production on arable lands would necessitate the establishment of a better equilibrium and a new orientation in agricultural practices: the creation of wide artificial pastures on waste and marginal lands, a big increase in the fodder crops from lands that may be irrigated at least to a certain extent and the stocking of hay and concentrate feeds for periods of acute scarcity.

10. Such a 'forage revolution' is only possible in so far as farmers and breeders understand that it is in their own interest to collaborate with each other and, above all, in so far as the government and regional authorities are able to push and speed up the progressive integration of animal husbandry with agriculture, by acting at the economic and social level (in which the prime role is propaganda and education).

11. The economic measures should aim: (a) at managing and controlling the market in animal products (large scale sheep buying, slaughtering and storing, particularly when natural clamities occur) and (b) at organizing a real forage and fodder market, granting loans, giving rewards and other advantages to these agriculturists and breeders who devote a large portion of their lands to forage and fodder production.

12. Various laws will have to be passed and strictly enforced to eliminate factors which lead to the rapid destruction of rangelands: excessive ploughing and cultivation, the felling of forest trees, the uprooting of shrubs for fuel and the uncontrolled grazing of goats.

13. The final goal is not to force the disappearance of nomadic breeding, nor even to impose a permanent control over it, but rather to make it more productive by reducing the number of animals grazing on the natural rangelands, while at the same time developing a rational sedentary breeding integrated with agriculture starting with the regions which are most favoured as regards climate.

14. In the immediate future, the only way to increase forage production and to permit sedentary breeding is to persuade the farmers, if necessary by legal pressure, to turn over a minimum percentage (ten to 15 per cent) of their irrigated lands to the cultivation of high-yielding fodder crops. This would compel them to carry out at long last the rotations which are so essential to the maintenance of land fertility.

15. Such an increase in forage and fodder production on the richest lands will help essentially in the breeding of cattle but it will be both insufficient and too expensive to improve sheep breeding, which is at present entirely dependent on rangelands.

16. Substantial new forage resources must therefore be developed over wide areas of non-irrigable lands, on dry-farming fallows, on the lands formerly cultivated then abandoned to weeds and even in place of rangelands which are too depleted to be restored without artificial methods. Millions of ha of unproductive lands could be transformed into permanent artificial pastures; it is even probable that in many cases the production of such pasturelands would be more profitable than following the traditional cultivation of cereals followed by fallow.

17. The experiments undertaken during the last few years, particularly at the Homand Station, have proved clearly that this forage and pasture production is technically and economically possible on the lands which get more than 250 to 300 mm of precipitation, namely a large part of west and north Iran.

18. It is therefore essential and urgent to undertake serious research and methodical experiments in that field using plant species adapted to long summer drought. Many such plants are already known and their utilization on a large scale will be possible as soon as suitable techniques in mechanical reseeding are discovered, such techniques varying perhaps according to climate, soil or the selected species. In fact, what is needed is to create a new forage and pasture agronomy for the arid and semi-arid regions of Iran.

19. This point can only be reached by training teams of technicians whose qualifications are complementary to one another; such teams should include an ecologist, a plant introduction and multiplication specialist, an agronomist specialized in both dry-farming methods and farm machinery and a specialist in range management.

20. In addition it is essential to resolve the problem of rural fuels; economic solutions must be found, and the most obvious is to multiply plantations of hardy trees and shrubs with no industrial value along the edges of fields, irrigation ditches and roads or lanes of all cultivated areas. There are a number of suitable and well-adapted species in Iran, unfortunately largely ignored by foresters. Large areas of saline lands could also be reclaimed for the production of firewood. The establishment of such plantations should be strongly encouraged. They would not only help to safe-guard the woody species and micro-climates of the rangelands but would also allow animal manure which is at present used for fuel to fertilize the land.

21. Finally, while searching for solutions to the problems of range improvement and traditional breeding, we must also make a critical appreciation of the whole of the present agricultural practices and rural habits. We will then discover that all the problems of production are interrelated and the modern techniques which we endeavour to introduce and extend (deep wells, mechanization, chemical fertilizers, etc.), thanks to a large supply of funds and credit, are only partial solutions. These are far too often only temporary or even sometimes detrimental, as they are almost never co-ordinated with measures to manage and improve the natural resources, to diversify agricultural production at the level of poor villages (lack of proteins and lack of fuel), to restore the fundamental equilibrium and biological cycles and, most important of all, to return to the ground all organic waste materials which, through humus formation, are the only means of reconstituting the structure of the soils and improving their water balance.

22. Therefore, the competent authorities and the planning organizations should adopt as soon as possible a long-term rural policy which would be based on a consistent 'agro-sylvo-pastoral' doctrine taking into account not only the economic and social factors but also the biological and ecological tenets: the extension of the most modern techniques should be subordinated to the terms of such a policy.

23. As long as cereal straw and stubble remain the primary feed for livestock during a large part of the year and as long as manure remains the principal fuel used by millions of peasant families, it would be vain to hope for an important and general improvement in agricultural production or for a significant rise in the standard of rural life, whatever technical progress might be made in certain specialized fields. An active campaign of extension and propaganda should, therefore, be instituted and pushed ahead with the following goal borne in mind. *'To produce huge quantities of all kinds of food and fuel at the lowest possible price'.*

Range management in Pakistan

S. M. Ali
Animal Husbandry Commissioner, Government of Pakistan

Introduction

About 75 per cent of land area of West Pakistan, that is nearly 150 million acres (60 ha), is not suitable for crop production or forestry and can only be utilized as range land. There is no range land at all in the East Wing of the country.

The range lands of West Pakistan cover large areas and have rainfalls varying from four to 15 in. (100–380 mm) annually. Major concentrations of range lands are in five regions as indicated below:–

i. North-western range lands – These are part of Quetta Division north of Ziarat and the tribal areas. The region consists of rugged mountains and valleys varying in elevation from 2,200–7,000 ft. (670–2,100 m) above sea level. The mean annual rainfall varies from ten to 17 in. (250–425 mm) and is almost equally divided between summer and winter.

ii. South-western range lands – These consist of part of the Quetta Division, south of Ziarat and Kalat Division. This is a winter rainfall area with a mean annual rainfall of four in. (100 mm).

iii. Chagai-Kharan range lands – This is an extremely dry area with a mean annual rainfall of under four in. (100 mm), most of which falls in winter.

iv. Kohistan range lands – These are located in Kohistan area of Hyderabad Division. The mean annual rainfall is seven in. (170 mm), most of which falls during summer.

v. Sandy range lands of Tharparkar, Registan, Thal and Cholistan – These lands have a mean rainfall varying from three to 15 in. (70–380 mm), mostly during summer.

The carrying capacity of range lands in West Pakistan differs widely from area to area. Some experts have classified them into six regions using the average annual rainfall in delineating the grazing regions in preference to the more elaborate climatological classifications of rough grazing capacity. These climatic regions are as follows:–

Annual rainfall	*Grazing capacity* (Area needed per Animal Unit)
1. 0–4 in. (0–100 mm)	Unsuitable for grazing
2. 5–9 in. (130–230 mm)	20 acres (8.10 ha)
3. 10–14 in. (250–350 mm)	10 acres (4.05 ha)
4. 15–19 in. (380–480 mm)	6 acres (2.43 ha)
5. 20–24 in. (500–600 mm)	5 acres (2.03 ha)
6. 25–29 in. (630–730 mm)	4 acres (1.62 ha)

It should be noted that the 'mother-cow' weighing about 800–900 lb is usually selected as the 'Animal Unit' (AU) to measure carrying capacity, forage requirements of other animals being expressed in this basic unit as follows:–

Type or Class	*Unit of forage or Animal Equivalent*
1. Mother cow	1.0
2. Dry cow	0.9
3. Yearling	0.8
4. Sheep	0.2
5. Goat	0.3
6. Horse	1.3
7. Bull	1.3
8. Mule	1.3

In the past hardly any attention was paid to the utilisation of these vast land areas but due to increasing demand for animal protein attention has been directed towards the possibility of these areas being used as grazing grounds for beef cattle and sheep.

The ownership of the range lands mainly rests with the Government, though the grazing rights are enjoyed by the nearby communities. This has created difficulties in the way of transfer of range lands to private parties in blocks for their development and use for sheep and cattle raising. It is nevertheless essential to prevent deterioration of the range lands through uncontrolled grazing.

The Research Department of the Pakistan Industrial Credit and Investment Corporation Limited undertook a survey of the ranching prospects in West Pakistan in 1969 and made the following recommendations:–

1. Effective implementation of Government policy to bring private enterprise into the field.

Previous Page Blank

2. Lease of land in plots of 200,000 to 500,000 acres (81,000–203,000 ha) to prospective ranchers for a minimum of 50 years.
3. Settlement of land rights to remove the present confusion in the matter.
4. Allotment of irrigated land up to ten per cent of the size of ranch for the growing of fodder crops.
5. Announcement of easier lease terms to attract private investment in the ranching industry.
6. Generous incentives such as treatment of income from cattle ranches as tax free agricultural income and grants of cash subsidies depending on the sizes and types of herds.

Improvement of range land

The range lands of West Pakistan have deteriorated due to heavy and indiscriminate use in the past. The Government is, however, alive to this problem and has carried out surveys with the help of a number of foreign experts. The report of these surveys emphasised the importance of proper range management and this ultimately resulted in the initiation of the Maslakh range and pasture improvement scheme near Quetta in 1954, covering about 115,000 acres (46,600 ha).

Encouraged by the results achieved in Maslakh the Government decided to extend the range management programme to other areas but, as very little information was available on the range resources of the country, it was not considered advisable to embark upon a major range project without collecting basic information. A reconnaisance type of range survey was, therefore, carried out during 1958–59 which indicated the possibilities of initiating a range management programme on a large scale. As a result of this the West Pakistan Range Improvement Scheme was initiated in 1960, covering 110,300 acres (44,700 ha) of land in twelve representative areas in various parts of the country.

These were developed not only as demonstration areas but also for the collection of basic information about range improvement techniques suitable for local conditions. Moreover, in order to develop the major range regions, a range management operational programme was initiated in Cholistan, Tharparkar and Kohistan regions. A Range Management Division is now in operation in Cholistan and is gradually extending development activities to over 13,000 square miles (3,370,000 ha) of the desert ranges. Similarly, a Range Management Division is now in operation in the Tharparkar desert covering an area of 10,000 square miles (2,590,000 ha).

Measures adopted for improving range lands included closure, artificial reseeding, water spreading and stock water development,

1. *Closure* – Under this technique the range lands to be improved are closed to grazing and as a result grass plants get a chance to develop and mature.

2. *Artificial reseeding* – Some of the areas selected for development under the Range Development Scheme are in an extremely depleted condition. Plants of good forage species have disappeared from these areas and closure alone will not be effective. In such areas artificial reseeding proves very useful.

In part of the Thal area artificial reseeding with native grass species of sandy areas was started in 1962 over an area of 6,553 acres (2,650 ha). The success achieved was substantial. Here an excellent stand of grass has been established. The yield of fodder rose from 391 lb per acre to 1,750 lb per acre and the carrying capacity of the range increased from 50 acres per animal unit to seven acres per animal unit. The best results (about 90 per cent success) were achieved by reseeding with a disc plough. The reseeding trials have also shown that large scale reseeding in these areas is feasible.

3. *Water spreading* – The range land can also be improved by water spraying. As a result of this operation, the yield of fodder could be increased from 650 lb to 9,400 lb per acre and the carrying capacity of the range increased from 28 acres per animal unit to 2 acres per animal unit.

4. *Stock water development* – Due to arid conditions there is a great scarcity of water in most of the project areas. To overcome the scarcity of water measures have to be taken to develop and conserve the stock of water in the range. These may consist of installation of tube-wells, hand pumps and construction of water ponds and dams, etc.

Results

Range research conducted under the 'West Pakistan Range Improvement Scheme' has suggested that the profitability of the range management operation in West Pakistan may be as indicated below:–

	Grass cover (per cent)	*Herbage returns* (lb per acre)	
1. *Poor management*	15.8	32	0.38
2. *Improved management*			
a. Grazing controlled for 2 years	27.7	27	0.56
b. Grazing deferred for 2 years	68.2	190	1.76

Range land policy

The Government has come to the conclusion that past efforts at proper management of the arid and semi-arid areas have been hampered by the lack of a comprehensive objective. After full consideration of the problems they have come to the conclusion that these areas should be reserved for increased and improved livestock production in the country. This is not only

essential because of increased food requirements, but also for getting the best results out of a difficult area and for building up a possible export market in beef and mutton.

The Government are of the view that such vast areas cannot be developed through Government efforts alone. They feel that the development of range land should be programmed on the basis of associating the public through the allocation of land to private parties with credit facilities, assistance in exploration for underground water and sinking tube-wells, provision of technical know-how for livestock rearing and pasture development, provision of veterinary and medical facilities and the establishment of better marketing, specially through co-operative effort. They also realise that normal facilities necessary for settling people in the new lands should be extended to areas of this type.

The Government also feel that it is necessary to develop pilot projects for experimentation in the best method of development of these areas.

Arid Zone Research Institute project of the Agriculture Research Council of Pakistan

This is a Fourth Five-Year Plan (1970–75) at a cost of over 12 million rupees over a period of five years. The main objective of this project is to set up a National Institute for undertaking research on problems peculiar to arid and semi-arid areas of the country.

Conclusion

The study of commercial ranching prospects in Pakistan shows that they are not particularly bright without active assistance by the Government. In view of the huge losses now incurred in the absence of modern-style cattle and sheep ranching, this assistance is considered to be amply justified and would in turn be expected to induce private enterprise to enter this industry in sufficiency numbers to make a real impact on the livestock economy of the country.

Report on Third Session: Range management

Chairman, Mr D. F. Davidson

1. It was generally recognized that numbers of livestock kept on ranges in Turkey, Iran and West Pakistan were excessive in relation to the present carrying capacity of the ranges. This degree of grazing was continuing to degrade the natural pastures both by removal of the best forage species and by subsequent erosion. Overgrazing was due to both an increase in animal numbers and a continuing reduction in the area of the rangelands. It was clear that this situation could only be remedied by firm control of range utilization which would of necessity involve a drastic degree of de-stocking.

2. Any process of de-stocking would, however, present a number of problems of a socio-economic nature. In particular the value attached by pastoralists to possession of as large a number of animals as possible, irrespective of individual quality, was a factor which presented special problems. Furthermore there was a considerable constraint to offtake from the ranges as a result of inadequate marketing facilities. The present system of land ownership, which provided few incentives for individuals or groups of individuals to adopt controlled grazing practices, should be revised.

3. There seemed to be no obviously easy solution to these problems but it was considered that there were some procedures likely to have a beneficial effect. These included improvement of marketing facilities, incentives for the production of good quality animals, and the creation of disincentives to keeping excessive numbers of livestock by appropriate taxation measures. A particularly interesting approach suggested was to encourage the utilisation of the range mainly for the production of young store animals for fattening in other areas on locally produced forage.

4. Undoubtedly increased forage production on arable land would to some degree alleviate the pressure on the ranges, provided that care was taken to ensure that animal numbers did not increase as a result of such an expansion in fodder availability. Fodder production on arable land would also be of value for fattening young store animals bred on the ranges and moved to feed lots. It was mentioned that considerable increase in fodder production without detriment to cereal production could be obtained in many areas by growing leguminous forage crops in otherwise fallow periods.

5. The first essential for the rehabilitation of degraded ranges was destocking followed by control of animal numbers and movements. The beneficial effects of such measures had already been demonstrated experimentally in certain places. In addition, it had also been shown that range recovery could be expedited by certain treatments such as re-seeding and soil working, but as yet the value of these measures in economic terms had not been fully assessed.

6. There were no obvious short-term solutions to the problems of conserving and rehabilitating the ranges. There was, however, in the long term an urgent need for gathering further information to understand the problem better and to carry out pilot investigations to arrive at appropriate solutions.

Previous Page Blank

Fourth Session

Poultry nutrition

Chairman
Dr. W. Bolton OBE,
Head of Nutrition Department,
Poultry Research Centre, Edinburgh

Previous Page Blank

Aspects of poultry nutrition

W. Bolton
Nutrition Department, Poultry Research Centre, Edinburgh, United Kingdom

Before I begin my talk I thank the organizers for the honour they have conferred on me by asking me to be your Chairman for this session and I am delighted to think that I can be of help to poultry industries in countries other than my own.

I regard my introductory remarks as a combination of two things: an introduction to the subject of feeding poultry in hot countries and a framework on which to hang subsequent discussion. I shall therefore confine my remarks to: Why do we feed and what do we feed?

Why do we feed

Poultry developed from jungle fowl which laid about 24 eggs per year. By continued selection the egg output has been increased. This is not a recent development for in the 'Boke of Hosebondrie' published in 1523 we find that the hen was expected to produce 115 eggs for human consumption plus seven chickens.
In her wild state the fowl had to find all its food. To obtain the type of production we expect today the food gleaned by the hen must be supplemented. Such supplementation need only be of a simple character; during the 1939 to 1945 war domestic poultry keepers obtained reasonable egg production by offering the birds household scraps and, since human food was rationed, these were not of high quality. If a high rate of production is required the birds in the United Kingdom are housed intensively and the 'supplement' forms 100 per cent of the diet. However under such a system the cost of the food as a percentage of the total cost of production is a major item. Recently my Director and I carried out an exercise on costs of production in 1969 in the UK and from our results I have calculated the percentage costs of production set out in Table 1. This table relates to egg and meat production by fowls and it can be seen that food costs represent 78 per cent of total costs.

The breakdown of costs in your countries will not necessarily be the same as in the UK and in deciding to what extent it is economic to supplement fowls a similar exercise could be of value to you.

Table 1
Costs of production

	Per cent
Annual cost of land and buildings	6.99
Cost of chicks at day-old	12.26
Light, heat and ventilation	1.13
Manure disposal	1.07
Litter	0.27
Fumigation	0.06
Labour	5.29
Food	78.20
Less value of birds at end of lay	−5.27
	100.00

When I was a student I was taught that the good farmer does not keep animals on his farm, the animals had to keep the farmer. This is still true today and our object in feeding birds should be to maximise the monetary profit from the enterprise, not to obtain the maximal number of eggs per bird. To put this another way, we feed birds to increase the output to that percentage of the bird's potential which is most economic at that particular time in that particular place. One can also say that we feed to satisfy the bird's needs. These needs can conveniently be divided into three sorts: the control of body temperature, the maintenance of the body in a state of well-being, and the production of liveweight gain and/or eggs.

1. *Control of body temperature*

The fowl is a homeothermic animal and to maintain its body temperature it oxidises carbohydrate, fat and protein to produce heat. Regions of the world do not all have the same climate and the amount of heat needed for the maintenance of body temperature in one region may be different from that in another. The heat-producing potential of a food is usually expressed in terms of energy and, since the heat is produced from carbohydrate, fat and/or protein, it is not strictly a nutrient, although for the purpose of dietary formulation it is convenient to consider it as such.

Previous Page Blank

2. *Maintenance of the body in a state of well-being*

The life processes involve the continual building-up and breaking down of tissues, e.g. the cells lining the duodenum region of the alimentary canal are renewed every thirty-six hours. Energy is used to build up tissues, and released when they are broken down. Similarly all other nutrients are needed in various amounts during the building up and released on break-down. Some of the nutrients in the broken down tissues can be reused, others are voided in the droppings, or shed as discarded feathers, scales etc. To keep the bird in a state of well-being the nutrients lost must be replaced via the diet. The needs of the bird for such nutrients normally take priority over those for production.

3. *Production of liveweight gain and/or eggs*

Food in excess of that needed for the functions mentioned above is available for production. Production may be of feathers, muscle, skin, fat, eggs, etc.

What do we feed

The bird uses food to satisfy a number of different needs and, since the requirements of nutrients are not the same for them, the composition of the food offered should vary according to the stage of life and the region of the world.

Irrespective of the stage of life or the region of the world the bird must be able to digest sufficient of the food offered to be able to supply the body with the nutrients required. Thus, although old leather boots are a very rich source of protein it is useless adding ground leather boots to poultry diets - the bird cannot digest leather.

The foods available for poultry are not the same in all countries, human demands must take precedence and only that which the human finds unacceptable, or which is in excess of human needs, is available for poultry. The diet of the human tends to be highly digestible so the less digestible portions of foods are less readily accepted. Acceptability is also affected by personal preferences and the food laws of the country. Thus in practise we formulate poultry diets from foods that are in excess of human demands and from the less digestible portions of articles of human foods.

1. *Effect of stage of life*

The normal life-span of a fowl can be divided into five stages: young chick, grower, early laying, laying and late laying.

Young chick – When newly hatched the body of the chick is covered with down. During the first few weeks this down is replaced by feathers, consisting almost entirely of protein. Growth rate in proportion to body weight is high and the combination of the two leads to very high needs for protein. Because of the surface area of the bird is high in relation to body weight, and the insulation from down plus feathers is less than that when fully feathered energy demand is also high. These circumstances find practical expression in a narrow energy to protein ratio in diets for young chicks and, because the total food eaten per bird is small, when highly digestible foods are scarce it is wise to devote them to the young bird.

Grower – From about six to 18 weeks old the bird is completely feathered and therefore the insulation is good, the surface area in relation to body weight is gradually decreasing and the need for protein is considerably less per unit body weight than in the chick stage. The resultant is a widening of the energy to protein ratio needed and good results can be obtained from foods relatively low in energy. If a high growth rate is needed, as in the production of table poultry, some increase in growth rate can be obtained by feeding high energy foods, but the economics of the operation must be watched carefully if maximal profit is to result.

Early laying – At the onset of lay the bird is gaining weight and laying eggs. Eggs are rich in protein and energy and the extra needs of the bird find expression in an increased intake of food. Little is known about the needs of the bird during this stage and research is urgently needed. In the absence of information the bird is offered diets formulated to meet the needs of the laying stage.

Laying stage – During the laying stage eggs are produced but body weight remains constant. Egg production rises to a peak and then slowly decreases. At the same time the weight of an individual egg slowly increases so the decline in egg mass per unit time is less than the decline in egg number. High energy diets are not needed during this stage and good results have been reported at relatively low energy concentrations.

Late laying - When the bird comes into lay it has incurred a considerable debt to the poultry farmer, made up of the cost of the day-old chick, food, labour and use of land and buildings. As laying proceeds the debt should be gradually reduced until, during the last few months of the laying year, the debt is finally paid and a profit accrues. An examination of egg production per hen during the last month showed that some birds never repaid the debt, others laid at a high rate to the end and showed a handsome profit. The average rate of production of a flock is not a good guide to nutrient requirements for, if the high-laying birds are adversely affected, the profits will be greatly reduced. As with the early-laying stage, little is known about the needs at this time and research is urgently needed.

2. *Effect of climate*

When one thinks of climate one normally thinks of the macro-climate of the region. With the development

of intensive husbandry this concept is no longer applicable to poultry and instead one must think of the micro-climate enjoyed, or endured, by the bird. Thus, on a hot day in the UK the ambient temperature can rise to about 24°C, in winter it may fall as low as -6°. However the temperature inside the poultry house would range from about 25° to 10°C. In your countries the maximal temperature would certainly be higher and your problem may well be that of cooling the bird rather than heating it.

Because the temperatures are higher in your countries the amount of energy needed to maintain the body temperature of the bird will be less than in the UK but, and this is very important, the needs for the other nutrients will be the same for the same weights of bird and rates of production. Petersen of the USA found that at 13°C the energy needed for maintenance of birds weighing 1.8 kg and laying at 60 per cent production (three eggs in five days) was about 365 kilocalories per day, whereas at 29°C it was only 295 kilocalories per day. He states that these needs should be increased by 9 kilocalories per day for each ten per cent increase in egg production. Therefore if the need for amino-acids is satisfied by 16 per cent protein at 13°C, the protein level in an isocalorie diet would need to be 19.8 per cent at 29°C. Similarly an allowance of 3.75 per cent calcium would meet the needs at 13° but this would have to be increased to 4.65 per cent when the temperature was 29°. This type of calculation needs to be carried out for all nutrients except energy before the specifications of the diets can be written. As a baseline the recommendations of the Agricultural Research Council of Great Britain, 1963 (ARC) or those of the National Research Council of USA, 1971, (NRC) can be used, bearing in mind that these relate to an ambient temperature of about 13° and an energy content of 2,800 kilocalories metabolizable energy (M.E.) per kg food.

Table 2
Effect of temperature on M.E. intake, heat loss and egg energy (Sykes)

Temp. (°C)	M.E. intake (Kcal)	Heat loss	Egg energy
7.2	311	231	77.8
15.6	286	204	82.0
23.9	272	189	79.5
29.4	257	179	76.9
35.0	235	166	71.5

The bird tends to eat to satisfy its energy requirements and the requirements for other nutrients have only a modifying effect on food consumption. Therefore when formulating a diet, especially by the use of a computer, it is an advantage to relate all other nutrients to M.E. The amount eaten of a diet so formulated will have the best chance of supplying all the nutrients needed in the weight of food eaten.

You may be surprised at the use of the word 'chance'. There are variations between strains of birds, and between birds within a strain. When compiling a table of nutrient requirements one goes through the papers published on a particular nutrient and first of all discards those where the experiment was obviously not properly designed, or where the conclusions do not follow from the results. Those remaining usually give a spread of needs. For the ARC list the median value was selected as the requirement. Husbandry conditions other than the optimum can lead to an increase in the requirement and in the UK it is a common practise in the food compounding industry to add what is termed a 'margin of safety' to the requirements before formulating. This margin of safety is about 100 per cent for fat-soluble vitamins, 20 per cent for water-soluble vitamins and ten per cent for amino-acids.

3. *Effect of competition from the human*

In the UK the human population does not, in general, suffer from a severe limitation in food supplies and where such limitation does apply it is due to shortage of money, not the lack of available food. Regrettably this is not true in all parts of the world; if it were so organizations such as Oxfam would not be needed. Where the amount of food available to the human is limited, it would be very wrong to use acceptable food for feeding poultry. Under such conditions poultry can still make a useful contribution to the human diet when allowed to forage for their own food. They have the advantage over other animals in a hot climate of being small enough to be carried live to and from the market and to be eaten in one meal, thefore the meat does not deteriorate, and eggs are a very valuable food for young children; the yolks of lightly cooked eggs can be digested by babies aged two months or more and are rich in iron.

When supplemental food can be spared for poultry the increased return in terms of meat or eggs can show a handsome profit to the poultry farmer and at the same time provide very valuable food for the human.

The main problems of poultry nutrition in Turkey

A. Kemal Göğüş
Animal Nutrition Department, Ankara University, Turkey

Introduction

It is well known that Turkey is one of the less industrially developed countries of the world. Nevertheless the rate of development in the last ten years has been higher than before and much progress has been obtained in the field of animal husbandry. Unfortunately, this progress has almost stopped, or even disappeared because of our internal disorders and political problems, as these have prevented the government from improving the economy of the rural areas. However, in my opinion, the main problems of Turkey are not political but are due to a rapidly expanding population which suffers from a lack of food. If we can feed our people enough, the problems will be solved as rapidly and our internal struggles will end. Today, Turkey leads the world in having an annual rate of population increase of 2.91 per cent. On the other hand the rate of increase of our food resources is diminishing as time goes on. Because we in Turkey do not have enough food, especially foods of animal origin and because we do not pay enough attention to nutrition, the physical and mental powers of the people are inadequate to sustain a high rate of economic development. Table 1 shows the total calorie intake, sources of calories, total protein intake and the sources of proteins in our country. This table shows that the daily calorie intake per person is between 2,790 - 3,318 in Turkey and almost 70 per cent of this total comes from vegetable foods. The calorie intake from animal foods is only about ten per cent, although it is well known that for a balanced nutrition, 25 - 30 per cent of total calories should come from animal foods such as meat, milk, eggs, cheese, etc. The same is true for our protein consumption; almost 78 per cent of the consumed protein comes from wheat products. According to FAO estimates (Table 2) we consume three times more bread than Americans, who consume seven times more meat than us. Our daily animal protein consumption per person is around 14.5 which should be increased by at least 25 - 30 for healthy nutrition. Indeed, every person who lives in this country does not consume 14.5 g of animal protein daily because the distribution of meat, milk, eggs, cheese is quite different among

Table 1
Calorie and protein intake: calorie and protein sources in Turkey

	School of Nutrition (1966)	F.A.O. (1957)	N.P.O. (1960)	N.P.O. (1967)
Total daily Calorie (Kcal) intake	2,814	2,790	3,313	3,318
Sources of Calories (percentage)				
Grain	66.3	70.1	71.9	67.7
Other plant production	23.2	20.3	19.2	22.2
Foods of animal origin	10.5	9.6	8.9	10.1
Total daily protein intake	72.1	88.5	107.1	107.5
Sources of protein (percentage)				
Grain	78.5	70.3	71.0	67.2
Other plant production	11.2	13.3	12.0	13.2
Foods of animal origin	10.3	16.4	17.0	19.6

Table 2
Food intake in some countries (average per year)

Countries	Meat (*kg*)	Milk (*kg*)	Egg (*kg*)	Grain (*kg*)	Protein of animal origin (g/day)
USA	92.1	162.9	21.2	67	66
Canada	86.6	203.0	16.4	71	62
UK	66.7	149.1	12.6	85	51
France	68.7	97.8	10.3	110	49
Italy	20.4	55.8	7.8	142	25
Denmark	63.2	162.2	7.5	90	26
Egypt	13.1	48.7	1.1	188	13
Pakistan	4.5	56.3	–	151	8
China	16.8	0.1	1.7	148	–
Turkey	13.5	52.3	1.7	204	14.5

Source: FAO Production Yearbook, 1968.

Previous Page Blank

various income groups; whereas some families consume more than 50 times more meat than others, some consume no meat at all in any year.

Because it is well known that the meat production of poultry is much higher than for other farm animals (some chickens in developed countries produce one kg meat with 2.1 kg of feed) and although we already have many more poultry farms than sheep and cattle farms, we must consider increasing poultry production as much as possible in order to correct the animal protein shortage in Turkey.

The hen, as an egg producer, plays an important part in the economy and nutrition of any country. The egg is the best protein source for human nutrition and contains many essential vitamins and minerals. The digestibility of egg nutrients is good and even sick people with poor appetite can consume eggs. Poultry meat is also much more digestible than the other types of flesh. In spite of these advantages, our people do not like to eat chicken, and current consumption is rather low in Turkey. The majority of families in our country do not even consume one chicken a month, compared with most people in well developed countries where chicken may be consumed two or three times a week.

It is shown in Table 3 that the consumption of chicken in Turkey has paralleled the per capita national income. In the last 20 years the number of hens and cocks has increased to 12 millions, of turkeys 738 thousand and the annual egg production to around 892,398 thousand.

Table 3
Poultry and hens eggs production in Turkey 1950–1969

Years	Hens and cocks (1,000)	Turkeys (1,000)	Hens eggs (1,000)	National income (yearly) per person
1950	–	–	–	TL 1,181
1951	20,307	1,285	935,870	
1952	21,159	1,252	978,629	
1953	22,395	1,301	1,094,269	
1954	22,887	1,379	1,113,412	
1955	23,629	1,393	1,118,421	
1956	24,196	1,454	1,166,672	
1957	25,315	1,474	1,193,350	
1958	26,320	1,602	1,238,581	
1959	26,850	1,660	1,303,550	
1960	27,164	1,675	1,322,510	TL 1,539
1961	26,116	1,687	1,308,033	
1962	26,614	1,716	1,349,043	
1963	26,759	1,708	1,335,043	
1964	28,395	1,669	1,359,462	
1965	29,255	1,768	1,478,894	
1966	28,449	1,796	1,455,319	TL 1,788
1967	30,387	1,773	1,536,189	
1968	32,020	1,955	1,760,010	
1969	32,313	2,023	1,828,268	
Rate of increase	59%	57%	95%	

In other words, the number of hens and cocks has increased by 59 per cent, turkeys by 57 per cent and egg production by 95 per cent. Notwithstanding this, our people consume very little chicken due mainly to the large number of families with low incomes.

The feed industry

The government owned feed mills of Turkey produced 147,455 tons of all types of compounded feed in 1970 of which 58.3 per cent (85,969 tons) was poultry feed. Of this 58.3 per cent, 41.5 per cent was layer feed, 14.5 per cent chick grower feed and 2.6 per cent broiler feed. Although the government factories were working at over 90 per cent capacity on the basis of their present working system, the introduction of multiple shift working could increase production considerably.

In addition to the government owned feed mills there are a number of privately owned mills e.g. Tenik Feed Industry, Abalioglu Feed Industry, Abic Feed Industry, Özkaşikçi Feed Industry and the Cider Feed Industry with a combined capacity of about 50,000 tons per annum.

However, the amount of feed presently produced in Turkey is only sufficient to supply one in eight of the hens currently kept. Indeed as most of the poultry are kept in villages and are of traditional breeds, they are given very little feed and rely mainly on scavenging. Although the egg production of these village chickens is low their low input requirement makes them efficient producers in economic terms, and competition from low cost village eggs has seriously retarded the establishment of a modern poultry industry in Turkey. The substitution of the present 30 million of local breeds of chickens with modern breeds producing four or five times as many eggs will, however, be necessary in future. The important question will then be whether or not the feed resources of Turkey will be adequate to support 35 million or so of chickens, and to answer this it will be necessary to look at each type of material separately.

Protein concentrates

It will be seen from Table 4 that Turkey produces substantial quantities of sesame, cottonseed and sunflower seed, but only small quantities of linseed, groundnuts and soya-beans.

Cottonseed is perhaps the most important source of vegetable protein concentrates in Turkey today, and 567,000 of the 642,000 tons produced in 1967 were processed into oil and cake (481,000 tons) in Turkey. Extracted meals and expeller cake are produced both from decorticated and undecorticated cotton-seed.

Table 4
Oil seed production in some countries for 1968

Countries	Soybeans	Countries	Sunflowers	Countries	Peanuts (in shells)	Countries	Cottonseed	Countries	Linseed	Countries	Sesame
	1,000 tons		*1,000 tons*		*1,000 tons*		*1,000 tons*		*1,000 tons*		*1,000 tons*
USA	30,023	USSR	6,685	India	4,476	USA	4,209	USA	688	India	4,145
China	10,670	Rumania	730	China	2,200	USSR	3,917	Canada	500	China	3,650
USSR	528	Bulgaria	459	USA	1,153	China	2,948	USSR	485	Turkey	500
Canada	246	Yugoslavia	309	Japan	122	India	1,895	India	438	Pakistan	399
Japan	168	Turkey	230	Pakistan	106	Pakistan	1,058	Poland	65	Iran	61
Mexico	112	Hungary	93	Mexico	98	Mexico	946	Rumania	30	Greece	57
Rumania	47	USA	91	Turkey	33	Turkey	696	France	24	Japan	30
Turkey	9	China	70	Israel	11	Iran	352	Netherlands	14	Italy	11
Yugoslavia	3	Spain	27	Italy	9	Spain	141	Turkey	12	Bulgaria	6
		France	26	Spain	8	Greece	122	Pakistan	11	USA	4
		Canada	11	Greece	7	Israel	53	Hungary	10	Yugoslavia	3
		Greece	4	Bulgaria	2	Bulgaria	21	German Democratic		USSR	1
		Israel	3	Yugoslavia	– 1	Yugoslavia	6	Republic	5		
		Italy	1			Italy	3	Iran	4		
World Total	43.613		9.944		15.034		21.202		3.041		16.285
Turkey	%0.03		%2.3		%0.2		%3.3		%0.4		%3.1

Source: FAO Production Yearbook, 1968.

Expeller cake may be produced with very inefficient machinery and oil contents of ten to 12 per cent are not uncommon. However, the Turkish Standards Institute has now established a set of standards for the oil and protein contents of Turkish cottonseed cake and extracted meal.

The main use for cottonseed cake is of course in ruminant feeding, but due to lack of demand for protein concentrates for this purpose much is exported from Turkey at present. Due to the presence of gossypol, poultry nutritionists do not recommend the inclusion of cottonseed cake in poultry rations at levels exceeding five per cent. Cottonseed meal contains gossypol both in the free form and a non-toxic form in which it is combined with the E amino group of the protein lysine. Unfortunately the process of detoxifying cottonseed by encouraging the combinations of gossypol with lysine by heating, results in loss of nutritionally available lysine. As lysine is normally the limiting amino acid in poultry diets, it is important to introduce processes for detoxifying cottonseed meal which do not affect the nutritional availability of lysine. Several such methods have been developed utilising solvent extraction or mechanical separation techniques, but have not gained widespread commercial application as yet. It will be seen from Table 5 that the quality of cottonseed protein with regard to lysine content, biological value and net protein utilisation is good compared with coconut and groundnut protein. It is considered that it is too early to suggest the growing of glandless seeds at present, due to the poor quality of lint produced by the varieties currently developed.

Table 5
Amino acid contents and protein qualities of cottonseed oil meal, peanut oil meal and coconut oil meal

	Coconut oil meal (g/16gN)	Cottonseed oil meal (g/16gN)	Peanut oil meal (g/16gN)
	percentage		
Lysine	3.6	3.9	3.0
Methionine	1.9	1.7	1.1
Cystine	1.3	1.6	1.4
Leucine	7.3	6.7	7.6
Isoleucine	4.8	3.9	3.8
Valine	6.5	6.0	4.7
Threonine	3.0	3.6	2.0
Phenylalanine	5.7	6.3	5.2
Tryptophan	1.2	1.3	1.0
Histidine	2.5	2.5	2.5
Arginine	12.8	7.4	11.6
Total essential amino acids	50.6	44.9	43.9
NPU values	63	50	40–45
Digestibilities	95–100	75	95–100
BV	63–65	60	40–47
Non-Essential amino acids			
Aspartic acid	7.0	9.8	11.8
Serine	4.8	5.0	4.5
Glutamic acid	15.9	18.5	17.2
Proline	2.9	3.4	3.9
Glycine	4.6	4.7	4.2
Alanine	4.2	4.8	3.6
Tyrosine	2.2	3.3	3.7
Ammonia	1.6	1.9	2.1

Source: The Rowett Research Institute, Dept of Biochemistry.

Soya bean oil meal production is at present small in Turkey, and is about 4,500 tons per annum. In general the climate of Turkey is not conducive to soya bean cultivation, although some may be grown in the Black Sea region of Anatolia. However, due to the high nutritive value of soya meal, it is highly advisable to have larger supplies by either importation, or the development of short growth period varieties.

The annual production of sunflower seed oil meal is about 205,000 tons and is second only to that of cottonseed meal. Groundnut oil meal (25,000 tons), sesame oil meal (34,000 tons), linseed oil meal (12,000 tons), poppy seed oil meal (10,800 tons), rapeseed oil meal (8,100 tons) and hempseed oil meal (2,800 tons) are also produced in smaller quantities each year.

Animal protein concentrates are scarce in Turkey. Only 400–1,000 tons of fishmeal is produced per annum, while meat and bone meals are also in very short supply.

Dehydrated alfalfa meal is also in very short supply in Turkey, and much of that which is produced is of poor quality due to primitive methods of processing.

Carbohydrate (energy) sources

The main carbohydrate sources in Turkish poultry diets are cereals such as wheat, yellow and white maize, barley, rye, oats and milo. Figures for the production of these in Turkey during 1959–69 are given in Table 6. It will be seen that a substantial increase in production has only been achieved for wheat, and this has been by cultivating larger areas of land rather than increasing production per unit area.

The main grains available for poultry rations are barley and to a lesser extent maize. Substantial quantities of wheat milling offals such as bran are also used for poultry feed.

Feed additives such as vitamins (mineral mixes and medicaments) are partly imported and partly produced locally.

Table 6
Cereal production in Turkey, for 1959–1969

Year	Wheat	Barley	Rye	Oats	Corn	Millet and milo	Total
	1,000 tons						
1959	7,852	3,330	665	475	1,000	56	13,352
1960	8,450	3,700	700	530	1,090	57	14,527
1961	7,000	2,948	570	435	1,017	65	12,035
1962	8,450	3,500	690	450	800	60	13,950
1963	10,000	4,288	900	500	990	60	16,738
1964	8,300	3,200	735	550	1,000	53	13,838
1965	8,500	3,300	775	540	945	60	14,120
1966	9,600	3,800	850	510	1,000	60	15,820
1967	10,000	3,800	900	510	1,050	55	16,315
1968	9,520	3,560	820	450	1,900	53	15,403
1969	10,500	3,740	817	468	1,000	56	16,581

Source: National statistics of Turkey.

Nutritional problems of poultry industry of Turkey

There are currently only 390 enterprises in Turkey having more than 500 hens each. Of these 261 are layer units, 15 broiler units and 92 mixed layer-broiler farms. The birds kept in these units comprise only 2.2 per cent of the total number kept in Turkey, indicating that 97.8 per cent of poultry are kept by traditional methods in the villages. The average annual production of 56 eggs per bird in Turkey is very low compared with that of

Table 7
Poultry production and hens egg production in some countries

Countries	Hens, ducks, geese, turkeys	Countries	Hens eggs production	Countries	Average Egg production per hen per annum
	1,000		*1,000,000*		
USSR	528,151	USA	69,326	Sweden	189
China	490,000	USSR	35,200	Japan	176
USA	435,959	Japan	24,694	Israel	176
France	210,000	UK	14,964	USA	163
Poland	156,302	Federal Republic of Germany	14,076	Federal Republic of Germany	159
Japan	140,707	France	10,000	Rumania	155
UK	127,458	Italy	8,580	Austria	139
India	115,390	Rumania	7,292	Finland	139
Italy	113,000	Spain	6,576	Spain	138
Federal Republic of Germany	91,387	Poland	6,315	Australia	135
Canada	85,875	Canada	5,436	UK	123
Hungary	56,902	German Democratic Republic	4,046	Czechoslovakia	110
Thailand	56,054	Netherlands	3,969	German Democratic Republic	109
Spain	48,659	Belgium	3,276	Switzerland	105
Netherlands	47,806	Czechoslovakia	3,270	Belgium	93
Rumania	47,148	Australia	3,043	Netherlands	87
German Democratic Republic	37,976	Hungary	2,792	Denmark	80
Yugoslavia	35,974	Yugoslavia	2,186	Italy	76
Belgium	35,588	India	2,155	Canada	71
Turkey	34,775	Turkey	1,760	USSR	67
Czechoslovakia	31,208	Thailand	1,640	Greece	62
Iran	29,602	Sweden	1,613	Bulgaria	58
Bulgaria	27,726	Bulgaria	1,565	Turkey	55
Greece	25,626	Greece	1,554	Hungary	52
Australia	23,147	Austria	1,510	Poland	49
Denmark	19,530	Denmark	1,478	France	48
Israel	12,150	Iran	1,320	Iran	46
Austria	11,130	Israel	1,224	Thailand	45
Sweden	9,063	Finland	964	India	19
Finland	7,045	Switzerland	648		
Switzerland	6,360	Pakistan	484		
Pakistan	–				

Source: FAO Production Yearbook (1968).

other countries (see Table 7) which produce most of their poultry products by modern intensive methods, using balanced compounded feeds. For example, Israel and Japan produce nearly four times more eggs per hen than Turkey, even though they have poorer feed resources.

