THE STATUS OF LIVESTOCK PASTURE AND FORAGE RESEARCH AND DEVELOPMENT IN ETHIOPIA

Proceedings of the workshop held in Addis Ababa, Ethiopia
8-10 January 1985

Published 1987
Institute of Agricultural Research
P.O.Box 2003
Addis Ababa, Ethiopia
Livestock production plays a major role in the overall development of Ethiopia's agriculture. The large cattle population and the vast area of grazing land are potential resources to be exploited. However, very little has been done to improve this important subsector of agriculture. Livestock productivity is generally low because of poor genetic make-up, poor nutrition, poor husbandry practices and poor veterinary care. On the other hand, various indications and experiences have shown the possibility of increasing the output from these animals, provided adequate attention is given to the breeding, husbandry, nutrition and health of the animal. It is therefore high time that we should pull together our limited improvement services, skilled manpower and resources if we want to make a breakthrough in this subsector.

The Institute of Agricultural Research has organized this workshop in order to review past and current research and development programmes in the different areas of livestock production, assess their weak and strong sides and come up with a workable solution for the future as to how we can best organize ourselves for the betterment of this sector.

The workshop was structured to cover what has been done in development and research, both in different classes of livestock, namely dairy, beef, sheep and goat production, poultry, apiculture, pack animals and fishery, and in different disciplines of animal sciences, namely animal nutrition, forage and pasture agronomy, range management, animal health and livestock marketing.

Speakers from different institutions and organizations with long experience in the different areas mentioned above were invited to present papers.

ACKNOWLEDGEMENTS

The organizing committee and IAR are very much indebted to the International Livestock Centre for Africa (ILCA) for the use of its facilities at ILCA headquarters during the workshop.

The Organizing Committee
SUMMARY OF DELIBERATIONS

The session started with a welcoming address from the Animal Science, Pasture and Forage Department Coordinator at 9:15 in the morning, which was followed by opening remarks from the General Manager of IAR. After indicating the constraints to livestock research and development in the country, the General Manager put emphasis on the need for the formation of a National Livestock Committee for the purpose of organizing National Livestock Improvement Conferences, similar to the functions of the National Crop Improvement Committee. Reviewing the present research activities and outlining future research undertakings, as well as coordinating national research work, were identified as the objectives of this workshop.

After the opening remarks the workshop dealt with the subject in three parts as follows:

PART I

PART I consisted of three major papers, summarized as follows:

1. The status of dairy research and development in Ethiopia
   Beyene Kebede - IAR

   The speaker described the two systems of milk production which are practiced in the country, namely traditional and modern. In the former, nearly all the milk produced is for home consumption whereas the latter system caters for urban centres. Both systems combined cannot meet the milk demand in the country as a whole and consequently the milk processing plants operate below capacity. Various institutions and organizations, i.e., IAR, MOA, MSFD, ILCA and teaching institutions, are dealing with the improvement of local breeds for milk production through crossbreeding. However, there is no or very little coordination among these institutions, the work seems to be fragmented and the number of animals used is often small. Thus the research results so far obtained have had very little impact on the development of the dairy industry in the country. Furthermore, the research results obtained are not comprehensive or conclusive. The following recommendations were proposed to overcome these problems:

   - Livestock development programmes of the country should be stratified and dairying should concentrate in the highlands. This warrants a strong dairy research centre in this area.
   - Short- and long-term development and research programmes should be coordinated among the institutions concerned.

   - Livestock improvement centres in the highlands. This warrants a strong dairy research centre in this area.
a) to avoid duplication of efforts  
b) to have a uniform recording system  
c) to delineate responsibilities  

- An accurate cattle population census and identification of different local breeds/types should be made.  
- The introduction, adaptation and management of pure exotic breeds should be looked into.  

The status of beef cattle research in Ethiopia  
Alemu G/Wold - IAR  

In Ethiopia beef is produced mostly by the traditional system from aged cows, bulls and overworked oxen, giving poor quality beef. Major constraints in this sector have been indicated. Institutions engaged in beef research are IAR, MOA, MSFD and teaching institutions using the local breeds and in a few cases using crosses. 

Although to date there is no defined beef cattle research programme in Ethiopia and no breed type is kept for beef production alone, some of the local breeds (Horro, Baraka) have been studied to some extent for their beef traits. A notable feature of the entire beef research effort is the absence of coordination amongst the various institutions mentioned. In addition the lines of research are not geared towards solving the major problems at the farm level. The following recommendations were made:  
- A multi-disciplinary research activity should be considered in view of the large cattle population in relation to feed and other resources.  
- A well-defined national beef production research policy and guidelines are needed.  
- Because of the need for coordination amongst the various institutions, their terms of reference, duties and responsibilities should be defined.  
- Beef cattle research should focus on:  
  a) Cattle population census and breed identification  
  b) The study of the beef performance traits of the local animals  
  c) Market preference, e.g., breed type, sex and age  
  d) Development of a beef grading system  
- The formation of a National Livestock Committee could do much to ensure that beef research and development programmes conform with the policy and guidelines established.  

The status of sheep and goat research and development in Ethiopia  
Kassahun Awgichew - IAR  

Ethiopia has an estimated population of 24 million sheep and 18 million goats. Sheep are utilized mostly for mutton and wool production. Goats are, however, reared for both milk and meat production, especially in the lowlands. Sheep are concentrated mostly in the highlands while most of the goats are found in the lowland.  

Few of the Ethiopian sheep breeds/types have been adequately identified to date (Adal, Black Head Somali, Horro, Mens, Ars and Baraka), and virtually none of the goat breeds/types (except the Adal).  

Institutions engaged in sheep and goat research and development programmes were listed as IAR, MOA, ILCA, MSFD and teaching institutions. Some research and development work is being carried out on the above-identified local and a few exotic breeds and their crosses. There is little coordination amongst the institutions engaged in sheep and goat research or development programmes. The major constraints in the programmes were indicated and the following recommendations were made for developing the industry:  
- A proper sheep and goat population census should be made together with the identification of major characteristics.  
- The genetic potential of the local sheep and goat breeds/types should be investigated.  
- A multi-disciplinary approach is needed to improve the productivity of both sheep and goats.  
- Stratification of the sheep production industry should be considered in the long term.  
- Concerned organisations should coordinate their programmes, possibly by forming teams, to enhance the level of a national genetic improvement plan.  
- The role to be played by and the responsibilities of various organizations/institutions should be clearly defined.  

The status of wildlife research  
Part II was intended to consist of five papers but no paper was submitted on the status of wildlife research.  

A summary of the rest of the papers is as follows:  

PART II
The poultry industry in Ethiopia is based upon household production of over 50 million indigenous hens whose productivity is considered very low. No emphasis has been given to the improvement of the indigenous birds while the developmental aspect of the poultry industry has focused on exotic breeds for the production of both meat and eggs.

Institutions engaged in the poultry industry were listed as MSFD, MOA and teaching institutions. IAR was indicated as not being involved in either research or development of poultry while research in poultry is limited to the teaching institutions. The current status of research activities in the teaching institutions is unknown. In general, poultry development suffers from lack of research findings, mainly with respect to least-cost rations and disease control.

Finally, the speaker emphasized that institutions that should be responsible for poultry research must be identified together with research priorities in the field.

Animal traction

2.1 Animal traction research in Ethiopia

Abiye Astatke - ILCA

Although the use of modern farm machinery is increasing, animal power is still very important, particularly in most developing countries of Africa, Asia, Latin America and parts of south-eastern Europe. Animal power is used more for small-scale farming and in areas where the nature of the terrain does not allow the use of farm machinery. In Ethiopia, both farm-scale and terrain limitations are evident. Traditionally the cattle economy of the highlands is geared towards providing ploughing oxen. The sarascha, which is used for ploughing, was shown to have a power requirement that does not exceed the available power source (pair of local oxen). The advantages and disadvantages of using the sarascha were discussed.

Institutions involved in animal traction research and development were listed as ILCA, MOA, IAR, and the College of Agriculture, particularly in developing improved implements. The animal traction network formed between ILCA, IAR and ARDU was also mentioned and it was suggested that it should be strengthened and other concerned institutions should be included for a more coordinated approach.

Recommendations included:
- More research should be carried out regarding the available power source (animals) and usage.
- An effort should be made to improve farm implements to be used on the various soil types.
- Some sociological studies are needed in relation to the economic and technological level of the farmers.
- The use of single ox, cows and equines should also be looked into.

2.2 Animals for work: non-draught uses in Ethiopia

R.T. Wilson - ILCA

In Ethiopia very little research has been carried out and few attempts made to develop the use of animal power for non-cultivation purposes. ARDU has carried out some developmental work in this field, particularly in the introduction of ox and donkey carts and cart-mounted water tanks in limited areas. Some organizations that individuals have attempted to establish, quantitatively and qualitatively, the value and role of animals for transport or other purposes.

The role played by donkeys in the transportation of goods was described and the results of an observation around Mekele were presented.

It was also pointed out that currently there is no organization dealing with pack animals.

The lack of information regarding the energy requirements for work and therefore the nutritional needs of working animals is a major constraint to the more economic use of working animals.

In addition social and religious observances may limit the use of work oxen in the highlands to as little as 25% of the possible time. Working animals are rarely used for multiple and alternate purposes and, even where animals are used for other purposes, the traditional method are inefficient.

The recommendations given were:
- The cost of energy production should be studied in terms of feed efficiency of pack animals compared with cattle.
- Sociological studies should be carried out.
- Research was needed on improving output from work animals using:
  a) Carts and wagons
  b) Sledges
  c) Other types of animal powered machinery
  d) Improvement of the animal themselves

PART III

A total of six papers were presented in Part III, of which one dealt with the status of fisheries research and development, three with forage, pasture and range management and animal nutrition research, one with animal health.
problems and the last with marketing of livestock and livestock products.

A brief summary of the three related papers together and the remaining papers separately is given below:

1. The status of fishery research and development in Ethiopia
   Tesfaye Wudineh - MOA

   The speaker pointed out that Ethiopia with its large number of lakes has a high potential in fishery resources. The importance of this sector of the country's economy has not been given due consideration until recently and the potential is not yet fully exploited.

   Since the field is a new one, no research activity has been undertaken at a national level up to date. Surveys made to identify fish distribution and approximate estimation of the fish yield in the major lakes were cited as examples.

   The organizations engaged in fishery development work at present are MOA (Fishery Resource Development Department), Asmara University and Awasa Junior College.

   The speaker emphasized the need for research into breeding habits, migration, fishing methods, fish processing and preservation methods.

   Finally, there is need for high-level cooperation between research institutes and the Fishery Development Department.

2. The status of animal nutrition, pasture and forage, and rangeland management research in Ethiopia
   Seyoum Bediye, Lulseged G/Hiwet and Girina Bisrat

   The speakers emphasized that one of the major constraints for the development of livestock industry, which plays an important role in the Ethiopian economy, is feed inadequacy. The major problems are undernutrition and malnutrition.