The obvious first approach to increasing egg production in Turkey is to educate and encourage farmers to adopt modern scientifically based methods of poultry production. However, the immediate prospects for any significant improvement by this approach do not appear to be very good, and it is suggested that the only way in which a rapid improvement could be obtained in the near future would be by encouraging and expanding the use of compounded feeds.

The main problem of this latter approach is that the compounded feeds might not be nutritionally well balanced as the quality control of feeds in Turkey is very inadequate. The feed factories usually declare the total amount of crude protein (minimum), crude fibre (maximum), crude fat (minimum) and crude ash. Figures given by the factories look alike and appear to meet the nutritional requirements for poultry, but these figures have no real meaning as to the nutritional value of the manufactured feed: for instance, one of the factories declares that his chick feeds contain 21 per cent of crude protein, another factory declares the same amount of protein. Now the question is, are these two types of feeds nutritionally the same or not? The answer is usually no because one factory uses a good quality protein source such as fish meal, meat meal, meat and bone meal or soybean oil meal the other uses only cottonseed oil or sunflower seed oil meal. Many of the feed factories declare that good quality protein sources are used in their own feeds, but this may not be so due to the higher prices of good quality protein concentrates compared with cottonseed oil meal or sunflower seed oil meal. This problem could be solved by enforcing quality control procedures compelling manufacturers to produce high quality feeds.

The poultrymen in Turkey usually complain that the prices of manufactured feeds are much higher than they should be. Indeed the prices of feeds are high in comparison with the prices of animal products such as eggs and chickens. In spite of the high prices of feeds the existing feed factories have no difficulty in selling their products. Table 8 gives the current prices of various finished poultry feeds and raw materials used in poultry feeds in Turkey.

Table 8
Feed prices and optimal costs of different diets (kş)

		Layers				Broilers	
	Price (kg)	0–8 weeks	8–20 weeks	20–30 Growers	30< Layers	Starter (0–6)	Finisher (6–14)
Barley	84	125.0	101.8	103.9	104.0	135.0	131.5
Wheat screening	68			102.0	100.5	133.6	120.4
Corn	88			101.2	97.5	126.0	112.7
Bran	62						
Oats	84						
Millet and milo	80						
Soybean oil meal	2.05						
Cottonseed oil meal	1.11						
Peanut oil meal	1.20						
Sesame seed oil meal	1.20						
Sunflower oil meal	1.06						
Fish meal	4.35						
Meat and bone meal	1.56						
Dehydrated alfalfa	1.35						
Selling prices (kş)		135	123	120	120	155	155

Another important question is what kind of feed formulae should be used in Turkey. Some formulae which have been developed taking into account the particular conditions of Turkey are given in Table 9. It will be seen that the use of 30 per cent of yellow maize and 25 per cent of barley for layer type chicks diets has been suggested and that only eight per cent of soya meal has been included due to its high price and the difficulty in obtaining supplies. Sunflower oil seed meal and sesame seed oil meal were included as the main protein sources of the ration. Due to the shortage of alfalfa meal and fishmeal in Turkey, these were used as little as possible in the formulae. The layer type grower formula contains only barley as a carbohydrate source (at a level of 40 per cent) because this feed is cheaper and more abundant than any other carbohydrate in Turkey.

Table 9
Suitable poultry feed formulae for Turkey

	Layers								Broilers					
	Chicks		Starting period			Laying period			Starter			Finisher		
	0–8 week	8–20 week	20–30 week N.1	20–30 week N.2	20–30 week N.3	N.1	N.2	N.3	0–6 week N.1	0–6 week N.2	0–6 week N.3	6–14 week N.1	6–14 week N.2	6–14 week N.3
Yellow maize	30.00	10.00	43.50	25.00	25.50	49.50	18.00	10.00	54.00	50.00	30.00	60.00	55.00	33.00
Barley	25.00	40.00	15.00	25.00	25.00	10.00	46.50	50.00	–	5.00	23.00	–	5.00	25.00
Wheat	–	10.00	–	7.50	10.00	–	–	5.00	–	–	–	–	–	–
Bran	–	7.00	–	–	–	–	–	–	–	–	–	–	–	–
Soybean oil meal	8.00	3.00	5.00	5.00	4.00	5.00	4.00	3.00	10.00	10.00	10.00	6.00	6.00	6.00
Sunflower oil meal	10.00	10.00	7.00	10.00	10.00	7.00	7.00	7.20	10.00	7.00	10.00	10.00	10.00	10.00
Sesame seed oil meal	11.00	5.00	10.00	6.00	4.00	8.00	4.00	2.00	10.00	10.00	10.00	10.00	11.00	11.00
Dehydrated alfalfa	3.00	5.00	3.00	5.00	5.00	3.00	3.00	5.00	3.00	3.00	2.00	3.00	3.00	5.00
Fish meal	6.00	3.00	2.50	2.50	2.50	2.50	2.50	2.50	7.00	7.00	5.00	8.00	5.00	3.00
Meat and bone scrap	2.00	2.00	3.50	3.50	3.50	3.50	3.50	3.50	2.00	2.00	3.00	2.00	2.00	3.00
Bone meal	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	3.00	3.00	–	–	1.00
Molasses	2.00	2.00	3.00	3.00	3.00	3.00	3.00	3.00	2.00	2.00	3.00	–	2.00	2.00
Limestone	0.50	0.50	6.00	6.00	6.00	7.00	7.00	7.00	0.50	0.50	0.50	0.50	0.50	0.50
Salt	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Minerals	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Vitamins	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Protein (%)	20.6	17.2	16.9	16.8	16.0	15.9	15.4	15.0	20.8	20.8	21.2	19.7	18.9	19.0
Met. energy (Kcal/kg)	2,771	2,583	2,669	2,567	2,566	2,661	2,536	2,473	2,894	2,826	2,756	2,948	2,906	2,753
Calcium (%)	1.13	1.46	3.41	3.13	3.40	3.84	3.72	3.68	1.46	1.6	2.1	1.22	1.06	1.29
Phosphorus, inorganic (%)	0.5	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.62	0.39	0.3	0.3
Lysine (% of protein)	3.41	2.97	2.49	3.33	3.25	3.08	2.73	2.60	2.88	2.84	3.40	3.04	2.65	3.3
Methionine (% of protein)	2.63	2.38	2.66	2.32	2.56	2.64	2.53	2.40	2.64	2.60	2.64	2.04	2.75	2.7
Cystine (% of protein	1.46	1.51	1.48	1.49	1.50	1.50	1.56	1.53	1.44	1.44	1.46	1.47	1.48	1.5
Price (k$/kg)	125	102	104	102	101	104	101	98	135	134	126	132	120	113

The fact that hens grow and gain during the first ten month period of laying has been taken into account and three different formulae recommended for this period. The first one contains mainly yellow maize while the other two contain yellow maize and barley together as carbohydrate sources. Very small amounts of soybean oil meal are included in these formulae. The amounts of added fish meal, alfalfa meal, meat and bone meal are also smaller than they should be. The amount of sunflower seed oil meal and sesame seed oil meal used are different in these three types of formula so that the poultrymen can choose the one which is to his particular benefit.

The three formulae for layers after this first ten month period are also based on yellow maize and barley. Diet 1 contains yellow maize, and Diets 2 and 3 contain barley as the main carbohydrate sources.

It is known that the formulae suggested for broiler rations contain smaller amounts of lysine than is considered desirable under ideal conditions. This deficiency could only be corrected by increasing the amounts of soya, fish, or meat meal in the ration, which would be very difficult under the current conditions in Turkey.

Cottonseed meal is produced in large quantities in Turkey, but as mentioned above it is not considered advisable to include them at rates exceeding five per cent in chick diets due to the presence of gossypol. Cottonseed protein is a rich source of lysine compared with other vegetable protein concentrates, but the binding process used to reduce the pure gossypol content makes much lysine nutritionally unavailable. The deficiency of lysine in Turkish poultry diets and the lack of the conventional sources of lysine adds force to the suggestion that efforts should be made to produce cottonseed meal which is both low in gossypol and high in available lysine by the new processes developed in recent years.

Broiler production is currently very small in Turkey and it will be seen from Table 10 that the total poultry meat production is currently only 29,000 tons per annum.

Table 10
Poultry meat production of some countries[1]

Countries	Metric Tons
USA	5,439,900
USSR	800,000
France	680,000
UK	504,000
Canada	464,000
Italy	369,000
Spain	258,300
Japan	255,000
Netherlands	230,000
Federal Republic of Germany	210,000
Hungary	182,300
Rumania	143,000
Poland	114,300
Australia	109,200
Yugoslavia	107,000
Belgium	91,400
Israel	89,200
Czechoslovakia	78,500
Bulgaria	69,900
India	69,000
Denmark	65,000
Greece	48,000
Austria	41,000
Portugal	40,000
Pakistan	33,000
Sweden	29,000
Turkey	29,000
Iran	22,000
Norway	3,700
Finland	2,900

Source: FAO Production Yearbook (1968).

Problems faced by the poultry industry of Turkey and some possible solutions

1. *Scientific Research*

There is a general lack of reliable scientific information on the nutrient requirements of poultry in Turkey, while no studies have been carried out on the development of economical and balanced rations suited to different districts. Nutrient requirements are at present calculated on the basis of tables prepared in other countries which themselves vary (see Tables 11 and 12) and are not necessarily applicable to the local conditions of Turkey. There is a need, therefore, for scientific research to determine at first hand the nutritional requirements of poultry in Turkey.

2. *Education problems of the poultrymen*

One of the main functions of the animal research centres of Turkey is to educate poultrymen by regular courses, demonstrations and publications. There used to be two types of course – one for researchers and the other for poultrymen, but for two to three years no such courses have been held. Indeed, research centres are unable to arrange courses because there is not enough equipment, enough money, enough material, or sufficient scientists in these departments. Almost all the departments of research centres have a need for new laboratories, barns and poultry houses, available animal material, equipment laboratory furnishings and fully qualified research scientists.

3. *Marketing of the poultry products*

One reason why the poultry industry of Turkey is under-developed is that poultry marketing is very poorly organised. Almost all poultrymen in this country do not know the best time and place to sell their products.

Table 11
Percentage amino acid requirements of chickens according to different countries

Amino Acids	Chicks, 0–4 Weeks			Layers	
	France	UK (ARC)	USA (NRC)	UK (ARC)	USA (NRC)
Arginine	1.05	0.8	1.2	?	0.8
Glycine	0.84	1.0	1.0	?	?
Histidine	0.35	0.35	0.4	?	?
Isoleucine	0.65	0.5	0.75	0.5	0.5
Leucine	1.40	1.5	1.4	1.7	1.2
Lysine	0.95	1.0	1.1	0.5	0.5
Methionine/Cystine	0.73	0.7	0.75	0.55	0.53
Methionine	0.40	0.28	0.4	0.22	0.28
Phenylalanine/Tyrosine	1.40	1.2	1.3	0.7	?
Phenylalanine	–	0.6	0.7	0.35	?
Threonine	0.70	0.55	0.7	0.4	0.4
Tryptophan	0.20	0.15	0.2	0.13	0.15
Valine	0.85	0.8	0.85	0.55	?
Protein	–	20.0	20.0	15.0	15.0

Table 12
Minimal vitamin requirements of chicks (0–6 weeks) according to different countries

	Federal Republic of Germany	India	Japan	Holland	USSR	UK	USA
A (IU/kg)	20.000	4.000	2.650	7.500	15.000	1.500	2,000
D_3 (IU/kg)	2.500	600	200	750	1.500	300	200
E (mg/kg)				10	30		
K (mg/kg)				0.6	1.5	0.99	0.53
B_1 (mg/kg)		2	2.5	2.2	3.0	1.0	1.8
B_2 (mg/kg)	8	5	7.2	4.5	6.0	4.0	3.6
Niacin (mg/kg)		20	37	35	30	28	27
Ca-Pantothenate (mg/kg)		11	10	12		11	11
B_6 (mg/kg)			6.7	3.5	6.0	3.5	3.0
B_{12} (mg/kg)	0.01	0.015	0.009	0.01	0.02	0.03	0.009
Folic acid (mg/kg)			0.55	0.8		1.5	1.2
Biotin (mg/kg)		0.1	0.09	0.15		0.1	0.09
Choline (mg/kg)			1,300	1,500	1,000	1,300	1,300

For profitability every poultryman should know this in advance and also have an assured market. An organisation was established for this purpose in 1965 under the name of General Agricultural Marketing and Standardisation Office but has so far done almost nothing in the field of poultry marketing. The price of an egg is between 50–60 k$ at most times but in some years it may suddenly drop to as little as 15 k$ and poultrymens' incomes consequently suffer.

The greater part of the egg production of Turkey comes from villages. The price of eggs produced by villagers is cheaper than those from poultrymen, the eggs in villages being gathered by middle-men who re-sell the eggs to other traders. These two classes of people make nearly a hundred per cent profit but the producers earn only very little. It is believed that if an organized poultry co-operative system existed producers could earn more money and consumers would be able to buy eggs more cheaply. Today, there are only a few poultry co-operatives which gather eggs daily with trucks. Also many of the poultry farms are very far from main roads and in winter many roads are not open for trucks. Poultrymen or villagers living in such districts keep their eggs in straw in boxes, and market them whenever a road is open. These eggs are usually kept under extremely unsuitable conditions and can become bad.

There are no quality controls for poultry products and no accepted standard specifications for egg and chicken quality. The age of the eggs and chickens which are sold in the markets are not normally known. Large and small size eggs are sold at the same price; chickens are sold without removal of internal organs and most of the chicken stores have no refrigerators. In the last few years however, daily fresh good quality chickens and eggs are being sold in the markets of big cities such as Ankara, Istanbul and Izmir. Packing methods for the export of eggs are very primitive; products are exported to foreign countries in 100 kg wooden boxes full of wood shavings.

There are only a few broiler farms in Turkey and the chickens which are sold in the markets are usually brought from villages by trucks belonging to middlemen. Such chickens are very old, sick and extremely weak and undernourished. The slaughtering and preservation of these chickens is also very primitive, and for this reason people hesitate to consume chickens.

The following action is suggested as a means of improving the marketing of poultry products in Turkey:

a. Organizations such as the Farmers Education and Information Centers which are financed by the International World Bank should be organized in every big city, and farmers should be taught how to raise poultry, keep animals in good health, produce good quality chicken meat and eggs, prevent diseases, select breeds, etc.
b. Villagers should be encouraged to organize co-operatives for at least one hundred hen poultry house units.
c. Eggs and chickens should be gathered by co-operatives and the role of the middle-man ended.
d. All poultry products should be collected in the first place at centers under sanitary conditions. These centers already exist for milk collection but not for poultry products.
e. The products should be priced according to quality.
f. Prophylactic and therapeutic precautions should be considered.

It is assumed that more than ten million chickens die each year with infectious diseases. Many poultry houses are contaminated with pathogenic micro-organisms.

Almost no poultryman attempts to create clean and sanitary conditions, nor can he vaccinate his own chicks: the only man who can do this is a veterinary surgeon who takes ten kş for one vaccination. There is not enough fresh vaccine available in many districts although it is well known, that chicks need two vaccinations; one when they are three to four days old and the other when they are 45 days old. No poultryman wants to pay for vaccinations.

The problem of vaccination could be solved by teaching poultrymen to vaccinate their chicks at periodically arranged courses.

The long-term solutions to the feed shortage problem are to gradually stop exporting oil seed meals and brans, to produce fish meal (having made progress in fish catching methods), to produce meat and bone meal using sick, poor or old animals and to establish more new factories for producing alfalfa meal. The National Feed Industry should be responsible for producing antibiotics, vitamins, minerals and other feed additives. This industry should be organized with laboratories for research and farms for feeding experiments. The National Feed Industry must also have mobility to supply wherever it is necessary. A price control system should be enforced for animal products. As it is well known that poultry farming requires much more capital and labour and carries much more risk than other agricultural production, an equivalent price control system should be arranged for agricultural products (in some years one kg of onion is sold for TL 2–3, which is half the price of meat in some parts of the country). Feed regulations and controls should be applied as quickly as possible. Any kind of feed which is produced in any factory should be subject to quality control. Also research laboratories must be equipped to carry out such determinations as NPU, PER and TPE values and feeds must be analysed for vitamin and mineral content.

Most types of hens in our villages are genetically poor producers and it is therefore advisable to exchange these for modern high producing breeds. However, we must first raise enough high producers in national units for this purpose.

Credits for building modern and scientific poultry farms are too small. Both educated and uneducated people want to use such credits but some people can have more credit than they need, and others cannot receive sufficient. Also there are no insurance agencies for poultry establishments and their products.

There is no meat industry at all in Turkey. If there was a well developed meat industry, good quality chicken soups, table-ready chickens, smoked, fried and cooked chickens could be exported. In order to have a place in the world among well developed countries, Turkey must have a well developed animal industry.

Increasing feed sources and improving feeding methods to achieve the development targets for poultry in Turkey

Nurettin Gürsoy
General Veterinary Directorate, Istanbul, Turkey

Turkey has entered a period of developmental planning, and in order to reach the development targets projected it is necessary that animal and more especially poultry rearing be taken in hand from the beginning, with an understanding of both the existing industries and modern methods of production.

Animal protein production tends to increase in parallel with industrial development, and the level of animal production as a proportion of total agricultural production gives a good indication of the extent to which a particular country has developed. Turkey under today's conditions is one of the countries consuming the largest amount of cereal grains per individual. The consumption of protein of animal origin is too low by comparison with other countries. According to Ministry of Agriculture statistics ('Turkey with Figures'), the consumption of protein of animal origin for various years was as follows:

Average consumption per head per annum

	1950	*1955*	*1960*	*1965*	*1966*
Milk, kg	101	104	111	115	120.6
Egg, number	37.6	43.5	46.5	44.9	44.8
Chicken meat, kg	0.967	0.99	0.91	0.924	0.876
Meat, kg	–	8.1	10.7	12.4	14.0

In order to increase the consumption of animal protein in Turkey to nutritionally desirable higher levels, it is necessary to obtain animal products in greater quantities, of better quality and more cheaply. For this purpose, our growers must feed their animals by modern methods and they must use balanced mixed feeds to obtain products of better quality at lower cost. Especially in poultry, which holds a very important place in animal rearing, a profitable result cannot be obtained without knowledge of modern rearing methods and with unbalanced feeding.

As will probably already be known, first experiments on the use of balanced mixed feeds and modern feeding techniques were started in the second half of the nineteenth century in the USA. With the discovery of vitamins and their synthetic products and the later discovery of the importance of amino acids and minerals in feeding during the first half of the twentieth century, large advances have been made concerning feeds, and animal rearing has become a branch of industry itself. Poultry which have been animals of only minor importance throughout history have gained importance only since scientific feeding methods have been developed. Poultry now produce eggs and meat in the shortest time possible and in the most economic way, and this is the reason why both broiler and egg production must develop in parallel with the rapidly increasing Turkish population and the development of industry.

When considering development of poultry in Turkey, it is wrong to consider only the subject of feeds, because with modern poultry, in order to develop poultry and increase production, it is important to be able to combine many important factors under a carefully considered programme.

Under Turkish conditions these factors are as follows:

1. A poultry committee should be formed by the Ministry of Agriculture and at the Organisation of Planning and all subjects concerning poultry should be followed by this committee.
2. A regional working system for poultry should be applied in Turkey.
3. Farms should be establishment according to the climatic conditions of the particular region and poultry-house erection techniques should be reviewed in accordance with scientific findings of today.
4. In each region breeding units and hatchery units should be established according to the conditions of the region.

5. Production of commercial chicks of low productivity which has been carried out up to now by the Government should be stopped and production of commercial chicks of higher productivity should be considered.
6. Technical co-operation and co-ordination should be established with a country or a poultry sector which has already obtained world-wide fame on the subjects of hybridization and genetics.
7. Education of experts on the subjects of poultry-house erection, farm establishment, hatcheries, genetics, management and nutrition should be taken into hand under a definite programme.
8. The production of raw materials in a way to supply requirements of the country should be improved.
9. Importation formalities for synthetic nutrients which should be present in a balanced mixed feed but which are not found in Turkey, should be made easier.
10. An organisation should be formed for the standardisation and marketing of poultry products.
11. Credits should be distributed more effectively.
12. The quality of raw materials that are produced in Turkey and all types of mixed feeds must be controlled by the Government.

Some of the best work in the development of modern methods of poultry rearing has been in the production of balanced mixed feeds at least cost. Balanced mixed feeds should be produced from high quality raw materials at the most economic price level and fortunately Turkey is rich in some feed raw materials. However, these raw materials vary in quality because no regulations concerning standardisation of feed raw materials have been established as yet. For example oil cakes which form the major protein source of vegetable origin for animal feeds are never of standard composition, and oil cakes from various firms have different protein, fat and ash values. A similar situation exists for protein sources of animal origin i.e. fish meal, meat meal and bone meal, and materials of this type which are produced by 'Et Balik Kurumu' always show variation in protein, calcium and phosphorus content. It will be seen, therefore, that it is very important that the composition of feed raw materials and balanced mixed feeds be subject to legal regulation. The amino acid composition of raw materials produced in Turkey is not accurately known as yet and the amino acid balance in all mixed feed rations which are being prepared is theoretically regulated according to figures obtained in Western Countries. Thus, it has to be accepted that mixed feeds prepared in Turkey are not perfectly balanced from the point of view of amino acids. The importance from the point of view of poultry rearing of determining the amino acid values of raw materials produced in Turkey so that feeds are completely balanced with regard to amino acids is very obvious.

From a feed technological point of view it is also very important to know the percentage of fat in oil cakes and to know whether oil cakes are fresh or stale. Our oil cakes contain a high percentage of fat and when they are used in a fresh state, excess fat will increase energy level of the feed and will therefore be advantageous. However, stale oil cakes contain high percentages of peroxides due to oxidation of fat which causes loss of vitamin A and E in the feeds. The level of fat in oil cakes should, therefore, be low.

Adequacy of Existing Feed Resources

According to latest statistics, Turkey has about 30,000,000 chickens, and if these are to be fed with balanced mixed feeds, 120 g feed per chicken daily which is 1,314,000 tons yearly feed production is needed. However, in the year 1969, Yem Sanayii TAS produced a total 82,535 tons chicken feed in all its factories together. If it is taken that feed enough for 3 per cent of the chickens in Turkey is produced by the private sector, total feed production in Turkey is sufficient for only 10 per cent of the total chicken population. It is evident, therefore, that 90 per cent of chickens are fed by primitive methods. This is the reason why egg production does not on average exceed 48 eggs per chicken per annum.

Raw material sources for balanced mixed poultry feeds are produced in too small quantities to meet current demands, the materials in shortest supply being fish meal, meat meal, soya oil cakes and alfalfa meal.

Let us assume that Yem Sanayii TAS and the private sector together produce 100,000 tons of balanced mixed chicken feed per year. If 3 per cent of fish meal is on average to be added to this feed, it will be seen that 3,000 tons of fish meal would be needed, whereas only 1,515 tons of fish meal were produced in Turkey during 1970 (including the production of Trabzan Fish Meal Factory). Even today when compounded chicken feed is produced in insufficient quantity there is a 50 per cent deficit in fish meal production. The position with regard to meat and bone meals is very similar, while the shortfall of soya oil cake and alfalfa meal production is even greater. It is evident, therefore, that to solve the problem of feed in Turkey, it is first necessary to take in hand the production of raw materials as otherwise it will be necessary to import them.

Classification of Feed materials

Energy Sources

Cereal grains constitute the main energy source of chicken feed. Cereals are, however, poor in limiting essential amino acids especially lysine and tryptophan, and at the same time are poor in minerals such as calcium, phosphorus and sodium. Maize, wheat and milo contain the largest amounts of energy per unit weight and are, therefore, used in large quantities in chicken feed.

The most valuable materials from the point of view of energy are oils and fats which are two to three times richer in energy than grains. It is desirable, therefore, to add them to feeds to increase energy levels and 3–5 per cent of them can be added to mashes and 7–8 per cent to pelleted feeds.

As generally edible oil production is deficient in Turkey and its price is high, oils are not added to mixed chicken feeds, as a result of which energy levels of mixed feeds are below those generally recommended. (Under optimal conditions, chick feed must contain 2,800–3,000 kcal/kg energy and layer feed must contain 2,600–2,800 kcal/kg for metabolic energy demand).

Protein sources

Protein sources for chicken mixed feeds are oil cakes and Et Sanayii residues, meat meal, fish meal, and chicken slaughtering house residues. Among oil cakes, soya oil cake, corn gluten, pistachio oil cake and cotton seed cake are those most widely used.

Soya oil cake is currently used in chicken feeds in large amounts in Turkey. Soya oil cake with hulls contain 44 per cent protein while without hulls it contains 50 per cent protein. Among vegetable protein sources soya oil cake is the one containing the largest amount of lysine, but it is poor in methionine and cystine. In soya oil cake there are many thermo-labile anti-nutritional factors which retard growth, and in order to free the oil cake from these factors, it should be tested before being fed to chickens.

Cotton seed cake contains a toxic material named 'Gossypol' which retards development of chicks and causes some deformation and it should therefore, be carefully used in feeds. Gossypol also causes a change of colour of egg-yolks. Gossypol may be rendered largely nutritionally unavailable by heat treatment of the cake, and can then be incorporated in poultry rations at levels of 10–15 per cent. However, cotton seed cake is low in lysine and such heat treatment reduces lysine availability, thus exacerbating this deficiency.

Meat meal is obtained by drying and rendering waste animal tissue. A good meat meal should not contain excessive quantities of hair, nail, horn, blood, droppings, or stomach contents. If phosphorus level exceeds 4.4 per cent the product is called bone meal. Meat meal must generally have at least 50 per cent protein and is fairly rich in minerals and lysine. It is, however, poor in methionine, cystine, tryptophan and energy. It can be used at levels of 8–9 per cent in mixed feeds, but if it is used at too high a percentage the amount of calcium and phosphorus in the ration will be too high.

Fish meal contains 60–70 per cent of protein and is fairly rich in lysine, methionine, calcium, phosphorus and energy. Fish meal which makes up a rich source of protein and unknown factors (UGF) for chicken feeds has the highest energy level among all other protein concentrates. Blood meal, liver meal and dairy residues are also used widely in poultry feeds, being rich protein sources.

The amount of protein in chick and chicken feeds is regulated according to the ME level of the feed. The energy: protein rates of poultry feeds should be 1:17 in summer and 1:15 in winter.

Amino acids are produced synthetically today and are added to rations. In modern poultry industries the addition of synthetic methionine and lysine to balanced mixed feeds is now widely applied. Synthetic methionine may be marked under the name DL Methionine Hydroxyanalog.

The reason for the importance of amino acids in poultry feeds is that some acids cannot be synthesised in chicken's body. These amino acids are:

1. Arginine
2. Histidine
3. Lysine
4. Leucine
5. Isoleucine
6. Valine
7. Methionine
8. Threonine
9. Tryptophan
10. Phenylalanine

Although glycine can be synthesised within the body of the chicken, due to its very high requirements, glycine in addition to that which can be synthesised is needed in the ration.

Amino acid levels which are currently recommended for chicks and chickens are given below:

	Chicken ration *per cent*	Chicken ration *per cent*
Arginine	1.2	0.8
Lysine	1.0	0.64
Methionine or Methionine + Cystine	0.7	0.58
Methionine (minimum)	0.4	0.32
Tryptophan	0.2	0.16
Glycine	1.0	–

Source: Milton L. Scott, 1969

Minerals

Those feeds which are prepared only by use of vegetable and animal protein sources are poor in some minerals, and minerals like Ca, P, Na, Mn, Fe, Zn, Co and I need to be added to balanced mixed feeds.

In mixed feeds, limestone or oyster shell meals are used as calcium sources. It is important that the limestone does not contain too much magnesium as this could give bad results.

Phosphorus requirements of mixed feeds are supplied by dicalcium phosphate or bone meal, and trace minerals and vitamins requirements are supplied by various premixes.

The poultry industry in Iran

Akbar Noormanesh
Animal Husbandry Research Centre, National Livestock Organization, Tehran, Iran

Introduction

It is no secret that poultry farmers have a difficult time obtaining feed to raise chickens and make a profit on their operations in Iran. Every poultry keeper is looking for less expensive ways to raise poultry for meat and egg production. The poultry industry in Iran has increased in importance during recent years as a supplier of these products. There are two main reasons for this and these are, firstly, the relative efficiency of poultry in converting feed into food for humans and, secondly, the fact that poultry production is not only a farm enterprise that uses relatively inexpensive labour and provides considerable quantities of eggs and meat for home use as well as for sale, but also because there has been considerable commercial expansion of the industry in Iran.

The history of poultry in Iran is old and it has been reported that fowls were carried by traders from India and Malaya to the north end of the Persian Gulf of Iran, although domestic fowls were mentioned by Persthetaerus of Persia about 500 BC.

Background information

Iran is an agricultural country covering an area of about 1,648,146 km^2 with a population of approximately 30 million people. According to the 1966 census, the rural and tribal element of the population is about 67 per cent while the remaining 33 per cent live in urban areas.

The climate is diverse and the country may be divided into three different climatic regions:

1. The Caspian Sea area in the North which has a subtropical climate with high rainfall and abundant forests. In this area wheat, oilseeds, barley, alfalfa, sugar beets, etc. are grown.
2. The Central Plateau which is located east of the Zagross and south of the Alborz ranges, and is covered mainly by natural ranges and desert.
3. The arid zones of Baluchistan, Kerman, Khorasan and southern Fars also have natural range lands, playing an important role in the livestock economy of the area. Overgrazing has depleted this resource to the point that it is an acute obstacle to the development of satisfactory livestock production.

The value of livestock products takes second place after oil exports. Animal husbandry products are Iran's largest agriculture commodity exported, of which poultry is at the end of the line.

Poultry husbandry in Iran

During the resign of Raza Shah the Great, a small number of purebred cattle and poultry were imported in Iran and kept at the Haydarabad Livestock Station with the intention of improving local livestock and its by-products. However, it was not until 1952 that Iran's poultry rearers paid more attention to commercial production under the stimulus of the National Livestock Organization (NLO) which provided technical assistance. The NLO encouraged poultry raisers near urban areas to establish larger scale specialized poultry farms. Various brochures and pamphlets were published and distributed by the NLO on the management, feeding, housing, brooding, etc. of hens, turkeys and ducks.

Private commercial poultry production in Iran has mushroomed and this business effort is lessening Iran's meat shortage. Since 1951 the number of modern poultry farms has increased from one to around 500. Annual egg production has increased from 300,000 to 400 million in this time, while broiler production, a new idea in 1951, now exceeds over 15 million broilers annually. Incubator capacity has also greatly increased (Iran-American Economic Survey, 1967).

The growth and development of commerical production of broilers in Iran has been so rapid in the past ten years that, when speaking of the production of

Previous Page Blank

poultry meat, two types of such production must be distinguished:

1. Domestic poultry production by traditional methods.
2. Commercial poultry production by modern intensive methods.

Domestic poultry production still has an important role in the production of poultry meat, but as its growth is very slow its percentage contribution to the production of poultry meat in the country will gradually diminish. The present domestic production of poultry meat has been estimated at about 14,000 tons. The commercial production of broilers began 16 years ago with 200 tons of meat per annum and has now reached about 25,000 tons. It will be seen that broilers now supply the greater proportion of poultry meat consumed in Iran (estimated at two kg per capita per annum in 1967). This type of production is very well organized and leading poultry farms can match similar farms in countries having otherwise a much more developed agriculture with respect to their feeding organization and management. The leading poultry farms, located in and around Tehran, have achieved a production of one kg of meat per 2.00–2.40 kg of feed. Feed results of small farms are not so good, but these farms secure economical production based on a different structure of other costs.

Many factors required for a future rapid development of commercial production of poultry meat in Iran already exist. The country already has a large production capacity of hatching eggs, necessary for raising day-old chicks, and there are several large scale, well equipped hatcheries producing about 40 million day-old chickens per year.

It is estimated that about 70 per cent of broiler producers in Iran raise 3,000 to 10,000 broilers in one turn, while another 20 per cent raise about 10,000 to 50,000 broilers in one turn, and 20 big broiler farms have more than 50,000 broilers in one turn. One broiler producer has about 250,000 chickens in one turn. There are plans for the establishment of a dressing plant near Tehran in 1971 with a capacity of 20,000 broilers per day.

The National Livestock Organisation has over the past 15 years established a number of small scale poultry farms in the provinces, plus one big hatchery of an 11 million unit capacity in Tehran, 'The Government Narmak Hatchery'. The Narmak Hatchery sells its chicks at cost price in order to control prices asked by private hatcheries.

The National Livestock Organisation also plans to establish a five million capacity breeding center for mother stock near Tehran, while ten mother stock poultry farms, seven hatcheries and six demonstration and extension stocks are also planned for the provinces. This government set-up is designed to encourage the private sector to enter into commercial operations, and will be run on a commercial basis. Details of intensive poultry farms currently operating in Iran are given in Table 1.

Table 1
Details of poultry farms of Iran

	No. Houses	Area, m^2	No. of Hatching Machines	Kind of H. M.	Capacity (No. of birds)	No. of mother stock (Meat)	No. of mother stock (Egg Prod)	Comm. Name
Poultry Growers	36	34,000	–	–	–	92,000	–	Anak-Royal
Eghbal Producer Co.	5	5,000	4	–	210,000	5,000	10,000	Hyline Indian Riv
Iran Toyoor	18	5,000	–	–	–	–	7,000	Leghorn
Joojeh Khoroos	17	12,850	5	B. Coto	396,000	44,000	–	Hybro
Tolid Joojeh (Tehran farm)		12,300	–	–	–	8,000	–	–
Blue Bird Co.	7	10.520	18	–	420.000	41,000	19.500	Sterling
Damdaran Co. Ltd	–	14,000	1	B Coto	100,000	43,000	2,500	Huhard Ledbress
Iran-American Co.	8	7,200	2	Dig J.	80,000	26,300	–	Arhur acre
Iran Germany Co.	16	17,000	8	Dig J.	640,000	22,900	4,000	Nick Chick (Brown)
Morghak Inst. (Tehran farm)	2	1,400	3		300,000	–	7,500	Boh-cock
Pullet Co.	3	3,100				–	15,000	
Iran Joojeh	–	–	–		–	96,000	–	Piltch

Diseases and pests

The high mortality due to diseases and infestation with parasites that occurs annually in the chicken and adult flocks of Iran is one of the main difficulties facing the entire poultry industry. Not only is the economic loss from dead chickens and hens very big, but in addition there is the cost of retarded growth, poorly finished market birds, and decreased egg production.

The main pests and diseases occurring on poultry farms in Iran are as follows:

1. Internal parasites
   a. Small round worms
   b. Large round worms
   c. Gapeworms
   d. Tapeworms
2. Protozoan diseases
   a. Coccidiosis
   b. Black head
3. Bacterial diseases
   a. Limberneck
   b. Fowl tuberculosis
   c. Coryza
   d. Pullorum disease
4. Virus diseases
   a. Loucosis (Facial paralysis)
   b. Bronchitis
   c. Fowlpox
   d. Newcastle disease

Other diseases can also be seen, for example Bumblefoot, Frozen comb, Crop impaction, etc.

Housing

Poultry houses in Iran began when commercial poultry industry started. Laying houses vary with respect to their dimensions and other details but most farms use one storey houses, although there are a few commercial egg-producing farms using multistorey systems.

Some poultry houses are too small in relation to the size of the laying flock and not wise enough to keep the birds comfortable in cold weather and provide for properly controlled ventilation. Some houses are built with glass windows in the rear and front and some are windowless.

The laying houses are equipped with roosts, nests, feed hoppers (some with automatic feeders), water containers and other items that are durable. The largest egg-producing farms are keeping their birds on the floor using litter (mostly straw) but some have their layers in cages.

Poultry feeds

Successful feeding practice is based on good knowledge of the requirements for growth, fattening and egg production, and consequently knowledge of various nutrients. While there are many satisfactory feed materials in Iran the proportions of nutrients in rations is often variable due to poor control.

The various concentrate feedstuffs of Iran can be classified into high carbohydrate energy sources, protein supplements, mineral supplements and vitamin supplements.

1. *High carbohydrate energy sources*

a. Barley is a good cereal feed for poultry. It grows anywhere in the country. Barley meal is sometimes used in fattening poultry.

b. Corn (maize) is very palatable and readily digested and has become a very important feedstuff in Iran. Maize for commercial growing for poultry feed is being introduced at this moment in Iran but most of the maize is currently imported.

c. Wheat is extensively grown in Iran and is widely used as a source of nutrients for animals because of its palatibility and digestibility.

d. Oats, rye and rice (rice grows in the north of the country, 'the Caspian Sea area') are used to feed domestic poultry.

e. Sorghum may be used to replace a small portion of corn in the diet, depending upon their relative prices.

2. *Protein supplements*

a. Animal Protein

As cereal grains have a lower protein content and are deficient in certain essential amino acids, it is necessary to use certain quantities of protein supplements in order to provide a properly balanced diet to promote growth and produce eggs efficiently. Animal protein supplements which are available to poultry keepers in Iran include the following:

Blood: Fresh blood can be obtained from slaughterhouses. It can be used after drying or wet in mash. The use of this source is not yet familiar to poultry keepers in Iran but some feed factories are using it.

Chicken scrap: It can be obtained in poultry dressing plants and can be used when dried and ground.

Fish meal: Inedible by-products of the fishing industry and whales are used extensively in feeding poultry in Iran. Suitable fish can be found in the North (Caspian Sea) and the South (Persian Gulf), but there is only one factory for fish meal production in Iran located in Sandar Abbas in the south. Its present production of about 1,080 tons of fish meal per year, is not enough for the needs of poultry industries in the country. Some fish meal is imported from outside by Iranian private companies.

Hatchery residues: Infertile eggs and dead embryos from commercial hatcheries could constitute a good source of 'Hatchery by-product meal' in Iran as in other countries with modern poultry industries. The processed residues contain about 35 per cent protein, 30 per cent fat, and 30 per cent minerals when boiled and dried. However, poultry keepers of Iran are not aware of the use of this feed resource in the diet of poultry.

Meat scrap: There are abundant sources of raw materials to produce this in Iran, but it is as yet not known to Iranian poultry keepers.

Milk products: This source is available to poultry keepers. Only some domestic and a few commercial poultry farms feed buttermilk and curdled milk to their chicks. Dried whey was familiar to poultry growers before the increase of commercial industries in Iran and it is common to add two to five per cent dried whey to poultry rations.

b. Plant Protein

Plant protein supplements are usually less expensive than other sources of feed in Iran and there is also less variability in composition. Cottonseed meal, sunflower seed meal, and linseed meal can be obtained in Iran. Cottonseed meal, which contains almost 40 per cent protein and the production of which was 204,000 tons in 1968–69 is most used in poultry rations. The production of cottonseed is increasing at the rate of 15–20 per cent per annum. Sunflower seed meal is an excellent protein supplement containing protein of high biological value, and is being increasingly used in poultry feed as supplies become available.

3. *Mineral supplements*

It is known that the dry matter of the fowl's body contains approximately 10 per cent mineral matter. Dry matter of whole egg contains about 35 per cent mineral matter. The main minerals which are limiting in poultry diets are calcium, phosphorus, manganese, sodium and chlorine.

If most or all of the protein supplements in the diet are of plant origin the mineral deficiency must be made up by adding certain mineral supplements such as bone meal, iodine, limestone, manganese, oyster shells and salt to the ration.

Most poultry keepers in Iran use bone meal, this being produced by a chemical factory in Karaj near Tehran. This factory also produces fertilizer under the supervision of the Ministry of Agriculture. The current production of the above mentioned factory is about 1,200 tons of bone meal per year. Private factories are also producing bone meal, but in smaller quantities and of poorer quality than that prepared by the Government factory.

4. *Vitamin supplements*

No research results are currently available in Iran on vitamin supplementation of poultry diets under Iranian conditions.

At the moment there are three big animal feed factories in Iran, one of which belongs to the Government while the other two are privately owned. There are also some 25 smaller plants in Tehran and other cities. At present about 80 per cent of the production of these factories is used by poultry farmers. There are also some companies importing concentrates into Iran. Poultry feed costs from ten to 12 Rials per kg in Iran at present.

Analysis of the nutritive value of Iranian poultry feeds

As mentioned above, Iran is an agricultural country, with extremely variable conditions from area to area. The production of materials suitable for feeding farm animals and poultry varies accordingly as does also their quality. Since in Iran the amount of material presently available for animal feeding is limited in relation to the number of animals to be fed, it is important to make most efficienct use of all available materials.

One of the first concerns of the Nutrition Division of the Animal Husbandry Research Center of Haydarabad (Karaj) upon its formation in 1967 was to establish systematic collection of properly identified samples from as many parts of Iran as possible for laboratory analysis. It was felt that information on the dry matter, crude protein, crude fibre, calcium, and phosphorus contents of samples would give a good basis for estimating feeding values. Tables 2, 3 and 4 give the results of some of their analyses.

Table 2
Analyses of cereal grains

Feedstuff and source	Type	Year sampled	No. of samples	Composition (as of Dry Matter)			
				Crude protein		Crude fibre	
				Average	Range	Average	Range
				percentage			
Barley							
Purchased – Tehran	–	1967	10	12.1	10.6–16.3	–	–
Produced – Shiraz	–	1968	4	13.3	12.4–14.0	–	–
Produced – Ahvas	Varieties	1968	6	11.4	10.1–12.9	5.4	4.7–7.2
Produced – Varamin	Varieties	1968	9	11.7	10.8–13.2	5.3	4.3–5.8
Produced – Karadj	Varieties	1968	9	12.9	11.4–14.6	5.5	4.9–6.1
Produced – Isfahan	Salty Land	1968	1	12.6	–	5.5	–
Produced – Dusadj	–	1968	4	10.1	9.4–10.8	6.3	5.9–6.9
Produced – Mashed	Irrigated-Fall Planted	1967	4	8.9	8.4–9.3	–	–
Wheat							
Produced – Mashed	Irrigated-Fall Planted	1967	5	11.1	9.5–11.9	–	–
Produced – Mashed	Irrigated-Spring Planted	1967	2	15.9	15.4–16.4	–	–
Produced – Mashed	Dryland-Fall Planted	1967	1	9.6	–	–	–
Produced – Behbahen	–	1968	1	14.2	–	–	–
Produced – Kormanshah	–	1968	1	11.7		2.7	–
Corn							
Produced – Vaanamin	–	1968	1	9.6	–	–	–
Produced – Karadj	–	1968	1	8.6	–	–	–
Produced – Gorgan	–	1968	2	11.4	10.6–12.2	–	–

Table 3
Analyses of by-products

Feedstuff and source	Year sampled	No.of samples	Composition (As % of dry matter)			
			Crude protein		Crude Fibre	
			Average	Range	Average	Range
			percentage			
(a) Cotton						
Cottonseed oilmeal						
Purchased Tehran	1967	29	53.9	51.1–56.3	–	–
Produced – Caspian	1967	1	34.4	–	–	–
Purchased – Tehran	1968	1	52.4	–	–	–
Produced – Shiraz	1968	1	22.4	–	25.6	–
Produced – Isfahan	1968	2	32.3	24.5–40.1	18.0	13.9–22.1
(b) Sugar beet						
Beet pulp, dried						
Purchased – Tehran	1967	11	10.5	9.9–11.1	–	–
Purchased – Tehran	1968	19	10.7	10.0–11.6	–	–
Beet pulp + 20% Molasses						
Produced – Shiraz	1968	1	11.2	–	–	–
Beet Pulp + 5% Molasses						
Produced – Isfahar	1968	1	9.9	–	19.9	–
Beet Pulo Silage						
Produced – Karadj	1968	7	10.3	9.4–11.7	22.9	19.3–27.5
(c) Wheat						
Wheat bran						
Purchased – Tehran	1967	11	16.4	15.4–16.8	–	–
Purchased – Tehran	1968	16	16.0	14.4–18.2	–	–
Produced – Mashad	1967	1	16.6	–	–	–
Produced – Shiraz	1968	1	15.2	–	–	–
Produced – Khorramabad	1968	2	17.2	16.9–17.5	–	–
Wheat straw						
Purchased – Tehran	1968	8	2.5	2.1–3.4	37.9	28.5–42.5
Produced – Isfahan	1968	1	3.2	–	38.2	–
Produced – Dusadj	1968	1	2.7	2.5–2.9	–	–
Produced – Dusadj	1967	10	3.2	2.8–3.6	33.1	24.2–38.1
(d) Other						
Bonemeal						
Purchased – Tehran	1968	3	28.3	27.3–29.4	–	–
Fishmeal						
Produced – Persian Gulf	1968	1	72.9	–	–	–

1. *Grains*

Averages and ranges of crude protein and crude fibre contents of grain samples analysed are given in Table 2. Dry matter content is not included since it was not determined only for all of the samples. Variations in dry matter content was small in these samples for which moisture content was determined, and dry matter content was in the region of 90 per cent in all cases.

2. *By-products*

Averages and ranges of crude protein and crude fibre contents of by-products both of plant and animal origin are given in Table 3. Although dry matter content is not included in the table the values for the samples on which it was determined were again close to 90 per cent.

3. *Forages (fresh and conserved)*

Averages for dry matter content are given in Table 4 for some fresh-cut forages conserved as silage or hay.

The following conclusions may be drawn from the analyses of feedstuff raw materials collected from various sources in Iran by the Animal Husbandry Research Centre, Haydarabad (NAHRC):

a. Spring-planted wheat contained more crude protein than fall-planted types.

b. Cottonseed oil meal samples varied widely in quality according to source and should be much more widely sampled.

c. Wheat bran samples varied only slightly in crude protein content.

d. Dried sugar beet pulp samples varied only slightly in crude protein content.

e. Silage corns and corn silage tended to be low in crude protein content, although it was possible to increase it to some degree by nitrogen fertilization.

f. Alfalfa hays tended to be low in crude protein and high in crude fibre content due to late harvesting or leaving them in the field too long during curing.

Table 4
Analyses of forages

Forage Type	Location harvested	Year harvested	No. of samples	Average dry matter content	Composition (as % of dry matter)			
					Crude protein		Crude fibre	
					Average	Range	Average	Range
			%	%	%	%	%	%
(a) Fresh Cut								
Alfalfa (1/10 Bloom)	Karadj	1967	22	25.7	19.1	15.9–21.1	24.8	14.6–32.4
Sorghum								
Milk stage	Karadj	1967	4	20.3	6.7	6.5–6.9	27.6	26.7–28.4
Milk stage	Varamin	1966	8	20.8	5.9	4.0–8.3	–	–
Dough state	Varamin	1968	8	27.5	5.7	3.2–11.3	–	–
Silage corn								
Milk stage	Heydarabad	1967	6	20.4	6.7	6.2–7.1	23.7	22.3–25.6
Soft dough stage	Heydarabad	1967	6	28.8	6.2	4.7–7.7	21.3	19.2–22.3
Hard dough stage	Heydarabad	1967	6	37.7	5.5	4.9–6.7	20.2	16.9–22.5
Soft dough stage	Varamin	1967	18	27.3	5.0	3.7–6.3	24.0	22.0–25.7
Hard dough stage	Varamin	1967	18	32.5	4.4	2.9–7.2	21.7	18.0–26.1
Soft dough stage	Hashtgerd	1968	14	24.3	6.8	5.7–8.1	–	–
Soft and hard dough stage	Heydarabad	1968	20	29.2	5.4	3.1–6.6	–	–
Hard dough stage	Varamin	1968	18	30.0	4.5	2.9–6.9	–	–
Hard dough stage	Karadj	1968	3	33.1	5.3	4.1–6.4	–	–
(b) Silages								
Corn silage								
Bunker silo	Heydarabad	1967	3	32.4	5.8	5.5–6.2	24.6	23.5–25.2
Bunker silo	Karadj	1967	3	34.0	4.5	3.3–5.5	33.5	32.5–34.1
Bunker silo	Hashtgerd	1968	21	24.7	7.3	6.5–8.1	–	–
Bunker silo	Heyderabad	1968	11	32.9	5.8	4.8–8.2	–	–
Sorghum silage								
Bunker silo	Rasht	1967	1	26.4	6.2	–	28.6	–
(c) Hays								
Alfalfa	Karadj	1967	9	–	12.8	10.9–16.1		–
Alfalfa	Heydarabad	1967	10	–	13.4	9.2–17.1	31.4	19.5–42.0
Alfalfa	Shiraz	1967	2	–	17.8	17.5–18.1	25.9	25.6–26.3
Alfalfa	Gorgan	1968	1	–	13.7	–	32.8	–
Alfalfa	Isfahan	1968	1		19.1	–	25.4	–
Alfalfa	Heydarabad	1968	11	87.9	14.3	10.9–18.3	37.4	28.3–46.8
Alfalfa	Dusadj	1968	4	89.7	12.9	11.7–15.3	34.0	27.8–36.7
Sainfoin	Heydarabad	1967	1	–	12.1	–	27.3	–

From data gathered to date by NAHRC it is not at present possible to make any firm general assessment of the quality or variation in quality of feedstuffs in Iran.

There is need of a greatly expanded programme of sampling to obtain samples from other areas and producers throughout Iran. Forage crops particularly need a much wider coverage. Even though it is not possible to make a firm assessment, some trends and points of interest can be noted.

Discussion

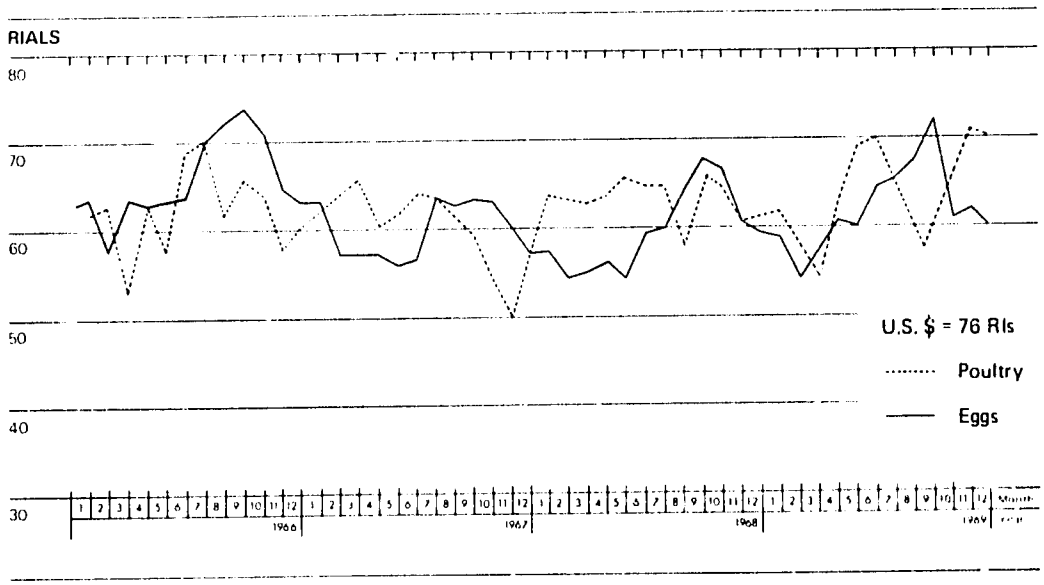
In Iran feed is usually purchased by the 100 or 50 kg bag from factories. It is obviously known that a low feed input to egg output ratio is desirable financially by Iranian poultry keepers, and is assisted by high egg prices, or low feed prices. However, the latter merely indicates whether conditions are good or poor, and not how profitable any particular business may be.

The feed input to egg output ratio has been and still is high in Iran and because of the high feed prices which prevail, poultry keepers in Iran have difficulties in continuing their operations. So to obtain less expensive feed is one of the big current needs for poultry keepers in Iran.

For any given period the price received for broilers or eggs produced and the price paid for feed, chicks, and hired labour are factors of vital importance affecting returns secured from the broiler or egg production enterprise in relation to costs of production. These two types of enterprise are the most important of the five sections of poultry farming and influence the other sections.

Another difficulty which poultry rearers face is uncertainty as to the price at which they can sell their end products after the investment in chicks and feed. The variations in poultry meat and egg prices are illustrated in Figure 1, where it will be seen that egg prices were generally high only during the ninth and tenth months of each year.

Figure 1
Variations in prices of poultry and eggs to the consumer 1966–1969



It should be mentioned that the handsome profits made in poultry farming occurred during the first few years in which the poultry industry was growing and increasing in the country.

Whereas foods of plant origin, if consumed in sufficient quantity, provide humans with adequate energy, foods of animal origin are generally of higher nutritive value due to better quality and higher content of protein.

Foods of animal origin also supply more of certain vitamins and minerals than do foods of plant origin. It will be seen from Table 5 that the higher protein, calcium, iron, sodium, potassium, thiamine, riboflavin and nicotinic acid contents of poultry meat compared with lamb meat (the meat consumed in greatest quantity in Iran) would indicate that there would be some nutritional advantage in encouraging poultry production in Iran.

Table 5
Composition of meat (red meat, lamb) and poultry: constituents of 100 g of edible portion

	Protein Content		Minerals			Vitamins		
Name	Protein g	Calcium mg	Iron mg	Sodium mg	Potassium mg	Thiamine mg	Riboflavin mg	Nicotinic acid mg
Lamb	17.7	11	1.6	–	–	–	–	–
Poultry	20.5	15	1.8	78	320	.10	.24	5.6

Suggestions for future action

It is considered highly desirable from many points of view to increase poultry product consumption in Iran, and to improve and stabilise the prices of poultry products. The Iranian poultry industry should work towards this objective in close collaboration with the poultry division of the National Livestock Organization. Poultry industries can for the convenience of better management and the correct implementation of expert advice, be classified into five types as follows:

1. Layer-pullet replacement production.
2. Market egg production.
3. Hatchery egg production.
4. Broiler production.
5. Baby chick production.

Each of the above types of enterprise should become specialised with appropriate regulations enforced by controllers and inspectors, so that satisfactory returns can be secured.

The poultry division should have a definite plan for poultry keepers in the country, even to the point of establishing relevant classes if it is considered necessary. In these classes the producers would gain some knowledge of the more important factors affecting returns and how to be a proficient manager capable of taking advantage of every opportunity to secure increased returns from his enterprise.

Further suggestions are as follows:

1. All poultry feed rations should be standardised.
2. All of the animal feed factories should be controlled and random samples tested by the NAHRC.
3. Breeding and intercrossing of high yielding exotic stock with local breeds should be executed in an overall scientific organisation.
4. The native stocks of poultry should be a part of any planned system of breeding for improvement of productivity.
5. Research on poultry should continue and be upgraded scientifically at the NAHRC.

Also suggested is the organization of a 'National poultry improvement plan' which would be administered in each province by an official state agency co-operating with the National Livestock Organization.

Authority for an official provincial agency to administer the plan within the provinces must come from a memorandum of agreement between each province and the Ministry of Agriculture of Iran. The Ministry of Agriculture or the National Livestock Organization will be responsible for co-ordinating the programme among the co-operating provinces.

It is recommended that a yearly conference take place, sponsored by the above-mentioned 'National poultry improvement plan', and participated in by the following delegates of the provinces: breeders, hatchery men, feed producers, poultry researchers and poultry owners.

The objectives of this suggested plan are, therefore, as follows:

1. To improve production.
2. To improve the market quality of chickens.
3. To reduce losses from hatchery-disseminated diseases.
4. To keep the market price of poultry products from fluctuating too much.
5. To keep the market price of poultry feed from fluctuating too much.
6. To improve the marketing situation.
7. To help their own country by helping themselves.

References

BOWDEN, D. M., MANOUCHEHRI, M. and van OERS, J. Date unknown. Analysis of feeding stuffs available in Iran. *Animal Husbandry Research Institute, Haydarabad, Iran, Technical Report No. 4.*

DEHGHAN ROOZ MAGAZINE. Various statistics.

IRAN-AMERICAN ECONOMIC SURVEY. 1967.

PUBLIC BUREAU OF STATISTICS. 1968.

Poultry nutrition in Pakistan

M. Y. Bhatti
Director of Animal Husbandry, Baluchistan, Quetta, West Pakistan

Introduction

The poultry industry in Pakistan occupies a unique position in the country in as much as the large majority of 40 million birds reared are of local types kept on an extensive scale in the rural areas. The advent of the commercial hybrid chicken took place during the year 1963. Prior to this, efforts to introduce improved varieties in the private sector did not make a significant impact except for paving the way for the subsequent spread of commercially bred poultry stock in the private sector around big cities. The reason for this was that the improved varieties could not stand the harsh environment of rural areas where adverse nutritional, climatic and managemental conditions existed. However, such chickens of the broiler and egg type now comprise about ten per cent of the entire production in the country.

The low producing rural chicken is kept as a scavenger bird living on waste food in rural areas and does not compete with humans in the consumption of grains. The position is, however, different with the commercially produced hybrid chickens in big industrial areas or cities. These chickens require a balanced feed and sound management for optimum production. As such, the private poultry feed industry grew up to fulfil the requirements of this type of chicken primarily. The present upsurge of poultry production in the private sector is closely tied with the development of the feed industry together with chick production in commercial hatcheries.

Organised research work on the scientific feeding of chickens under local conditions has been conducted since 1954 in Pakistan. An animal nutrition section was added to the Punjab Veterinary College Lahore in West Pakistan during 1954 under the supervision of a visiting professor from USA Dr. Burch H. Schneider, and this section did pioneer work in formulation of rations from locally available feed materials both for chickens and livestock. This valuable research work provided the much needed base for the ushering in of a privately owned poultry feed manufacturing industry in Pakistan in 1961. After 1961 full-fledged Departments of Animal Nutrition were established in the two Agricultural Universities of East and West Pakistan, which took up further work on poultry nutritional problems in the country.

The availability of coarse grain feeds in the country is perhaps the greatest constraint in increasing home mixed feeds. However, with the recent green revolution in wheat production in Pakistan, large quantities of coarse grains like sorghum, maize and barley should become available for use in poultry feed. In view of the current low production of poultry products in Pakistan (eight eggs and eight oz of poultry meat per head of population per year at present), the potential for increasing commercial poultry production is very great and for the realisation of this potential there will inevitably be the need for greater production of coarse grains.

Feed resources and utilisation pattern

The following ingredients are used to a greater or lesser extent in the formulation of poultry rations in Pakistan:

1. Maize (corn).
2. Sorghum (jowar).
3. Wheat.
4. Rice.
5. Bran (wheat and rice).
6. Oil cakes (cottonseed, til, groundnut, maize).
7. Fish meal.
8. Bone meal.
9. Meat meal.
10. Limestone.
11. Salt.

The rural poultry, which form the bulk of poultry population, are not fed mixed rations, but live by scavenging for waste feed, fallen grain, insects and green matter. Since they are low yield producers, they can only be raised on an almost no cost basis, but they contribute very significantly to the total production of poultry eggs and meat, being raised by a large majority

of the rural population (about 80 per cent of total population of Pakistan). The mixed poultry feeds are exclusively fed to improved varieties of chickens which are high yielding and can justify the feeding of expensive rations. The debut of the modern poultry industry in Pakistan making use of imported pure breed and hybrid stocks could not have come about if the challenge of providing balanced feed had not been met by the private sector. The growth of the private feed industry made it possible to increase the production of commercial hybrid chicks from a quarter of a million in 1964 to 4 million during the year 1970. In this connection, the pilot experiments in feed trials carried out at Government poultry experiment stations in the last decade have paid dividends, as these formed a basis for the establishment of a viable feed industry.

The progress of poultry feed production can be judged from Figure 1 while the growth of commercial chick production during the past 7–10 year period is shown in Figure 2. In the modern poultry sectors, balanced feed is a pivot on which the economy of production moves as feed supplies certain exo-factors, which on combining with certain endo-factors on the genetic side result in the phenomenal production of the modern hybrid fowl. It must be realized that the modern technology makes it much easier to multiply poultry on a mass scale than to provide for a corresponding increase in the quantum of balanced poultry feed. This is a more complex problem involving the local availability of scores of feed ingredients, some of which like stabilised vitamin mixes and trace mineral supplements may have to be imported.

As has been previously mentioned poultry require large quantities of cereals which must be in the form of coarse grains, supplies of wheat in Pakistan being barely sufficient to meet the requirement for human consumption. The major coarse grains used in Pakistan for poultry feed are maize and sorghum. The production pattern of these grains over the past ten years is depicted in Figure 3, from which it would appear that the total production of these two grains has increased only from 0.7 million tons in 1960 to 0.9 million tons in 1970. The small increase is due to the fact that the high yielding varieties of these grains have not yet been popularized in the country as has been the case for wheat, the production of which increased from 4.5 million tons in 1965 to 7.2 million tons in 1970.

If all the present production of coarse grains were to be diverted to balanced feeding of the entire poultry population of Pakistan in confinement, it would still fall short of full requirements. However, since the bulk of the poultry population in rural areas lives on waste food, it should be possible to use the available supplies from coarse grain production for feeding only the commercially produced four million chicks. Any planned future increase in commercial stocks would necessitate a further increase in coarse grain production of maize and sorghum by the introduction of high yielding varieties. The projected maize production during year 1975 would produce an additional one million tons of grain at an estimated average yield of 30 maunds per acre against the present 10.8 maunds per acre. Similarly sorghum production is projected to produce another one to 1.5 million tons of grain during the fourth plan period averaging 30–35 maunds per acre compared with the present yield of five to seven maunds per acre.

Government is also making efforts to stabilize the prices of other raw materials used in the manufacturing of poultry feeds. Modern abattoirs are being established at Karachi and Lahore, while one has recently been established at Islamabad. These abattoirs will have facilities to process slaughter house waste products like blood, offals etc., which would help in providing better sources of animal proteins at cheaper rates. One of the fish meal manufacturing concerns has started producing feed grade fish meal of 50–55 per cent protein content. Similarly the supply of vegetable protein ingredients is improving with establishment of vegetable ghee/oil industries.

In view of the shortage of locally produced coarse grains to meet the rising demands of the poultry industry in Pakistan, 105,000 metric tons of maize and sorghum are to be obtained from the World Food Programme. This will ensure that the price of poultry feeds is kept at a reasonable level. The grains received under the above programme are supplied to recognised feed mills at a subsidised rate, and the mills in turn reflect this concession in the prices demanded for their poultry/broiler feeds. In the fourth year of operation, when it is anticipated that almost self sufficiency will have been reached in the production of grains, funds generated by the sale of World Food Programme grain in previous years will be further utilized to stabilize prices of feed. Government will purchase locally produced grains and make them available at a reduced price to supplement the purchase by feed mills at normal prices. If considered necessary these funds will also be utilized for the further development of the poultry industry in the private sector.

Nutritional problems

The nutritional problems facing the poultry industry of Pakistan may be summarised as follows:

1. A shortage of coarse grains which is (as mentioned above) being temporarily met by importation under the World Food Programme.
2. Non-availability of micro-ingredients such as vitamin mixes, trace element supplements and antibiotic additives, which are essential if the full productive potential of intensively reared modern hybrid poultry breeds is to be realised.
3. Lack of regular supplies of animal protein, such as slaughter house by-products (blood, meat and bone meals) and fish meal, making it difficult to ensure that feeds contain adequate amounts of lysine.

Figure 1
Poultry feed production in Pakistan 1960–1970

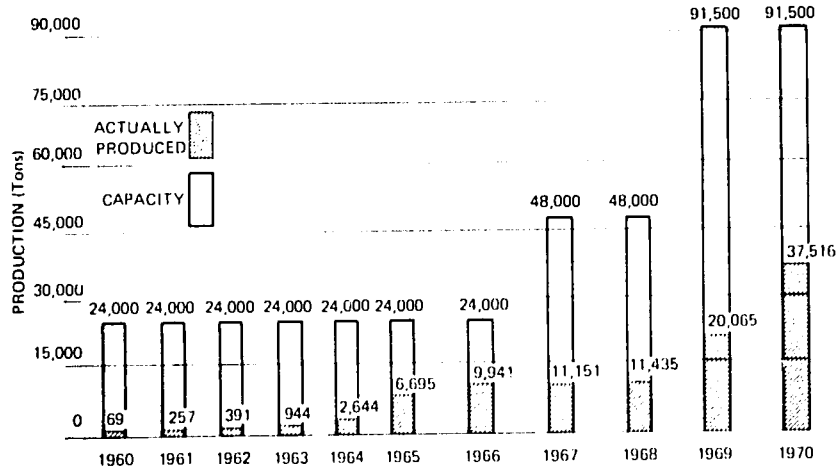


Figure 2
Growth of commercial hybrid chick production in Pakistan 1964–1970

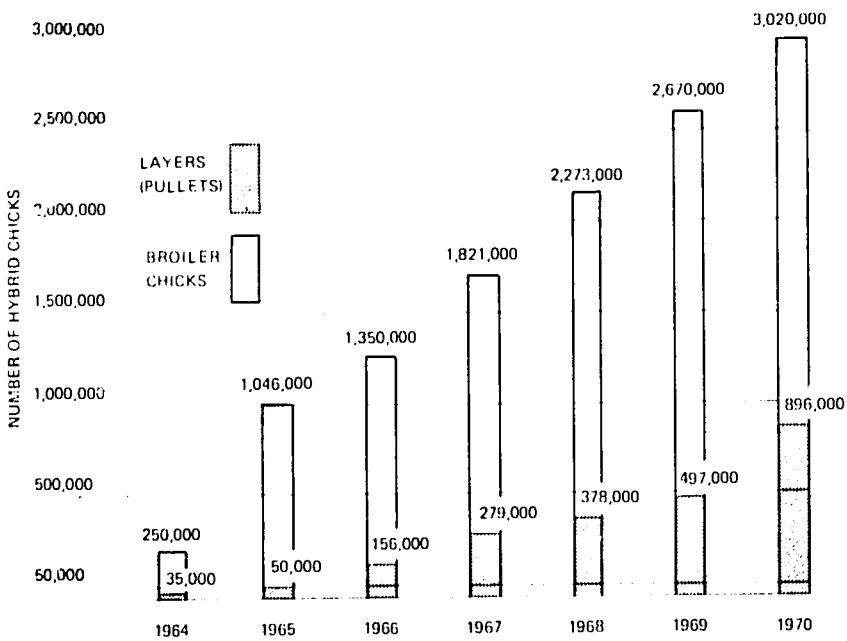
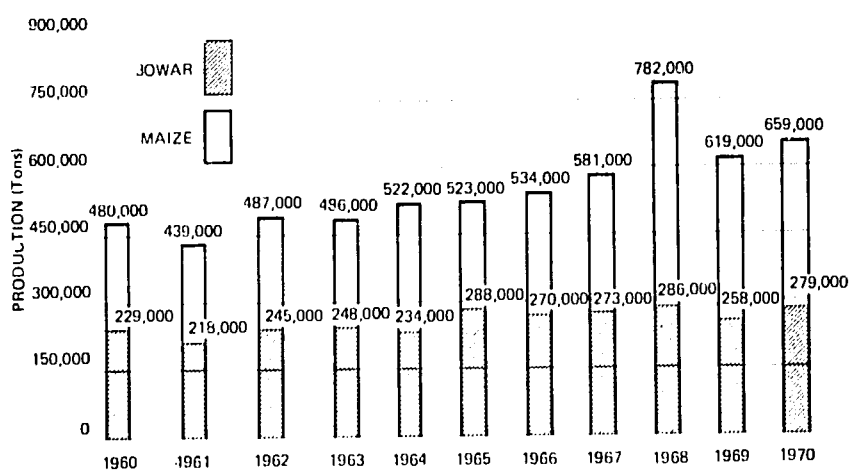


Figure 3
Production pattern of course grains in Pakistan 1960–1970



4. There is at present a complete lack of legislation to enforce standards for each raw material without which quality control of mixed feeds cannot be ensured.

5. There is a problem of lack of proper storage facilities for mixed poultry feed with the result that under severe tropical climatic conditions oxidation of feed ingredients takes place with a resulting loss in quality.

Measures to overcome problems

1. The shortage of coarse grains can be made up only by introduction of high yielding varieties of maize and sorghum in the grain producing areas. There has been some introduction in parts of the country and a research institute is working in the Punjab exclusively on evolving better maize and sorghum varieties. Its work could be extended all over the country to produce a sizeable effect in the way of boosting the coarse grain production.

2. The problem of additives requires the grant of adequate foreign exchange to the feed manufacturers for the import of stabilized vitamins, mineral and antibiotic supplements to make the feed balanced in all respects. Efforts being made to prepare alfalfa or berseem meal in adequate quantities to provide vitamin A and improve the texture of feed would go a long way to bridge the gap in the shortage of vitamins in the feed.

3. The shortage of animal protein can be overcome by both increasing the processing of slaughter house wastes into blood and meat meal and increasing the production of fish meal. At present very little slaughter house waste is utilised as animal feed, and it is vital that this situation be improved by the establishment of rendering plants. There is considerable potential for increasing fish meal production especially in West Pakistan where a new fish harbour is being constructed at Gawadar on the Mekran Coast in Baluchistan.

4. The need for effective legislation to enforce quality control of feed ingredients in mixed feeds is paramount, and would be of great benefit to poultry producers who have at present no way of knowing the authenticity of mixed feeds and are at the mercy of feed manufacturers completely.

5. There is a great need for the building of proper storage facilities for protection of mixed poultry feeds, which cannot be kept for long periods under hot and humid tropical conditions. A Government subsidy or arrangements to store poultry feeds along with other grains held for human consumption could be considered in this connection. At present it is not possible to have proper storage facilities for individual poultry producers and the storage at feed manufacturing plants is also not adequate, with the result that mixed feeds cannot be stored in quantity resulting in delay in meeting supply orders from the field.

Future development of feed resources in relation to poultry production

The main factor which would contribute to the development of feed resources in Pakistan would be the boosting of coarse grain production by the introduction of high yielding varieties of maize and sorghum along with other inputs like irrigation water, fertilizers and pesticides also needed to achieve increased production. The projected increase in the production of coarse grains from the present 0.9 million tons to three million tons by 1975 would also result in the need to set up more feed plants so as to increase their capacity from an existing production of 91,500 tons to 251,817 tons during 1975. This increased production of feed is estimated as the basic requirement in relation to plans to effect an increase in annual production of broiler and layer chicks from the present four million and one million to 13 million and 4.5 million respectively in 1975 as depicted in Table 1.

Table 1
Production of broiler and layer chicks in Pakistan

Year	No. of broiler chicks	No. of layer chicks
	1,000,000	*1,000,000*
1970–71	4.00	1.00
1971–72	7.00	1.75
1972–73	9.50	2.50
1973–74	11.25	3.50
1974–75	13.00	4.50

The projected increased production of commercial hybrid chicks is based on plans that have been finalized or are under negotiation to increase the weekly production of baby chicks by 0.125 million over and above the existing combined production of 0.25 million chicks per week by the four concerns currently operating in Pakistan. Table 2 gives the future production plans of the existing four hatcheries in Pakistan.

Table 2
Production of existing hatcheries

Year	No. of existing hatcheries	Production of chicks per week
1971	4	247,000
1972	4	320,000
1973	4	418,000
1974	4	548,000
1975	4	679,000

The salient difficulties that may be identified as obstacles to the planned future expansion of poultry production in Pakistan are allied to the expansion of poultry feed industry in many ways. Foreign exchange will be required to import the machinery needed for the expansion of a modern poultry industry including feed mixing mills, incubators, brooders, egg graders as well as feed additives, drugs and medicines. Similarly the inescapable need for the establishment of modern

slaughter houses and rendering plants will also inevitably result in the expenditure of much foreign exchange for the import of machinery. The future development of feed resources and poultry production plans will also result in the need for trained manpower and technicians as well as scientific workers, without which a sophisticated industry like the poultry industry with exacting needs of nutritional, breeding, managemental and disease control cannot succeed.

Another difficulty that will be faced by the growing broiler industry will be the lack of packing plants and storage facilities for the frozen chicken. Without the provision of these facilities it is very doubtful, if the increased production of broilers could be marketed. The previous experience in Pakistan shows that broiler production cannot succeed by marketing live chickens, which is a hazardous, inefficient, and uneconomical process. The packing industry would further have to overcome the problems of consumer appeal and a distaste for frozen chicken by proper salesmanship and consumer education.

The crucial problem of rising feed prices would have to be constantly examined so as to make and maintain the status of poultry production on an economic basis. The present method of subsidising mixed feed by supplying grain at cheaper rates cannot be treated as a panacea for all times, and the ultimate test of success and failure in the poultry industry in Pakistan will depend on whether a similar revolution in coarse grain production, oil seed production and animal protein production can be ushered in as has the green revolution in wheat production. Without the above steps it will be extremely difficult to ensure the future progress of the poultry industry (also the feed industry) as intensively reared poultry directly compete with humans for feed resources in developing countries like Pakistan. In this connection Pakistan has only recently become self sufficient in the production of cereals for human consumption.

Finally another problem will emerge as commercial hybrid chickens multiply, in that after saturation of markets around big cities it will not be profitable to extend it to rural areas, where most of the poultry production is being undertaken at present. This is because the hybrid needs special conditions of management, feed and disease control, which are not available in rural areas. In other words the livability of commercial chickens is very low compared to native bred poultry under rural environs, the latter being more hardy and of a rangy type.

In order to improve the genetic potential of rural chickens experiments were conducted to evolve a cross bred strain suitable for being reared under harsh rural conditions, yet potentially more productive than the present unimproved chicken. This crossbred chicken which involved the native chicken and three exotic breeds viz the White Leghorn, New Hampshire and White Cornish has been developed at the West Pakistan Agricultural University, Lyallpur and named as the Lyallpur Siver Black after its plumage colour. This chicken has a production potential of 150 medium eggs per year as against 75 small eggs from native chickens under rural conditions, weighs one lb more at maturity than the native chicken and is 30 days earlier in maturity than the native bird. Side by side with the establishment of commercial poultry industries around big cities the newly evolved breed for rural areas will be introduced as tailor-made for village conditions so as to have maximum utilization of waste food available in the rural areas. Needless to say well planned disease control operations will be provided to the rural poultry industry against major poultry killers like Newcastle Disease, which is a common threat to all types of poultry. On the other hand the newly evolved rural type is much more resistant to lymphomatosis and chronic respiratory disease, which takes quite a heavy toll of commercial hybrids reared under hot tropical conditions, which act as a stressor to the heavy production oriented strains of poultry.

Report on Fourth Session: Poultry nutrition

Chairman, Dr W. Bolton

1. The Conference noted that birds were kept under two completely different conditions: those kept in the villages, and those kept intensively in commercial enterprises.

Birds kept in villages

2. It was recognised that there was no competition between sheep and poultry and that improvement of yield from the two species could proceed in either case without jeopardising the other.

3. It was agreed that the most economical way of producing eggs was by the use of village birds because the cost of production was zero.

4. The Conference accepted that the indigenous village bird was well adapted to the conditions under which it lived. It was a good forager and a good mother, especially in protecting its chicks from predators. It was relatively resistant to the local protozoan diseases and required less medication to survive. It was also agreed that, within the Region, people usually preferred the meat of local birds to that of modern hybrids because, with their methods of cooking, the flesh remained firm.

5. There was some discussion on the attempts which had been made to upgrade local breeds by the introduction of White Leghorn cockerels in the villages. These had been singularly unsuccessful mainly because of their very poor disease resistance, relative lack of aggressiveness and their white colour which made them an easy prey for predators.

6. The Conference recognized that the relationship between the cost of the feed supplied and the value of the eggs produced was a sigmoid curve and that a large increase in production could be obtained for a small outlay on feed. Therefore the supplementation of the feed supply of the local bird obtained by foraging with a small amount of grain would most probably result in a large percentage increase in egg production. Since village birds formed the major proportion of the total flock in the CENTO countries such supplementation could have the greatest impact on total egg production.

7. The Conference recognized that eggs from the local breed possessed strong shells and were therefore well suited to transportation to the markets. It was, however, apprehensive about the low returns to the farmer from the present system of marketing and considered that the encouragement of farmers by the extension services to form co-operative marketing groups covering one or a number of closely situated villages, would be of enormous value to the village community.

8. It was considered that further benefit could be obtained by the gradual replacement of the indigenous birds by improved breeds which had been proved to stand up to village conditions.

Commercial chickens

9. The Conference recognized that commercial poultry production was located near to large centres of consumption and that these birds formed only a small proportion of the total flock in the Region. Even so there was a problem in supplying sufficient feed of adequate quality to meet the demands of these birds.

10. In the commercial flocks in this Region the bird of choice was the White Leghorn hybrid; coloured breeds had not done so well under intensive systems practised by the commercial producers.

11. It was clear that the main problem in commercial poultry production was in the compounding of adequate diets from indigenous materials, largely due to the short supply of protein-rich supplements. Such compounding was further complicated by the lack of knowledge of the nutritional requirements of the birds under the prevailing climatic conditions. Tables produced in other countries showed discrepancies in certain respects. This may have been due, in part at least, to the terms of reference given to those responsible for the preparation of the recommendations. Thus, in some cases,

Previous Page Blank

those concerned may have been asked to set out the requirements of the bird, and in others the amounts of various nutrients that should be put into the feed, making due allowance for losses during manufacture and storage, so that when the feed reached the bird it would contain sufficient of the nutrients to satisfy its needs.

12. The Conference discussed at length the protein supplements and potential protein supplements available in the Region.

13. It was noted that the main protein concentrate in the Region was cottonseed meal. Due to the method of processing the gossypol, gossypurpurin and about 10 per cent of the oil, which contained cyclopropanoid fatty acid, remained in the meal. Newer methods of extraction removed these and did not render the lysine non-available, as did the older methods. When the current methods of extraction were used cottonseed meal could form about 10 per cent of the diet of non-laying birds, e.g. growing stock, but levels as low as 5 per cent caused discolouration of the yolk and albumen when such diets were fed to laying hens.

14. A very important point brought out in the discussion was that the cost of the plant necessary to process the cottonseed by one of the newer methods would be recovered in a very short space of time from the value of the extra oil obtained and by making available a valuable feed for all classes of poultry, including laying hens. The cost of the plant would probably be comparable to the amount which was already, or would be, spent in obtaining adequate quantities of imported protein concentrates to meet the demand in one year.

15. The amount of soya bean meal produced in the Region was small and the discussion led to the suggestion that farmers should be encouraged to grow the crops with which they were familiar, e.g. sesame and sunflower, rather than unfamiliar crops such as soya. It was also pointed out that when oilseeds were made into feed they should first be decorticated.

16. It was noted with satisfaction that in some parts of the Region the production of fish meal was to be increased. However the Conference realised that it was doubtful whether this increased amount could meet even the present demand for the product.

17. It was felt that more use should be made of dead animals, slaughterhouse and broiler packing station offal and of hatchery waste. It was, however, noted that in some areas and at certain times of the year the collection of dead animals for processing was so difficult as to render it impracticable.

18. Delegates were interested to hear that in some countries, e.g. the United Kingdom, experiments had shown that good production could be obtained from all-vegetable diets and that in one of these experiments barley was the main cereal and the field bean, *Vicia faba* was the main protein source. This work had demonstrated that the addition of animal protein supplements to poultry diets was not essential for good production.

19. The Conference was strongly of the opinion that expenditure by a country on research, development and advice was normally an extremely profitable investment. For instance, it had recently been calculated that in the United Kingdom the cost of poultry production in 1969, using 1969 technology, was £260 million but that, had the industry been forced to use 1939 technology at 1969 prices, the cost of production would have been £370 million. The total benefit to the United Kingdom poultry industry of research, development and advice in the 30 year period was estimated as exceeding £500 million.

20. It was recognized that in the CENTO countries, as in the more highly developed countries, expenditure on development, otherwise known as applied research, would show the greatest yield in the short term but that it was essential for it to be backed up by expenditure on advice from the extension services.

Fifth Session

Production and marketing of compounded feeds

Chairman

Mr. R. K. Peberdy,
Technical Manager,
Messrs J. Bibby Agriculture Ltd,
Liverpool

Production and marketing of compounded animal feeds

R. K. Peberdy
Messrs J. Bibby Agriculture Ltd, Liverpool, United Kingdom

Introduction

In talking about the making and marketing of complete or supplementary animal feed it seems, from reference to the other papers given in this conference, that we must cover the whole range between raw materials (converted from nutritional requirements) and the feed being offered to the animal.

In a well developed agricultural system this range involves many specialised disciplines, which may be summarised as follows:

1. Raw material procurement involving a knowledge of raw material quality availability, cost and methods of procurement.
2. Formulation, which requires the above knowledge coupled with detailed nutritional analysis of each raw material and the finished feed nutrition standards, and involves calculation, which is usually performed on an analogue or a digitional computer, in order to provide a formula which satisfies all of the constraints at least cost.
3. Transportation of the raw materials to the mill in such a way that the handling storage and stock finance costs are at a minimum.
4. Manufacture of the feed involving the use of production and engineering specialists in locating, sizing and operating the mill so that the feed is produced to the required standard at minimum cost.
5. Transportation of the feed to the livestock involving decisions of whether it shall be in bags or in bulk, and how it shall be handled at the mill and at the livestock end seeking again the least cost system.
6. Handling the feed at the farm or livestock enterprise.
7. Marketing, which involves a knowledge of the current and future demand for feed, and sets a programme for the whole operation.

Where to start

In covering such a wide range we must start somewhere if we are to approach the best arrangement in organising and developing feed business. It seems obvious that first it is necessary to assess the demand for feed. Now this is a difficult job in any circumstances and the circumstances with be different in all of the countries represented here.

You will not expect me to assess this demand today but it must be assessed both now and for the foreseeable future before committing capital and operation costs. However difficult this job is it must be done as well as possible. It is not as simple as saying 'we have a growth rate of 20 per cent per annum and therefore our business will double in four years, we had better start building a big feed mill now',

Things are never quite as simple as that. Development plans must be laid on coldly assessed current and future demand estimations by the right people, and the various marketing functions eventually involved are set out in Appendix 1. Having assessed the feed demand both in size and location it is then necessary to decide how it shall be satisfied at least cost by providing new or modifying existing feed production resources.

Assuming feed production resources are required then the problem of where they are to be located arises. It is necessary to locate and size the feed mill or mills so that the total cost raw materials, transport feed manufacture, finished product transport and selling costs can be at a minimum.