   At present animal feed resources are entirely based on natural pastures which are generally overgrazed and low in productivity. Crop residues and industrial byproducts provide a small proportion of the livestock feed and these are poorly utilized. Due to all these factors animals cannot meet the energy and protein requirements for high levels of production.

   In general, the government's socioeconomic objective is to increase the national food supply in quantity and quality, and to increase equitable income distribution for the steadily increasing population.

   The achievement of this goal depends, among other things, on the development of the livestock industry by improving feed, management and veterinary services.

   Organizations involved in undertaking research and development activities in these fields were listed as IAR, MOA, MOFD, ILCA, ARDP, RRC and teaching institutions.

   Despite initial research findings obtained from the works of these organizations over the past few years, many research priority areas still need urgent investigation.

   The three speakers listed research priority areas in their respective fields as follows:

   2.1 Animal nutrition

   Seyoum Bediye - IAR

   2.1.1 Assessment of the nutritive value of available feedstuffs through laboratory and animal evaluation.

   2.1.2 Improvement of crop residues either by using legumes or by chemical treatment.

   2.1.3 Assessment of nutrient requirements for different classes of livestock.

   2.1.4 Need for demonstration of benefits from improved animal nutrition.

   2.2 Pasture and Forage

   Lulseged G/Hiwet - IAR

   2.2.1 Collection and evaluation of widely occurring indigenous forage species to be used for future forage development schemes and pasture improvement programmes.

   2.2.2 Overstocking of natural pastures with legumes which may provide high-quality feed for the livestock and contribute significant amounts of biologically fixed nitrogen to the soil. Along with this the establishment of a microbiological laboratory to identify and produce effective rhizobial strains is also essential.

   2.2.3 Integration of forage crops with arable crops by strengthening studies such as rotation and undersowing, both at the research level and on farmers' fields.

   2.2.4 Use of annual and perennial fodder crops at farm level.

   2.2.5 Techniques for the establishment of perennial pastures.

   The achievement of this goal depends, among other things, on the development of the livestock industry by improving feed, management and veterinary services.
2.2.6 Seed production: Ideal sites for seed production have to be identified and the agronomic techniques need to be thoroughly investigated.

2.2.7 Forage conservation and utilization: methods for conserving the forages produced during the wet seasons and using them in the dry season, when the shortage of green feed is acute, should be investigated.

2.3 Range management

Girmaalendar - Third Livestock Development Project

2.3.1 Identification of drought-resistant forage crops.

2.3.2 Exploration of water resources - with regard to water conservation and water harvesting systems.

2.3.3 Socio-economic studies in pastoral communities.

2.3.4 Assessment of the potential of rangelands and vegetation cover.

2.3.5 Evaluation of range condition and trend.

2.3.6 Marketing studies.

General recommendations for the three disciplines were:
- Formation of research teams
- Recommendation, particularly regarding animal nutrition, for the early establishment of a National Animal Laboratory

3 The status of animal health research in Ethiopia

Feseha G/Ab - Addis Ababa University

Animal health studies in Ethiopia clearly indicate that animal diseases are one of the major constraints contributing to low productivity of Ethiopian cattle. Diseases like rinderpest, anthrax, black leg, trypanosomiasis, internal and external parasites and diseases associated with nutritional disorders are common in the country.

Control measures against these diseases are impeded by lack of functional organization, funds and full knowledge of their prevalence.

The country also has only a limited development of disease survey, investigation and diagnosis work.

Organizations other than MOA engaged in veterinary disease investigation are:
- Institute of Pathobiology
- Faculty of Veterinary Medicine

The speaker summarized also the achievements made by the National Veterinary Institutes regarding production of vaccines and identification of veterinary diseases, and specific duties performed by the above organizations and at different disease-identifying laboratories in the country.

The top research priority suggested was the identification of animal diseases of greatest economic importance and their control.

The recommendations made include:
- Reorganizing the research structure by bringing together related disciplines like animal production and health protection so that they work in cooperation to overcome constraints in the field.

4 The status of livestock products marketing development in Ethiopia

Sintayehu G/Mariam - MOA

The speaker pointed out that the marketing of animals and animal products involves several activities. The paper then described the three market systems which occur in Ethiopia, namely primary (product), secondary (intermediate) and consumer markets.

Some of the investigations made in this field so far include type of animals coming to these markets, type of buyers and seller, and percentage body-weight losses on trekking at different seasons.

In regard to research priorities, the speaker said that emphasis should be given to well-coordinated marketing research to improve both the local and the export markets.
After hearing the summary of deliberations, the chairman, Ato Beyene, said that much had been learnt from this meeting about the status of livestock research and development of our country and many useful recommendations had been made for future work. He pointed out, as a common feature of the papers, that research has been done in a fragmented way, and no coordination exists among the different institutions engaged in research and development. Ato Beyene urged the participants to try to resolve the problems of coordinating research work in the future. He pointed out that the proposal is to set up a Livestock Committee/Conference/Team, as recommended in several papers, under the leadership of the Science and Technology Commission. The committee is to be composed of representatives from various institutions, and the question of priority needs urgent attention. In general, research results had not produced low-cost producer extension “packages” and lacked guidance from clear national policy.

At this junction Dr. Seme Debela, General Manager of IAR, commented on the policy issue. He said there is a Science and Technology Commission which has an Agricultural Council; this council has already designated areas of priority. The problem is that to date no action has been taken. In order to make it functional it should be revived. The General Manager urged the participants to concentrate their efforts on organizing livestock programmes in the best way. He further pointed out that research in livestock is impeded more by lack of application and coordination than by lack of funds.