Techniques of mill location

Developing the outline given above, the first task is to mark off on a suitable map the location of current and future estimated demand for feed. It then becomes necessary to specify the sources of all possible raw materials and their cost at these sources. It is reasonable to assume that there are a number of possible locations for the mill to make feed and it is necessary to make calculations of the cost of satisfying the demand using various sizes of mill at various locations with a knowledge of all the costs involved. Some notes on the various costs are given below.

Previous Page Blank

Raw Materials

The sources, availability and costs of raw materials is a specialised study in any particular country. A list of raw materials used in the making of feed in countries with well-developed agricultural systems is given in Appendix 2.

The important feature of raw material cost is that the actual cost in any given feed mill location is determined by the formulations used. It is not enough to only compare the costs of individual raw materials between two particular locations, it is also necessary to convert these into a set of least cost formulations at the two locations.

Transportation Costs

In calculating the costs of transport for raw materials to the feed mill and finished products to the livestock, it will be necessary to assess the fixed and variable charges so as to be able to make comparable estimations of costs between various alternative journeys when considering a number of sites for feed mills, a number of alternative sources of raw material and delivering the feed to the livestock.

Appendix 3 gives a breakdown of the elements of cost incurred in operating a lorry fleet.

Making the feed

The cost of making feed is dependent upon the proportion of feed made in pellet form, the degree of utilisation of the mill, the number of different types of feed produced, the degree of mechanisation, the proportion of finished product to be delivered in bulk, the cost of energy (electricity and boiler fuel) and the cost of labour.

Appendix 4 sets our the elements of cost in making feed and gives two examples.

Having assembled all of the cost data outlined above it is possible to make total cost estimations of a number of possible solutions to the problem of where and how large shall the feed mill or mills be. The various solutions can be compared and the best choice made to give the best return on the capital involved.

The feed mill

There are so many different types of feed mills that one can write a separate paper on each type, a summary of the different types is given as follows:

1. The large comprehensive type built at a port taking its imported raw materials direct from dock facilities and producing a complete range of feed for distribution over a wide area. The advantages of such a mill are claimed to be minimum cost of importing raw materials, availability of suitable labour taken from an industrial area and the availability of a reliable source of various services (electricity, engineering, etc.).

   The disadvantages are high capital cost, high managerial and labour costs and high distribution costs from the mill to the livestock.

2. A smaller mill located nearer to intensive pockets of demand and/or sources of local supplies of raw material. The advantage of such a mill are a smaller capital, operating and distribution cost. The disadvantages are a remoteness from the necessary services and the high cost of imported raw materials to the mill.

3. The specialised mill built at or near intensive livestock units making feeds for these units only. The advantages are low capital and operating costs and finished product distribution cost (which can be zero). The disadvantages are inflexibility if changes are made in the livestock units, the possible remoteness from reliable services and the high cost of transporting imported raw materials.

4. Mobile mills built on large vehicle chassis which carry supplements to be added to local raw materials available on the farms they visit. The advantages are low capital and operating costs and simplicity. The disadvantages are limited capacity and the non-productive time taken up in journeys between farms.

   It is probably unlikely that you will develop into the use of large feed mills located at the ports, since you should learn from the mistakes made by other countries which have a highly developed feed business. Here large mills located at the ports are acknowledged to be a mistake and there is a steady move towards smaller mills being built where they are required, and where the total cost solution discussed earlier in the paper demands that they should be.

   It is also unlikely that a large proportion of your feed business will be satisfied by using mobile mills.

   Strategically placed mills of medium size producing a general range of feeds and the specialised mill which is built to satisfy the particular demand of a well-developed intensive livestock unit, are the sort of mills which you are most likely to be concerned with.

The business of making animal feed has, however, certain common processes no matter what the size of the mill. Firstly it must be capable of receiving raw material which will involve a weighbridge, a mechanical conveying system to accept the materials which arrive in bulk or are to be converted to bulk at the point of intake, and a means of off-loading bags of raw materials which are received in this form and are to be stored in this form. The mill must also have sufficient space to store these raw materials both in bulk and bagged form.

The main purpose of the feed mill is to proportion the raw materials according to the formula to make a particular feed, and this it must do to acceptable standards. There is a considerable difference in price between the cheapest and the most expensive raw material, and if the operation is to be economically viable and if the standards of the finished products are to be acceptable, then each raw material must be accurately proportioned. In nearly every case this means weighing the correct proportions of

each raw material for each batch of feed made.

The proportioned batch must then be thoroughly mixed. Whilst it may be theoretically possible to get a perfect mix, in actual practice perfection is not obtainable (and probably cannot be measured any way), but a reasonably safe criterion would be to say that a micro ingredient should be present in any four oz batch of finished product to within ten per cent of its stated inclusion rate for 95 per cent of the samples taken. It will of course be necessary to reduce the particle size of those raw materials which arrive at the mill with particles which are too large to be included in the finished product. This grinding operation can take place either before or after proportioning.

Liquids such as molasses and fats must be added to the dry matter either in the main mixer operation or in a separate process after the major mixing has taken place.

Weighing and packaging of the mash must be performed on that portion of the mash, which is sent out packaged, and suitable storage bins must be provided for the various brands of mash which are going to be delivered in bulk. These bulk bins must be so located that they can discharge readily into vehicles which will take them to the farms or livestock units.

Product which is to be formed into pellets or broken pellets known as crumbs must be passed through a conditioner where live steam is added, and the conditioned mash is fed into a press which extrudes the product under high pressure through a die to make pellets. The product must be cooled, cleaned on a sieve to take out unacceptable fines and then weighed and packed or delivered to bulk bins in a similar manner to that described for mash. If the product is required in crumb form then there is an additional process after cooling to cut the pellets into smaller pieces before the screening operation. All of the above operations are common to all mills making animal feed. If we are to proceed in discussing feed mill design and operation then we must take a more detailed and specific look at mills designed to produce a stated number of brands of feed of a particular type and at a particular rate.

Additives

The preparation of raw materials used at low inclusion rates (say less than 1 per cent of the mix) tends to be a specialist business but it need not be. Some feed manufacturers purchase each of such ingredients and make up the complete formula. Others purchase premixes of the small usage ingredients for addition to the main ingredients.

If the scale of feed demand is sufficient then it eventually becomes attractive to buy each small usage ingredient at a competitive price and then prepare, either at a centralised point or at each mill, a pre-mix of these ingredients for addition to the main raw materials used in making a batch of feed. All that is required is a system for procuring these additives, a means of weighing each one at the required dosage and a means of adding them to the main mixer, assuming of course that there is sufficient knowledge of the use of such materials to decide upon the inclusion rate of each one.

Formed feed or mash

I will not intrude upon the nutritionist's views on the advantages of formed feed over mash (or vice versa) in producing improved feed conversion rates but there are some features which are important to the feed mill. Equipment to produce formed feed (pellets) is expensive and requires a supply of steam, and operators to man the equipment. This clearly is a cost disadvantage. There are however advantages which must be evaluated and carefully compared with the additional capital and operating cost of the formed feed plant.

These are as follows:

1. With formed feed there is more freedom in choice of raw materials in that the process permits a wider particle size vartiation and more freedom on liquid addition
2. Formed feed is denser than mash and therefore incurs a lower cost of distribution.
3. There are fewer problems in handling formed feed and a bin which is used for bulk storage at the mill or livestock unit is cheaper, per ton stored, than one required for storing mash.

Quality control

1. *Nutritional Quality*

It is obviously desirable to know that a feed possesses the nutritional values which have been designed into the formula. There are two basic ways of ensuring this, and these are as follows:

a. The first method is to monitor the nutritional values of the raw materials and the operation of weighing at the proportioning stage. Given adequate mixing then the finished product will possess the designed nutritional values within a defined and calculable variance.

b. The second method is to sample the finished product and compare the results of the assay with those stated on a control chart to see if the nutritional values are within acceptable limits previously calculated.

The major trouble with the second system is that by the time the results of the assay are available the feed may have been eaten by the livestock and the results appear to have somewhat limited value. Certainly the best method is to monitor the raw

material nutritional values (updating the data used by the formulator as required) and to control the weighing operation at the proportioning stage in the manufacturing process. The use of mechanised weighing equipment at this stage provides the facility of recording the actual weighments of each raw material which passes through the weigher, thus providing a precise knowledge of the feed quality and incidentally the use of raw materials.

The control chart referred to above is simply a method of stating what value is desired and what variations above and below this are permitted.

2. *Physical quality*

For a mash a physical specification is usually stated as a particle size range with permissive tolerance, and control is exercised in choice of raw materials and degree of particle size reduction in the grinder.

For formed feed the specification will state the physical dimensions together with a permissive tolerance and also a measure of the durability of the formed feed. Control of durability is in choice of raw materials, degree of conditioning prior to the press the rate of feed to and the characteristics of the die in the press.

General comments

The making of animal feed from suitable raw materials is a relatively simple process. However, like all other processes it has its know-how in the process, plant design and operation. It would for example be seeking trouble to feed wet beet pulp into a silo designed simply for storing cereals and it is difficult to make firm pellets from a feed containing 75 per cent molasses.

The know-how on animal feed manufacture is a fairly common commodity in many countries and there are mills in countries all over the world designed and built by UK, Swiss, German, Dutch engineers and engineers from other countries. Many of the problems of feed mill operation result from inadequate specifications of what is required from the mill and what raw materials are to be used. A typical set of specifications for a feed mill are given in Appendix 5. This sets out simply what goes in as raw materials and what must emerge as finished product, and would be followed by detailed specifications as to the major items of plant required.

Finally, the steps involved in setting out to build or develop a feed manufacturing operation may be summarised as follows:

1. Decide upon the current and most likely feed market which you intend to satisfy.
2. Do a complete cost exercise on where to locate and how big the mill or mills shall be.
3. Take care in specifying precisely what the mill is to do – its raw materials and the finished product requirement in form, quantity, number of brands and how it is to be handled.
4. Design a complete system of raw material procurement, least cost formulation, transportation, manufacture, stock control, finance, marketing and selling.
5. Appoint an effective manager, and train him, his staff and operators well.

Appendix 1

Marketing functions

1. Marketing research

Finding out who and where are the potential purchasers and what are the factors which influence their buying decisions – a continuous gathering, analysing and interpreting of facts and opinions.

Comprises:

1.1 Size and location of markets.
1.2. Attitudes, preferences and needs regarding company products, product service and marketing policies.
1.3 Sales and distribution methods, channels and territories.
1.4 Price indices, price trends, product pricing.
1.5 Sales and advertising programmes.
1.6 Industry sales forecasts.

The gathering of information is done through:

1.7 Desk research.
1.8 Field research.

2. Product planning

Products become obsolete and new products are needed at the right place, the right time, the right price. Overall objectives must be set and attained and must be within the guide lines of company philosophy.

Comprises:

2.1 Control of products.
2.2 Integrating, planning and timing: additions, eliminations and modifications.
2.3 Formulation of pricing, discounts, conditions, terms and permitted costs.
2.4 Product function and quality level.
2.5 Appearance, identification, packaging.
2.6 Simplification, standardisation, adaptation.
2.7 Appraisals: competitive offerings, markets, buying motives, and plans and results.

3. Marketing strategy

3.1 *Advertising and sales promotion.*

Creating a demand for the product by planning and implementing effective combination of advertising and sales promotion. This involves their creation and scheduling: and their co-ordination with other marketing functions.

Comprises:

3.1.1 Creative advertising development.
3.1.2 Media relations.
3.1.3 Copy research.
3.1.4 Exhibits and displays.
3.1.5 Product publicity – print.
3.1.6 Advertising business procedures.
3.1.7 Production and distribution.

3.2 *Sales*

This includes sales management, sales planning and selling.

Management:

3.2.1 Sales analysis and control.
3.2.2 Sales training.
3.2.3 HQ and field sales management.
3.2.4 Carrying out pricing, discounts, conditions and terms.

Planning:

3.2.5 Sales objectives and policies.
3.2.6 Product sales analysis.
3.2.7 Sales and merchandising programmes.
3.2.8 Planning and recommendations of sales and distribution channels.
3.2.9 Analysis of needs and recommendations on pricing, discounts, conditions and terms.

Selling:

Meeting the buyer head on.

4. Marketing (administrative) services

This function serves marketing management and all other functions of marketing by providing facts, tools and procedures for effective and efficient operation.

Comprises:

4.1 Sales forecasting (and targeting).
4.2 Sales budgets.
4.3 Sales records and statistics.
4.4 Marketing expense budgets, analysis and standards.

5. Marketing personnel development

Overall personnel administration work in marketing.

Comprises:

5.1 Training.
5.2 Development.
5.3 Selection and recruitment.

List of raw materials used in animal feedstuffs in the United Kingdom, Europe and USA

Cereals

Barley (whole or rolled)
Wheat
Maize (whole or flaked)
Milo
Oats
Peas
Rye
Millet
Beans
Rice

Cereal by-products

Barley flour (de-hulled)
Grain screenings
Malt culms (brewers grains)
Wheatfeed (pollards)
Rice meal or extract

Extracted oilseed meals

Cotton seed extract
Groundnut extract
Rape extract
Soya extract
Sunflower extract
Maize germ extract
Maize gluten extract
Palm kernel extract
Olive extract

Animal protein

Meat meal
Blood meal
Fish meal
Feather meal

Expelled oilseed cake

Cotton cake (undecorticated)
Cotton cake (decorticated)
Groundnut cake
Sesame cake
Guar cake
Linseed cake
Palm kernel cake

Other materials

Citrus pulp
Locust beans
Carophyll (synthetic colouring material)
Grass and forage crops
Sugar
Sugar beet pulp
Biscuit
Potato flakes
Dates (de-stoned)
Cocoa meal
Coffee waste
Grape pomace
Tea leaves
Totanin
Urea
Milk by-products (skimmed dried milk and whey)
Synthetic amino acids (methionine and lysine)

Minerals

Limestone (granular or flour)
Dicalcium phosphate (bone meal)
Salt
Ferrous sulphate
Copper sulphate
Zinc sulphate
Zinc oxide
Potassium iodide
Magnesium sulphate
Manganese sulphate

Liquid Additives

Molasses
Oils (or fats)

NB In addition to the above various vitamins and drugs are used.

Appendix 3

Road transportation costs

A basis for assessing transportation costs when using a road vehicle fleet consisting of various numbers of vehicles of different types is given in the example set out below.

	8-ton flat bed vehicle	Bulk vehicles	Tractor/ trailer vehicles
Miles per annum	25,000	35,000	30,000
Fixed costs per annum	£	£	£
Wages	1,000	1,000	1,000
Depreciation over 8 years	200	600	500
Tax	90	188	198
Insurance	50	50	73
Running costs			
Fuel	417	596	565
Tyres	105	125	303
Maintenance	365	600	660
Fixed cost per annum	£1,340	£1,848	£1,771
Cost per mile	£0.03425	£0.03775	£0.051

Costs in producing feed

The elements of cost incurred in operating a mill to produce animal feed are outlined in the following two examples:

Example 1

Tonnage – related costs	At stated tons/week						
	1,500	1,900	2,000	2,400	2,600	2,800	3,000
	£	£	£	£	£	£	£
Salaries	345	365	370	378	383	389	395
Services (electricity, fuel oil, gas and water)	575	720	756	901	973	1,046	1,118
Purchases (except R and R)	200	248	260	292	306	318	330
Maintenace materials and die rings	345	437	460	552	598	642	690
Canteen, personnel and pensions	72	74	75	81	82	96	86
Insurance, rent and rates	216	220	221	223	224	225	226
Total:	1,753	2,064	2,142	2,427	2,566	2,706	2,848

Man-power related costs	In stated tons/week range					
	1,500–1,900	1,900–2,000	2,000–2,400	2,400–2,600	2,600–2,800	2,800–3,000
	£	£	£	£	£	£
Production wages	1,024	1,138	1,304	1,475	1,475	1,532
Maintenance wages	350	375	375	450	450	470
Total:	1,374	1,513	1,679	1,925	1,925	2,002

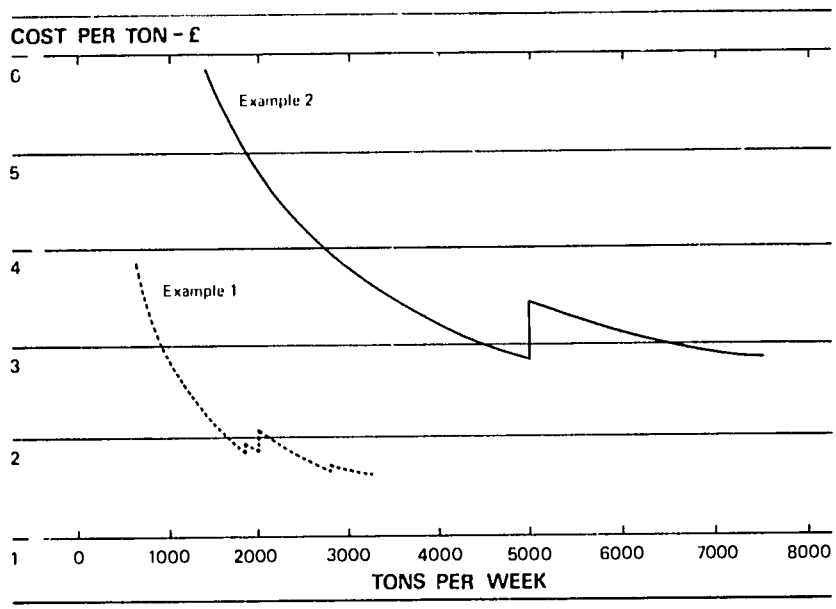
Example 2

Tonnage – related costs	At stated tons/week			
	4,500	5,500	6,500	7,500
	£	£	£	£
Salaries	957	1,150	1,150	1,150
Services (electricity, fuel oil, gas and water)	1,554	1,871	2,198	2,524
Other services	1,628	1,675	1,722	1,765
Maintenance, materials and die rings	889	1,089	1,287	1,485
Canteen, personnel and pensions	1,035	1,173	1,221	1,277
Insurance, rent and rates	699	699	699	699
Intake costs	2,025	2,171	2,711	3,099
Total:	8,787	9,628	10,988	11,999

Man-power related costs	In stated tons/week range					
	4,500–5,000	5,000–5,500	5,500–6,000	6,000–6,500	6,500–7,000	7,000–7,5000
	£	£	£	£	£	£
Production wages	4,446	5,558	5,780	6,002	6,356	6,668
Maintenance wages	1,489	1,654	1,744	1,834	1,924	2,009
Total	5,955	7,212	7,524	7,836	8,280	8,677

NB Plant depreciation is not included in costs in the above examples since the rate varies according to the financial policy of the particular company.

Figure 1
Manufacturing cost per ton (see Appendix 4)



General specification for mill of nominal capacity of 1,000 tons per week

Introduction

This specification gives only the basic data for the proposed mill, it is concerned with saying what is required from the mill rather than how it is to be designed.

Site

This is at least two acres and is nearly square, it is level to within six ft and is virgin land with a load bearing capacity of two to three tons per ft^2. There is a road along one side of the site.

An electricity supply of 11 kW and adequate capacity is available at the perimeter. There is a water supply at 40 lb per in^2 in a 2 in main in the roadway. A main drain exists in the roadway. Outline planning approval has been obtained for a normal animal feed mill structure.

Mill capacity

The mill is to produce 56,000 tons of animal feed per year. The demand will vary from an average of 1,250 tons per week during the seven cold months to 850 tons per week during the five warmer months.

It would be our intention to operate the plant with two fully manned day shifts (i.e. 06.00 to 14.00 and 14.00 to 22.00) and one partially manned night shift making the bulk, during the seven month cold period. During the five month warm period we would drop back to two day shifts. In this way we would require a capacity to produce 100 tons in each 8 hour shift.

In order to cope with product changes, meal breaks, etc. we believe that a figure of 75 per cent plant utilisation should be used, i.e. in every eight hour shift the plant would be producing at full capacity for at least six hours.

80 per cent of the demand on the mill is required as formed feed, i.e. $\frac{3}{16}$ in. pellets and crumbs of $\frac{3}{8}$ in. and $\frac{1}{4}$ in. diameter, while the remaining 20 per cent is required as a meal or mash.

Of the total demand 5 per cent will be $\frac{3}{16}$ in. pellets, 17 per cent in crumbs made from $\frac{3}{16}$ in. pellets, while 52 per cent will be $\frac{3}{8}$ in. diameter and 6 per cent $\frac{1}{4}$ in. diameter.

The mill should be designed to handle 50 per cent of its finished product output in bulk and 50 per cent in 56 lb multiwall paper sacks. The paper sacks would be palletised in one ton units. The bulk installation should be capable of extension to handle up to 60 per cent of the output.

It is our experience that bulk bins for finished product can be used 2½ times per week and that the bag warehouse should be capable of carrying one weeks stock with pallets stored two high. The mill should cater for 12 separate finished products in bulk form.

Raw materials

The following raw materials will arrive in bulk or be converted to bulk (if in bags) at the intake point:

Name of raw material	Weekly usage, tons Min.	Max.	Proposed stock level, weeks
Barley	250	500	1
Wheat	125	440	1
Maize and/or milo	50	150	1
Total cereal usage	750 tons		1
Grain screenings (soft pellets)	140 tons		1½
Fish (soft pellets)	40	50	1½
Grass (hard pellet)	12 tons		1
Wheatfeed (meal or pellets) (Pollards)	60	140	½ to 1
Groundnut (expelled cake or extracted meal)	20	50	1½
Extracted soya meal	25	45	1
Extracted rape meal	40	25	1
Malt culms	15	20	1
Limestone	25	45	1
Dicalcium phosphate	10	15	1

The following liquid raw materials will arrive in bulk and are to be stored in bulk:

	Weekly usage tons Min.	Max.	Proposed stock level, weeks
Molasses	25	70	1
Fat	2	10	1

(the minimum tank size for fat is 15 tons).

Other materials will arrive in bag form and will be stored in this form e.g. certain extracted meals and expelled cakes, locust beans, salt etc. up to a total usage of 40 tons per week with a proposed stock level of one week.

A range of additives and drugs will be used and it will be necessary to provide a suitable room for the preparation of additive pre-mixes. These pre-mixes are to be dumped into the appropriate batch of feed at a suitable point in the system.

We have a strong preference for a batch gravimetric proportioning and mixing system. It will be seen from the raw material list that there is a requirement to deal with 15 raw materials at the proportioning stage. In order, however, to deal with variations in raw material choice, we believe it necessary to provide for 20 individual raw materials at this stage.

Services

Weigh-bridge

A suitable weighbridge for weighing in of raw materials and weighing out of finished product is to be provided.

Office Accommodation

This is required as follows:

Five separate offices each approx 15 ft^2.

One general office of approx 400 ft^2.

One further office of about 200 ft^2.

together with suitable toilet accommodation and a mess room for mixed staff.

The offices could be of the portable building type.

Toilet and mess room facilities are also required for mill operators.

Steam

A suitable automatic boiler will be required to provide steam for the process plant and the heating, via a calorifier, for the office block.

Electricity

The site would require a suitable electrical sub-station complete with transformers and necessary switchgear.

Workshop

A tradesman's workshop of approx 300 ft^2 is required complete with bench, vice and pedestal drill.

General

The mill is to be designed to have a minimum fixed capital cost but regard should be paid to operating costs. Alternatives may be suggested which would lead us towards the optimum situation of minimum total cost i.e. capital and operating.

The price quoted is to be a complete total capital cost excluding the cost of the land.

It will be the contractor's responsibility to commission this proposed feed mill and to ensure that the capacity shall be capable of satisfying the demand stated in this specification.

The compound feed industry in Turkey

Orhan Üstunsoy
Turkish Feed Industry Corporation, Ankara, Turkey

The need for a compound feed industry

Turkey is a developing country, and like other countries in the same category it faces a large number of problems. Among them the food supply for meeting the requirements of rising population is one of the most noteworthy. Official statistics indicate an approximately 2.5 per cent yearly increase in population, and it is estimated that the population of the country might reach 62,000,000 by the year 1990. This figure is based on an average increase of 2.5 per cent between 1950 and 1970.

If the present rate of expansion in population is not restricted, Turkey will have a population density of 77 persons per km^2 in 1990, as compared with 26 in 1950. On the other hand, the pattern of land use will not remain unchanged. Demands for dwelling areas, factories, highways, etc. will certainly reduce the amount of cultivated land.

The decrease in the area of cultivated land per person as a result of the population boom leads us to the question of how we will be able to supply food for these rising numbers. The question is not only the supply of any food to the people but is to supply it in a better way. For the majority of Turkey's population, especially for those living in the rural areas, the normal daily diet consists mainly of plant products, and often a single product such as wheat bread. This type of diet is too unbalanced for human health and this situation needs to be changed rapidly.

The value of animal protein in meeting human requirements for protein is well known. Although diets adequate to meet requirements for essential amino acids can be obtained solely from plant products, by calculating the ration very delicately, it will be very difficult for the population as a whole. Morris (1945) has suggested 70 g per day as an optimal level of total protein, and 33 g as an optimal level of animal protein.

These optimal levels are based on recommendations which have been published by the National Research Council in the United States (NRC, 1948), and are useful as general guides[1].

The Food and Agricultural Organization (FAO) has published estimates of the total protein and animal protein contained in national food supplies of some 120 countries. According to the FAO publication *Production Yearbook, 1969* total protein consumption per person per day in Turkey has varied from 97.5 to 78.2 g between the years 1948 and 1966. These amounts are above the optimal level of total protein requirement, but the animal protein fraction of the total supply has always remained below the optimal level varying between 14.5 and 16.8 per person per day.

Against this background of a rising population and a decrease of arable land, a sound approach towards the solution of the problem of supplying food both in sufficient quantity and improved quality is through increased animal production. In addition to animal protein foods such as meat, milk and eggs, many other products of animals contribute to man's prosperity. Among these are animal fats, hides and skins, wool and mohair by-products of the meat-packing industry, manure and power. In spite of the increasing role of mechanisation in agriculture, the Turkish farmer still depends on his animals to a substantial degree as a source of farm power.

Although Turkey has a rather high animal population according to the official statistics shown in Table 1, yield per animal is often low. The Ministry of Agriculture has published a pamphlet (Turkey in Figures) giving the average yields of different animal products, per animal. The figures taken from this pamphlet are seen in Table 2. Also given in the same Table, for purposes of comparison, are figures for average yields per animal in several countries which have developed in the field of animal husbandry.

[1] R. W. Philips. The necessity of defining needs and establishing priorities for solution of animal production problems, world conference on animal production. Rome, Italy.

Previous Page Blank

Table 1
Numbers of animals in Turkey, 1951–69
Animal numbers (1000 head)

Years	Sheep	Ordinary goats	Angora goats	Cattle	Buffaloes	Horses	Donkeys	Mules	Camels	Pigs	Chickens	Turkeys
1951	24,832	16,531	4,370	10,395	967	1,173	1,713	110	107	–	20,307	1,285
1955	26,443	16,216	4,816	11,058	1,058	1,218	1,618	125	72	–	23,628	1,393
1960	34,463	18,636	5,995	12,435	1,140	1,312	1,891	170	65	10	27,164	1,675
1961	33,306	18,100	5,847	12,097	1,140	1,305	1,916	186	56	9	26,116	1,687
1962	31,614	16,420	5,655	12,662	1,159	1,238	1,800	207	52	8	26,614	1,716
1963	32,278	15,917	5,587	12,704	1,165	1,170	1,887	204	48	11	26,759	1,708
1964	32,654	15 599	5,563	13,211	1,202	1,209	1,998	216	46	17	28,395	1,669
1965	33,382	15,305	5,500	13,203	1,216	1,109	1,971	225	45	17	29,255	1,768
1966	34,663	15,315	5,617	13,769	1,253	1,204	1,996	238	42	16	28,449	1,796
1967	35,878	15,200	5,459	14,165	1,248	1,183	1,965	259	43	13	30,387	1,773
1968	36,587	15,187	5,450	13,761	1,257	1,151	1,986	273	42	14	32,020	1,955
1969	36,251	15,336	4,931	13,189	1,178	1,110	1,938	291	39	18	32,313	2,023

Note: Male and female animals in all ages included.
Source: Summary of Agricultural Statistics 1969. State Institute of Statistics, Ankara, Turkey.

Table 2
Average yield per animal per annum[1]

	Turkey[2]	United Kingdom	W. Germany	Nether-lands	Italy	Denmark	Spain	United States	Canada	Australia
Carcass weight (kg)										
Cattle	92	254	267	247	223	233	235	268	248	206
Buffaloes	135	..	..	..	160	..	..	..	..	..
Sheep	18	19	24	25	14	35	16	23	20	19
Goats	18	..	8	..	7	..	8	..	..	..
Angora goats	14	..	..	..	..	..	..	..	..	..
Milk (kg)										
Cattle	631	3,910	3,771	4,230	2,080	3,928	1,620	4,085	3,179	2,350
Buffaloes	850	..	..	..	..	..	..	..	..	..
Sheep	47	..	..	..	..	..	..	..	..	..
Goats	75	..	..	..	..	..	..	..	..	..
Wool (kg)										
Sheep (wool)	1.5	..	..	..	..	..	..	..	..	..
Angora goats (mohair)	1.6	..	..	..	..	..	..	..	..	..
Eggs (number)										
Native breeds	52	..	..	..	..	..	..	..	..	..
Modern hybrids[3]	170	139	152	205	..	235	..	211	..	..

.. Data not available
[1] Source : Production Yearbook 1969. FAO, Rome, Italy.
[2] Source : Turkey in Figures. Ministry of Agriculture, Ankara, Turkey.
[3] Source : Hy-Line, Euribred bulletin, 1965.

If a comparison is made between livestock yields in Turkey and in other countries, it is very clear that a big difference exists. Turkey needs to raise these animal yields nearly to the levels of other countries to improve its animal husbandry.

On the other hand, as will be seen in later paragraphs, the annual production of various kinds of feedstuffs is not sufficient to maintain a satisfactory level of animal yields. In order to secure the most efficient utilization of specific nutrients, in relation to species differences, and stage of development, it is necessary to be more careful in the formulation and compounding of feedstuffs. There exists also a need for careful assessment of input costs and output values, taking into account the economy of feed conversion. In Turkey, the compound feed industry was established 14 years ago mainly due to the above reasons.

Present situation of the compound feed industry in Turkey

There is no feedstuff which exactly meets the nutrient requirements of livestock, and which could therefore be used in its simple form. Moreover, feeding systems based on simple products often lead to wastage (e.g. rations over-rich in non-metabolized energy), or to the emergence of limiting factors (e.g. deficiency in amino acids leading to a drop in digestibility).

On the other hand, the need to facilitate the livestock producer's work and the desirability of obtaining a balanced diet, has greatly influenced the development of the compound feed industry[1]. The same reasons greatly influenced the establishment of the compound feed industry in Turkey in 1957. In that year a government organisation, the Turkish Feed Industrial Corporation[2], was set up to promote the feed industry of the country and extend technical know-how to those who were willing to establish feed plants. The Turkish Feed Industrial Corporation first planned to build eight compound feed plants with a capacity of 62,900 tons of feed on a single shift basis. Four of them (Istanbul, Ankara, Konya, Erzurum) belonged entirely to the government while the other four plants (İzmir, Bandırma, Eskişehir, Mersin) were established in partnership with the private enterprise. In 1969, two government plants (Adapazarı and Samsun) with a capacity of 15,000 tons each were also brought into operation. At present the total manufacturing capacity of the ten feed plants under operation has reached 92,900 tons of feed per year (single shift).

The rapid increase in sales of compound feeds produced by these plants has encouraged both the Government and private enterprise to build other mixed-feed plants.

Sales around Ankara and Istanbul increased so much that the plants located in these cities were not able to meet the needs of their regions for compound feeds, although they operated with double shifts daily. For this reason two modern feed plants, controlled with a punch-card system and with a capacity of 37,500 tons each, are presently being constructed in place of the old ones. Another similar type of feed plant with a capacity of 22,500 tons of feed is being constructed in Bursa. These three plants will start to operate by the middle of 1972.

Several other joint-venture feed plants are either under construction or at the project stage in Kayseri, Aksaray (Nigde), Biga, Manisa, Çorum, Kars, Sivas, Uşak and Isparta. These will have an annual production capacity of 135,000 tons of feed on a single shift basis.

Table 3 indicates the yearly production capacities of various compound feed plants which are either under operation, construction or at the project stage.

Apart from the feed plants listed in Table 3 several other plants belonging entirely to private enterprise are under operation in different parts of the country. It is not possible to obtain any reliable data on their capacities but, on a rough estimate, they possess a combined feed production capacity of 40,000 tons annually.

[1] Study on the factors influencing the use of cereals in animal feeding. O.E.C.D., 1971

[2] Its Turkish name is 'Yem Sanayii Türk A. Ş.'

Table 3
Manufacturing capacities of various compound feed plants in Turkey[1]

Plants	Capacities, metric tons
Under operation	
Government plants	
Istanbul	12,500
Ankara	8,400
Konya	8,400
Erzurum	8,400
Samsun	15,000
Adapazarı	15,000
Joint-venture plants	
Bandırma	8,400
İzmir	6,300
Eskişehir	4,200
Mersin	6,300
Total	92,900
Under construction	
Government plants	
Istanbul	37,500
Ankara	37,500
Bursa	22,500
Joint-venture plants	
Kayseri	15,000
Aksaray (Nigde)	10,000
Biga	15,000
Manisa	20,000
Çorum	15,000
Kars	15,000
Uşak	15,000
Isparta	15,000
Sivas	15,000
Total	232,500
Grand total	325,400

Source: Annual management reports of Turkish Feed Industrial Corporation, Ankara.

[1] Capacities are based on the production of 100 per cent lager pellets (4.8 mm) and per single shift per year.

Production trends

The first feed plant in Turkey started to operate in Ankara in 1958 and thereafter, the other seven plants entered into operation between 1959 and 1962. Samsun and Adapazarı plants are more recent, and commenced operation in 1969.

From 1958 the production of compound feeds showed fairly good development in certain plants. The development trend of compound feeds in respect of various plants between 1958 and 1970 is seen in Table 4, which shows clearly an ever increasing trend at most of the plants, with a most remarkable rise in the plant located in Bandırma. A closer examination of the table also reveals a slower development rate between the years 1958 and 1964 and a higher growth rate from 1965 to 1968. During the last two years (1969 and 1970) production seems to have increased at a slower rate.

Table 4
Annual production of compounded feeds in Turkey 1958–70

Years	Feed Plants										Total
	Ankara	Konya	Erzurum	İstanbul	İzmir	Bandırma	Eskişehir	Mersin	Samsun	Adapazarı	
	metric tons										
1958	391	194	–	–	–	–	–	–	–	–	585
1959	1,846	1,648	38	–	–	–	–	–	–	–	3,532
1960	3,745	1,323	366	356	–	–	–	–	–	–	5,790
1961	3,856	1,898	1,818	2,798	400	–	–	–	–	–	10,770
1962	4,910	3,045	2,984	3,729	1,492	406	462	342	–	–	17,370
1963	4,995	2,721	1,304	5,482	2,201	2,272	1,380	2,286	–	–	22,641
1964	6,332	2,760	1,307	7,694	3,189	4,715	1,757	2,989	–	–	30,643
1965	10,840	4,842	3,134	10,417	5,471	4,932	3,292	4,489	–	–	47,418
1966	13,324	6,831	4,063	15,302	7,837	8,653	4,458	4,864	–	–	65,332
1967	17,237	10,147	6,351	14,708	10,741	14,641	7,461	5,484	–	–	86,770
1968	22,034	17,853	6,448	22,009	17,400	25,534	11,533	5,912	–	–	128,723
1969	21,577	14,819	13,687	23,014	14,136	32,531	8,814	6,181	1,590	1,008	137,357
1970	19,557	15,566	13,876	20,701	8,964	43,064	9,217	6,970	5,119	4,310	147,344

In the plants taken as a whole production has risen from 17,370 tons in 1962 (when all eight plants came into production) to 147,344 tons in 1970. Thus between the years 1962 and 1970, an increase of 850 per cent or an average growth rate of 94.4 per cent per annum has been recorded.

With a production of 43,064 tons in 1970, the Bandırma plant is the biggest producer of compound feeds. Between 1962 and 1970, this plant recorded a 106-fold increase in its production. However, it may be noted that, whereas production has been constantly increasing in some plants, in the Ankara, Konya, İstanbul, İzmir and Eskişehir plants a drop occurred in the years 1969 and 1970.

The increase in production has naturally resulted in increased quantities of compound feeds being fed to animals, but in some regions, production does not show any correlation with livestock numbers. For example, the plant in Erzurum has a sales area covering 22 provinces in the eastern section of the country with a very considerable cattle and sheep population, but its production has reached only 13,876 tons in 1970. However, it is noticeable that a high degree of correlation exists between poultry numbers raised in modern poultry houses and the production of compound feeds in a region. The ever increasing production of the Bandırma plant is readily explained by this correlation.

Although there has been a fairly large increase in production of compound feeds, Turkey's production of feed is the least among the OECD countries, excluding Luxemburg. The production of compound feeds in some OECD countries from 1960 to 1968 is given in Table 5 for comparison.

Table 5
Production of compound feeds in selected countries

Country	1960	1961	1962	1963	1964	1965	1966	1967	1968
	thousand metric tons								
Turkey	5.8	10.8	17.4	22.6	30.6	47.4	65.3	86.8	128.7
United Kingdom	8,979.0	9,489.0	9,464.0	9,283.0	9,667.0	9,850.0	9,475.0	10,114.0	10.394.0
Germany	3,576.1	4,604.5	5,015.6	5,128.4	6,090.9	7,203.1	7,578.9	7,701.0	7,545.3
Belgium	1,550.0	2,050.5	2,056.2	2,039.8	2,339.2	2,637.0	3,034.1	3,085.6	3,206.3
Luxemburg	13.9	19.9	21.2	17.1	26.3	24.7	35.5	33.5	34.1
France	2,198.5	2,781.0	3,274.9	3,484.5	4,140.4	4,761.4	5,429.0	5,582.0	5,516.3
Italy	850.0	975.0	1,175.0	1,400.0	1,750.0	2,150.0	2,400.0	2,500.0	3,188.0
Netherlands	4,650.0	5,153.0	5,044.0	5,199.0	5,705.0	6,169.0	6,386.0	6,629.0	7,117.0
Austria	..	..	..	..	..	..	361.8	435.4	492.2
Denmark	..	..	..	..	2,629.8	2,712.0	2,738.5	2,574.8	..
Finland	198.3	159.5	191.7	179.3	243.7	280.0	283.3	358.7	388.3
Norway	562.0	580.0	646.0	671.0	725.0	816.0	885.0	978.0	..
Sweden	737.8	774.9	884.0	976.2	1,116.9	1,236.8	1,345.7	1,420.5	..
Switzerland	..	..	..	..	..	..	357.4	..	457.5
Spain	551.0	855.0	1,180.0	1,849.0	1,686.0	1,914.0	2,327.0	2,544.0	2,863.0
Portugal	..	..	133.0	187.0	282.0	458.0	525.0	633.0	885.0
Canada	2,295.0	2,579.0	2,607.0	2,688.0	4,361.0	4,788.0	5,489.0	6,052.0	6,023.0
USA	..	..	55,313.0	57.377.0	56.208.0	..	..	..	..
Japan	2,882.0	4,096.0	4,990.0	6,201.0	7,496.0	8,160.0	9,898.0	10,324.0	11,356.0

.. Data not available

Source: Study on the factors influencing the use of cereals in animal feeding. OECD, 1971.

Production of different types of compound feeds

Generally a very wide range of compound feeds is manufactured according to the feed requirement for each type of animal production. Approximately 40 kinds of feeds are produced either in mash or pellet form in the feed plants of the Turkish Feed Industry Corporation. Crumbler production will also commence very soon in some plants.

The range of compound feeds manufactured has increased from year to year. A general classification of the kinds of compounded feeds produced is shown in Table 6.

Table 6
Types of compounded feeds

1. Poultry feeds

Feeds for egg laying strains of chickens

Starter – Grower feeds
- Chick starter feed
- Pullet grower feed
- Pullet developer feed
- 32% protein pullet grower concentrate

Layer feeds
- Floor layers' feed
- Cage layers' feed
- Breeder layers' feed
- 32% protein concentrate feed for layers and breeders

Feeds for meat producing strains of chickens

Turkey feeds
- Turkey starter feed
- Turkey grower feed
- Turkey finisher feed
- Turkey breeder feed

2. Cattle and sheep feeds
- Calf starter feed
- Lamb feed
- Dairy feed
- 32% protein dairy supplement
- Beef and sheep feed
- 32% protein beef and sheep supplement
- Dry and freshening ration
- Bull feed
- Sheep breeder feed

3. Horse feeds
- Working horse feed
- Race horse feed
- Mare feed
- Stallion feed
- Foal feed

4. Rabbit feed

5. Miscellaneous feeds

Laboratory animal feeds
- Mouse feed
- Guinea – pig feed

Fish feeds
- Trout feed
- Catfish feed

Dog feed

Feeds for zoo animals
- Feeds for herbivorous animals
- Pheasant feed

Apart from these feeds, certain special feeds are also manufactured according to customers' specifications.

Although the price of pelleted feeds is higher than that of mash, some farmers prefer to use pellets for various reasons. In 1970 36.1 per cent of the total output was produced in pellet form, of which poultry and cattle feeds accounted for 15.1 per cent and 21.0 per cent respectively, while 25.9 per cent of total poultry feeds and 51.5 per cent of total cattle and sheep feeds were manufactured in pellet form.

The quantities and percentages of various classes of feeds manufactured in 1970 are seen in Table 7. It will be seen that poultry feeds account for a large proportion of the total production. This branch of production absorbed 58.3 per cent of all compound feeds. The feeds for dairy and beef cattle accounted for 36.3 per cent of total production. It should also be noted that the share absorbed by layer and layer – breeder feeds takes the largest part of the production.

Table 7
Production of compound feeds according to type in 1970

Classes of feed	Feed Plants										Total	Average %
	Ankara	Konya	Erzurum	İstanbul	İzmir	Bandırma	Eskişehir	Mersin	Samsun	Adapazarı		
	metric tons											
Poultry											85,969	58.3
Starter – grower	3,865	1,469	374	1,951	1,426	7,196	2,017	1,370	496	861	21,025	14.2
Layer – breeder	8,773	3,973	852	3,870	4,974	29,639	4,534	2,069	915	1,499	61,098	41.5
Broiler	491	–	–	1,542	453	1,013	32	32	3	280	3,846	2.6
Cattle											53,462	36.3
Dairy	3,698	2,253	2,325	10,186	1,431	3,808	1,432	2,326	1,593	529	29,581	20.0
Beef	1,912	6,731	9,585	596	359	455	950	1,065	1,353	875	23,881	16.3
Miscellaneous	818	1,140	740	2,556	321	953	252	108	759	266	7,913	5.4

Source: Turkish Feed Industrial Corporation, Ankara.

If Table 7 is examined closely, it is seen that feed plants located in the western part of the country, with the exception of the Istanbul plant, have largely produced poultry feed whereas the production of the plant in Erzurum has consisted mainly of cattle feeds. This situation is the result of the better development of the poultry industry in western Turkey.

Among the miscellaneous feeds are a wide range of compound feeds such as those used for calves, horses, rabbits, laboratory animals etc. Since the annual production of these is negligible, they were not taken into consideration in Table 7. There is no production of pig feeds in Turkey due to religious prohibition.

Table 8 gives a comparative picture of the share of poultry, cattle and pig feeds as a percentage of total production in some selected countries and Turkey in 1969.

Table 8
Poultry, cattle and pig feeds as a percentage of total production in certain countries during 1967[1]

Country	Poultry feeds	Cattle feeds	Pig feeds
		per cent	
Turkey[2,4]	51	40	0
United Kingdom	41	36	21
France	37	21	35
Germany	43	25	29
Netherlands	27	25	43
Italy	43	27	24
Denmark	19	27	53
Spain	58	9	29
USA (1969)[3]	40	21	21
Canada	26	37	30

[1] Source: Study on the factors influencing the use of cereals in animal feeding. OECD 1971.
[2] Source: Turkish Feed Industrial Corporation, Ankara.
[3] Source: Feedstuffs Yearbook Issue, 1970.
[4] The percentages of poultry and cattle feeds within total production in 1970 were 58.3% and 36.3% respectively.

The average quantity of compound feeds fed per animal has been steadily rising over the years. Whereas the average yearly consumption of compound feed per head of cattle in 1960 was only 0.1 kg, it reached a level of 3.6 kg per head in 1969. Similarly, poultry feed consumption per chicken increased from 0.1 kg in 1960 to 2.6 kg in 1969. Since official statistical data on livestock numbers have not been issued yet, it has not been possible to calculate the figures for the year 1970.

In spite of the steady increase in compound feeds fed per animal in Turkey, the amount fed has remained very low as compared with those of other countries as shown in Tables 9 and 10. These tables show the average amount of compound feeds being consumed per chicken and per head of cattle annually in several selected countries. Turkey has to make every effort to increase compound feed consumption per animal to something near the level of other countries if it is to improve its animal production.

Marketing of compound feeds

The Turkish Feed Industrial Corporation and certain other compound feed firms have been selling their feeds under guarantee although there is no feed legislation to compel them to do so. The minimum amounts of crude protein and crude fat, and the maximum amounts of crude fibre and ash are declared and guaranteed on the labels attached to the sacks. For some kinds of feeds the percentages of calcium and phosphorus are also declared.

The sales of feeds are either effected directly from the plants or through dealers. Livestock producers and co-operatives may also function as dealers and receive a premium related to the total value of the feeds they purchase. Thus feed costs to them are somewhat lower.

The feeds are packaged in burlap or paper bags containing 50 and 30 kg of feed respectively. In recent

Table 9
Average quantity of compound feeds fed to poultry per annum in selected countries[1]

Country	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
					kg per head					
Turkey[2]	0.1	0.2	0.3	0.3	0.4	0.7	1.1	1.5	2.5	2.6
France	11	11	13	15	16	18	19	19	19	...
Germany	25	28	31	31	32	36	35	36	35	...
Netherlands	51	48	45	44	44	42	41	40	...	...
Italy	5	5	6	6	8	14	10	10	13	...
Denmark	..	..	..	..	21	24	23	25	..	...
Spain	10	14	18	31	33	32	32	32	34	...
United Kingdom	30	29	29	29	28	29	33	34	31	...
Canada	12	13	13	14	20	20	18	18	18	...
Japan	42	43	41	46	50	44	53	54	53	...

Table 10
Average Quantity of compound feeds fed to cattle per annum in selected countries[1]

Country	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
					kg per head					
Turkey[2]	0.1	0.3	0.6	0.9	1.1	1.7	2.0	2.4	3.4	3.6
France	19	25	32	34	47	48	54	54	54	..
Germany	72	87	94	98	128	142	140	136	136	..
Netherlands	325	399	410	465	499	520	523	526	..	..
Italy	19	24	30	36	42	52	63	68	113	..
Denmark	..	..	..	..	225	232	226	215	..	..
Spain	20	30	42	53	45	48	56	59	64	..
United Kingdom	267	271	273	261	281	285	275	298	308	..
Canada	48	51	51	48	95	115	139	155	177	..
Japan	99	129	161	194	222	277	363	444	554	..

.. Data not available
1 Source : Study on the factors influencing the use of cereals, OECD, 1971
2 Source : Turkish Feed Industrial Corporation, Ankara

years the use of three-walled paper bags has shown a great increase. Bulk delivery of feeds has not yet expanded since the feed plants do not possess any facilities for bulk loading, and also the animal raisers do not have silos for storing of bulk feed. The plants to be constructed in Ankara, Istanbul and Bursa will possess bulk loading facilities and thus the bulk delivery of feeds will be promoted.

Feed prices vary rather frequently due to wide variations in raw material prices and other costs. Such frequent variations in price constitute a hindrance to promoting the use of compound feeds by livestock producers, and a strong and stable situation in the feed market is therefore a necessity.

Competition among the feed compounders has been increasing from year to year. Since livestock farmers have begun to realize the value of high quality feeds in raising animal yields, feed manufacturers will have to produce the best quality feeds in future to remain in the market. Quality will determine the amount of compound feeds to be consumed in the future.

Present status of the feedingstuffs used in the compound feed industry

Due to the absence of legislation and standards in the feed market, the composition of the raw materials used in the compound feedstuffs industry shows very wide variation. The results of assays carried out in our central analytical laboratory for over ten years clearly reveal very wide variations in the content of protein, fat, fibre, ash and nitrogen free extract of the same kinds of raw materials. Even feedingstuffs purchased from the same firm at various periods and under contract show great variations. Table 11 indicates the maximum and minimum limits of these variations, together with the average values, in respect of crude protein, fat, fibre, ash and nitrogen free extract of different feedingstuffs.

In view of this wide variation in composition of raw materials, it is difficult to produce a uniform compound feed over a long period even if the same formula is applied. For this and other reasons, feed legislation covering both raw materials and compound feeds has been prepared by the Ministry of Agriculture and is ready to be submitted to the National Assembly for authorization.

Ingredients used in the compound feed industry

At present a great variety of raw materials are incorporated in the compound feeds. Among them, cereal grains, by-products of the milling, starch and brewing industries, and oil cakes (excluding soyabean cake) are available in sufficient quantities to meet the present requirements of the feed industry. But, since the annual production of certain feedstuffs such as fish meal, meat and blood meal do not meet the needs of the feed industry, these – especially fish meal – are imported to bridge the deficit.

The needs of the industry for feed additives such as synthetic vitamins, trace minerals, medicaments, antibiotics etc. are also met by importation, for there is no chemical industry in the country to produce these types of raw materials.

A general list of the raw materials available for the compound feed industry in Turkey is given below:

1. Cereal grains
   Barley, oats, maize, rye, wheat, sorghum grain, milo, buckwheat, broom corn seed.
2. Leguminous seeds
   Beans, peas, broad-bean, vetch seed, gram, lentils, locust bean, lucerne and clover seeds.
3. By-products of milling, starch and brewing industries
   Wheat bran, wheat middlings, rice bran, rice polishings, corn gluten feed, corn gluten meal, corn germ meal, malt sprouts.

Table 11

Composition of selected feedstuffs analysed during 1966–70

Feedstuffs	Crude protein		Crude fibre		Crude fat		Ash		N. free extract		Moisture		Number of samples
	Range	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range	Average	
							Percentages						
Barley	9.01–11.46	10.09	4.12–5.06	4.50	1.95–2.27	2.15	2.14–6.66	3.98	64.06–69.49	67.69	10.68–13.32	11.98	8
Maize	6.83–11.88	8.53	1.21–2.87	1.94	3.72–7.39	4.76	1.15–4.46	2.26	61.04–72.28	68.10	12.36–16.84	14.86	9
Oats	8.04–12.22	9.35	8.70–11.70	10.50	4.66–6.82	5.78	3.04–7.52	5.50	55.60–59.36	57.53	10.95–12.56	11.48	6
Rye	7.35–9.28	8.48	1.89–2.20	2.03	1.85–2.37	1.99	2.66–3.71	3.18	70.61–73.29	71.71	11.78–14.65	13.22	4
Milo	9.76–10.82	10.21	0.91–1.80	1.50	3.15–4.44	4.02	1.50–3.15	2.20	66.52–74.75	70.25	9.17–15.49	11.83	4
Wheat bran	12.57–13.30	13.05	8.61–10.44	9.81	3.19–4.98	3.90	4.21–5.59	5.14	55.70–59.34	57.05	9.11–12.37	11.05	6
Corn gluten feed	10.53–27.28	17.96	2.59–15.59	10.99	3.30–4.59	3.98	1.14–8.54	4.30	52.50–57.66	55.41	5.42–14.24	9.48	39
Corn gluten meal	23.53–59.48	51.05	0.20–3.75	1.09	1.27–5.22	2.88	0.69–9.16	2.32	22.16–62.14	40.12	3.63–16.16	10.98	46
Lucerne meal (1)	20.36–25.78	23.10	12.18–23.62	15.96	2.81–5.28	4.20	11.51–20.72	15.60	34.33–39.53	36.37	2.96–6.67	4.77	15
Lucerne meal (2)	13.20–22.64	17.05	22.30–36.68	25.89	2.32–3.77	3.16	8.85–15.51	11.26	34.05–42.84	38.85	2.70–7.51	5.79	17
Soybean cake	40.04–44.46	42.76	2.64–6.72	4.98	1.18–11.24	4.24	6.03–12.51	8.47	25.91–33.95	29.24	4.59–13.62	10.31	4
Cottonseed cake	27.35–44.90	38.01	6.01–22.84	12.00	0.65–11.75	4.45	5.18–9.58	6.92	25.06–33.83	31.41	4.30–13.36	7.63	27
Sunflower cake (solvent)	26.70–40.36	35.24	12.89–29.42	17.24	0.43–6.13	2.16	5.73–12.24	8.30	23.96–32.53	28.88	5.99–10.16	8.25	30
Sunflower cake (expeller)	21.10–36.80	30.06	14.71–31.25	21.69	6.68–13.11	10.20	4.98–17.10	7.56	14.75–36.64	24.98	3.05–9.50	5.48	103
Linseed cake	29.98–37.00	33.88	7.08–21.40	14.05	0.53–10.19	3.26	7.80–17.19	11.50	17.58–35.96	27.63	6.92–13.07	9.68	4
Fish meal	32.52–64.38	48.76	– (–)	–	10.63–29.78	20.22	4.13–23.44	14.74	0.33–10.15	3.05	5.93–23.42	12.22	14
Meat and bone meal	125.15–49.83	38.62	– –	–	5.19–14.14	9.31	26.38–45.93	36.88	0.39–27.47	9.39	3.63–8.83	6.24	19

Source: Turkish Feed Industrial Corporation, central analysis laboratory assay reports.

4. Oil cakes
   Cottonseed, sunflower seed, linseed, soyabean, groundnut, sesame, opium, safflower and rapeseed cakes.
5. By-products of sugar industry
   Dried beet pulp, molasses, molasses yeast.
6. Animal by-products
   Fish meal, meat and bone meal, blood meal.
7. Dehydrated alfalfa (lucerne) meal.
8. Sources of mineral matter
   Salt, limestone, precipitated limestone, oyster shell, marble powder, steamed bone meal.

1. Cereal grains

Cereals constitute the largest component of the compound feeds from the standpoint of cost and quantities used. The main aim in using cereal grains in a mixture is to supply energy to the ration. Cereal grains comprised 42.0 per cent of the total raw materials consumed by the Turkish Feed Industrial Corporation over the last five years.

Barley is the most common of the cereals used. In view of its low price and ready availability it is used in a much greater proportion than other cereals in almost all kinds of feeds (except broiler rations), in spite of its low energy value compared with maize, sorghum grains or wheat. Between 1966 and 1970 barley comprised 22.3 per cent and 53.1 per cent of total raw materials and of total cereals respectively.

Maize takes second place among the cereals with regard to the amount used. Even though maize contains the largest amount of energy and also possesses a high level of carotene and xanthophylls, it comprises only 10.7 per cent of the cereal grains used because of its high price and the difficulty of obtaining it in the requisite quantities. Most of the maize grown in Turkey is consumed as human food or used by the starch factories.

Oats are mainly used in some special types of feeds such as pullet developer rations, horse feeds and bull feeds to provide bulk to the diet, since it contains a low amount of starch equivalent. Oats make up 8.6 per cent of all cereals used in feed mixtures.

Wheat is not consumed in compound feeds in appreciable amounts because its price is high as compared with those of other cereals. Wheat screenings of good quality are occasionally available for the feed industry and may be used to substitute for other cereals.

For some years, rye has been sold at a fairly low price and may be used to replace other cereals in limited quantities. Since ergot might be present in certain samples of rye, careful examination is necessary when purchasing. On average during the last five years rye grain comprised 6.5 per cent of total cereals.

Although a few varieties of grain sorghum are grown in Turkey, total annual production is very low and so it is used by the feed plants only in small quantities. Lately milo, a variety of sorghum grain, has been produced on a fairly large scale. Milo has a high energy content and if its present convenient price remains steady and its high moisture content can be lessened by drying to a suitable level for storage, milo may be substituted for most of the barley in compound feeds.

Buckwheat, spelta and broom corn seeds are sometimes available to the feed industry, but the amounts used by the feed industry are not noteworthy. Figures for the production of various kinds of cereals in Turkey over the last five years (1965–1969) are given in Table 12.

Table 12
Cereal production in Turkey 1965–69

Types of cereals	Years				
	1965	1966	1967	1968	1969
	Thousand metric tons				
Wheat	8,500	9,600	10,000	9,520	10,500
Barley	3,300	3,800	3,800	3,560	3,740
Rye	775	850	900	820	817
Oats	540	510	510	450	468
Maize	945	1,000	1,050	1,000	1,000
Sorghum grains	60	60	55	53	56
Spelt	130	115	110	83	93

Source: Summary of Agricultural Statistics 1969, State Institute of Statistics Ankara, Turkey.

2. Leguminous seeds

Leguminous seeds or pulses mainly comprise beans, peas, broad beans, chick peas, cow peas, lentils, vetch seeds, locust beans, lucerne and clover seeds. Most of these leguminous seeds are produced for purposes other than livestock feeding. They are however occasionally available for stock feeding when they become unsuitable for human consumption. Among the leguminous seeds, broad beans and locust beans are used in compound feeds for specific purposes. Broad beans are sometimes incorporated in stallion feeds for improving breeding, while locust bean is used for the purpose of increasing palatability of such feeds as calf starters and horse rations.

Leguminous seeds comprised only 1.8 per cent of total raw materials over the last five years.

3. By-products of milling, starch and brewing industries

By-products of the milling, starch and brewing industries such as wheat bran, wheat middlings, rice bran, rice polishings, corn gluten meal, corn germ meal and malt sprouts are available for the feed industry. Among these wheat bran is used in the largest proportion. This product of wheat milling is usually incorporated in cattle and horse feeds up to a level of

 30 per cent of the ration. Between 1966 and 1970 wheat bran comprised 14.8 per cent of total raw materials used for compound feeds.

Rice bran is occasionally available and if its price is satisfactory it could replace wheat bran, particularly in dairy feeds. Rice middlings are rarely available and command a very high price.

The by-products of starch production such as corn gluten meal, corn gluten feed and corn germ meal are used in compound feeds if they are of good quality and not too expensive. As the composition of these products varies considerably from sample to sample they need to be purchased under special agreement providing certain guarantees with regard to their content of different nutrients. Among these products, corn gluten meal which has a crude protein content of between 55 and 60 per cent is worthy of special mention. This product, because of its high energy and low fibre content, is particularly used in broiler rations. It also possesses a very good pigmenting activity. These by-products constituted 3.7 per cent of total raw materials used in the last five years.

4. Oil cakes

These feedstuffs consist of the residues remaining after extraction of some of the oil from oil-seeds. Where the removal is effected by pressure, the residues are sold as cakes and contain between 5 and 12 per cent of oil. But where solvents are used to dissolve the oil the residues are sold as extracted meals and contain only 0.75 to 2 per cent of oil.

Since oils of vegetable origin have a much higher energy value than starch, oil cakes containing more than small amounts of oil might be sold at a higher price. The situation is so for all oil cakes except sunflower cake. Extracted sunflower meals are always sold at a better price than the pressed cakes, since the latter contain lower amounts of protein and higher amounts of fibre in relation to the former. This reverse situation is the result of the presence of a great number of oil extracting plants using rather primitive presses, and the lack of any attention by the owners to the quality of cakes they produce.

Among the oil cakes, cottonseed and sunflower seed cakes contribute most to the protein component of the various formulae. Cottonseed cake is preferred for cattle, sheep and horse feeds, while sunflower seed cake is mostly used for poultry feeds. Since the gossypol content of the cottonseed cakes produced in Turkey has not yet been determined, they are incorporated in the feed formulae for poultry in amounts not exceeding 5 per cent.

As regards soybean meal, it is used mainly only in broiler rations and certain types of feeds, e.g. those used for laboratory animals, because of its high price and very limited availability. Recently several attempts have been made to promote the cultivation of soybeans and thus to increase the production of soybean meal.

Linseed meal is an occasional feed ingredient. It is not always available in the feed market, but from time to time it is offered to the feed plants. It is then used in calf starters, lamb fattening rations and horse feeds.

Sesame, ground-nut, opium, rapeseed and safflower cakes are used only to a negligible extent in compound feeds as the amounts offered to the feed market are limited.

The proportions of various kinds of oil cakes used in the compound feeds (between 1966 and 1970) are as follows:

Oil cakes	*As proportion of oil cakes*	*As proportion of total raw materials*
Cottonseed	45.0%	10.0%
Sunflower seed	42.2%	9.3%
Soybean	7.7%	1.7%
Linseed	1.5%	0.3%
Others	3.6%	0.8%

There are no official statistical data indicating the amounts of various kinds of oil cakes produced annually. However, taking into account the yearly production of oil seeds and their fat content, the amounts of the different kinds of oil cakes manufactured locally have been computed, and are given in Table 13. It must be emphasised, however, that these figures are only estimates.

Table 13
Oil cake production in Turkey, 1969

Oil cakes	*Amount of production in 1969 as metric tons*
Cottonseed	300,000
Sunflower seed	150,000
Linseed	8,000
Soybean	6,000
Sesame seed	15,000
Rapeseed	5,000
Opium	6,000
Safflower	700
Groundnut	?
Total	490,700

5. By-products of the sugar industry

Two products from the sugar industry are available to the feed industry viz. beet molasses and dried beet pulp, with or without molasses. Recently a product from the distillation of molasses during the production of alcohol has also become available.

Because of its low price in relation to its nutritive value, its binding property for pellets, and its palatability, molasses is used in compound feeds. As an average over the last five years, molasses comprised 2.1 per cent of total raw materials consumed.

Dried beet pulp is not used on a large scale in the feed industry as most of the beet pulp is in the wet form. The very limited quantity of dried beet pulp is usually distributed to the beet farmers directly. The very small amount of dried beet pulp obtained by the feed industry is used to substitute for barley or oats in dairy and beef rations.

There are no official statistics on the production of molasses and dried beet pulp, but the Head-Office of the sugar factories has given the following figures in respect of the years 1969 and 1970.

Years	*Amount of molasses produced*	*Amount of dried beet pulp produced*
1969	126,000 tons	3,654 tons
1970	161,000 tons	3,309 tons

6. Animal by-products

Three kinds of feedingstuffs used in the feed industry are supplied from the meat and fish industry of the country, viz. meat-bone meal, blood meal and fish meal. These products are mainly produced in five slaughter-houses and one fish meal factory of the State Meat and Fish Company. This organisation has provided the following figures of production for the years 1969, 1970 and 1971:

Years	*Meat-bone meal*	*Blood meal*	*Fish meal*
		metric tons	
1969	1,997	289	409
1970	2,168	209	270
1971	?	?	1,522

Apart from the fish meal produced locally, 650 and 1,350 tons of fish meal were imported in 1970 and 1971 respectively.

Fish meal and meat-bone meal are especially used in poultry feeds as sources of certain essential amino acids, unknown growth factors, some vitamins, calcium and phosphorus. Blood meal is used as a source of lysine for poultry and also for calf starting rations.

The quantities of these products which are produced locally and imported from abroad are not sufficient to meet the needs of even today's feed industry. If we take the production figures of 2,168, 920, and 209 tons for meat-bone meal, fish meal and blood meal respectively and compare them with the figure of approximately 126,000 tons representing compound poultry feeds produced by the feed plants in 1970 (including the production of completely private plants), it may be calculated that only 0.75, 1.72 and 0.16 per cent of fish meal, meat-bone meal and blood meal respectively were used in compound poultry feeds. Since the production of poultry feeds is expected to rise in the next few years, measures should be taken as soon as possible to supply the animal by-product requirements of the industry.

Another by-product of the meat and fish industry is steamed bone meal, but, in Turkey, this product is usually manufactured by producers not dealing with the meat and fish business. These producers purchase raw bones from small slaughter-houses, sausage manufacturers and butchers and produce the steamed bone meal in their own plants.

Steamed bone meal is incorporated in compound feeds as a source of calcium and phosphorus. In the official statistics there are no data on yearly production, but according to an estimate, 4,000 tons of steamed bone meal was manufactured in 1970. At present, there is sufficient available in Turkey to meet the needs of the feed industry. In 1970, steamed bone meal comprised 1.6 per cent of the total feedstuffs used in the feed plants of the Turkish Feed Industrial Corporation.

7. Dehydrated alfalfa (lucerne)

This type of feedingstuff is produced in four dehydrating plants of the Turkish Feed Industrial Corporation. Another two plants producing lucerne meal are operated by the Ministry of Agriculture. Three more plants are ready to be operated this season by the Turkish Industrial Corporation.

In 1970, Turkish Feed Industrial Corporation's and the Ministry of Agriculture's lucerne dehydrating plants produced 727 and 270 tons of various types of lucerne meal respectively.

Lucerne meal is especially used in the feeds produced for broilers, replacement chicks and pullets, layer/breeders, turkeys, beef cattle, sheep and rabbits. In 1970, its contribution to compound feeds was, on average, about 0.52 per cent.

8. Sources of mineral matter

Sources of calcium such as limestone, oyster shell, precipitated calcium carbonate and marble powder are very abundant and inexpensive in the country. Salt is also plentiful and inexpensive.

Feed additives

Because there is no chemical industry in the country to manufacture various types of feed additives like synthetic vitamins, trace minerals, antibiotics, medicaments, antioxidants etc., these products have been imported either in the form of premixes or in pure forms which are diluted and/or premixed afterwards. As long as the commercial transactions are done well in advance, there is no difficulty in obtaining these products to meet the needs of the compound feed industry.

Forecasting future needs for compound feeds in relation to a 30 year development plan prepared by The Ministry of Agriculture

With the collaboration of the Ministry of Agriculture and a number of experts representing various fields of agriculture, an agricultural development plan covering the years up to 2000 was prepared in 1966. This plan proposed certain targets in respect of various forms of animal production, yields per animal, and consumption of animal products per capita in the year 2000. These targets and the corresponding figures for the year 1968 are given in the following Table 14.

Table 14
Targets for 2000 in Turkey

	1968	*2000*
Animal products (metric tons)		
Meat	476,000	1,619,539
Milk	4,226,987	18,262,910
Eggs (in 000)	1,900,000	18,700,000
Chicken meat	44,729	652,000
Native wool	42,311	39,728
Merinos wool	1,320	31,975
Mohair	8,900	13,907
Consumption of animal products per capita		
Meat (kg)	14.3	23.6
Milk (l)	123.6	234.8
Eggs (number)	54.9	200
Chicken meat (kg)	1.3	8
Yield per animal		
Cattle:		
meat (kg) (carcass weight)	92	200
milk (l)	631	2,134
Sheep:		
meat (kg) (carcass weight)	18	30
milk (l)	47	52
wool (kg)	1.3	2.2
Chicken:		
meat (6–8 weeks) (kg)	?	1
eggs (number) (native breeds)	52	60
eggs (number) (cultural breeds)	170	200

The same plan has proposed the following animal numbers for the year 2000:

Cattle	24,671,000
Buffaloes	825,000
Sheep	33,000,000
Ordinary goats	11,200,000
Angora goats	7,400,000
Chicken layers	50,000,000
Broilers (8–10 weeks)	322,000,000

According to this plan, the target for compound feed consumption in the year 2000 is 6,230,000 tons. This figure for compound feed consumption has been based on the above projections of animal populations, and targets in respect of compound feeds to be fed per animal in the year 2000.

Animal numbers were converted into animal units for this purpose, except in the case of chickens. For the determination of animal units, specific coefficients were applied to the numbers of different kinds of animals and then added together[1]. Thus 32,300,000 animal units were calculated.

The plan proposes that 120 and 28 kg of compound feed should be fed per animal unit and per layer per year respectively in the year 2000. In addition to these figures, it is supposed that each broiler chicken will consume 3 kg of compound feed up to the age of 8–10 weeks. Taking into account these figures, the production of compound feeds for the year 2000 should reach 6,230,000 tons as computed below:

For 32.3 million animal units	32.3 x 120 = 3,864,000 tons
For 50 million layers	50 x 28 = 1,400,000 tons
For 322 million broilers	322 x 3 = 966,000 tons
Total	= 6,230,000 tons

In forecasting the tonnage of compound feeds which will be consumed in future years, the needs of such draft animals as horses, mules and donkeys were excluded, since it is believed that by the year 2000 modern motorized vehicles will largely replace them.

As seen from Table 15, feed for poultry will comprise about 38 per cent of total output in future, although as a result of favourable prices for eggs and chicken meat in last two years, this ratio increased to 58.3 per cent in 1970 with a corresponding decline in the proportion of dairy, beef and sheep feeds. However, with the adoption of measures to promote the consumption of milk, cattle and sheep meat as recommended in the plan, this ratio will stabilise at approximately 40 and 60 per cent for poultry and cattle – sheep feeds respectively.

On a rough estimate, three quarters of the compound feeds destined for cattle and sheep will be consumed for milk production while the remainder will be fed to cattle and sheep for meat production.

The production trends of these three main types of compound feeds from 1971 to 2000 as forecasted in the plan are shown in Table 15 for successive Five Year Development Plan periods.

Capacity requirements for production of the forecasted quantities of compound feeds

In order to manufacture the required amounts of feeds shown in Table 15, compound feed plants possessing the necessary capacities should be present.

The increase in capacities required in successive Five Year Development Plan periods are given, in Table 16.

[1] Conversion coefficients: Cattle = 1; buffaloes = 1.5; sheep = 0.12; ordinary and angora goats = 0.13.

Table 15
Estimated future requirements for compound feeds in Turkey

Years	Total	For poultry	For dairy cattle	For beef and sheep
		metric tons		
1973	240,000	96,000	108,000	36,000
1974	280,000	112,000	126,000	42,000
1975	320,000	128,000	144,000	48,000
1976	360,000	144,000	162,000	54,000
1977	400,000	160,000	180,000	60,000
1978	480,000	192,000	216,000	72,000
1979	560,000	224,000	252,000	84,000
1980	640,000	256,000	288,000	96,000
1981	720,000	288,000	324,000	108,000
1982	800,000	320,000	360,000	120,000
1983	940,000	376,000	423,000	141,000
1984	1,080,000	432,000	486,000	162,000
1985	1,220,000	488,000	549,000	183,000
1986	1,360,000	544,000	642,000	214,000
1987	1,500,000	600,000	675,000	225,000
1988	1,800,000	720,000	810,000	270,000
1989	2,100,000	840,000	945,000	315,000
1990	2,400,000	960,000	1,080,000	360,000
1991	2,700,000	1,080,000	1,215,000	405,000
1992	3,000,000	1,200,000	1,350,000	450,000
1993	3,460,000	1,384,000	1,557,000	519,000
1994	3,920,000	1,568,000	1,764,000	583,000
1995	4,380,000	1,752,000	1,971,000	657,000
1996	4,840,000	1,936,000	2,178,000	726,000
1997	5,300,000	2,120,000	2,385,000	795,000
1998	5,600,000	2,240,000	2,520,000	840,000
1999	5,900,000	2,360,000	2,655,000	885,000
2000	6,230,000	2,492,000	2,803,000	935,000

Table 16
Requirements for feed plant capacity in Turkey 1973–1997

The name of the Development Plan	Years	Required increase in capacity	Total capacity
		Capacities as metric tons	
			325,400
Third Five Year Development Plan	1973–1977	150,000	475,400
Fourth Five Year Development Plan	1978–1982	300,000	775,400
Fifth Five Year Development Plan	1983–1987	500,000	1,275,400
Sixth Five Year Development Plan	1988–1992	1,000,000	2,275,400
Seventh Five Year Development Plan	1993–1997	2,000,000	4,475,400

The capacities indicated in Table 16 are on the basis of a single shift (8 hours per day). It is supposed that certain feed plants will operate in double shifts (16 hours a day) to meet the required quantities of feeds.

Requirements of raw materials to be used in the compound feed plants

For computing the kinds and amounts of feedingstuffs required by feed manufacturers in future years, two general skeleton formulae (one for poultry and the other for dairy, beef and sheep rations) have been used, for the sake of convenience. These two formulae were arrived at with two main considerations in view:

(I) The raw materials used in the formulae must be available under present conditions, and/or it might be possible to produce them in required quantities in the near future.

(II) The formulae should be the most economical ones under the present and projected future circumstances of the Country, while still producing satisfactory results.

For these reasons, the compound feeds based on these formulae cannot be regarded as the ideal diets.

The kinds and quantities of the raw materials required in future years have been calculated on the basis of these two formulae and the production trends indicated in Table 11. The kinds and quantities of the raw materials calculated in this manner are shown in Table 17 according to successive Five Year Development Plan Periods.

Table 17
Estimated future feed raw material requirements 1973–2000

Raw materials	3rd stage		4th stage		5th stage		6th stage		7th stage			
	1973	1977	1978	1982	1983	1987	1988	1992	1993	1997	1998	2000
metric tons												
Barley	50,400	84,000	100,800	168,000	197,400	315,000	378,000	630,000	726,000	1,113,000	1,176,000	1,302,000
Maize	33,600	56,000	67,200	112,000	131,600	210,000	252,000	420,000	484,400	742,000	784,000	868,000
Oats	19,200	32,000	38,400	64,000	75,200	120,000	144,000	240,000	276,800	424,000	448,000	496,000
Sunflowerseed cake	12,000	20,000	24,000	40,000	47,000	75,000	90,000	150,000	173,000	265,000	280,000	310,000
Cottonseed cake	19,200	32,000	38,400	64,000	75,200	120,000	144,000	240,000	276,800	424,000	448,000	496,000
Soyabean cake	14,400	24,000	28,800	48,000	56,400	90,000	108,000	180,000	207,600	318,000	336,000	372,000
Linseed cake	10,800	18,000	21,600	36,000	42,300	67,500	81,000	135,000	155,700	238,500	252,000	279,000
Wheat bran	42,000	70,000	84,000	140,000	164,500	262,500	315,000	525,000	605,500	927,500	980,000	1,087,000
Meat and bone meal	3,840	6,400	7,580	12,800	15,040	24,000	28,800	48,000	55,360	84,800	89,600	99,200
Fish meal	3,360	5,600	6,720	11,200	13,160	21,000	25,200	42,000	48,440	74,200	78,400	86,800
Blood meal	1,728	2,880	3,456	5,760	6,768	10,800	12,960	21,600	24,912	38,160	40,320	44,650
Bone meal	4,800	8,000	9,600	16,000	18,300	30,000	36,000	60,000	69,200	106,000	112,000	124,000
Lucerne meal (20% protein)	1,200	2,000	2,400	4,000	4,700	7,500	9,000	15,000	17,300	26,500	28,000	31,000
Lucerne meal (17% protein)	1,200	2,000	2,400	4,000	4,700	7,500	9,000	15,000	17,300	26,500	28,000	31,000

The kinds of raw materials listed in Table 17 should not be considered as unchangeable, since it will always be possible to substitute, for instance, a synthetic product or another feedingstuff which is available abundantly, in place of a corresponding listed raw material if there is any economic advantage in such substitution. Every effort should be made to supply the raw materials in the required quantities to the feed compounders, either by production within the country or by importation. At the same time as mentioned in the next section measures should also be taken to find new kinds of feedstuffs, and to improve the quality of the present feedstuffs so that more productive and economical rations may be produced in the compound feed plants of Turkey.

Some major problems encountered in the compound feed industry of Turkey

In the light of what has been said earlier, it is clear that the Turkish compound feed industry faces a number of problems. Some of these need to be solved urgently, while others are of a long-term character. Most of these long-term problems concern the supply of certain necessary feed ingredients to meet the requirements of raw materials as indicated in Table 17. The meeting of the deficits in these feedingstuffs calls for long-term measures under the general agricultural development plans. For this reason, during the preparation of development plans to increase the production of feed materials, the requirements for these feedingstuffs should also be taken into consideration.

The following problems are some of the most urgent ones awaiting immediate action:

1. Feed legislation and standards

The need for feed legislation and feed standards covering both compound feeds and feed ingredients is strongly felt both by livestock producers and feed manufacturers.

In Turkey no feedstuff is sold with a declaration indicating its nutritive value, and since there is no law or regulation regarding feedingstuffs, producers have not been compelled to provide a guarantee on the nutrient contents of their products. Although most feed manufacturers declare the maximum and minimum proportions of certain nutrients on the feed tags attached to the bag, control of these declarations has not been possible due to lack of feed legislation.

In Turkey, livestock farmers have a tendency to complain about the feed being fed to their animals when there is a decrease in yield and sometimes in the case of disease, even if the cause does not lie in the feed. Feed legislation covering compound feeds will be beneficial for feed manufacturers as well as for livestock farmers because the feeders will trust the declaration on the tag and look for other reasons

rather than feed when they are not satisfied with the performance of their animals.

The standards to be applied to feed ingredients and compound feeds should be determined by taking into account the specific conditions of the country rather than adopting those of other countries. Certainly extensive investigations on the compositions of feedstuffs and feed market are necessary to determine the standards for the feed ingredients.

As regards standards for the compound feeds, the present ones applied by the Turkish Feed Industrial Corporation have been confirmed to be satisfactory by field observations, and consequently may be adopted by other feed manufacturers as well.

In order to make recommendations on feed standards and follow their results a scientific committee should be organized. This committee would not only deal with the feed standards and feed legislation, but it might also give advice on various feed additives such as vitamins, minerals, medicaments, hormones etc. and carry out research on feedingstuffs and feed additives at its research centres.

2. The need for experts in feed manufacturing and formulation

As the feed industry makes advances, the need for specialized personnel on animal nutrition, and on the operation and management of compound feed plants will increase. At present, most of the feed manufacturers do not realize the importance of technical know-how in their business. For this reason, a sufficient number of experts specializing in various fields of animal nutrition, feed technology and the administration of feed plants is urgently needed.

The training of the necessary personnel for the feed industry should be carried out under a co-operative programme involving the Universities, the Ministry of Agriculture and the State Compound Feed Organisation. Meanwhile the related Faculties should promptly commence courses which will enable University graduates to specialize in the above fields.

3. Analysis, research and experiments on feed ingredients

The nutritive values, particularly the energy, amino acid, vitamin and mineral contents, of most feedingstuffs produced locally have not yet been determined. Similarly research and experiments on the use of these feedingstuffs are also lacking.

Lack of comprehensive analytical tables indicating the average quantities of various nutrients in the native feed ingredients, as well as information on their proper usage has been a hindrance in formulating good quality feeds. Frequent analysis of feed ingredients for the determination of amino acids, minerals and vitamins is an expensive process, and cannot be afforded by feed plants with a low capacity. For this reason analytical tables showing the nutritional compositions of the native feed ingredients is a requisite for the feed manufacturers.

Research and experiments carried out with the feedstuffs may provide very valuable information to the feed manufacturers about how to use them in feed mixtures.

The preparation of the analytical tables and the carrying out of research and experiments may be accomplished by the co-operation of Universities, the Ministry of Agriculture, large feed manufacturers and perhaps, also, private commercial laboratories.

4. Energy ingredients for poultry rations

As cereals rich in energy such as maize, sorghum grains and wheat, are not available in adequate quantities or are too highly priced, compound feeds contain a low percentage of these types of feedstuffs and are therefore rather low in their energy content. Because animal fats and vegetable oils are too scarce and costly at present, it is not economical to incorporate these into the compound feeds so as to raise the energy level of the ration.

The energy level is more critical in poultry feeds than in other kinds of feeds. Although barley, the most frequently used feed cereal for compounded rations has a lower energy value for poultry feed than other cereals such as sorghum, maize and wheat, its energy value to cattle, sheep and horses is more nearly similar to that of the prementioned other cereals, due to the ability of these animals to digest cellulose.

For this reason poultry rations, with the exception of broiler and turkey rations, are formulated with a low level of metabolizable energy. The chick starter, pullet grower, pullet developer and layer rations manufactured in the feed plants of the Turkish Feed Industrial Corporation provide an average of 2,650, 2,600, 2,550 and 2,600 Kcal of metabolizable energy per kg of feed. These levels of energy increase feed consumption but decrease the feed efficiency to some extent.

The production of maize and grain sorghum on a larger scale may be the easiest means of solving the problem. Milo particularly, among the grain sorghums, may play an important part in solving the problem because recently the cultivation of milo sorghum was commenced in certain parts of the country and the results obtained have been very promising from the standpoint of both yield per decare and its low cost. It seems that milo may replace barley in poultry rations in the future due to its higher level of metabolizable energy and its lower price. Taking into consideration this situation, the production of milo grain should be encouraged by every means, and as rapidly as possible.

Water-treatment and enzyme supplementation of barley may probably prove beneficial in improving the energy value of barley and therefore certain research work should be done on these subjects. Since the Swedish type of barley contains a higher amount of metabolizable energy than the native strains some trials should also be carried out on whether the Swedish barley may be adapted to Turkey's climatic and soil conditions.

The incorporation of fats, particularly tallow, into the compound feeds to raise their energy level will depend on the cost and availability of fats in sufficient quantities in the future.

5. The lysine problem

Under the present circumstances in Turkey lysine is regarded as the most critical amino acid in compound feeds produced for poultry, whereas methionine is the limiting amino acid in European countries and the United States. In Turkey a high proportion of the protein requirements of poultry rations is met by sunflower seed cake, for this feedstuff is very plentiful and inexpensive as compared with other protein sources. In recent years another feed ingredient, namely corn gluten meal containing between 40 and 55 per cent protein has begun to be available for the feed industry. These two feedstuffs, particularly corn gluten meal, provide a rather high amount of methionine.

Since protein sources rich in lysine like soybean cake, fish meal, meat meal or blood meal are very scarce and costly in Turkey, filling this deficit has always been a problem for the animal nutritionists. As barley is richer in lysine than maize, attempts have been made to overcome this deficiency to some extent by using barley as a high proportion for the cereal portion of the ration, and also limited amounts of fish meal, meat and bone meal, blood meal and soybean cake. Barley, however, contains a lower amount of metabolizable energy than maize and decreases the energy content of the formula.

The problem will be more critical in later years but an increase in opaque-2 maize and/or Swedish barley instead of the local varieties may be a partial solution to the problem. Similarly, the use of synthetic lysine or even yeasts grown on petroleum products may play an important part in meeting the lysine requirement in the future. But at present their high cost limits their use in compound feeds.

Because the above ideas are not of immediate applicability, short-term measures need to be taken to meet the lysine problem. It is essential to take serious measures urgently in order to increase the production of soybean cake, fish meal, meat meal, blood meal and other kinds of feedstuffs rich in lysine. Blood meal is one of the richest feedstuffs in lysine although its protein has an unbalanced amino acid composition, but currently blood is usually wasted at abattoirs. On the other hand, the establishment of slaughter-houses for poultry and the resulting production of poultry by-product meal and even hydrolized feather meal will ease the problem to some extent.

6. The use of synthetic urea

Urea is used chiefly in cattle and sheep rations as a partial substitute for protein. Urea and other non-protein nitrogen compounds are effective in ruminant feeds because the bacteria in the rumen convert such forms to protein within their cells. These cells, in turn, are digested in the true stomach.

Supplementation of compound feeds with synthetic urea has not yet been started due to the lack of any local production of urea, and also because other protein feedstuffs such as cottonseed cake and sunflower cake cost less than imported urea. However, if in the next years some shortage in protein feedstuffs used in cattle and sheep rations should occur, then a product like urea which can substitute for these feedstuffs will be of great value.