Ato Beyene opened a discussion on how best to organize the livestock research programmes. Proposals were discussed concerning the formation of:

a) National livestock improvement team
b) National livestock improvement conference
c) National livestock improvement committee

Ato Beyene Kebede - IAR - Chairman
Ato Tefera G/Meskel - MOA - Member
Dr. Feseha G/Ab - AAU - Faculty of Vet. Med. - Member
Ato Tesfaye Hudineh - MOA - Member
Ato Alexayehu Mengistu MCA - Member

The meeting discussed the team approach at length. Shortage of trained manpower in each team was the major concern for the implementation of the programme. Finally the proposed nine teams were accepted. It was also agreed that, as much as possible, each team leader should be from IAR and that IAR should take it up from there and identify team members and team leaders. A question was raised whether all nine teams should be formed at present. Ato!Beyene replied that all teams would be formed immediately, but it did not mean that all would be functional at the same time. Some commodities might need time to build up the necessary staff. Some programmes might need to be consolidated for the team having knowledge of the particular species, but it did not mean that the team would be functional at the same time. Some commodities might need time to organize the team.

The meeting adjourned at 12:10 for lunch and agreed to meet at 3:00 P.M.

The afternoon session started by hearing reports of the ad-hoc committee. Ato Beyene reported that the committee proposed to form nine teams and four networks. He said that the proposed teams were commodity-oriented and the networks discipline-oriented. The proposed teams and networks are as follows:

**Teams**

- **Dairy**
- **Beef**
- **Poultry**
- **Sheep and goats**
- **Apiculture**
- **Pack animals and traction**
- **Fishery**
- **Dryland farming**
- **Pasture, forage and range**

- **Networks**

  - **Animal feeds and nutrition**
  - **Animal health**
  - **Breeding**
  - **Marketing**
  - **Pasture, forage and range**

Regarding the proposed network approach, some questions were posed as to what it means, its relation to the teams, and its relation to the livestock sector. It was pointed out that each network would deal with a discipline and would provide a forum for people/scientists in similar fields to come together and discuss new developments in their field and how they could assist in development. The detail of the network approach will be further discussed by the ad-hoc committee.
Before the closing of this workshop the ILCA Library and Documentation head was requested to brief the participants about ILCA's library. Ato Michael Hailu briefly described the Documentation Centre at ILCA, what it offers, how it functions and how one can benefit from the centre. He pointed out some of the services available, namely:

- Computerized literature search
- Selective dissemination of information (SDI)
- "Current Content" service and microfiche

CONCLUDING REMARKS

In his closing remarks, Dr. Brumby, Director General of ILCA, emphasized two points:

1) Importance of research in relation to changes affecting agriculture: He pointed out the need for knowledge about large-scale production methods. In this connection he said government policy issues are very important in agricultural production.

2) The importance of a farming system approach: Dr. Brumby said that farming system research showed the relevance of research to farmers' conditions. At ILCA over the last 10 years two things had been achieved: new methods of farming and better understanding of the problems of producers. He said that ILCA would undertake more on-station research and hoped to develop more collaborative work with national institutions.

Dr. Sene closed the workshop by thanking the participants for attending, Ato Beyene and his staff for preparing the workshop and Dr. Brumby and ILCA for allowing IAR to use ILCA's facilities.
WELCOMING ADDRESS
Beyene Kebede

Distinguished guests,

I would like first of all to welcome you all on behalf of the Institute of Agricultural Research and myself to this important workshop.

Although the large potential contribution of the livestock industry to the nation’s economy has been talked of time and again, there has been very little progress in the development of this sector in the past. Of course there are technical and non-technical reasons for this but I don’t want to go into that since this workshop will deal with that in much greater depth.

This workshop, we feel, has brought together a distinguished group of people working in various aspects of livestock, to review and discuss the status of livestock research and development work in this country. It is our feeling that a coordinated effort involving the best utilization of all available facilities and resources should be attempted no matter what the precise name or character of the various organizations. Some effort has already been wasted in the past by a fragmented approach and much more is likely to be wasted if we don’t come and sit together and do something. In any case all are essential to the development of the livestock sector and one merges into the other like this, involving various organizations and individuals, are the best avenues for close cooperation and coordination of research and development.

I hope that at the end of this workshop, we shall come out of this hall with some concrete ideas as to how we can best organize ourselves in the future for the betterment of the livestock industry of this country.

After these short remarks I would like to invite Dr. Seme Debela, General Manager of the Institute of Agricultural Research, to officially open this workshop by saying a few words.

Thank you.

3/Coordinator, Development of Livestock and Forage Research, Institute of Agricultural Research.

OPENING REMARKS
Seme Debela

Seminar participants and colleagues,

I am greatly honoured to address this august gathering of research scientists and development workers in the areas of livestock research and development. This assembly involves people from various institutions dealing with this important sector of the national economy.

Since I am sure that everyone in this hall knows the statistics of our animal types and numbers, I am not going to take time quoting them. What is more, the statistics do not necessarily show clearly the practical significance of our livestock population to the daily life of the country’s population.

It is an often-repeated fact that Ethiopia is an agricultural country, with more than 85% of its people drawing their daily subsistence from agriculture. A large majority of this rural population is engaged in farming, whose source of draught power is livestock. This, in effect, means that Ethiopia’s crop production activities too are overwhelmingly dependent on Ethiopia’s livestock population. To this must be added all other outputs - milk, meat, hides/skins, etc...