Urea is to be manufactured by the nitrogen industry which has been established in the country. In this industry studies on the manufacture of urea should be started as soon as possible. Meanwhile, research work on the economic and nutritional value of urea should be carried out and the principles of incorporation of urea into compound feeds under local conditions should be determined.

In future, synthetic urea will have to be used on a large scale as a means of partially closing deficits in protein sources used for ruminant animals.

7. Milk replacers

Milk replacers are the types of feed utilized by young animals instead of the mother's milk. Dried milk by-products such as dried buttermilk, dried skim-milk and dried whey constitute the largest proportion of the milk replacers. Also, practically all milk replacers contain some amount of added fat, vitamins and minerals.

It seems likely that the use of milk replacers may be economical in certain parts of Turkey, particularly in the neighbourhood of big cities where the milk may be sold at a satisfactory price through-out the year.

At present the greater part of the by-products of dairy factories are wasted, or a very small amount is utilised locally for young stock feeding in the wet form. If the cheese and butter factories possessed the necessary drying facilities and could convert the considerable quantities of buttermilk skim milk and whey into dry forms, they could well be used by the feed plants to manufacture milk replacers. The incorporation of fats into the milk replacers might not be economical at first but, for a start, it should be possible to produce a sort of milk replacer with no added fat.

8. The rationalization of the animal products market

In Turkey there is a large difference between producer and consumer prices for livestock products, and this indicates a weak situation in various aspects of marketing such as livestock markets, transport, meat, milk and egg processing and wholesale and retail meat markets. Animal producers especially those situated at a considerable distance from the large cities often complain about meat, milk and egg prices and that they are not making enough profit from their business. For this reason rationalization of the livestock products market is urgently necessary.

If rationalization were effected, an increase in prices at producer level and a decrease at the consumer level might be expected. A decrease in prices to the consumer may stimulate demand especially from low-income groups, and as a result a marked increase may occur in the use of milk, meat and eggs. Certainly, such an increase in consumption of animal products would encourage the farmers to increase production and also lead to more people entering the livestock business. This, in turn would greatly increase the tonnage of compound feeds consumed.

Improvement of the market may be accomplished by the Government itself, as well as by co-operative organisations consisting of livestock producers. Co-operatives, in particular, may play an important part in regulating the market from the producer up to the consumer, by establishing livestock markets, processing plants for meat, milk and eggs and retail stores.

Industrial production of compounded feeds in Iran

M. Manouchehri
Nutrition Section, Animal Husbandry Research Center,
National Livestock Organisation Tehran, Iran

Introduction

Iran had about 6,745,000 ha of land devoted to crop production in 1968. This is 10 per cent more than was planted in 1966, although the area planted without irrigation increased only slightly during this period. Therefore, the irrigated area increased by about 25 per cent during these eight years.

Major increases were realized in the area planted in cotton, sugar beets, tea, oilseed crops and forage crops, as well as wheat and barley and crop yields have been greatly improved by irrigation. Wheat yields in 1960 averaged 1,204 kg per ha on irrigated land compared to only 469 kg without irrigation, while oil seed crops yield three to five times as much as on irrigated land as on dry land.

Irrigated forage legumes have been grown on a small scale in Iran for many years. In recent years the increased need for milk and meat in Tehran and other big cities has resulted in the establishment of large dairies, intensive poultry units and livestock finishing yards with the consequent need for more forage and grains.

Cultivation of alfalfa has improved and high yielding fodder varieties of maize have been introduced during the last two years.

In general there is a great water shortage throughout the country for fodder production. The annual precipitation is less than 300 mm except in the Caspian zone where it is 600–2000 mm.

Raw materials for compounded feed manufacture

Feed materials used as ingredients of compounded feeds for poultry and livestock can be divided into three main categories as follows:

1. Sources of energy
2. Sources of protein
3. Sources of minerals

1. Sources of energy

The important concentrate energy sources in Iran are wheat, barley, maize, wheat bran, dry beet pulp and molasses.

a. Wheat and barley

It is not known exactly how much wheat is used for animal feeding in Iran, but 60 to 70 per cent of the barley produced is fed to animals. The wheat and barley used for animal feeding is normally all produced in Iran, but during dry years additional supplies have to be imported.

b. Maize

At the present time Iran has only a small acreage of about 10,000 ha devoted to maize production which yields about 6,000 to 10,000 tons of maize annually, and nearly 40,000 tons per annum is imported. Maize is currently the main ingredient in all compounded livestock feed produced in Iran. Recently most of the dairy farms in the Tehran area have started planting maize for use as a fodder both in the green form and after preservation as silage.

c. Wheat bran

Wheat bran is one of the common feeds for livestock and poultry in Iran, and constitutes one quarter to one third of the concentrates fed to dairy cows. The wheat bran produced in Iran is of very good quality and contains a high percentage of middlings. The quantities of wheat bran produced from wheat delivered to flour mills in Iran are given in Table 1.

Table 1
Production of wheat bran in Iran

Year	Wheat delivered (Tons)	Wheat bran (Tons)
1959–60	392,000	47,040
1960–61	423,860	50,863
1961–62	457,963	54,955
1962–63	495,454	59,454
1963–64	532,727	63,921
1964–65	788,478	94,617
1965–66	1,992,701	239,124
1966–67	2,301,102	276,132

Previous Page Blank

d. Dry beet pulp and molasses

Dry beet pulp is one of the most important by-products used for animal feed in Iran, but still only about half the production is used for this purpose. The reasons for incomplete usage of beet pulp are that some farmers especially at the village level are not familiar with it and that transportation from the areas of production to those of usage may be too expensive.

Farmers are now becoming more familiar with this by-product in Iran, however, and its usage is steadily increasing. Production figures for the 1967–68 crop of sugar beet are given below:–

Area under cultivation	148,200 ha
Sugar beet production	3,411,586 tons
Molasses production	70,297 tons
Dried beet pulp	81,817 tons
Wet beet pulp	822,638 tons

Sugar beet production is expected to increase to 4.5 million tons by 1972 and to six million tons by 1977. It is expected that 292,500 tons of dried molassed pulp (containing 15–20 per cent molasses) will be produced by 1972 and 390,000 tons by 1977.

The sugar beet tops which account for 44–75 per cent of the total weight of vegetable matter produced are also a useful animal feed but obviously are not used in compounded feeds.

Molasses is also produced from sugar cane (17,640 tons in 1967 to 1968) but in smaller quantity than beet molasses.

2. Sources of protein

The main protein concentrates used for compounded feed manufacture in Iran are oilseed meals and cakes, fish meal, dry skimmed milk and 'kashk', and meat meal.

a. Oilseed meals

The government helps and encourages the farmers to increase oil seed production by giving them credit. There are two main reasons for this i.e. the production of vegetable oil for human consumption and meals and cakes for animal feeding.

Cotton seed meal is one of the readily available and inexpensive sources of plant protein for livestock and poultry in Iran. Cotton seed meal production was 204,000 tons in 1968–69 and oil cake consumption is increasing at the rate of 15–20 per cent per annum.

Investigations on the cottonseed meal produced by some factories in Iran have shown gossypol to be high. Due to this high level of gossypol it is likely that cottonseed meal which is currently used for poultry rations will gradually be replaced by soya and sunflower seed meal, the production of which is now increasing in Iran.

During the last five years oil cake valued at 950 million Rials has been exported from Iran, but exports are now decreasing due to increasing internal demand. Cultivation of soya in Iran began only in 1965 and local production is inadequate to satisfy the local demand. About 4–5 thousand tons of soya meal are currently imported into Iran. Production of sunflower oil meal was 7,500 tons in 1968–69.

b. Fish meal

There is one factory in southern Iran which currently produces 1,080 tons of fish meal per annum. As this is not enough to satisfy the requirements of Iran, fish meal is also imported (4,465 tons in 1968).

c. Dry skim milk and 'kashk'

Dry skim milk is produced in Iran in some pasteurisation plants, but production is inadequate to meet local demand. When available it is used for calf and poultry rations. Kashk or dry whey is a milk by-product produced in villages. It is used as an ingredient of poultry rations normally at inclusion rates of two to five per cent.

d. Meat meal

Meat meal is produced at the Tehran abattoir and is used as an ingredient of poultry rations. However, production is low in relation to demand.

3. Sources of minerals

The main sources of minerals for poultry and livestock rations are oyster shell (from the Caspian Sea shore), limestone and bone meal. Oyster shell and limestone are sources of calcium, while bone meal is a source of phosphorus as well.

Bone meal is produced at the rate of 1,200 tons per annum in a plant operated by the Ministry of Agriculture, while there are some private sector companies making bone meal by burning bones. Bone meal produced in Iran normally has a calcium content of about 35 per cent and a phosphorus content of 15 per cent.

Imported commercial preparations of vitamins and trace minerals are widely used in Iran as ingredients of compounded feed for poultry and dairy cattle.

Present production of compounded feeds in Iran

Production of meat and eggs by modern methods is strongly dependent on the use of balanced rations. Although concentrates such as beet pulp, molasses and cottonseed cake have been used for many years in Iran, the first factory for the production of compounded feeds was not established until 1953. Another factory was established in 1962 with the assistance of the Netherlands, while a government owned factory recently commenced operations. These factories were established to meet a demand for compounded feeds covered by a general shortage of fodder and pasture, and a programme for the production of meat, milk and eggs by modern methods which would not be accomplished by old systems of feeding and management.

Currently about 1,000 tons of compounded feed is made per day by different factories throughout Iran, about 650 tons being made in Tehran and 360 tons in other cities.

The percentages of the present production of compounded feed used for different classes of livestock and poultry are as follows:

Poultry	80 per cent
Dairy	12 per cent
Sheep	3 per cent
Others	5 per cent

This total of one thousand tons of compounded feed is made by the three big factories mentioned above, together with eight medium sized and 30 small factories. The factory established in 1953 now has a daily capacity of 300 tons but is currently working at only one half its full capacity. The second has a daily capacity of 200 tons but is also working at only half of its present capacity. The government owned feed factory has a daily capacity of 80 tons.

The compounded feed factories produce feed by one of the following three systems:

(1) Compounding from raw materials only.

(2) Purchasing of necessary vitamin and mineral mixes of these with energy and protein concentrates purchased as raw materials.

(3) Purchasing of semi-finished compounded feeds e.g. vitamin/mineral/protein supermixes and subsequent blending with energy concentrates.

Future plans for increasing compounded feed production in Iran

It has been estimated that there will be a need for the production of 650,000 tons of compounded feeds in Iran by 1972 and 1,400,000 tons by 1977. These feeds will be used for all classes of stock, namely sheep and goat fattening, beef cattle, dairy cattle, and poultry. It is envisaged that most of the raw materials for this production, namely wheat and rice bran, oil cakes, dried beet pulp, molasses, blood meal, meat meal, etc., will be produced within Iran. However, it will be necessary to increase local production of alfalfa and to import additional quantities of maize (about 25,000 tons in 1972 and 100,000 tons by 1977). It will also be necessary to import animal protein concentrates (fish meal and milk powder especially) but the requirements for food yeast and urea could be covered by production within Iran.

To meet the anticipated increased demand for compounded feeds it is recommended that consideration be given to constructing plants in Meshed, Tabriz, Shiraz, Rasht and Dezful by 1972, with a combined total capacity of 480,000 tons per annum. It will also be necessary to construct factories in seven other towns with an additional combined total capacity of 450,000 tons by 1977. The locations of these factories would be in areas where strong development of livestock production is planned for feed lots, dairy farms and intensive poultry units.

Two fish meal factories should also be established in the south of Iran, to utilise inedible species of fish which are available from the Persian Gulf and Oman Sea. The production of meat meal and blood meal should also be increased by establishing abattoirs with by-product processing facilities throughout Iran.

Marketing and distribution of feed in Iran

The large feed factories employ technical advisory staff, who visit farms and instruct them on animal feeding, management, vaccination, etc. Such technical assistance enables farmers to achieve better results and the demand for compounded feed increases accordingly. These services are provided free by the factories.

There is no specific organisation for feed distribution to villages and small towns, private hauliers being usually contracted on individual bases. Only 20 per cent of the feed produced in Tehran is sent to other areas of the country due to high transportation charges. Roads are not good in some parts of Iran and this contributes to the high costs of transporting feed by road which is the commonest method of distribution. Transportation of feed by rail should be encouraged by introducing concessionary rates, as is currently practiced for fertilisers.

Compounded feeds are distributed either in bulk or in bags (polypropylene, paper or jute). However, even though bulk distribution is cheaper, farmers currently prefer to receive their feed in bags, as it enables them to keep account of its use more easily.

References

CENTO. 1968. Report of CENTO *ad hoc* working party on fertilisers.

CENTO. 1969. Conference on regional and national livestock development policy, Islamabad, Pakistan.

MANOUCHEHRI, M. A. 1969. Feed production and distribution in Iran.

TABEH, M. and ZOHARI, M. 1970. Some problems in poultry husbandry in Iran. *Proc. 17th Int. Poultry Conf., Varese, Italy, May 1970.*

The industrial production of compounded feeds in Pakistan

M. Y. Bhatti
Director of Animal Husbandry, Baluchistan, Quetta, West Pakistan

Present position of production

The advent of the era of industrial production of compounded feeds in Pakistan for both poultry and livestock took place during the year 1960 when 69 tons of feed were produced. Annual production had increased to 37,000 tons during 1970 although this was only a little more than one third of the total installed capacity of 91,500 tons. The growth of the feed industry, which began initially both for poultry and livestock concentrate feed production, became identified almost completely with the growth of the commercial poultry industry after 1963. The reason for this was the generation of demand for compounded or mixed feeds for commercial hybrid chickens, these having exacting nutritional requirements.

The cattle feeds mixed at the beginning of the last decade did not find much favour with private dairy farmers due to the fragmentary and extensive nature of dairy business in the country and to the simpler nature of cattle feed formulae, which can be more readily compounded by individual owners of dairy animals themselves. Also as milk production is largely handled by uneducated groups (these may have as few as one or two or as many as two hundred cows or buffaloes near big cities) with little regard for scientific feeding methods, there has been little demand for scientifically formulated dairy concentrate feeds. There is little demand also for concentrate feed for goats, sheep or beef cattle, goats and sheep in particular being largely kept by migratory herdsmen on open ranges. A need for compounded feeds for animals kept on open ranges has, however, arisen in recent years due to overstocking causing famine conditions at certain seasons.

Summarising, it is evident that due to the nature of livestock production being extensive compared with modern methods of intensive poultry production, the production and marketing of compounded poultry feed is basically much easier than for ruminant feeds.

There are at present five major concerns manufacturing poultry feed in Pakistan their annual productive capacities being as follows:

1. Messrs Lever Brothers Pakistan Limited, Rahim Yar Khan.	24,000 tons
2. Messrs Pakistan Cattle Feed Industries Limited, Gujranwala.	24,000 tons
3. Messrs Aftab Flour and Allied Industries Limited, Karachi.	24,000 tons
4. Messrs Arbor Acres Poultry Feed Mill, Karachi.	15,000 tons
5. Mesrss Al-Fatah Poultry Feed Mill.	4,500 tons
Total :	91,500 tons

The present annual production of 37,000 tons from all the above mills is used to feed the four million chickens currently produced annually by the commercial hatcheries in Pakistan. It would appear that these mills are running below capacity due to limited demand for compounded feed. As the production of commercial hybrid chicks increases in years to come, however, more mills may be required to go into operation to meet the growing demand.

Another possible factor that could be responsible for under-capacity production of mills is the lack of availability of liberal quantities of coarse grains for poultry consumption. Self sufficiency has been achieved in wheat recently but during 1971 due to lower rainfall production of wheat may be reduced. A similar increase in the yield of coarse grains like maize and sorghum will be necessary before compounded feeds could be made more cheaply and popularised. The manufacturers of poultry feeds have experienced difficulties due to high grain prices, but 20,000 to 30,000 tons of maize is currently being provided by the World Food Programme to Pakistan to assist in reducing grain prices. This grain is supplied to feed mills at subsidized rates, which in turn reflect the concession given to them in the sale price of the manufactured feeds. The reduction in prices thus effected per bag of 50 kg by feed manufacturers is as follows:

Broiler starter ration. Rs.2.55–3.00
Broiler finisher ration. Rs.2.00–2.70

With the above price reductions the cost of raising broilers to 8 weeks has been reduced by 15–21 per cent.

Previous Page Blank

The government is also making efforts to stabilize the prices of other raw materials used in the manufacture of feeds for poultry. Modern abattoirs are being established at Karachi and Lahore, while one has recently been established and started working at Rawalpindi (Islamabad). These abattoirs will have facilities to process by-products, which will result in the provision of better sources of animal protein ingredients at a cheaper rate. One of the fish meal manufacturing concerns in Pakistan has started producing feed grade fish meal of 50–55 per cent protein content. Molasses is also made available in required quantities from sugar mills as a by-product. Similarly the sources of vegetable protein ingredients are improving with the establishment of vegetable ghee industry, although at the same time a further increase is required in oil seeds production to increase the production of oilcakes.

Problems to be faced in the future development of the compounded feed industry of Pakistan

1. Perhaps the biggest problem of the future for the compounded feed industry is the availability at reasonable rates of coarse grains like maize and sorghum, which are the major constituents of all compounded feeds both for livestock and poultry in Pakistan. The entire growth of feed manufacturing plants will depend on the extent to which the production of coarse grains can be increased so as to make them freely available for feeding to livestock and poultry. With the current increases in human population, all out efforts will be needed to effect increases in the production of the two most important coarse grains. This will involve the adoption of modern practices in agriculture such as use of high yielding seeds, fertilizers, irrigation water and better pest control. Research work already carried out on maize and sorghum elsewhere may well assist in this regard.

With the introduction of Mexican wheats into Pakistan it is envisaged that it will be possible to meet all the wheat requirements of Pakistan from a smaller acreage and to divert land for maize production. This will also reduce the human consumption of maize as wheat is preferred to maize for human consumption. Maize production is expected to increase by another one million tons during the fourth plan period ending in 1975, while the sorghum production is also expected to go up by another one to 1.5 million tons during the same period. The present acreages under maize and sorghum cultivation are 1.3 and 1.5 million acres respectively, which are not expected to increase very substantially, but the yield per acre is expected to increase with better cultural practices.

2. The problem of supply of animal protein sources will accentuate as the capacity of feed mills increases. For this purpose additional rendering plants along with modern packing plants will have to be constructed so as to utilize the slaughter house by-products like blood, meat offals, meat scrap etc. which are not properly utilized at present. The sources of fish meal supply will also have to be improved and good possibilities exist for this in Pakistan, where schemes for opening new fish ports are currently in hand.

3. The problem of importation of machinery for feed mills will also arise as it will involve payment of scarce foreign exchange. Along with this, the need for importation of feed additives like stabilized vitamins, trace minerals and antibiotics will also exist. The current production capacity of feed mills even if utilized in full will not suffice to meet the future need of compounded feeds taking into consideration the future production plans of poultry industry alone and ignoring possible livestock ranching operations. The present capacity of 91,500 tons per annum will have to be increased to at least 251,000 tons per annum. This will be just enough to feed the proposed 17.5 million broiler and layer chicks expected to be produced by the year 1975. The requisite numbers of biochemists and nutritionists will be provided by the two agricultural universities of Pakistan, which have had full-fledged animal nutrition departments operating since 1961.

4. The problem of storage and transportation facilities will also arise with the increase in the quantities of manufactured feeds. At present a shortage of railway wagons occurs at times when emergency despatches of feed are required. However, it is expected that the development of road transport in Pakistan will ultimately take care of any enhanced needs of the industry. The problem of building enough storage space suitable for tropical climates will also have to be tackled so as to arrest deterioration of ingredients in stored mixed feeds.

5. Extension work will become necessary especially for popularising the use of compounded feed for livestock, because under current conditions it is difficult to market such a product. All out efforts to educate, inform and demonstrate the good effects of such feeds will be required in order to encourage dairy farmers and sheep and goat herders to use them. This could open up a vast source of expansion in the mixed feed industry, for which there is a great need, but little realization of this as yet. The current fodder shortage periods which occur almost every year at one place or the other could be satisfactorily tided over by the use of judiciously fed concentrates in the form of supplements. This could help avoid the malnutrition and starvation of animals especially in the range areas of the country.

The role of the feed compounding industry of Pakistan in relation to livestock and poultry production

The feed compounding industry in Pakistan has a vital role to play in the development of poultry as well as livestock production industries. The poultry industry comprising the commercial hybrid chicken is almost entirely dependent on the concomitant mixed feed production and the future poultry production

plans in the commercial sector are both a cause and effect of the allied progress in the mixed feed production. There will not be much difficulty in using the boost in feed manufacture to increase poultry production except that as businesses develop, quality control of feed will have to come so as to introduce an element of healthy competition in the feed industry and to give a fair deal to the poultry breeder.

The feed industry could further the cause of expansion of the poultry industry by feed financing and extending other management advisory services. It could also undertake useful research in the feeding values of locally available grains and moreover encourage the cultivation of high yielding coarse grains in selected areas, on the same lines that sugar mills adopt for the cultivation of sugar cane in their surrounding areas. A real close tie in of the feed and poultry industry could be mutually beneficial to both. The feed mills would do well to maintain their own small poultry research stations to test the efficiency of the feed produced by them so as to eliminate any chance of error before the finished product is widely sold. Over a period of time the feed industry may also be required to prepare supplemental feeds for the improved rural chicken, which will open up another avenue for their sales. The rural poultry keeper will be able to afford some expenditure on feeding a little supplemental feed to his birds, if these are better producers than the present native chickens, which can only be kept at no cost basis.

The efforts being made to introduce a crossbred strain involving the native chicken holds promise in this respect for the feed industry in addition to the rural poultry industry.

The role of the feed industry in developing and serving the livestock industry is not spelled out clearly as yet, but over a period of time a growing organised production of livestock both for milk and meat requiring mixed feeds is bound to come. The possibility of establishing livestock ranching enterprises in range areas of Pakistan is already being examined by private companies. One of the provinces in West Pakistan, namely Baluchistan, has already constituted a Livestock Ranching Development Board to help co-ordinate efforts in both the public and private sector for undertaking livestock ranching operations in an integrated fashion. As and when such operations develop, the need for concentrates in the form of compounded feeds will be keenly felt as the range lands in large parts of Pakistan cannot support livestock without feeding supplemental feed for part of the year at least

The urgency of livestock ranching is also being felt, due to the reason that the present system of migratory herds of sheep and cattle with little regard of range management principles has tended to overstock and denude the range lands of grass cover, resulting in periodic forage shortages. Such situations will tend to highlight the need for supplemental feed in both cattle and sheep production operations, which will in turn provide a stimulus for the production of compounded livestock feeds.

The canal irrigated areas in Pakistan are concentrating on arable cash crop production, which is more economical than livestock production, the latter being reduced to a fringe business. As such, livestock is being confined more and more to areas unfit for crop production or the wastelands. The scarcity of fodder in irrigated areas, due to priority of arable cash crops has also resulted in a greater need of supplemental compounded feed availability for livestock in such areas. The dairy industry is becoming organised in the country and certain offers of high yielding cows like Friesians have been received from abroad. Similarly, recently milk type Hlahwara Short Horns have been imported from Australia, which will form a base for organising the dairy industry in the country.

All of these steps will tend to emphasise the need for the development of the livestock feed industry. So the stage seems to be set for the take off of the livestock feed industry on the same lines as for poultry, which established the lead by being more intensive oriented than the livestock industry. In fact the future development of the livestock industry will remain doubtful till such time that the compounded feed industry provides a base for the production of supplemental feed to be used normally along with roughage and in special circumstances, where livestock is threatened with downright starvation in scarcity periods. The livestock feed industry is thus destined to play the same role in the development of livestock production as it has done in other developed countries and it is only a matter of time before this is realized in Pakistan.

As mentioned before, the inherent nature of the livestock industry and the traditional practices of livestock rearing offer a great resistance to the acceptance of newer feeding practices, but steadily due to sheer economic pressures it will become normal to feed supplemental rations to livestock kept in traditional pastoral ways, and the demand for the provision of compounded feeds is bound to be generated. In this connection efforts to educate the livestock breeder in improved practices of livestock production by extension agencies would go a long way to smooth and hasten the way for acceptance of the improved feeding of livestock. The feed companies could help in this connection by offering free advice and samples to demonstrate the effectiveness of their feed formulae.

Changes in nutritive value of concentrate feedingstuffs during storage

I. Cockerell, B. Francis and D. Halliday
Tropical Products Institute, London, United Kingdom

Introduction

The materials commonly used as constituents of concentrated feedingstuffs may be classified as follows:

1. Cereals e.g. maize, barley, wheat, sorghum and millet and by-products from their processing e.g. milling offals and brewery residues.
2. Oilseed expeller cakes and extracted meals e.g. those from cottonseed, groundnuts, soya, sesame and coconut.
3. Grain legumes e.g. various types of beans, peas, grams and lentils.
4. Dried roots and tubers e.g. cassava and potatoes.
5. Leaf meals e.g. those from dried grass and alfalfa.
6. By-products from sugar processing i.e. molasses and dried beet pulp.
7. Animal products e.g. fish meal, meat meal, dried blood, bone meal, feather meal and poultry by-products meal, and dried milk products.

Figures for the proximate composition of some of the more important materials taken from the literature are given in Table 1. The production of concentrate feedingstuffs inevitably entails some storage both of raw materials and finished compounded feeds. Losses in nutritive value and other changes which may reduce their value as feedingstuffs may occur during storage, and it is obviously important that these be minimised. These changes are related to composition and storage conditions. This paper will indicate the changes which can occur, the relationship of such changes to storage conditions, and methods of minimising them so as to avoid economic losses.

Environmental effects

The environment in which feed concentrate materials are stored is of vital importance in determining the extent and type of change which may occur. The most important environmental factors are ambient temperature and humidity, which greatly influence the rate at which chemical changes may take place and the growth of pests such as fungi and insects. Certain chemical changes are closely related to the activity of fungi and insects, and it is difficult to consider these factors in complete isolation. Other environmental factors are closely related to the quality of construction and general hygiene of the storage facilities. A dirty and poorly constructed (or maintained) building will encourage changes due to admission of rain or the activity of rodent and insect pests. This damage may be in the form of weight losses and general addition to the chemical deterioration mentioned above.

Moisture content

Moisture content of stored produce is closely related to ambient relative humidity. The relationship of equilibrium relative humidity to moisture content for a number of common commodities is given in Figure 1. It will be noted that oil-free materials such as grains have higher moisture contents than those containing oil, in equilibrium with the same ambient relative humidity. However, differences in moisture content/relative humidtiy relationships are small for oil-free feed materials, and it is possible to generalise for these to some extent with regard to moisture contents which are critical for different types of biological activity. Moisture content in equilibrium with a given relative humidity varies with temperature, and for a 10°C rise decreases by 0.6–0.7 per cent for the oil free material (Mackay, 1967).

The moisture content in equilibrium with a given relative humidity is also affected by the so-called 'Hysteresis' effect. Due to this, feed materials absorbing water to achieve a given equilibrium relative humidity, have lower moisture contents than those drying out to the same equilibrium relative humidity. This effect is illustrated for yellow maize in Figure 2. Biological activity both within the materials and by pests is greatly affected by moisture content. Insect pests will not develop on feedingstuffs at relative humidities outside the range 30 per cent to 95 per cent while bacteria will only develop at relative humidities in excess of 90 per cent. Fungi generally grow only at relative humidities

Table 1
Approximate composition of concentrated feed materials, per cent

Materials	Dry Matter	Crude Protein	Oil	Crude Fibre	Mineral Matter	Nitrogen Free Extract
Maize	87.0	9.9	4.4	2.2	1.3	69.2
Barley	85.0	9.0	1.5	4.5	2.6	67.4
Wheat	87.0	12.2	1.9	1.9	1.7	69.3
Sorghum	89.6	10.8	2.8	2.3	2.0	71.7
Wheat bran	90.1	16.4	4.5	10.0	6.1	53.1
Rice bran	90.8	12.4	13.6	11.6	13.3	39.9
Cottonseed cake (undecorticated)	92.4	28.0	5.2	21.4	4.6	33.2
Cottonseed cake (decorticated)	90	41.1	8.0	7.8	6.7	26.4
Groundnut cake (undecorticated)	90	30.3	9.1	23.0	5.7	21.9
Groundnut cake (decorticated)	90	45.4	6.0	6.5	5.7	26.4
Soya Meal (extracted)	89	4.8	1.5	5.1	5.5	32.1
Sesame cake	91	44.7	11.9	4.5	8.9	21.0
Coconut cake	90	21.2	7.3	11.4	5.9	44.2
Broad beans (*Vicia faba*)	89	23.4	2.0	7.8	3.4	52.4
Bengal Gram (*Cicer arietinum*)	89	20.1	4.5	4.9	2.9	56.6
Lentils (*Lens esculenta*)	89	24.2	1.8	3.1	2.2	57.7
Dried cassava roots	94.4	2.8	0.5	5.0	2.0	84.0
Dried potatoes	91.4	9.7	0.3	2.1	4.3	75.0
Dried grass	90.0	15.0	2.6	20.9	10.8	40.7
Alfalfa meal	92.7	21.1	3.3	17.5	11.5	39.3
Beet molasses	80.5	8.4	0	0	10.1	62.0
Cane molasses	73.4	3.0	0	0	8.6	61.7
Dried beet pulp	91.2	8.8	0.6	19.6	3.5	58.7
Fish meal (white)	87.0	61.0	3.5	–	21.0	1.5
Fish meal (oily)	93.5	62.1	8.3	0.7	18.2	4.2
Pure meat meal	89.2	72.2	13.2	–	3.8	–
Dried blood	68.0	81.0	0.8	–	2.7	1.5
Bone meal (cooked)	93.6	26.0	5.0	1.0	59.1	2.5
Feather meal	94.6	87.4	2.9	0.6	3.7	0
Poultry by-products meal	93.4	55.4	13.1	1.6	18.7	4.6
Dried skimmed milk	89.7	32.8	1.5	–	7.5	47.9

in excess of 70 per cent while germination normally requires relative humidities of more than 95 per cent. Expressing these in terms of approximate moisture contents of oil-free material stored at temperatures of 20–30°C, the following could be anticipated:

1. Up to 8 per cent moisture (30 per cent relative humidity): no significant biological activity.
2. 8–14 per cent moisture (30–70 per cent relative humidity): insect infestation possible. Mites can infest at relative humidities in excess of 60 per cent.
3. 14–20 per cent moisture (70–90 per cent relative humidity): insect infestation and mould growth possible.
4. 20–25 per cent moisture (90–95 per cent relative humidity): insect infestation, and mould and bacterial growth possible.
5. Above 25 per cent moisture (more than 95 per cent relative humidity): bacterial growth and seed germination possible.

In practical terms this means that moisture content should be kept as low as possible but in any case should not be allowed to exceed that which would be in equilibrium with relative humidities of 70 per cent or more. Allowing a safety margin to take into account fluctuations in equilibrium equivalents, a maximum moisture content of around 13 per cent for oil-free material would seem to be appropriate.

Lastly it should be mentioned that moisture content can influence the degree to which certain chemical changes, which are not biologically induced, may occur. However, its greatest effect is on the biological changes mentioned above.

Temperature

Temperature can also greatly influence changes in nutritive value of feed materials by affecting both the rate at which chemical reactions take place and biological activity. In the former connection enzyme activity may be enhanced by increasing temperature up to an optimum level, above which the enzyme itself is destroyed at a greater rate than its activity is enhanced.

The influence of temperature on biological activity is similar, in that the activity of the different types of organisms is enhanced up to an optimum level above

Figure 1
Moisture content/relative humidity equilibrium curves. Each curve has been compiled from the results of several workers to present a guide to the moisture content/relative humidity equilibrium values which vary between varieties of the same species of food product. (By courtesy of Tropical Stored Products Centre, Tropical Products Institute).

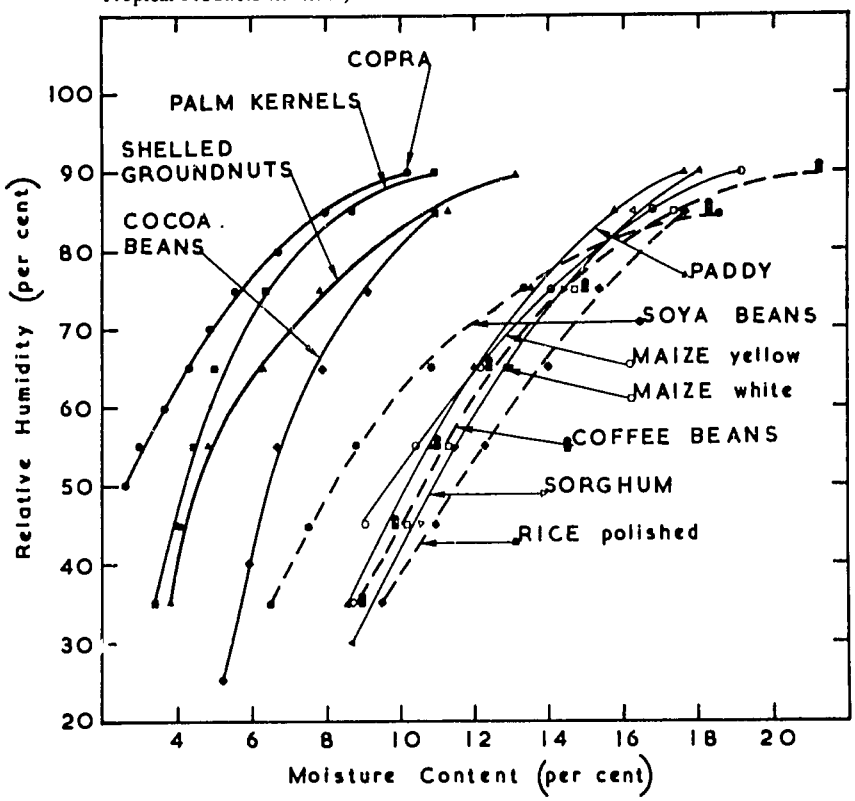


Figure 2
Hysteresis in the moisture content/equilibrium curve of yellow maize.

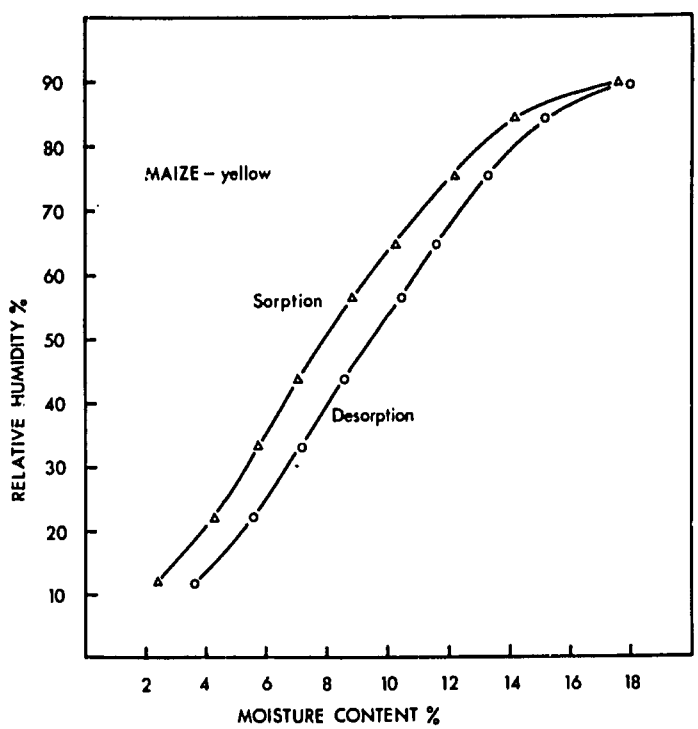
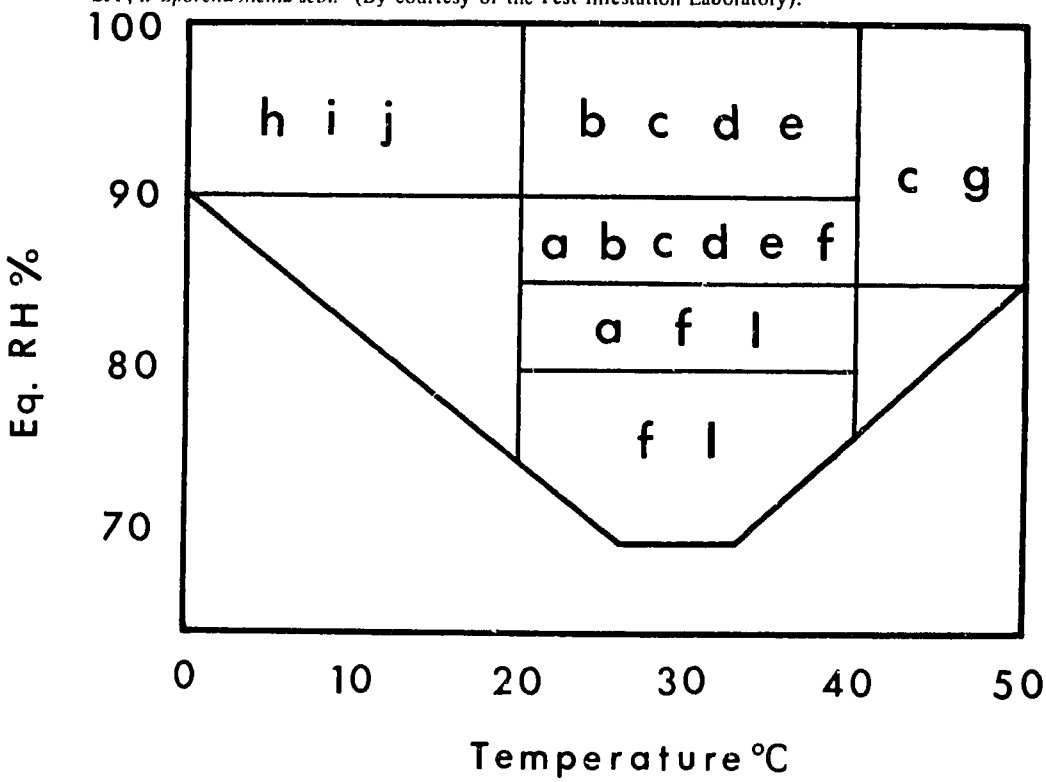


Figure 3
Temperature and relative humidity conditions at which species of fungi may be most important
a. *Aspergillus candidus*; b. *A. flavus*; c. *A. fumigatus*; d. *A. tamarii*; e. *A. niger*; f. *A. glaucus* group (including *A. restrictus*); g. *A. terreus*; h. *Penicillium cyclopium*; i. *P. martensii*; j. some *Cladosporium* SPP; l. *Sporendonema sebi*. (By courtesy of the Pest Infestation Laboratory).



which activity decreases. The optimum temperature range for fungal activity is around 35–40°C, while insects cannot normally survive at temperatures in excess of around 40°C.

Temperature plays an important role in influencing possible damage to stored feedingstuffs, especially if it is unevenly distributed (such uneven temperature distribution may in fact be caused by localised biological activity). Convection currents may be set up which may lead to condensation of moisture in the upper portion of the mass of material, causing localised portions of the feed to achieve moisture contents sufficient for fungal or other damage to occur. Condensation of moisture at the surface of a mass of feed at a temperature significantly higher than the ambient may cause similar problems.

Effects of pests

Micro-organisms

The most important micro-organisms which attack stored feed materials are the fungi, bacteria being of less importance due to the high moisture content necessary for their growth. Bacteria are of importance particularly in feed materials of animal origin, mainly as pathogenic contaminants such as *Salmonella* spp.

Fungi (as has already been mentioned above) are normally only active at relative humidities in excess of 70 per cent, and activity is generally greatest at temperatures of 35–40°C. The temperatures and relative humidities at which species of fungi commonly found on stored feed materials may be most important are given in Figure 3. They may reduce the value of feed materials in three ways:

1. Adversely affecting flavour and appearance.
2. Enhancing chemical reactions which reduce nutritive value.
3. The production of toxic metabolites.

It is unnecessary to enlarge to any great extent on the first way. Animals are influenced by the organoleptic properties of their feed and mould contamination could well affect acceptability.

Chemical reactions may be enhanced by enzymes secreted by fungi, the most common being that of lipolysis of any oil present. Fungi may also assist in the development of ketonic rancidity of oil. The heating effect of fungi may also enhance the development of non-enzymatic browning, but this and the other effects mentioned will be dealt with in greater detail later.

Perhaps the most serious aspect of fungal contamination of feeds is that of possible production of toxic

metabolites. The first of these to be identified was that produced by strains of the common storage mould *Aspergillus flavus*. This was isolated from a consignment of groundnut meal which caused the death of a large number of turkeys in 1960, and given the name "Aflatoxin". A number of other toxic substances produced by other moulds have since been identified, but aflatoxin is still by far the most important for animal feed materials. It has been most associated with groundnuts, and groundnut cake and meal, but is liable to contaminate any produce emanating from countries with hot and humid ambient conditions.

Since its discovery, methods for the determination of the very small quantities of aflatoxin necessary to have an acute toxic effect on farm animals (less than 1 part per million for the more susceptible species and age groups) have been developed. A code of practice has also been introduced and used in Britain and elsewhere which enables materials contaminated with aflatoxin to be incorporated into compounded animal feed at levels to ensure that particular classes of animals for which they are intended are not adversely affected. Methods of detoxification have also been developed, but these are unlikely to prove economic, and careful control of harvesting and storage conditions is perhaps the best method of avoiding aflatoxin contamination. In any case however, routine analysis of any material likely to have been subjected to conditions in which *A. flavus* growth could occur is essential.

Insect Infestation

The more important insect pests of stored feed materials in relation to the economic damage they may cause are given in Table 2 (Smith, 1969).

Table 2
Major insect pests of feed materials

Insect species		
Scientific name	Common name	Materials most likely to be attacked
Sitophilus spp	Weevils	Cereal grains
Rhizopertha dominica	Lesser grain borer	Cereal grains, pulses, dried roots
Trogoderma granarium	Khapra beetle	Cereal grains, pulses, oilseed cakes and meals, finished feeds, cereal milling offals
Oryzaephilus spp	Saw-toothed grain beetles	Cereal grains, oilseed cakes and meals, finished feeds, cereal milling offals
Tribolium spp	Flour beetles	Cereal grains, oilseed cakes and meals, finished feeds, cereal milling offals
Callosobruchus spp *Acanthoscelides obtecus* *Zabrotes subfasciatus* *Careydon gonagra*	Pulse beetles	Pulses
Cryptolestes spp	Flat grain beetles	Cereal grains, oilseed cakes and meals, finished feeds, cereal milling offals
Sitotroga cerealella	Angoumois grain moth	Cereal grains
Cadra cautella	Tropical warehouse moth	Cereal grains, oilseed cakes and meals, finished cereal milling offals
Plodia interpunctella	Indian meal moth	
Corcyra cephalonica	Rice moth	

In addition to these cockroaches should also be mentioned. These are scavenging insects which do not breed within the feed material itself. Three main species of cockroach may be found in stores – the German cockroach (*Blatella germanica*), the European cockroach (*Blatta orientalis*) and the American cockroach (*Periplaneta americana*).

As has been mentioned above, the activity of insects is closely related to temperature and relative humidity. In general, up to optimal limits activity is enhanced by increased temperature and relative humidity, but these limits vary for different species of insects. For example, *Trogoderma granarium* multiply under hot dry conditions, which would be too extreme for *S. oryzae*. Tables of limits of temperature and relative humidity within which the common insect pests of stored feed materials can multiply have been worked out with laboratory cultures, but these are not strictly reliable for extension to field conditions.

Some insect pests can only cause damage to a particular type of commodity, although they may well be found on others. For example pulse beetles can normally only damage pulses. Insects which are able to damage intact seeds such as grains and pulses are termed primary pests and these include, for example the grain weevils (*Sitophilus spp*), pulse beetles, the lesser grain borer (*Rhizopertha dominica*), the Khapra beetle (*Trogoderma granarium*) and the Angoumois grain moth (*Sitotroga cerealella*). Other insect pests can feed only on damaged seeds or meals, and these are normally

 termed secondary pests when found to be infesting seeds.

Insects can cause damage to feed materials in several ways. Firstly consumption of feed and powdering may lead to a significant weight loss, while palatability may be reduced due to insect frass. In the case of seeds, there may be an additional loss in nutritive value due to preferential consumption of the more nutritious portions of the seeds e.g. the germ. Deteriorative chemical processes may also be enhanced, by enzymes e.g. lipases secreted by the insects and by temperature increase. Scavenging insects such as cockroaches may also cause contamination with pathogenic bacteria such as *Salmonellae*.

Although it is clearly imperative to ensure the control of insect infestation in feed materials it is not proposed to deal in detail with the methods of achieving this. However it should be mentioned that even in areas with the most favourable ambient conditions for insect activity, it is possible to achieve reasonable standards of control with a combination of suitable storage facilities with the appropriate use of fumigants and insecticides (Hall, 1970).

Rodents

Rodents can cause considerable damage to stored feed materials in three ways. Firstly they consume a portion of the feed. While secondly they foul a much larger portion with their excreta. Thirdly they cause considerable damage to containers such as jute and paper sacks.

Rodent infestation may be controlled by the construction of adequate rodent-proof storage facilities, good storage hygiene and the use of respiratory and stomach poisons. However it is not proposed to deal with this in detail here.

Changes in lipids

The term lipid is arbitrarily applied to those substances present in plants and animals which are insoluble in water but soluble in such organic solvents as diethyl ether, chloroform, acetone, carbon tetrachloride and petroleum ether. Lipids particularly those of plant origin, are largely composed of mixed triglycerides with very much smaller quantities of phospholipids, carotenoids, vitamins, sterols etc. All foods necessarily contain some lipid material, which in common with the other constituents of foods is subject to storage deterioration, the most obvious and important form of lipid degradation being referred to as rancidity. Rancidity is quite a complex phenomenon but may conveniently be thought of as being of three main types viz. oxidative, hydrolytic and ketonic rancidity (Perkins et al, 1960).

Oxidative rancidity

Oxidative Rancidity is the commonest and most important type of rancidity encountered in animal feeds, and is most likely to occur when there is a high degree of unsaturation in the oils and fats present eg. in fish meal. The mechanism of lipid oxidation involves, primarily, autoxidation reactions accompanied by secondary reactions of the lipid hydroperoxides produced, which may or may not themselves be oxidative in character. Autoxidation, which is by no means confined to the lipid fraction of feeds, can be defined as the direct reaction of the substances with molecular oxygen. It is important to realise that it is not necessary for feed materials to possess a high proportion of lipids for autoxidation to be a serious storage problem.

Under normal storage conditions the main products of lipid autoxidation are hydroperoxides (Lea and Swoboda, 1958). These themselves are invariably tasteless and odourless but the secondary reactions which they may undergo may lead to "off flavours", destruction of essential fatty acids, reactions with proteins and the formation of toxic compounds. The possible paths of these secondary reactions are both diverse and complex and have not yet been fully investigated, but a number of reactions which have been established are given below (Togashi et al, 1961):–

1. Further oxidation of hydroperoxides to yield di-peroxides which in turn yield polymers of various types.
2. Dehydration of the hydroperoxides leading to the formation of ketoglycerides.
3. Fission of hydroperoxides to yield a variety of products containing carbonyl and hydroxy group which will react further to yield a complex of products.
4. Oxidation of the C = C double bond in other molecules giving rise to the formation of epoxides and hydroxy glycerides.

Carbonyl groups supplied by the aldehydic fission products of fat hydroperoxides mentioned in 3 above can react with free protein amino group such as the E amino group of lysine reducing the nutritive value of the protein (Goddis et al, 1960). This will, however, be dealt with later.

The oxidation of unsaturated fats apart from itself producing 'off flavours' can cause the degradation of the natural aroma, flavour and colouring substances present and also destroy those vitamins which are susceptible to oxidation e.g. Vit A, Vit D and Vit E. These coupled oxidations are not fully defined or understood, although a great number of compounds such as epoxides furanoxides and aldehydes are known to result from them.

Factors affecting the rate of lipid oxidation in stored feeds

A vast number of variable factors can affect the rate and type of oxidation undergone by food lipids. For this reason it is very difficult to predict and control - the more so in the case of compound animal feeds where a large number of components of diverse chemical composition may be mixed together. Some of the factors known to accelerate the oxidative deterioration of lipids are listed below.

(a) Enzyme systems:– It has long been known that lipoxidases catalyse the oxidative degradation of fats and oils but now other, largely unidentified, enzymes have been shown to operate in this way, Soya sugar beet and alfalfa storage experiments have indicated the presence of enzymes other than the lipoxidases involved in lipid oxidation reactions. The existence of lipoperoxidases has recently been postulated.

(b) Hematin:– All naturally occurring compounds catalyse the oxidation of unsaturated lipids. This effect has often been confused with lipoxidase catalysis though techniques are now available to distinguish between the two mechanisms. This factor is of particular importance in the storage of fish and meat meals.

(c) Peroxides:– The presence of peroxides in fats which already have undergone autoxidation or peroxides from other sources will cause a marked increase in the rate of oxidation of lipids.

(d) Light:– Light, especially ultra-violet light (notably sunlight), will adversely affect food lipids by supplying energy for the free radical mechanism photolysis of the peroxides.

(e) High temperature:– In general, the higher the storage temperature the faster is the breakdown of food lipids, but it has been shown that in the case of dried fish and milk powders oxidation can proceed more rapidly in the products stored under refrigeration than those stored at room temperature.

(f) Trace metal catalysis. Many metals, notably iron, copper, cobalt and zinc, have been shown to accelerate lipid oxidation often dramatically. Usually this is due to the metal participating in a redox reaction, that is direct electron transfer, but also some metals, such as zinc, induce hydroperoxide decomposition to free radicals.

There are also a number of other factors which are not as yet thoroughly understood which may accelerate lipid oxidation e.g. the presence of free fatty acids. It should also be mentioned that moisture content is a very important factor in controlling the rate of certain of the above reactions e.g. the influence of trace metals is greatest at very low moisture contents.

Lipid oxidation can be inhibited by the addition of 'antioxidants' such as ethoxyquin (EQ) and butylated hydroxy toluene (BHT), which combine with free radicals formed during the oxidative processes.

Hydrolytic rancidity

The hydrolysis of oils and fats which involves the cleavage of triglycerides to yield free fatty acids, di- and monoglycerides and glycerol, do not necessarily lead to the development of organoleptically detectable rancidity. Hydrolytic rancidity is most marked when fatty acids of low molecular weight are present, and oils mainly containing fatty acids with more than 14 carbon atoms and only a moderate degree of unsaturation do not develop 'off-flavours' when slightly hydrolised. In general it may be stated that hydrolytic rancidity is of much greater significance for extracted edible oils than for animal feedingstuffs.

Ketonic rancidity

Ketonic rancidity is another type of oxidative rancidity but is considered separately as its cause is microbiological. The action of some fungi of the *Aspergillus* and *Penicillium* groups can produce characteristic methylalkyl-ketones in oils and fats. The moisture content of the stored material is thus a very important factor for ketone formation. Most foods will 'go off' due to ketonic lipid rancidity but the effect is particularly marked when the lipid fraction is rich in oleic acid as a most objectionable taste and odour results.

In addition to ketonic compounds, alcohols, fatty acids and aldehydes can be produced, the carbonyl groups of the aldehydes and ketones can react with free protein amino groups causing loss in protein quality.

Changes in protein quality

Heating and high humidity in the environment are the two most likely factors which will affect chemical changes in the protein fraction of stored feed concentrates. Under such adverse storage conditions protein can undergo deleterious chemical changes which will result in a reduction in digestibility and loss of nutritive value (Rice and Beuk, 1953).

In extreme cases protein can be destroyed with the elimination of ammonia, carbon dioxide and hydrogen sulphide.

It is now well known that the chemistry involved in protein degradation is associated with the carbonyl-amino reaction, lipid oxidation and the little understood reactions involving the sulphur amino acids. Although these protein changes are part of the 'Browning' or Maillard reaction the complex mechanisms which lead to the formation of polymerised melanoidin substances are still imperfectly understood. In the initial stages however it has been established that the E-lysine groups of both free and protein lysine are involved in covalent linking with carbonyl groups (Hodge, 1953). The latter can arise from lipids (see above) or aldehyde and ketone groups of sugars of carbohydrate hydrolytic products. This

initial reaction is generally a condensation of a sugar with an amino compound to form a glycosylamine which is followed by enolisation and an Amadori transformation to give an amino-deoxy ketone. There follow two possible pathways to the production of carbonyl compounds which polymerise to melanoidins. In the first an hydroxy group is eliminated on the third carbon to give a deoxyhexosone which dehydrates to a carbonyl compound and in the second pathway the amino deoxy-ketone enolises with the elimination of amine to form a methyl-dicarbonyl intermediate followed by dehydration and polymerisation as before. Both these pathways provide reactive compounds for the Strecker degradation of amino acids to aldehydes and ketones (Hodge, 1953, Burton and MacWeeny, 1964). It can be seen therefore that during the initial changes of degradation of protein the loss of nutritive value is due to a loss of amino nitrogen with inter and intra molecular bonding which generally decreases the solubility of protein and is resistant to normal protease activity.

Poor protein quality has been correlated with low values in the availability (or loss of) certain vulnerable and essential amino acids; notably lysine and methionine. While the effect of heat on rendering lysine unavailable in such products as oil seed meal and in milk drying is well known, the mechanism by which methionine can follow a similar fate and become unavailable is not understood although this condition has been demonstrated. Destruction of methionine, however, and the sulphur amino acids generally, takes place at much higher temperatures than are experienced during the storage of feed concentrates (Woodham, 1967).

Although the carbonyl-amino reaction also takes place at high temperature, pre-processing can initiate degradative changes which can then continue (for example in milk) under bad storage conditions. Extremes of unsuitable storage conditions under which certain feedingstuff concentrates can undergo disastrous chemical deterioration are not very often encountered but nevertheless do occur. For the sake of completeness, the possibility of enzymic enhanced browning reactions should be mentioned, although the possibility of this mechanism causing degradation of protein in feedingstuffs is very remote. Enzymatic changes can take place in stored dried food; under conditions of low temperature dehydration, many enzymes in tissue remain undernatured and enzymatic reactions can continue in the 'dry' state and liberate sugar for secondary reaction with protein. Thus, for instance, the alpha amylose, maltose and nucleotide metabolizing enzymes of muscle can liberate glucose, ribose and ribose-5-phosphate. Such reactions explain why dehydrated raw flesh foods are less stable during storage than those that have been dehydrated from the cooked condition. The fonner type of material is not, however, widely available as an ingredient for mixed feeds. In stored cereals amylase activity during sprouting could make available further carbonyl groups from reducing sugars for the carbonyl-amino reaction.

Storage of grain

Except in extreme cases where heating has taken place or high humidity has induced sprouting, the degradative changes in the protein fraction of cereals would probably be small compared with nutritive loss due to insect activity or spoilage due to gross fungal infestation.

Proteolysis in stored grain is very slow and is not detectable until deterioration has reached an advanced stage. Wheat containing 11 per cent moisture stored up to 2 years has been accompanied by a decrease in protein digestibility, these changes occurring more rapidly in milled grains.

Oil seed meal

The nutritive value of oil seeds is generally diminished during high temperature processing to their by-products. Very few cases of protein deterioration during storage of oil seed meal have been reported and there appears to be little experimental evidence of lowered biological value due to adverse storage conditions. However, work recently carried out at the Technion Israel Institute of Technology, Haifa has shown that the protein nutritive value of groundnut meal steadily declined over 2 years in food stored under controlled conditions. The value decreased less rapidly when products were stored at 20°C and 40 per cent relative humidity than when stored at 20°C or 40°C and 60 per cent relative humidity.

Table 3
NPU values for groundnut meal stored in air for two years

Storage temperature	°C	20	40
Zero time		51.4	
After 12 months		48.2	43.9
After 24 months		49.0	44.3

Note Source:– Proc 7th International Congress of nutrition. Hamburg 1966, Vol 5, p.214.

Fish Meal

Loss of protein quality in fish meal is closely related to changes which may occur in lipids which are present. Fish lipids are very prone to oxidation and this may reduce protein quality in one or two ways. Firstly oxidation will lead to heat generation which will enhance the amino-sugar reactions mentioned above. Secondly oxidation and polymerisation of the lipids (as described above) may limit the digestibility of proteins by either physically preventing the digestive enzymes from reaching peptide bonds or reacting with the amino acids to form indigestible compounds (Ousterhout and Snyder, 1962).

Fish oils are generally more reactive than other natural oils of plant and animal origin due to the greater length of the carbon chain of the triglycerides and the more than usual number of unsaturated linkages which occur in the fatty acid side chains. It is obvious therefore that fish meal made from lean fishes having a low fat content of low reactivity are more stable than fish meal from oily fish with highly reactive fat. Exothermic oxidation of fresh fish meals occurs during storage and reactive meals are 'cured' before stacking and shipping, that is the bags of meal are stood apart or built up in single or double layers in order to allow the heat of oxidation to dissipate. Cured fish meal is never completley inactive and if bulk stocks are large enough there is still a danger of over-heating. Table 4 gives some indication of the relationship between reactivity (in terms of the rate of heat generation, RHG), size of stack and maximum temperature reached. Spontaneous heating of fishmeal through oxidation may be prevented by stacking or packing in airtight conditions such as silos or heat-sealed plastic bags, small amounts of oxygen present being quickly used up. The disadvantage of such storage is that the meal remains reactive and is liable to oxidation if repacked in paper bags and stacked. A better way of protecting fish meal against oxidation is by the use of anti-oxidants; the most effective and recommended one being ethoxyquin (EQ). Table 4 demonstrates the beneficial effect of the addition of EQ and another antioxidant butylated hydroxy toluene (BHT) in preventing the spontaneous heating of fish meal. The rate of heat generation (RHG) was reduced to a low but not insignificant value and showed a similar relationship of RHG against time to that of untreated meals.

It should be noted, however, that although anti-oxidants inhibit the rate of oxidation so as to retard spontaneous heating of fish meal, they do not actually prevent oxidation (Le Roux, 1962).

Table 4
Production of spontaneous heating in fish meal stacks

Stack details				Stack predictions		
Size of stack Feet	Mass of meal in stack Tons	RHG at one hour at 50°C at time of stacking cal. x 10^{-5}/g/sec	History of fish meal	Max. centre temp. rise above ambient °C	Time to reach max. centre temp. Hours	Centre temp. rise after 1,000 hours °C
9 x 9 x 9	13	1.5	0.012% ethoxyquin in meal	7.4	1,165	–
63 x 21 x 6	46.2	1.5	" " "	8.45	1,337	–
21 x 21 x 21	164	1.5	" " "	30.0	3,940	12.7
21 x 42 x 21	1,000	1.5	" " "	56.2	6,400	13.3
9 x 9 x 9	13	2.3	0.1% BHT in meal	12.0	1,089	–
21 x 21 x 6	46.2	2.3	" " "	13.95	1,233	–
21 x 21 x 21	164	2.3	" " "	54.0	3,460	24.4
63 x 42 x 21	1,000	2.3	" " "	131.5	5,130	25.4
9 x 9 x 9	13	8.5	14 days natural curing	66.0	685	–
21 x 21 x 6	46.2	8.5	" " "	83.6	737	–
9 x 9 x 9	13	5.0	28 days natural curing	44.8	813	–
21 x 21 x 6	46.2	5.0	" " "	51.6	915	–
9 x 9 x 9	13	0.7	156 days natural curing	3.4	1,242	–
21 x 21 x 6	46.2	0.7	" " "	4.23	1,398	–
21 x 21 x 21	164	0.7	" " "	13.1	4,330	6.2
63 x 42 x 21	1,000	0.7	" " "	22.0	7,520	7.2

Notes
1. Source:– Fishing Industry Research Institute, 19th Annual Report, 1965, University of Capetown, South Africa.
2. Stacking temperature was 20°C in all cases.

The nutritional quality of fish meal protein can be correlated with the available lysine (AVL) content. Losses of up to 60 pc of AVL having been recorded in commercial herring meal which became overheated during bulk storage. This was confirmed by poor results when subsequently fed to chicks (Lea et al, 1960).

Laboratory experiments indicate that under temperate conditions fish meals generally store well. For example it has been shown that the AVL content of freshly prepared herring meal from a commercial plant decreased by only 8–9 per cent after storage for one year at 20°C under atmospheric conditions, and that this decrease did not affect its feeding value to chicks.

In a similar group of experiments reported, even storage for seven to twelve years did not have a serious effect upon the nutritive value of fish meal when combined with supplements although there was a deterioration in quality when the stored meals were fed alone (Lakesvela and Aga, 1965). Anti-oxidants are effective in limiting losses in AVL and Table 5 shows the beneficial effect of adding EQ to a full pilchard meal.

Table 5
Storage test of full pilchard meal

Ethoxyquin	Storage timo	Available lysine	Available methionine	Corrected for constant casein values (NPU = 65.5, D = 97.5, BV = 67.2)		
ppm	(months)	g/16gN	g/16gN	NPU	D	BV
0	1 week	7.4	2.2	64	94	68
400		7.5	2.5	74	95	78
800		7.6	2.5	74	96	77
0	4	7.5	2.6	67	91	74
400		7.6	3.0	74	95	78
800		7.8	2.8	78	95	82
0	8	6.9	2.6	69	91	76
400		7.6	2.9	74	94	79
800		7.6	3.1	79	94	84
0	12	6.9	2.5	69	93	74
400		7.5	2.9	77	96	80
800		7.3	2.7	81	96	84
n	6			63	93	68
1,000 (BHT)				67	93	72

Notes: 1. Source:-- IAFMM, Symposium for compounders and concentrates manufacturers, Amsterdam, 2 October 1969.
2. NPU, D and BV were determined about 1½ to 2 months after the times shown in the table.

Other animal products

The problems of storage with other animal products are less acute than with fish meal, the problem of the latter, as mentioned in the previous section, being due to its highly unsaturated and consequently reactive lipid content. The difficulties with meat meals occur during the processing when high temperatures used for eliminating the potential danger of *Salmonella* infection can reduce the important available lysine content. However, in common with most concentrates there are no problems with protein deterioration when well stored under dry conditions. Milk powder, however, is very susceptible to deterioration (Patton, 1955). This is due to its unique chemical and physical structure; dried milk powder has a protein plus lactose content of from 60 to 90 per cent depending upon the original material. In this high concentration of loosely associated protein and reducing sugar the Maillard carbonyl-amino reaction can proceed at ambient temperatures to the formation of melanoidins (King, 1955). A product of moisture content not above 5 per cent will store reasonably well at moderate ambient temperatures if kept dry and in an environment of low relative humidity. The only ideal packing is gas packing in airtight metal cans which can preserve milk powder for 7 years or more in tropical conditions. Packed in Burlap bags even at 20°C and at a relative humidity at not more than 60 per cent the NPU value of defatted milk powder dropped from an initial 51.4 to 39.9 after two years (Yannai and Zimmerman, 1966).

Vitamin losses during storage

In considering losses in vitamins during storage it is important to differentiate between vitamins occurring naturally in feedingstuffs and synthetic vitamin additives. The prevention of vitamin losses in feed constituents is rendered difficult by interactions which may occur with the various substances present. This is particularly so for finished compounded feeds and these should not be stored for long before use if vitamin content is of vital importance. The fat soluble vitamins A, D and E are among the least stable and are unfortunately in the case of A and D those most likely to be deficient in animal rations.

Vitamin A

The main source of vitamin A for livestock is as the precursor, carotene, the main concentrate sources being materials such as dried grass and alfalfa, and yellow maize. Vitamin A itself occurs in fish meal and fish oils, but the amounts in fish meal are not sufficient to make a significant contribution to the Vitamin A status of the final compounded ration. Cod liver oil was formerly used as a feed additive but its use has now been discontinued due to too low vitamin A stability.

The carotene content of grass and alfalfa varies greatly with the drying process - losses of 30 per cent and even more have been reported on drying alfalfa at too

high a temperature. There is evidence that yellow maize rapidly loses carotene, losses of 50 per cent after 8 months storage at 25°C being common. Synthetic vitamin A is now a widely used feed additive and is commercially available in the ester form (normally the acetate or palmitate) being usually protected in gelatine or wax beads. Manufacturers claim that such products will maintain their declared potency for 12 months but it must be remembered that this is under ideal storage conditions and that after incorporation into premixes, concentrates or mashes the stability may decrease rapidly.

Vitamin D

As with vitamin A, animal products normally incorporated in compounded feeds contain only insignificant amounts of vitamin D. The main natural sources of vitamin D are via the precursor ergosterol which is widely present in plant material, and is converted into vitamin D when irradiated with ultra violet light. Losses of vitamin D during storage are believed to be of the same order as those given above for carotene. Powders containing synthetic vitamins D_3 alone or mixed with vitamins A and E are now available for inclusion in rations. The vitamins in these powders are protected and thus of fairly good stability.

Vitamin E

Eight tocopherols are known to occur in natural sources of vitamin E. Little information is available on the stability of vitamin E in animal products in livestock feeding but in vegetable products, especially cereals, oxidation can be quite rapid. Synthetic vitamin E is available as a tocopherol acetate and is sometimes used as an antioxidant in foods. Vitamin E deficiency is less common than vitamin A deficiency in livestock feeding.

Vitamin K

Vitamin K deficiency is in general very rare in livestock. Where diets are low in natural Vitamin K, K_3, Menadione Sodium Bisulphite is an inexpensive stable additive.

Water Soluble Vitamins

Vitamin B_1, thiamine, is the least stable of this group and is particularly sensitive to high temperature. The bulk of the thiamine in livestock feeds is derived from cereal grains and it has been demonstrated that appreciable losses can result during the kiln drying of cereals such as oats and wheat.

Vitamin B_2, riboflavin, is less affected by normal storage but is very sensitive to sunlight. Nicotinic acid is fairly stable under most normal storage conditions. The effect of storage conditions on the other B vitamins does not yet appear to have been studied in detail.

Biotin, pyridoxine hydrochloride and pantothenic acid (as calcium D-pantothenate) are in addition to the three vitamins mentioned above available as synthetic supplements and, as such, are of good stability.

Some Practical Implications

The foregoing brief summary of the types of deterioration which can occur in feedingstuffs and the conditions under which they are most likely to occur, has a number of practical implications for the storage of both raw materials and finished products.

Firstly it is essential to ensure that raw materials are dry and undamaged by insect or fungal pests before they are received at the compounding plant, while secondly they should be stored under clean dry conditions avoiding high temperature as far as possible. The avoidance of high temperature is particularly important for materials which are major sources of vitamins e.g. premixes of synthetic vitamins and animal protein concentrates such as fish meal. The storage period for both raw materials and finished feeds should preferably be as short as possible, but it is realised that seasonal fluctuations in supply and the necessity to import may make it necessary to store certain raw materials for long periods prior to compounding. In such cases special precautions including regular inspection and frequent check analyses will be needed to ensure that the nutritive value of the more valuable materials at least is not adversely affected to too great a degree.

The storage of finished feeds for long periods prior to marketing is most undesirable specially for poultry rations, where lysine availability and vitamin potency are vital. Even storage of finished ruminant feeds such as dairy concentrates is to be discouraged as palatability and nutritive value could be adversely affected by the action of various pests before it is marketed. It should be emphasised that if raw materials are found to be unsatisfactory the situation can be saved by changed in formulation, but the position is obviously irreversible if the finished feed deteriorates in nutritive value.

References

BURTON, H. S. and MACWEENY, D. J. 1964. Non-enzymatic browning: routes to the formation of melanoidins from aldoses and amino compounds. *Chemy Ind.*, 462–463.

GODDIS, A. M., ELLIS, R. and CURRIE, G. T. 1960. Carbonyls in oxidising fat: III The distribution of volatile and non-volatile carbonyls. *Fd Res.*, 25, 495–506.

HALL. D. W. 1970. Handling and storage of food grains in tropical and sub-tropical areas. *FAO Agricultural Development Paper No. 90, Agricultural Engineering Service, Agricultural Services Division, FAO, Rome.*

HODGE, J. E. 1953. Chemistry of browning reactions in model systems. *J. agric. Fd Chem.*, 1, (No. 15), 928–943.

KARTHA, A. R. S. 1960. The iodine value-decreasing reaction in fat autoxidation. *J. Scient. ind. Res.*, **19** (B), 199–205.

KING, N. 1965. The physical structure of dried milk. *Dairy Sci. Abstra.*, 27 (3), 91–104.

LAKESVELA, B. and ÅGA, A. T. 1965. Nutritive value and analytical characteristics of new and up-to-12 year old herringmeals. *J. Sci. Fd. Agric.* **16**, 743–749.

LEA, C. H., PARR, L. J. and CARPENTER, K. J. 1960. Chemical and nutritional changes in stored herringmeal – Part II. *Br. J. Nutr.*, **14**, 91.

LEA, C. H. and SWOBODA, P. A. T. 1958. The flavour of aliphatic aldehydes. *Chemy Ind.*, 1289–1290.

LE ROUX, B. D. C. 1962. *Fishing Industry Research Institute, Cape Town, South Africa, 16th Annual Report.*

MACKAY, P. J. 1967. Theory of moisture in stored produce. *Trop. stored Prod. Inf.*, **13**, 9–14.

OUSTERHOUT, L. E. and SNYDER, D. G. 1962. Effects of processing on the nutritive value of fish products in animal nutrition. *Fish in nutrition* (ed. E. Heen and R. Kreutzer). London: Fishing News (Books) Ltd.

PATTON, S. 1955. Browning and associated changes in milk and its products. *J. Dairy Sci.*, **38**, 457.

PERKINS, E. G. 1960. Nutritional and chemical changes occurring in heated fats: a review. *Fd Technol., Champaign*, **14**, 508–514.

PRIVETT, O. S. 1949. The course and mechanism of the autoxidation of fats. *Minnesota University, Hormel Institute, Annual Report.*

RICE, E. E. and BEUK, J. F. 1953. The effects of heat upon the nutritive value of protein. *Adv. Fd Res.*, **4**.

SMITH, C. V. 1969. Meteorology and grain storage. *World Meteorological Organisation, Geneva, Technical Note No. 101.*

TOGASHI, H. J., HENICK, A. S. and KOCH, R. B. 1961. The oxidation of lipids in thin films. *J. Fd. Sci.*, **26**, 186–191.

WOODHAM, A. A. 1967. Food processing and nutrient availability. *Nutrition Conf. for Feed Manufacturers, Univ. of Nottingham School of Agric., January 1967.*

YANNAI, S. and ZIMMERMAN, G. 1966. Changes in the protein nutritive value of different staple foods induced by varying humidity and temperature conditions during long term controlled storage: a preliminary report. *Proc. 7th Int. Congress of Nutrition, Hamburg.*

Report on Fifth Session: Production and marketing of compounded feeds

Chairman, Mr R. K. Peberdy

1. The discussion covered a wide range of topics associated with the marketing, manufacture and distribution of livestock and poultry feed.

Management

2. The Conference accepted the importance of defining objectives and of having effective control of the activities being managed. Existing plant capacity should be fully utilised if necessary by multiple shift working, before further investment in new plant.

3. The Conference recognized the need for thorough training for all levels of management.

Marketing

4. It was appreciated that satisfying the demand for poultry feed in the Region had dominated the market for compound feed but that as the livestock industry developed the demand for ruminant feed would grow.

5. In order that the feed milling industry should be efficient the Conference agreed that forecasting of local demand was very important. It was stressed that short term forecasts could and should be accurate. Longer term forecasting was obviously more difficult and perhaps it should be accepted that a medium term forecast, say of 1 year, should be made to the best degree of accuracy, long term forecasts being tentative in nature.

6. The dependence of the people responsible for formulating and buying raw materials upon the forecasts made was fully appreciated.

Formulation

7. 'Least cost formulation' was defined as satisfying the animals' nutritive requirements at least cost per unit of output.

8. It was recognised that in order to produce a feed that could be handled in a practical manner some constraint might have to be placed upon the formulator's freedom, and that there could be other constraints which necessitated deviation from the theoretical least cost formulation.

9. In the Region raw material availability would influence the type of formulation.

Formed feeds and mash

10. The Conference generally recognised that certain classes of livestock would perform more efficiently when offered feed in the form of cubes, pellets or crumbs. There was a divergence of opinion as to the relative merits of mash and formed feed for laying hens, and it was likely that the situation in different countries would dictate the type of feed used.

11. Some of the merits of formed feed were pointed out to be: sealed-in complete diet, ease of handling, greater latitude for the formulator. It was, however, appreciated that the production of formed feeds required a higher plant cost and increased plant operating costs.

12. Mash generally involved a lower manufacturing cost and poultry sometimes ate less per day for the same rate of production. It was, however, subject to wind-blown loss and was open to the risk of adulteration.

13. One possible disadvantage in the use of formed feeds mentioned in the discussion was that there could be some loss of vitamin potency due to the pelleting process.

Storage problems

14. The Conference recognised that precautions were necessary to reduce the loss of vitamin potency in raw materials, vitamin supplements and finished products.

15. It was agreed that care was needed in storage to minimise damage caused by insects, fungi and micro-organisms and so avoid the possibility of toxicity from these latter two sources. The Conference noted that a measure of control over *Salmonella* was obtained by pelleting.

16. Advice from the extension services was essential at farm level to minimise losses during the period between the delivery of the feed and its consumption. It was stated that literature on this subject was available from the Tropical Products Institute, London.

Quality control

17. The Conference recognised the prime importance of effective quality control to the feed manufacturing industry and discussed the use of central and/or local laboratories for this purpose.

18. It was pointed out that the plans for a new mill should include the control laboratory as an integral part. Initially such control should be simple but provision could be made for the introduction of more sophisticated analytical techniques when required.

19. The role of legislation in this field was discussed and the system in use in the United Kingdom was outlined.

Utilisation of manufactured feeds

20. The need for contact between the feed industry and the farmers was emphasised. It was stated that in some countries the feed manufacturers were carrying out practical trials and demonstrations in the use of feeds and co-operation between manufacturers and government sources for research and extension were worthy of encouragement.

Sixth Session

Role of credit and co-operatives in livestock production

Chairman
Mr J. M. Hill, Adviser on Fertilisers, USAID, Ankara

Livestock credit and its role in the livestock industry

J. M. Hill
USAID, Ankara, Turkey

The value of domesticated livestock was evident to primitive man. His domestication of sheep, cattle, horses, oxen and other animals represented time and effort on his part to obtain the value that he found could be derived from control and utilization of these animals. Many primitive societies and even developed societies today determine a man's wealth in the number of domesticated animals he possesses. Livestock have been used as a method of payment for brides, ransoms to pay victorious armies, to pay taxes, or exchange for grain, precious metals or other desired goods.

The value of a particular animal has been determined by man, based on the animal's ability to supply food in the form of meat, dairy products, transportation, work, clothing, leather, fuel, etc. Probably one of the earliest forms of livestock credit evolved when one farmer sold to another farmer a young heifer for some bags of grain plus the first spring calf produced by the heifer. The calf represented a promise to pay the balance of the purchase price at a later date. This simple example of livestock credit between two farmers represents trust on the part of the seller that he would recover a calf as part of the sale at a later date and agreement by the buyer that the first calf would be part of the purchase price.

Today we have developed various types of livestock credit programs. Each has a specific purpose. These types of loans could be divided into two major categories:

Medium term loans; one year to five years:

1. Breeding animals to improve livestock genetic characteristics.
2. Animals to increase herd size.
3. Producing animals for dairy products, wool, etc.
4. Barns, corrals, etc.

Short term credit; less than one year:

1. Animals for fattening for market.
2. Short term inputs such as feed, transportation, medicines, etc.

The driving force in a commercial livestock industry is a hoped-for profit. A livestock credit program's function, therefore, is to assist the producer in allowing him to practice his management and livestock technology to generate a profit. Production is carried out basically with the aim of marketing a product. If there is no prospect of selling with a profit, production by itself carries little meaning and the need for a credit program is non-existent. A viable livestock credit program then should be looked at as part of a package of practices which allows livestock owners to expand their earnings by participating in a viable market with increased production capabilities.

An economically sound credit program must have well informed credit administrators and knowledgeable borrowers. The fluctuation of a few cents per kilo in feed costs or animal prices can mean a loss or profit to animal fattening operators, meat processors and others who perform vital functions in the livestock market. Thus one of the many essential parts of a viable livestock market is a daily news service which informs the ranchers, agro business-men and others of market conditions and trends. Established grades, fair weight scales, stable prices, equitable government regulations, etc., all are factors that are needed for a viable market which can encourage a producer to plan and work towards a profit goal and, if need be, the use of sound credit.

There are various sources from which livestock credit can be generated. Some of these are:

1. The seller of animals or goods.
2. A money lender.
3. A commercial bank.
4. A government sponsored loan program.
5. A group of farmers or livestock producers who have banded together pooling their financial resources to assist each other in a co-operative activity.

Livestock transactions involving one or two animals can normally be financed by credit agreed on between the buyer and the seller or from other resources available in a village community. However, when livestock

Previous Page Blank

 transactions expand beyond this level, then the need for a viable credit system becomes essential.

Capital demands, and a credit system to meet these needs, increase rapidly as a livestock industry develops from an almost zero input industry to one where animal characteristics are upgraded through breeding and feeding with purchased feeds or feeds which were grown on purpose.

In many countries farmers have come together and formed co-operative activities for the purchase of a breeding bull, the joint ownership of a milk processing plant or a feed mill, and in some cases, even joint cattle fattening operations. The main purpose for formation of these co-operatives is to increase farmer returns. Success or failure often depends on the skill of their management.

In the creation of a viable credit system for livestock the lenders look for several things prior to making a loan:

1. The honesty, management skill and technical ability of the borrower to administer the loan, allowing him to repay his loan from the profits generated by the use of the borrowed money.
2. The economic condition of a market place and demand for livestock products.
3. The effect of government regulations which may help or hinder lenders from collecting from the borrower.

The principles of *livestock credit* are fundamental and are the same as those that apply to any other type of agricultural sector loan. *The loan must serve the purpose of the borrower to increase his financial well-being, allowing him to repay the loan and make a profit.* Programs that are relief or politically oriented with credit repayment a secondary issue are Socio-Political credit programs and should be so stated.

Many governments today have created agricultural credit programs which are truly Socio-Political credit schemes. Unfortunately, many of these programs have been promoted under the guise of economically sound credit systems. These programs have been directed at the marginal farmer where society has a real social obligation to improve this farmer's well being. The marginal farmer who receives a loan to increase his productivity will first use increased incomes to live better and last for repayment of his loan. This situation has resulted in low loan repayment levels for most Socio-Credit programs. In many instances credit programs are generated for political motives resulting in the farmer believing that any credit from these type programs are really a grant from the government. Thus Socio-Political programs may have their place and may be needed for various reasons, but to confuse them with economically sound viable credit programs, can create misunderstanding by borrowers and for most casual observers.

Credit is an important tool which can allow application of modern, efficient animal husbandry, resulting in increasing incomes or saving money. There are several things livestock growers can do to help build and maintain a good credit standing:

1. Get credit from specialists who understand your requirements and those of the markets.
2. Use loan funds only for the purpose for which borrowed.
3. Keep credit in one place rather than spreading it between two, three or four lenders.
4. Take an annual inventory of the farm (equipment, livestock, etc.) in order to determine your progress and to facilitate future loans.
5. Keep records on growing costs, taxes, interest etc. and proceeds from sales of livestocks and other farm products.
6. Plan ahead on credit needs and discuss needs with your banker early.
8. Use the right kind of credit; long term for investments requiring several years before proceeds are realized from implementation of the loan; short term credit where use of the loan will be complete and benefits will be realized in less than one year.
9. Work out a repayment plan for the loan with your banker that meets the requirements of the type of loan and your repayment ability.
10. Be frank with the lender.
11. Borrow money *to make or save money, not for luxuries or pleasure.*
12. Meet payments when due.

Sound economic credit programs are the basis on which successful modern agriculture is built. Sound economic credit helps the farmer earn more or save more; it is good for the farmer, the lender and the nation.

Provision of agricultural credit especially for feed and livestock improvement in Turkey

Ergin Taşçioğlu
Agricultural Bank of Turkey, Ankara, Turkey

Sources of agricultural credit in Turkey

In Turkey the national income per capita in the agricultural sector is very limited, and because of this and a lack of working and investment capital in this sector the need for credit is very large.

The only public institution giving agricultural credit in Turkey is the Agricultural Bank of the Turkish Republic. There are also some other regionally organized agricultural credit sources such as the Sugar Bank, the Tobacco Bank, the Grape Growers Bank and the Aegean Bank, but overall credits distributed by these banks constitute only three per cent of the total credits lent by the Agricultural Bank. Although the total credit available from the Agricultural Bank to the agricultural sector has been increased over the years, only a half of the farmers' need for credit is currently supplied from this source.

Due to lower rates of interest, long repayment periods and the absence of acceptable repayment guarantees privately owned commercial banks do not extend any direct loans to the farmers. Thus the rural areas are largely open to traders and private money lenders to supply the balance of credit requirements. Many farmers have to obtain their credit from these sources at very high rates of interest. According to a socio-economic study made in Denizli province in 1965 farmers borrowed 55 per cent of their requirements from the Agricultural Bank, 24 per cent from merchants and 21 per cent from other individuals.

Realising this problem the Government has been giving importance to encouraging and improving co-operative movements in the country and endeavouring through them to link credit with marketing.

Background information on the Agricultural Bank of Turkey

The Bank was established in 1863 by a well-known Turkish statesman, Mithat Pasha, in the form of some simple organizations to provide agricultural credit for the farmer. Since then the status of the Bank has been modified several times before it acquired its present position. The Bank does not only provide agricultural credits but is also engaged in many other financial operations relating to banking such as the provision of short-term loans on a commercial basis.

The Bank was reorganized as a state economic enterprise many years ago and now has a prominent position in Turkey, even in the world, with a network of 776 branches, 19,000 employees and deposits exceeding TL10 billion. It serves 2.5 million farmer families directly and 1.5 million families through the Agricultural Credit Co-operatives. The capital of the Bank is wholly derived from state funds with no participation by private sources. In addition important rediscount facilities with the Central Bank of Turkey are available.

Agricultural credits granted by the Agricultural Bank of Turkey

The provision of agricultural credit is considered by the Government as an effective instrument in the implementation of both the First and Second Development Plans. The Agricultural Bank in co-operation with the Ministry of Agriculture is to direct loans towards the investments listed in the annual programmes. Investment priority is given to irrigation schemes and other highly productive projects. A large use of inputs has been encouraged and feed, seed, fertiliser, machinery and equipment are made available to the farmers as credits in kind, repayable in cash after harvesting.

In the second plan the emphasis is given to medium and long term credit which will be to some extent made possible by discounting facilities with the Central Bank.

Agricultural credits extended by the Bank may be separated into three categories:

1. Loans to agricultural credit co-operatives.
2. Loans to agricultural sales co-operatives.
3. Loans granted to the farmer directly by the Bank.

Loans to agricultural credit co-operatives

The Bank functions as a central bank for the credit co-operatives and these societies are under the administrative authority and direct supervision of the Bank.

The loans made through credit co-operatives to farmers are in principle for production purposes. Short and some medium term credit requirements of the members are to be met by the co-operatives from both their own resources and the funds made available by the Bank.

The outstanding balance of the Bank advances to the credit co-operatives was TL2.1 million at the end of 1970, while at the same time the outstanding balance of the loans extended by the co-operatives to their members was TL2.4 million. These loans are for the supply of fertilizers, seed, feed, livestock and for general farming and crop raising requirements of the members of the co-operatives.