Despite its overwhelming importance, this area has not been given the serious attention it deserves. As a result, this potential source of wealth is largely untouched. A generalized assessment of this sector would appear as follows:

1 The positive side

1.1 Number and diversity

There is no doubt that Ethiopia has a very large animal population; cattle, sheep, goats, etc., number many millions. What can we say about genetic diversity within each of these animal types? I am not sure whether a survey on animal diversity has already been carried out here but I tend to think that there is at least as much diversity as can be found in most other countries of the world.

1.2 Environmental factors

Ethiopia is endowed with a large array of environmental conditions ranging from hot tropical to cool temperate. Our livestock population is distributed in these environments.

4/General Manager, Institute of Agriculture Research.
1.3 Utilization habit

The Ethiopian people have a long tradition of using livestock for various purposes, depending upon need, generally dictated by social and environmental factors.

1.4 Management experience

Although we cannot say much about local traditions in animal husbandry in general, there are clear indications that the capability to do a relatively better job of management in most circumstances.

1.5 Potential markets

It is often stated that Ethiopia's geographic location is strategic for various purposes. Market-wise, we are close to Europe and other large markets, as we can meet the market standards required. But, on the other hand, our own home market for various livestock products is quite substantial.

I am sure there is a lot more to say with respect to our advantages; however, we also have disadvantages. The negative side

2 The negative side

2.1 Genetic limitations

The native livestock population is believed to have poor genetic endowment for a number of desirable characteristics. They cannot possibly be reared under the conditions which exist today in Ethiopia. The traditional forms of agriculture and livestock production are still very possible that we need more data to substantiate this belief.

2.2 System of management

Generally speaking, all forms of agriculture in this country are far too low level to support livestock production. There is a need for many social and economic changes to make it possible for the livestock sector to reach its true potential. The same negative general remark can be made with respect to our pasture and fodder resources.

2.3 Market infrastructure

It is often stated that Ethiopia's geographic location is strategically well placed for various purposes. Market-wise, we are close to Europe and other large markets, as we can meet the market standards required. But, on the other hand, our own home market for various livestock products is quite substantial.

I am sure there is a lot more to say with respect to our advantages; however, we also have disadvantages. The negative side

3 The consequences

The balance between positive and negative factors is very much tilted, producing an unfavourable situation for the country with respect to this sector of the national economy. Poor environmental conditions and livestock production is far too low to support livestock production. There is a need for many social and economic changes to make it possible for the livestock sector to reach its true potential. The same negative general remark can be made with respect to our pasture and fodder resources.

In short, we have a long way to go to convert our livestock potential into the practical asset that it could be.

4 Research and development in livestock

It is clear from the above that it is high time that more should be done to accelerate our exploitation of our livestock potential. I am well aware that some major studies are being done at this time. I am sure that it is our collective wish that these studies be converted into concrete actions in the shortest time possible.

As scientists, we are convinced that the basis for action must be data that are generated through studies or controlled experiments. Both sources of data require time and facilities. But, considering the present realities in this country, we have to conclude that we don't have much of either, so what is to be done? This is where ingenuity and resourcefulness are called for, urgently.

I am sure that all of us are aware of the many institutions engaged in livestock research in this country. The Institute of Agricultural Research, the colleges of agriculture and veterinary medicine in Addis Ababa, ARDU and the Ministry of Agriculture are the major national institutions in this area. The International Livestock Centre for Africa has its headquarters in Addis Ababa.

The balance between positive and negative factors is very much tilted, producing an unfavourable situation for the country with respect to this sector of the national economy. Poor environmental conditions and livestock production is far too low to support livestock production. There is a need for many social and economic changes to make it possible for the livestock sector to reach its true potential. The same negative general remark can be made with respect to our pasture and fodder resources.

In short, we have a long way to go to convert our livestock potential into the practical asset that it could be.

As scientists, we are convinced that the basis for action must be data that are generated through studies or controlled experiments. Both sources of data require time and facilities. But, considering the present realities in this country, we have to conclude that we don't have much of either, so what is to be done? This is where ingenuity and resourcefulness are called for, urgently.

I am sure that all of us are aware of the many institutions engaged in livestock research in this country. The Institute of Agricultural Research, the colleges of agriculture and veterinary medicine in Addis Ababa, ARDU and the Ministry of Agriculture are the major national institutions in this area. The International Livestock Centre for Africa has its headquarters in Addis Ababa.

The balance between positive and negative factors is very much tilted, producing an unfavourable situation for the country with respect to this sector of the national economy. Poor environmental conditions and livestock production is far too low to support livestock production. There is a need for many social and economic changes to make it possible for the livestock sector to reach its true potential. The same negative general remark can be made with respect to our pasture and fodder resources.

In short, we have a long way to go to convert our livestock potential into the practical asset that it could be.

As scientists, we are convinced that the basis for action must be data that are generated through studies or controlled experiments. Both sources of data require time and facilities. But, considering the present realities in this country, we have to conclude that we don't have much of either, so what is to be done? This is where ingenuity and resourcefulness are called for, urgently.

I am sure that all of us are aware of the many institutions engaged in livestock research in this country. The Institute of Agricultural Research, the colleges of agriculture and veterinary medicine in Addis Ababa, ARDU and the Ministry of Agriculture are the major national institutions in this area. The International Livestock Centre for Africa has its headquarters in Addis Ababa.

The balance between positive and negative factors is very much tilted, producing an unfavourable situation for the country with respect to this sector of the national economy. Poor environmental conditions and livestock production is far too low to support livestock production. There is a need for many social and economic changes to make it possible for the livestock sector to reach its true potential. The same negative general remark can be made with respect to our pasture and fodder resources.