The number of co-operatives is now 2,021 with a total membership of 1.2 million.

Loans to sales co-operatives

Semi-official sales co-operatives and their unions have been established for a number of products important to the export trade, for example cotton, hazelnuts, raisins, olives and olive oil and pistachios. These bodies usually provide grading and processing facilities and supply farming requisites.

The sales co-operatives may engage in price stablisation measures on their own account assisted by loans from the Agricultural Bank. These advances are used mainly to cover the marketing of export crops until payment from overseas is received.

The number of sales co-operatives is now 556 with membership of around 200,000.

In 1970 the Bank allocated TL3.6 billion to sales co-operatives and their unions.

Direct loans to farmers

Total agricultural credits distributed by the Bank excluding loans to credit and sales co-operatives has been increasing quite rapidly. In 1966 they totalled TL1.5 billion while in 1970 they had increased to TL4.1 billion (see Table 1).

Table 1
Direct loans to farmers distributed by the Agricultural Bank of Turkey, 1966–1970

Years	*Amount of credit, TL*
1966	1,442,459,999
1967	2,932,820,359
1968	3,862,480,545
1969	3,966,009,935
1970	4,154,502,206

1. Terms: direct loans from the Bank to the farmer are granted to meet short, medium and long term credit requirements.

2. Interest rate: since September 1970 the interest rate has been changed by the Government. According to this alteration the interest rate is now 10.5 per cent in all agricultural credits, whether they are short or medium and long term, provided that they have been met from the Bank's own resources. However, because of a Governmental subsidy to the farmer (1.5 per cent), the charge of interest is equal to nine per cent. On the other hand the Government subsidizes the Bank to the extent of 1.3 to 2.5 per cent as well. Thus the true interest rate to the Bank has been increased up to 13 per cent. In addition the Bank charges the farmer 0.5 per cent as a supervision commission.

3. Securities: as far as the repayment guarantees are concerned the Bank has been requiring different type of securities such as the joint guarantee of the farmers, land mortgage, the pledge of any farming equipment, machinery, livestock, etc.

4. Credit purposes: short term credits are granted mainly for seasonal operating needs such as livestock feeding, fertilizer, seed, fuel, etc. and for easier marketing of farm products. Medium term credits are granted for purchasing of farm machinery, equipment and any type of livestock. Long term credits are granted for raising the producitivity and improvement of land and orchards, for foundation of farming enterprises, for financing land ownership or enlarging the size of farm unit, construction of stables, folds and chicken-houses, and for the establishment of orchard, nurseries and permanent pasture.

Supervised credit system

Apart from the traditional credits the Agricultural Bank has been practising a supervised credit system since 1964. This method is based on the principles used by the USA Farmers' Home Administration, but modified according to conditions and needs of the Turkish farmers.

The supervised credit programme was put in operation in only two provinces at first, but as a result of the satisfactory results of this limited implementation a further 28 provinces were brought under the programme. In the near future it is expected that supervised credit will be available throughout the country.

Under this new method of lending the overall requirements of a farming unit are studied before the loan is granted. This way of lending provides technical information and also assistance in the preparation of the loan project for the farmer through the Governmental extension services and technical staff of the Bank.

During the seven year period the Bank has allocated TL365 million for lending and TL336 million were actually disbursed.

Encouragement and development loans programme

The Bank implemented another new loan programme from 1968 to the end of 1969 based on a Law No 933 and financed by the Government. However, the law on which the programme was based was cancelled by Constitutional Court in October 1969, and these funds have not been operating since then.

Through this programme the Bank granted loans for the following:

1. Livestock breeding and fattening projects, as well as poultry projects.
2. Modern sheep fold and stable construction projects.
3. Export-orientated orchard, vegetable garden and green-house establishment projects.
4. Fishery projects.
5. Food processing projects.
6. Chemical industry projects.
7. Transportation and storage projects.

The Bank allocated TL290 million under this programme.

Loans for animal husbandry

Credits for livestock are granted by the Bank in accordance with the general system of terms, interest rates and securities mentioned previously. Loans extended by the Bank for this purpose only may be divided into seven categories.

1. Operating credits: these are the short term credits with which the farmer can meet the requirements for feeding and upkeep of his livestock.

The number of farmers borrowing from the Bank and the total amount of credit have increased rather rapidly (see Table 2).

Table 2
Operating credits disbursed by the Agricultural Bank of Turkey

	1965	1968	1969
Number of borrowers	120,997	152,545	180,825
Amount of credit, TL	78,049,124	148,693,000	221,600,000

2. Equipment credits: these are for a maximum term of 5 years. As can be seen in Table 3 these credits have also increased in the course of years.

Table 3
Loans disbursed by the Agricultural Bank of Turkey for the purchase of livestock

Kinds of livestock	1967			1968			1969		
	Number of farmers borrowing through the Bank	Number of livestock provided by the Bank	Amount of loan granted in the year	Number of farmers borrowing through the Bank	Number of livestock provided by the Bank	Amount of loan granted in the year	Number of farmers borrowing through the Bank	Number of livestock provided by the Bank	Amount of loan granted in the year
Montofon	466	1,151	2,682,059	1,249	2,843	9,423,369	950	2,687	9,248,376
Jersey	1	1	3,000	68	126	922,459	156	247	986,269
Holstein	50	94	306,318	217	591	2,399,928	227	464	1,840,658
Ordinary South red-yellow	29	180	360,827	60	332	764,379	41	273	587,148
Bull	12	12	20,500	8	29	20,270	14	18	71,849
Mannes type sheep	64	1,608	393,937	204	13,902	2,200,745	99	6,436	2,004,571
Kıvreik, ivesi, sakız, imroz sheep	122	1,612	244,175	188	9,020	1,612,817	87	4,713	807,634
Ordinary sheep	1,635	29,340	3,400,131	1,876	94,563	12,846,602	911	6,395	6,935,797
Angora goats	9	375	30,000	37	6,041	212,775	3	190	115,080

3. Credits for the construction of sheep folds and stables: these are the long term credits by which farmers can meet the requisites for establishing folds and stables. The Bank granted TL1.1 million in 1965, and TL10.4 million in 1969 for these purposes.

4. Loans for Feeds: currently there are 15 or 20 industries in Turkey engaged in the manufacture of compounded feeds. The Bank is financing and participating in these industries.

Also the Bank advances short term loans to the farmer for feed as operational credits, which are paid 50 per cent in cash and 50 per cent in kind. In 1969 the Bank distributed TL221,600,000 to 180,825 farmers s credits in kind.

The Bank has also been making loans for the purposes of establishing or improving artificial grasslands, feed crops and alfalfa foundations. It will be seen from Table 4 that there has been a rapid increase in such loans.

Table 4
Loans disbursed by the Agricultural Bank of Turkey for establishing/improving artificial grass, feed crops and alfalfa foundations

	1967	*1968*	*1969*
Amount of credit, TL	7,800	23,571	222,258
Number of borrowers	4	23	234
Area of foundation, m^2	37	264	1,000

5. Loans for livestock fattening: these are short term operating and equipment credits for a maximum term of six months. The Bank distributed TL 51,950,000 in 1969 for sheep and cattle fattening.

6, 7. The Bank also recognizes the importance of credits for poultry production and bee-keeping. A total of TL 13 million was lent to the farmer in 1969 for these purposes.

Apart from these traditional credits in 1968 and 1969 the Bank allocated TL 57.6 million to a total of 402 projects for livestock improvement *as an intensive credit* (encouragement and improvement credit).

In the course of seven years TL 150 million have been disbursed for the same purpose *as a supervised credit.*

An agreement between the Bank and the International Development Association was signed and put into operation just ten days ago. According to this agreement the International Development Association has provided US $ 4.5 million for development of intensive dairy production.

The problems that have been described in respect of the status of borrowers are the same in our country and the solutions suggested are applicable in Turkey.

Agricultural and livestock credit in Iran

Mostafa Djirsarai
Sheep Department, National Livestock Organization, Tehran, Iran

Preface

Provision of credit for agricultural and livestock improvement is of both national and regional importance and it is very difficult to cover all aspects of the subject in a short paper. In the present paper efforts have been made to look at the subject from special points of view which have not been discussed before.

The following subjects have been particularly in mind in preparation of this paper:

1. Sources of credit.
2. Types of credit recipients.
3. Economic and social interactions between the sources of credit and the types of credit recipients.
4. Flow of funds through credit channels and distribution of credit among different groups of producers.

Conclusions and recommendations are also made within this framework.

Introduction

Agricultural and livestock credit has always been a problem confronting agricultural improvement in the developing countries. The approach to the problem can be made from two distinct directions, namely the sources of credit and the recipients.

Sources of credit

The problems encountered with regard to sources of credit are as follows:

1. Amount of credit available to livestock raisers.
2. Methods of payment and control practices.

Credit recipients

The difficulties faced by the recipients when applying for loans are as follows:

1. The nature of the livestock industry, being of a long term investment, results in reluctance of creditors to supply loans.
2. The ever-influencing and unforeseen natural factors which endanger the repayment of loans.
3. The low capital return on agricultural and livestock investment in comparison with other sectors of economical activity.
4. The low level of literacy and lack of technical ability which is prevalent in the rural sector.

Sources of credit may be as follows:

1. Government banks.
2. Direct government loans.
3. Rural co-operatives.
4. Private banks.
5. Private money lenders.
6. Rural traders (village shop-keepers who exchange commercial goods for agricultural and livestock products).
7. Itinerant dealers (retailers who travel through several villages and exchange utilities as well as give loans to villagers in exchange for agricultural and livestock products).

History of Agricultural Credit in Iran

The history of agricultural and livestock credit in Iran is divided into two periods, namely the periods before and after the land reform of 1961.

The period terminating in 1961

For the 28 year period up to 1961 the Agricultural Bank of Iran was the main source at Government credit in the country, but the regulations influencing the extension of loans were on such difficult terms that it was almost impossible for the average farmer to obtain credit. Consequently the majority of loans were granted to landlords who were in turn the source of credit to farmers.

In repayment of loans the landlord received the bulk of the farmer's products at harvest time. Also due to the absence of acceptable repayment guarantees private

 banks did not extend any direct loans to the farmers. Thus the loaning field of rural areas was widely open to the itinerant dealers, rural traders and private money lenders. It has been shown that up to 1961 only 10 per cent of rural credits were supplied by Government sponsored bodies and the rest were covered by above-mentioned private sources charging high rates of interest.

To repay the loans villagers often had to sell their animals before they reached a profitable market size. For example many livestock raisers sold their unborn lamb crop for a price of 400–500 Rials (US$6–7) during the pregnancy of the ewe, while the lamb was worth at least US$13–16 six months later after delivery.

The period after 1961

After the land reform law was put into effect the 'landlord' as the main source of credit in the rural society was eliminated in a short time. In order to fill this economic vacuum government stepped in promptly by establishing and operating new loan organisations.

At the present time the agricultural and livestock credits in Iran are divided into short, medium and long term credits.

Short term credits

Main characteristics of these loans are as follows:

1. Repayment period	up to two years.
2. Rate of interest	average of four per cent.
3. Repayment guarantees	chain guarantee, co-operative guarantee, Government treasury documents, promissory notes, unmovable mortgage.

Medium term credits

Main characteristics of medium term credits are as follows:

1. Repayment period	two to five years (sometimes seven years).
2. Rate of interest	six per cent.
3. Repayment guarantee	unmovable mortgage.

Under special conditions the Agricultural Bank may extend loans of up to 20,000 Rials (US $2,670 without unmovable mortgages.

Long term credits

Main characteristics of long term credits are as follows:

1. Repayment period	up to 15 years.
2. Rate of interest	7.5 per cent.
3. Repayment guarantee	unmovable mortgages.

In some cases creditors may take part in joint investments in co-operation with private loan recipients.

The situation of credit sources in Iran at the present time is shown in Table 1.

Table 1
Sources of credit in Iran

Private Sector	Public Sector
1. Private banks	1. Agriculture Bank of Iran[1 2 3]
2. Feed mills[1]	2. Rural Co-ops[1 2]
3. Purebred cattle importers[1]	3. Agricultural Development Fund of Iran[2 3]
4. Hatcheries[1]	4. Other Government Banks[1 2]
5. Livestock traders and middle men[1]	5. National Livestock Organisation
6. Rural traders and itinerant dealers[1]	6. Ministry of Land Reform[2]

[1]Sources of short term loans
[2]Sources of medium term loans
[3]Sources of long term loans.

As will be seen in Table 1, the government sources of credit have been greatly expanded since 1961. The efforts which have been made by the various institutions mentioned above to increase the credit sources available to rural populations will be described in greater detail below.

Public sources of credit

Agricultural Bank of Iran (Agriculture Co-op Bank)

The Agricultural Bank of Iran was established in 1933 and is at the present time the largest source of agricultural and livestock credit in the country, having a registered capital investment of 10,000,000,000 Rials (US$134,000,000). As was mentioned before the Bank which was the only Government source of credit did not play an active role in the years before 1961. Activities of the Bank during three decades (1933–1961) produced only 380,000 individual loans. During the same period the total payment of the Bank did not exceed 8,000,000,000 Rials (US$107,000,000) while during the eight year period of 1961 to 1969 the total number of individual loans increased sharply to 2,850,000 individual loans. The total payment during the same eight years period equalled 44,600,000 Rials (US$594,600,000). In other words the loaning activities of the Bank increased by seven times from the view point of number of loans, and 4.5 times from the view point of total payments during the last eight years in comparison with the whole life of the institution up to 1961. The Agricultural Bank of Iran has advanced credits of 3,972,705,952 Rials (US$51,636,000) for animal husbandry during its existence, from which 95 per cent has been paid off in the last eight years. The trend of credit flow for the field of animal husbandry in the last nine years is shown in Table 2.

Table 2
Agricultural Bank of Iran – Loans advanced for animal husbandry

Years		Total payment for the purpose of animal husbandry		Livestock loans as per cent of total loans advanced
Iranian	Gregorian	Rials	US dollars	per cent
1341	(1962–1963)	5,368,150	71,575	0.4
1342	(1963–1964)	8,549,000	113,987	0.3
1343	(1964–1965)	178,601,674	2,381,355	4.3
1344	(1965–1966)	290,473,977	3,872,986	5.4
1345	(1966–1967)	139,184,824	1,855,797	2.7
1346	(1967–1968)	830,519,572	11,073,594	16.0
1347	(1968–1969)	946,384,016	12,618,453	17.9
1348	(1969–1970)	1,435,595,182	19,141,269	27.6
1349	(1970–1971)	750,794,656	10,010,595	–

The figures in Table 2 indicate that the livestock raisers are gradually occupying their real place in the agricultural economy of the country. However according to figures for 1969 published by the Central Bank of Iran livestock activity supplies approximately ten per cent of the gross national product (GNP) of the country, so the livestock industry still has a long way to go before it receives its full share of credit allocations.

Central Organization of Rural Co-operatives

At the present time the Central Organisation of the Rural Co-operatives is supervising 8,298 rural co-operatives throughout the country. The capital investment of the organization exceeded 4,800,000,000 Rials (US$64,000,000) at September 1st, 1969. The Organization normally extends small short term loans at interest rates of three to four per cent to villagers through rural co-operatives and co-operative federations, although on special occasions it may extend loans to federations of co-operatives with the exceptionally low interest rate of one per cent. The total amount of credit extended by the Central Organization of Rural Co-operatives during six years of activity is given in Table 3.

Table 3
Credit advanced by Central Organization of Rural Co-operatives

Years		Total credit extended	
Iranian	Gregorian	Rials	US dollars
1342	(1963–1964)	396.803,105	5,290,000
1343	(1964–1965)	1,434,000,313	19,120,000
1344	(1965–1966)	1,882,951,734	25,106,000
1345	(1966–1967)	3,023,907,108	40,319,000
1346	(1967–1968)	4,076,608,590	54,355,000
1347	(1968–1969)	5,041,337,381	67,218,000
1348	(1969–1970)	5,753,285,071	76,710,000
1349	(1970–1971)	6,314,251,838	84 190,000
Total		27,923,145,140	372,308,000

These loans have mostly been dual purpose loans used for both agricultural and livestock activities. However in the years 1347–1348 (1967–1969) the Central Organization of Rural Co-operatives extended credits of 20,000,000 Rials (US$267,000) for animal feeding.

Agricultural Development Fund of Iran

The Agricultural Development Fund of Iran was established in 1347 (1968) for providing long term supervised loans to agricultural and livestock institutions. The initial capital investment of this organization is 1,000,000,000 Rials (US$13 000,000) which has been taken from the National Development Fund. In addition the organization has obtained the legal right to lend up to US$250,000,000 from foreign sources, and in the case of need it can also issue 5,000,000,000 Rials (US$67,000,000) of Government bonds.

The Fund has already extended 13 individual loans for joint agricultural and livestock projects. The total credit payments of the organization had reached 206,600,000 Rials (US$2,755,500) up to October 1970, and 23 new projects amounting to 1,156,910,000 Rials (US$14,092,000) are under study at the present time. The interest rate of these long term loans is 7.5 per cent plus 0.5 per cent supervisional expenses.

Bank of Omran

The objective of this institution is to establish co-operatives and companies for tenants of Crown-owned and neighbouring villages already distributed among the farmers, as follows:

1. Development activities.
2. Cottage industries including carpet weaving.
3. Livestock farming.
   a. Livestock credit to rural co-operatives from 1342 to 1349 (1963–1970) 241,183,600 Rials (US$3,215,800).
   b. Credit for purchasing fodder crops to rural co-operatives from 1342 to 1349 (1963–1970) 86,359,100 Rials (US$1,151,500).

c. Other agricultural credits for the following:- Plowing, seed, fertilizer, irrigation, shallow and deep wells, building, handcrafts and household expenses. Up to 1349 (1970) 1,918,162,343 Rials (US$25,575,500).

d. Loans paid to sheep fattening programmes 140,000,000 Rials (US$1,866,700).

Pasture Development Fund of Iran

The capital investment is 1,000,000,000 Rials (US$13,300,000) which is realized from the following sources:

1. Plan Organization (five year development plans) 500,000,000 Rials (US$6,660,000).
2. Funds obtained from sale of forest lands 200,000,000 Rials (US$2,666,000).
3. From slaughter houses and taxes 300,000,000 Rials (US$4,000,000).

The fund is administered by the Ministry of Natural Resources.

The objectives of the Pasture Development Fund of Iran are:

1. The development and improvement of pastures, provision of feed for livestock and encouragement of the gradual settlement of the tribes.
2. The development of mixed farming by encouraging integration of livestock raising with farming.
3. The improvement of the range lands by reseeding.

The fund will operate by advancing loans and/or credit to the tribal holding, making available supervisory staff and expertise and supervision to ensure the proper utilization of the credit offered.

Animal Husbandry Organization

In addition to the foregoing sources of credit the government recently has been extending some direct loans to the farmers through its Ministries. In 1347 (1968) a sum of 400,000,000 Rials (US$5,300,000) out of National Development Funds was put at the disposal of sheep feeders as supervised credit through the Animal Husbandry Organization (Ministry of Agriculture) to produce more meat for Tehran. This organization had advanced credits of 250,000,000 Rials (US$3,333,000) to 69 individual livestock feeders by the end of March 1971. The interest rate of the above mentioned loans is six per cent.

Ministry of Land Reform, Rural Co-operatives and Rural Matters

When Agricultural Corporations[1] were formed in 1347 (1968), the Ministry of Land Reform launched a new credit scheme with easy terms especially for the benefit of these corporations. Approved loans are put at the disposal of the Ministry of Land Reform at an interest rate of one per cent by the Plan Organization. The Ministry then transfers the funds to different corporations in instalments. The interest rate of the loans extended to the Agricultural Corporations by the Ministry of Land Reform is four per cent, of which one per cent is paid to the Plan Organization and three per cent is spent for launching new projects in the same corporations. Each corporation is run by a college educated Government general manager who is a Government employee and who has to ensure the repayment of loans.

[1] Agricultural Corporations are formed with the goal of preventing agricultural lands being divided into small pieces due to family inheritance changes, as well as preparing a suitable environment for farm mechanization and rural industrialization.

Agricultural and livestock credit in the 4th National Development Plan

The Plan Organization itself is indirectly the main source of credit in the country, although credit is actually distributed through the above-mentioned institutions. In the fourth national development plan (1968–1972) a sum of 14,000,000,000 Rials (US$186,700,000) has been set aside for the purpose of agriculture and livestock loans, from which 6,000,000,000 Rials (US$80,000,000) will be for livestock credit only.

Private sources of credit

Although in parallel with the changes in the agricultural sector of the country in recent years the nature of private money lenders has changed and private bankers as well as feed mills, hatcheries, and pure-bred animal importers have appeared in the scene of rural credit, the interest rates offered by these sources (12–20 per cent) are too high in relation to the return on capital invested in agricultural and livestock activities. Government institutions are, at present therefore, the only suitable source of credit to serve the rural sector of the country.

Credit recipients in Iran

Information in the different categories of credit recipients for livestock production in Iran is given in the 'Report of the CENTO travelling seminar on marketing of livestock and livestock products, 1967' and it is of interest to quote the following passages from this report:

'The agricultural sector of the economy contributed 107.4 billion Rials to the gross national product which was 450 billian Rials in 1966–1967. Animal products accounted for 49 billian Rials or 46 per cent.'

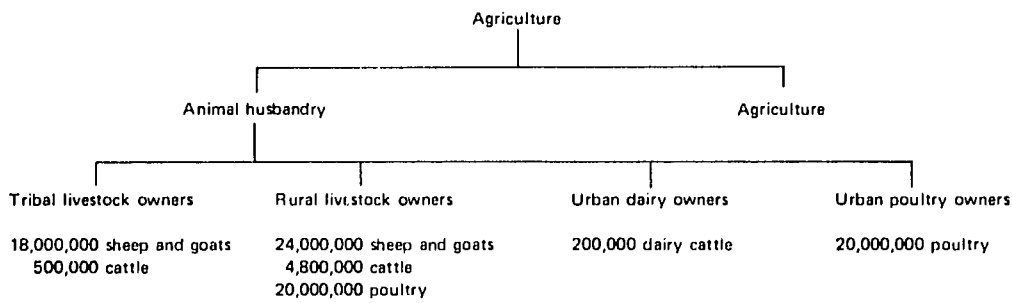
'It has been estimated that 22 per cent of the working population (or 17 per cent of total population in Iran) is directly involved with livestock production.'

'The sheep and goat husbandry practices in Iran are divided into two parts, namely village sheep and goat owners and tribal sheep and goat owners. About

18,000,000 sheep and goats (out of 42,000,000 total sheep and goats population of the country) are kept by tribal herdsmen.[1]

For better understanding the various categories of livestock raisers within the animal husbandry field of the country are illustrated in Figure 1.

Fig. 1
Organisation of livestock industry in Iran



Considering the number of animal units kept by each group the order of economic importance of different groups may be assessed to be as follows:

1. Rural livestock owners.
2. Tribal livestock owners.
3. Urban dairy owners.
4. Urban poultry owners.

However, the flow of credit among these groups is not in accordance with the above order in that the tribal livestock owners, who have the second position in the above categories, receive the lowest amount of credit from public sources due to the lack of social organizational factors and repayment guarantees. Accessibility of groups of livestock raisers to various sources of credit is illustrated in Figure 2.

It will be seen in Figure 2 that each group of loan recipients may receive loans from 6 to 7 public or private sources, except tribal livestock owners who are still only able to obtain credit on poor terms from rural traders, pedlars and intermediaries.

Conclusions and recommendations

The above discussions direct us to the following conclusions which may be of some value to enable credit problems to be solved in Iran and any other countries which are in a similar stage of development:

1. Government should take firm steps to build up a sound credit policy to ensure a flow of credit to different groups in the livestock field proportionate to the economic importance of their activities.
2. It is urgent to find desirable solutions for tribal credit, especially in the countries where tribal flocks constitute an important part of the livestock population.

The following means and solutions are considered to be appropriate:

1. Establishing tribal co-operatives or similar organizations that among other benefits would ensure repayment of loans extended.
2. Ensuring that the Government tribal credit policies conform with its general development policies with regard to, for example, tribal settling projects, tribal feed lots, etc.
3. Finding some solutions towards acceptance of livestock as repayment guarantees.
4. Applying new methods to extend loans to tribal livestock owners in kind rather than in cash.
5. Encouraging payment of supervised credit through specialised Government agencies, similar to the loans which have been extended to sheep feeders in Iran through the Animal Husbandry Organization.

Figure 2
Accessibility of livestock raisers to various sources of credit.

CREDIT RECIPIENTS (LIVESTOCK FIELD)

a Tribal Livestock Owners
b Rural Livestock Owners
c Urban Dairy Owners
d Urban Poultry Owners

SOURCES OF CREDIT

Private Sources		Public Sources	
b c d	Private Banks	b c d	AG. Bank
c d	Feed Mills	b	Rural Co-op's
b c d	Livestock Importers	b c d	AG. Fund
d	Hatcheries	b	Ministry of Land Reform
a	Rural Traders	c	Ministry of Agriculture
a	Itinerant Dealers	b c d	Other Govt.Banks (Bank Omran)

Credit and co-operatives in Pakistan

Anwar A. Qureshi
Director of Animal Husbandry, North West Frontier Province, Peshawar, Pakistan

Introduction

Although the necessary species of livestock are available in large numbers in Pakistan, availability of animal products for each person is among the lowest in the world due to poor livestock performance. There has in fact been a significant increase in livestock and poultry numbers in Pakistan during the last two decades but this has been insufficient to meet the demand for their products resulting in a gradual increase in prices. However, it is the intention of Government to pay more attention to the animal husbandry sector of the economy during current and future development plan periods.

One of the main problems which hampers the present development of the livestock sector is the shortage of forage and the small amount of concentrates fed. Perhaps more significant are the broad range of problems associated with animal nutrition. No feeding standards have been fixed so far nor have farmers been acquainted with improved feeding practices. Hence in attempting to improve livestock production emphasis is to be placed on extension efforts in the field and on increasing the yield of fodder and feeds on cultivated and range lands. As an immediate relief to the problems noted above the importation of considerable amounts of food grains would be essential to improve and increase livestock products and the health of animals. If livestock nutrition is improved, however, it will soon overtake the genetic potential of most of the present Pakistan farm animals, although some milk cows yielding more than ten thousand lb of milk in a lactation period have been reported, indicating that genetic potential for high milk product is possessed by some of West Pakistan breeds.

Feeds and feeding

Three feed mills were set up in the private industrial sector of West Pakistan and one in the public industrial sector in East Pakistan during the period of the Third National Development Plan, and during the current plan encouragement is being given to expansion of capacity in the private sector, particularly in the vicinity of selected sugar, rice and oil mills in both the East and West so that by-products from these mills could be utilized as raw materials for manufacturing compounded feeding stuffs. The question of subsidising feed for livestock and broiler production and other inducements to develop these industries is also being considered.

More research and experimentation to improve the efficiency of livestock in Pakistan is required. The impact of research and experimentation in the western countries on the efficiency of livestock production is illustrated by the fact that it took on average 18 per cent fewer feed units to produce 100lb of milk in 1956 than it did on average during 1940–44; it also took 12 per cent fewer feed units to produce 100lb of meat as cattle and calves; 13 per cent fewer feed units to produce 100lb of eggs and 32 per cent fewer feed units to produce 100lb of broilers. Experiment has revealed that the progeny of high performance sires made 24 per cent greater gain from birth to weaning age than progeny of low performance sires. Ability to gain efficiency in utilizing feed are heritable and genetically related.

The vital importance of the natural rangelands of West Pakistan in supplying feed for livestock should be mentioned but this has already been dealt with elsewhere. Allotment of range land to private sector individuals for livestock production by ranching techniques will necessitate among other things the provision of credit facilities for the sinking of tubewells, etc.

Sources of finance (loans and credit)

The whole question of agricultural finance is involved in the study of the sources of acquiring capital and its disposition for the operation of agricultural business with the objective of achieving improved output and income. The sources of the finance can be both internal and external. The sources of internal finance are the income from the farm and the owner of the farm acting as an entrepreneur. The primary source of agricul-

tural finance is savings from the income stream of the farm. The need for borrowing arises due to the low level and uneven distribution of agricultural earnings during the year on the one hand and the steady pattern of consumption and investment on the other. Borrowing gives command over resources otherwise not available, and improves the ability of the farmer to acquire articles of consumption as well as instruments of production. But borrowing only becomes possible when other persons or groups of persons are willing to save and lend, and the lender will extend credit only when he has confidence in the ability of the borrower to pay the principal and specified interest. The sources of external finance may be friends, relations, land-lords, commission merchants, middlemen and institutions namely co-operatives, the Agricultural Development Bank and the Government.

Private sources of credit

Friends and relations lend interest-free money which provides a basis for transferring purchasing power from one person to another in a rotating situation of crisis and of needs. Such transfers are normally within family or social groups. With economic development and commercialization, landlords also provide credit to their tenants while commission merchants and traders are another important source of rural credit. The commission agents advance loans free of interest to farmers and marketing firms on the condition that they will sell their products through them. It is generally complained that the commission merchants control market prices of commodities and that their debtors do not obtain fair prices for their products.

Co-operative credit societies

The co-operative movement was started in the North-West Frontier Province (NWFP) in 1922 but practical work began with the passing of the NWFP Co-operative Societies Act, 1925. The need for the co-operative movement arose to inculcate the spirit of thrift and co-operative help among the people, particularly the agriculturists who had to borrow money at unjustifiably high rates of interest.

Primary credit societies were established at the village level to promote the economic welfare of the members by providing loans at reasonable rates of interest. The working capital of the co-operative societies is composed of both owned and borrowed capital. Owned capital consists of paid up share capital and reserve funds while borrowed capital is composed of loans from members and non-members, co-operative banks and Government.

Government loans taccavi

This is the traditional system of providing financial help to the agriculturists at times of distress and emergency by the Government through the Revenue Department. This method of financial help was first systematised and regulated under the Land Improvement Loans Act, 1883 and Agriculturists Loan Act, 1884. The latter has now been replaced by the Agriculturists' Loans Act, 1958. These loans are provided for the permanent improvement in land such as the construction of wells, drainage and reclamation of land, irrigation facilities and for protective measures such as against floods and soil erosion and also for the purchase of livestock.

Agricultural Development Bank of Pakistan

In order to cope with the expanding financial needs for the development of agriculture, the Agricultural Development Finance Corporation (ADFC) was established in 1952 and the Agricultural Bank of Pakistan (ABP) in 1957 which the purpose of increasing the level of agricultural credit. Later on the recommendation of the *Credit Enquiry Commission Report* these agencies were merged together resulting in the establishment of the Agricultural Development Bank of Pakistan (ADBP).

Type of credit

Consumption credit is a loan to purchase articles for family consumption and provides no more than maintainance of a static long-term consumption pattern. Production credit, however, allows expansion of inputs and hence an expansion in production and income base. This latter form of credit is a useful concept since credit which allows an expansion of the income provides a means of easing re-payment and also meets the larger policy goal of increased production and increased rural welfare.

Short term credit

With technological changes the need for credit increases. This is particularly so in the case of short term credit required for a single cropping season to cover operational expenses like the purchase of improved seeds, marketing and storage of crops and for the purchase of articles for family consumption. The short term credit is timely and has a convenient repayment programme suited to the income flows of the agriculturists. Agriculturists generally depend on private lenders, namely traders, shopkeepers and money lenders for short term loans, as the institutional sources do not provide these requirements.

Intermediate and long term credits

Intermediate credit is provided for a period not exceeding three years and is for the purchase of, for example, machinery and cattle and for the construction of, for example, wells. The need for long term credit arises from the making of improvements to land such as levelling, installation of tubewells, small-scale irrigation, purchase of expensive farm machinery, etc. The existing credit institutions are geared largely to short term needs and the lack of intermediate and long term credit facilities represents a serious bottleneck to the development of agriculture in Pakistan. There is, therefore,

need for specified credit institutions to provide sufficient resources for the purpose.

Purpose-wise credit

The total institutional credit made available to the agricultural of Peshawar and Dera Ismail Khan Divisions during 1947–48/1968–69 was Rs. 58.8 million. Of these Rs 13.2 million were provided for the purchase of livestock and Rs. 9.0 million for bringing about permanent improvements in land.

Need for increased credit

Presently less capital is available to fully utilize the land and labour resources of Pakistan than is needed. According to the *Credit Enquiry Commission Report* the ratio of capital needs to the output flow in agriculture is 25 per cent, the annual value of farm products in the region being Rs. 1,387 million. The financial requirements of farmers are Rs. 347 million per year and assuming that 60 to 70 per cent of these are provided by the agriculturists themselves, the credit requirement comes to Rs. 121 million. Further assuming that 80 per cent of the total credit (Rs. 97 million) is obtained from the private lenders (as estimated by the Punjab Board of Economic Enquiry in 1951) and, since the institutional credit supplied is on the average Rs. 5.0 million, the total credit facilities come to approximately Rs. 102 million when the actual requirement is Rs. 121 million per annum. There is therefore need for the intensification of institutional credit facilities.

A substantial increase in credit requirements is likely to occur with technological change, which expands the demand and enhances the importance of credit. And on the top of this the increased commercialisation of the agricultural sector requires more finance. Also, agricultural credit alone is not a sufficient means of providing required increases in farm production. There is need for programmes combining credit with other services associated with technological changes. Supervised credit plus extension facilities make the farmers capable of modernizing agriculture. The earnings of a farm from loans must be greater than the opportunity return of credit, so as to remain in business. This is a necessary condition for the efficient utilisation of funds if maximum contributions are to be made to the economic development.

Man's needs multiply every day and so do his efforts to meet them. For these requirements the first and foremost thing is a survey of the existing needs. There is need to know all the latest developments regarding the food problems, that is how to obtain self-sufficiency in food, surplus and export possibilities, impact on the farm organisation and its input – output relationship.

Proposals for livestock development in Pakistan

1. Credit should be provided by agencies such as the Agricultural Development Bank for the setting up of pilot feed mills on a co-operative basis by the poultry and livestock producers, as well as for financing feed supplies to poultry production concerns. Loan recovery should be made by easy instalments when the project begins to yield a productive return.
2. Livestock censuses should be made and the annual production of animals and products estimated when framing realistic plans of development.
3. Instructions on nutrition and applied nutrition programmes should be given.
4. Range management should be introduced as a fully fledged subject in the curricula of the agricultural colleges leading to the establishment of a range management service within departments of agriculture.
5. Efforts are required to increase fodder production through the introduction of high yielding varieties (for example of forage legumes), use of fertilisers and improved culture practices.
6. Export of feed oil cakes which can be profitably consumed within the country should be discouraged while the import of feed ingredients (like vitamins) may have to be liberalized to provide balanced feed in larger quantities.
7. Better facilities for marketing food products including improvement of roads should be provided.
8. Industries especially those based on agricultural products should be established in rural areas.
9. Suitably trained personnel in the field of animal husbandry should be produced and plans for utilization of this manpower worked out. Practical tasks should be assigned to these experts.

Report on Sixth Session: Role of credit and co-operatives in livestock production

Chairman, Mr J. M. Hill

1. The Conference acknowledged that in the three CENTO countries the Government was playing the dominant role in providing formal agricultural credits. Private sources were taking a secondary place.

2. Credit repayment was a serious problem, with repayment varying from 25 to 75 per cent. Governments' inability to continue to subsidise programmes in the form of uncollectable loans was also beginning to become a problem. It was pointed out that agricultural loans in certain tribal areas had resulted in very low credit repayment, collection and enforcement being a major difficulty.

3. The Conference considered that projects should be formulated such that they would induce investment of capital. It was essential that these projects should meet current profitability requirements and prevailing interest rates. Such economic projects, which were based on sound technology, should then be funded adequately to allow their successful implementation.

4. The Conference considered that as the livestock industry grew the demand for capital would become a serious problem. This was the current condition in Turkey and Pakistan. Most operating organizations dealing in food production and meat processing were faced with shortage of capital to carry out their programmes in an effective and timely manner. An example was cited with regard to projections for supplying 100,000 tons of poultry feed per year in Turkey. At current retail costs this would represent 125 million TL. If the Government's Agricultural Bank were required to supply credit for 50 per cent of this amount it would result in a demand for TL 60 million in new retail credits. It was considered that because of the growing demand for agricultural credit other credit resources would have to be sought, as discussed in the various papers.

5. There was some discussion as to whether feed mills currently operating in the Region could finance sales to their customers. However, several delegates were of the opinion that their feed industries were not adequately capitalised to perform this function. With the exception of Iran's poultry industry the small scale of most of the operating units made credit services and collection almost impracticable.

6. In a discussion on interest rates it was pointed out that short term credit, which produced returns quickly, could stand higher interest rates than long term credit, where the returns came only after a long period during which the accumulation of interest may add substantially to the capital which has eventually to be repaid. The need for realistic interest rates to encourage proper use of credit was stressed, and the possibility of employing equity capital to supplement long term credit resources was mentioned.

7. It was agreed that modern agriculture differed from traditional agriculture in that it required greater inputs to be made to achieve a desired objective. For example, in the case of local breeds of chickens allowed to run free and find their own food, inputs were zero and production in turn was low. However, as the livestock industry developed and produced animals of higher productivity requiring greater care and feeding, investments would multiply. The Conference considered that, for the livestock industry in the CENTO countries to grow and prosper, credit programmes would have to be developed on a sound basis as part of the package of practices for a modern animal and poultry industry.

Previous Page Blank

Final Session

Recommendations of Conference

Chairman
Mr. P. Durran CBE,
Veterinary and Animal Husbandry Advisor,
Middle East Development Division, Beirut

Previous Page Blank

Recommendations of Conference

1. The Conference took note of the excessive numbers of livestock on natural rangelands in relation to estimated carrying capacity. Recognising the complexity of reducing livestock numbers by a number of measures suggested at the Conference, it was strongly recommended that the most practical step suitable for immediate implementation was the improvement of marketing facilities.

2. The Conference recognised the need for greater supplies of cultivated forage crops. These could be met partly by increased production and partly by better conservation of existing supplies, including waste materials from other economic crops. Forage crops could, in certain circumstances, be included in rotation systems without detriment and perhaps with benefit to economic crops already cultivated. Young stock could be usefully withdrawn from overgrazed ranges for fattening on cultivated fodder in more favourable areas provided that suitable economic circumstances were created for such ventures. The Conference strongly recommended that Governments actively pursue policies for increasing forage supplies. Priority should be given to the establishment of pilot farms to demonstrate in economic terms the profitability of intensifying existing arable rotations by the inclusion of forage crops.

3. The Conference, noting the likelihood of seasonal nitrogen deficiency occurring in the feed of animals kept on ranges and also during grazing on stubbles and fallows, recommended that investigations should be made into the use of licks containing urea and molasses, incorporating if desired other nutrients which might be limiting, such as minerals.

4. The Conference, although noting the more economic conversion of feed by certain imported breeds of livestock of high genetic potential, recommended that their substitution for indigenous stock should be undertaken only where suitable environment, feeding and management could be provided, including rigorous disease control. It further recommended that the potential of existing indigenous animals should be exploited by improved feeding.

5. The Conference recognized that indigenous village poultry were the predominant source of poultry meat and eggs in the Regional Countries and that this situation was likely to continue for the foreseeable future. It noted that the village bird, being a forager, did not compete with humans for feed, and that it produced at effectively zero cost. Supplementary feeding at a low level could greatly increase production and it was strongly recommended that this should be encouraged.

6. The Conference noted the high feed conversion efficiency of modern hybrid chickens, which could be kept successfully in large intensive units close to potential urban markets but recognized the impracticability of maintaining them at village level. It also noted that a cross-breed with local chickens, which had been developed in some parts of the region such as the Lyallpur Silver Black of Pakistan, had achieved considerable success under village conditions and recommended that such programmes should be more widely adopted.

7. The Conference noted the necessity for a complete understanding of the raw materials which were locally available for feed compounding, together with a knowledge of their seasonal availability, composition and interchangeability. The vegetable protein concentrate available in greatest quantity in the Regional countries was cottonseed cake, but this could not be used in quantitites of more than five per cent for poultry layer rations due to the presence of endogenous toxic polyphenolic compounds of the gossypol family and cyclopropanoid fatty acids. The Conference recognised that improved methods were now becoming available for producing low gossypol meals without seriously reducing lysine availability, while solvent extraction would remove cyclopropanoid fatty acids with the oil. The Conference strongly recommended that steps be taken to improve cottonseed processing so as to produce non-toxic meals suitable for inclusion without constraint in poultry layer rations.

8. The Conference drew attention to the need for the careful consideration of all relevant factors when establishing a feed industry. Full co-ordination of the various management functions including marketing,

 extension, quality control, formulation, raw material procurement and finance was essential.

9. The Conference noted the need for careful control of the quality compounded feeds. The quality and composition of raw materials needed careful monitoring and it was essential that adequate analytical facilities be provided preferably at the plant for this purpose. Careful control of the storage of raw materials and finished feeds was also essential. It was recommended that Governments should enact legislation to require an adequate statement of the nutrient contents of the finished feeds. Consideration should also be given to laying down minimal standards for different classes of feeds, allowing a reasonable latitude for unavoidable variations.

10. Evidence was presented to show the low percentage recovery rate of loans granted to the agricultural and livestock rearing industries of Regional countries. Nevertheless adequate credit facilities were vital for the future development of the livestock and poultry industries. It was recommended that a distinction be drawn between loans for defined feasible projects and loans which were largely non-recoverable and were in effect Government subsidies. This would be an essential first step in the application of credit in the most productive manner.

11. The Conference recognized that the increase in the demand for credit in the livestock industry could create problems especially of credit availability in Turkey and Pakistan and recommended that in planning schemes for livestock improvement the probable availability of credit to finance these plans should be considered at an early stage.

Printed for Her Majesty's Stationery Office
by Hobbs the Printers Ltd., Southampton
(1195) Dd817364 1,500 3/73 G3313