In short, we have a long way to go to convert our livestock potential into the practical asset that it could be.

As scientists, we are convinced that the basis for action must be data that are generated through studies or controlled experiments. Both sources of data require time and facilities. But, considering the present realities in this country, we have to conclude that we don't have much of either, so what is to be done? This is where ingenuity and resourcefulness are called for, urgently.

I am sure that all of us are aware of the many institutions engaged in livestock research in this country. The Institute of Agricultural Research, the colleges of agriculture and veterinary medicine in Addis Ababa, ARDU and the Ministry of Agriculture are the major national institutions in this area. The International Livestock Centre for Africa has its headquarters in Addis Ababa.

The balance between positive and negative factors is very much tilted, producing an unfavourable situation for the country with respect to this sector of the national economy. Poor environmental conditions and livestock production is far too low to support livestock production. There is a need for many social and economic changes to make it possible for the livestock sector to reach its true potential. The same negative general remark can be made with respect to our pasture and fodder resources.

In short, we have a long way to go to convert our livestock potential into the practical asset that it could be.

As scientists, we are convinced that the basis for action must be data that are generated through studies or controlled experiments. Both sources of data require time and facilities. But, considering the present realities in this country, we have to conclude that we don't have much of either, so what is to be done? This is where ingenuity and resourcefulness are called for, urgently.

I am sure that all of us are aware of the many institutions engaged in livestock research in this country. The Institute of Agricultural Research, the colleges of agriculture and veterinary medicine in Addis Ababa, ARDU and the Ministry of Agriculture are the major national institutions in this area. The International Livestock Centre for Africa has its headquarters in Addis Ababa.

The balance between positive and negative factors is very much tilted, producing an unfavourable situation for the country with respect to this sector of the national economy. Poor environmental conditions and livestock production is far too low to support livestock production. There is a need for many social and economic changes to make it possible for the livestock sector to reach its true potential. The same negative general remark can be made with respect to our pasture and fodder resources.

In short, we have a long way to go to convert our livestock potential into the practical asset that it could be.

As scientists, we are convinced that the basis for action must be data that are generated through studies or controlled experiments. Both sources of data require time and facilities. But, considering the present realities in this country, we have to conclude that we don't have much of either, so what is to be done? This is where ingenuity and resourcefulness are called for, urgently.

I am sure that all of us are aware of the many institutions engaged in livestock research in this country. The Institute of Agricultural Research, the colleges of agriculture and veterinary medicine in Addis Ababa, ARDU and the Ministry of Agriculture are the major national institutions in this area. The International Livestock Centre for Africa has its headquarters in Addis Ababa.
institutions and programmes are the products only of efforts by general managers, deans or department heads; the commitment and dedication of the research staff are just as crucial.

In this context, I would like to raise an issue close to my heart. There has been effort in the past to form a national conference for livestock improvement similar to the NCIC. This effort has not succeeded as yet. I would therefore, like to appeal to you to take up this issue and organize yourselves into an effective work force dedicated to livestock improvement in Ethiopia.

5 Workshop objectives

To attract great importance to this workshop. Its objectives are, I hope, very clear:

5.1 Review results of experimental activities in livestock, pasture and forage.

5.2 On the basis of this review, outline the general directions of research over the coming few years.

5.3 Work out a formula for a coordinated approach to the conduct of experimental programmes in the various institutions, both national and international.

I wish you success in your deliberations.

PART I

THE STATUS OF DAIRY RESEARCH AND DEVELOPMENT IN ETHIOPIA

Beyene Kebede, IAR1/

1 Introduction

Ethiopia is endowed with a large cattle population which makes it the first in Africa and among the top ten in the world. They are mainly of Zebu type; only a small number of exotic dairy cattle and their crosses have been introduced into the country. The majority of the cattle population (78%) are found in the highland settled crop farming area and the rest (22%) are found in the lowland pastoral area.

In both these areas milk and milk products have an important place in the traditional diet of the people. It is generally a subsistence enterprise. The pastoralist and especially the nomads and semi-nomads depend largely on milk from cattle, sheep, goats and camels as their staple food.

In the cultivated lands of the mid-altitudes and the highlands, although large numbers of draft oxen are kept, cows are also kept to provide the family with milk. In general, the rural population consumes nearly all the milk that is produced and only a small proportion is marketed in the form of butter or ghee.

Milk production systems can be broadly classified into (a) the traditional sector and (b) the modern sector. The traditional sector is the subsistence type of production and is largely based on the milk obtained from low-producing, unselected, native Zebu cattle. This sector constitutes the major source of the milk produced in the country, but it is mainly for home consumption and this sector is not market oriented. There is no specialized type of feeding system and cattle graze on unimproved natural pastures.

The modern dairy sector is where exotic crossbred and purebred cattle are used by either individual farmers, cooperatives or government institutions. This sector is not very much developed but is becoming increasingly important and is a major supplier of milk to the urban population. The modern dairy sector is largely found in the highlands where conditions are favourable for dairy development.

This report highlights some of the major constraints in the development of the dairy industry, indicates the different institutions and organizations involved in dairy development.
efficiency and production potential for meat and milk. Average results from four to six lactation records indicated that the average yield of each of the three breeds does not exceed 700 litres under relatively improved management conditions. Only a small percentage of cows gave more than 1200 litres and a higher proportion of them gave not more than 1000 litres per lactation (IAR 1972). This study cannot be considered very comprehensive since a few years of lactation records cannot reveal a breed’s genetic potential. However, the results confirm the findings from other studies (Eaton 1970, 1971) that Zebu cattle are not good producers of milk and cannot be used for specialized dairy farming. In the light of these findings it was decided that it would be too big and too slow a task to improve the national average level of milk production by selection among our native Zebu cattle alone. A long-term crossbreeding research programme was therefore proposed in 1972 with the assistance of a consultant (IAR 1982). The results from this crossbreeding research programme should provide guidelines for the kind of dairy breeding policy to be followed in the future in the different agroclimatic conditions of the country. The indigenous breeds used are those on which the previous improvement programme had been undertaken, namely, Borena, Horro, Barka and Fogera, which are considered to be distinct and relatively uniform and represent different regions of the country. Although the Fogera was included in the initial programme it was later discarded since the assessment was done on growth rate, reproductive efficiency and viability and disease resistance.

To date over 3000 animals have been born in the programme and over 1500 lactation records have been collected. Preliminary results on growth rate of different types of F₁ calves have already been published (Beyene and Galal 1982). Preliminary results on growth rate of different levels of exotic blood of the different types of crossbreeds are coming into production and data on their milk yield are being collected. As a "spin off" from the original programme a further study of different levels of exotic blood, such as F₂, F₃, and F₄, is also being undertaken and in the future the milk production of these will be studied. At present over 75% exotic and 50%-F₂ cows are being undertaken alongside the F₁ cows, which are genetically low producers of milk. A long-term crossbreeding research programme was therefore proposed in 1972 with the assistance of a consultant (IAR 1982). The results from this crossbreeding research programme should provide guidelines for the kind of dairy breeding policy to be followed in the future in the different agroclimatic conditions of the country. The indigenous breeds used are those on which the previous improvement programme had been undertaken, namely, Borena, Horro, Barka and Barsa, and the exotic breeds Friesian, Jersey and Simmental. The study was planned in such a way that it would enable us to do a further study of different levels of exotic blood, such as F₂, F₃, and F₄, alongside the main four stations representing different environmental conditions. The assessment is done on the effects of sire breed, dam breed and genotype by environment interactions. Traits considered are growth rate, final size, total dairy merit including milk yield, reproductive efficiency, viability and disease resistance.

To date over 3000 animals have been born in the programme and over 1500 lactation records have been collected. Preliminary results on growth rate of different types of F₁ calves have already been published (IAR 1971), and at present analysis is being carried out on the contemporary crossbreeding programme of exotic blood of the different types of crossbreeds. Preliminary analysis of milk production of F₁ cows has been completed (IAR 1982). At present more 75%-exotic and 50%-F₂ cows are being undertaken, namely, simulation and simulation. The study was planned in such a way that it would enable us to do a further study of different levels of exotic blood, such as F₂, F₃, and F₄, alongside the main four stations representing different environmental conditions. The assessment is done on the effects of sire breed, dam breed and genotype by environment interactions. Traits considered are growth rate, final size, total dairy merit including milk yield, reproductive efficiency, viability and disease resistance.

To date over 3000 animals have been born in the programme and over 1500 lactation records have been collected. Preliminary results on growth rate of different types of F₁ calves have already been published (Schra et al. 1981), and preliminary analysis of milk production of F₁ cows has been completed (IAR 1982). At present more 75%-exotic and 50%-F₂ cows are being undertaken, namely, simulation and simulation. The study was planned in such a way that it would enable us to do a further study of different levels of exotic blood, such as F₂, F₃, and F₄, alongside the main four stations representing different environmental conditions. The assessment is done on the effects of sire breed, dam breed and genotype by environment interactions. Traits considered are growth rate, final size, total dairy merit including milk yield, reproductive efficiency, viability and disease resistance. The objective was to produce F₂ heifers for distribution to farmers, but F₃ heifers were

3.2 Arsi Rural Development Project

Research work with the Arsi type of cattle and its crossbreeds started in 1967/68. The objective was to produce F₂ heifers for distribution to farmers, but F₃ heifers were...
crosses at Debre Zeit and 40 Fogera cattle at Gonder. Work with Barka was terminated in 1973. Crossbreeding programmes of Barka and Borena at Debre Zeit and Fogera at Gonder with the Friesian are continuing. Some results of the crossbreeding work have been reported in annual progress reports (Debre Zeit 1981). The adaptation of purebred Friesian as well as their crosses with native Sahi in terms of milk production has been studied by the College of Agriculture. More than 50% Friesian crossbreed heifers are used for distribution to farmers. It also operates an artificial insemination service and has a facility for processing fresh and frozen semen.

ARDP has generally made a great impact in the dairy development of the area and today well over 5000 crossbred dairy cows are kept in the area. About 22 dairy cooperatives are also operating at this time.

3.3 Teaching institutions

Agricultural teaching institutions like the Jimma Technical School, the Ambo Agricultural School and the College of Agriculture at Alemea are pioneers in dairy research and extension programmes. Studies on the milk-producing ability of the native cattle have been reported since 1956 (Glen et al. 1962, Swensson et al. 1981, Wagner et al. 1969, Wells 1965). The ranches include the Abernosa Ranch which has an area of 3000 ha and deals with Borena cattle, the Andasa Ranch with an area of 200 ha dealing with Fogera cattle and the Gobe Ranch with an area of 1800 ha dealing with Arsi cattle. In all these ranches, part of the herd is used for crossbreeding and the heifers are used for distribution to farmers. These ranches cannot keep up with the high demand for crossbreed heifers in the country. Some records are kept in these ranches but their utilization for further improvement of the breeds is minimal.

At present ARBD with the assistance of the Australian Agricultural Consulting and Management Company (AACM) has proposed a Dairy Rehabilitation and Development Project (8th MOA 1984). The project has two major components: cooperative dairy farm development and crossbreeding. Each cooperative dairy farm will be responsible for the production of dairy products, and the crossbreeding programme will be responsible for crossbreeding and distribution to farmers. In the cooperative dairy farm development, it is intended to rehabilitate the existing cooperative dairy farms and establish new ones. The rehabilitation will be achieved through increased indigenous management, use of locally available concentrates, improved calf rearing, improved herd management and structure, restriction of the level of exotic blood and where possible expansion to larger herds. New herds will be established to present number of 98 cooperative dairy farms to 600 cooperatives with average herd size of 40 cows in five years. It is estimated that birr 54 million will be required for the project and the African Development Bank is likely to finance it.

3.5 Ministry of State Farms Development

The Ministry of State Farms Development (MSFD) is responsible for large-scale commercial milk production.

Commercial dairy farming was actually established long before the creation of the MSDP. About 15 large commercial farms were about 40 large commercial farms in and around Addis.
Abeha. Milk collection was later established in the early 1960s with the assistance of the Ethiopian Development Bank (EADB). In 1964 Abeha Dairy Industry (AADI) was established to control and organize the collection, processing and distribution of milk. In 1966, the Addis Ababa University Dairy Development Enterprise (DDE) was able to install a pasteurization plant of 10,000 litres per day capacity which became operational in 1969. In 1971 the Dairy Development Agency (DDA) was established by a World Bank loan and was responsible for the planning and implementation of the national dairy development programme, thus taking over from AADI. The name DDA was later changed to Dairy Development Enterprise (DDE).

DDE is now responsible for the management of the state milk farm subsector which comprises mainly its own previous farms and some farms nationalized after the revolution. At present, there are a total of 18 such farms, 14 of which are within 120 km radius of Addis Ababa. These farms are more than 3000 grade, mainly Friesian cows in these farms. Milk production averages 11 litres/day. The management practices followed in these farms are generally low and feeding practices are generally poor. Cows are producing milk well below their genetic potential.

Another of DDE’s functions is the collection and processing of milk. At present, there are about 40 milk collection centres, the Addis Ababa Milk Plant, which has a capacity of 16,000 litres/day and is at present processing about 7000 litres of pasturized milk, and the Addis Ababa Meat and Dairy Products Factory, which processes 1500 to 2000 litres of raw milk into cheese and butter. In addition to these two sites, DDE is also operating a small-scale milk processing unit at Asela located at ARDP’s farm, which has a capacity of 2000 litres/day and is at present producing about 7000 litres of processed milk. At present, there are about 40 milk well below their genetic potential. Cows are producing milk well below their genetic potential.

The package was first introduced to 18 farmers at Debre Zeit in 1978; later, in 1980 to 400 farmers in both Debre Berhan and Debre Zeit. Crop yields of these farmers are reported to be higher than among surrounding farmers. Other related studies include the use of crossbred cows for traction, forage research and dairy technology studies.

Conclusion and recommendations

From the previous paragraphs, it can be clearly seen that dairy development and research on animal husbandry in Ethiopia have been going on for the past 20-25 years in Ethiopia. However, the impact of these programmes on the dairy industry is considered to be very minimal. The small amount of livestock available, the great importance of milk to the Ethiopian population, the ideal agro-climatic conditions in the Ethiopian highland for dairy production, are some of the main reasons for this low contribution. Other than the mentioned constraints mentioned earlier, the following must be considered as important:

4.1 Most of the experiments and developmental programmes have been conducted without a clearly defined strategy or programme.

4.2 Livestock research activity is scattered among many different institutions and organizations, each of which seems anxious to involve itself in every new trial. Thus the number of animals involved in each trial is too small and any chance of finding statistically significant differences.

4.3 There has been very little effort for coordination of work amongst institutions, the great waste of human and material resources.

4.4 Recording keeping is poor and there are lack of data recording systems and insufficient use of already accumulated data.
4.5 Although the indigenous cattle types are generally considered to be poor dairy animals, very few of them have been identified and studied and the information gathered on them is very scanty.

4.6 Crossbreeding studies have not been supported by management studies of infrastructure and facilities, e.g., barn construction and grazing area development, caulling systems, feeding systems, and calf rearing and weaning systems, etc.

In order to alleviate some of these problems, future strategies should be:

- The overall livestock development programme of the country should be stratified; potential areas for the production of specific livestock products should be identified and each of these areas should be strongly supported by research centres for the specific livestock production programme. To start, the Ethiopian Highlands can be considered near ideal for dairy production and the establishment of one strong dairy research centre in the highlands with satellite stations in other highlands locations would be a big step forward.

- There should be immediate coordination of future experimental work between institutions and between different disciplines. The composition of the dairy industry calls for an integrated drive to improve breeding, nutrition management and health. One possible way of doing this is to form a team of experts from different disciplines, regardless of their institution; this team would meet periodically to propose programmes, to define responsibilities, to follow up and to analyse results at the end. In this process no distinction should be made between research and development since both need to go hand in hand.

- Such a team of experts could concern themselves with the urgent need for a unified recording system. Records are being kept on breeding, veterinary treatments, production, etc., in all state, cooperative, private and government dairy farms and procedures must be organised for data collection, analysis and the generation of productivity indices for the improvement of management as well as genotypic.

- There is a need for a strong data base on which development programmes can be supported. An accurate census of the livestock population together with the identification of the different types that exist in the country is a vital requirement; outstanding indigenous cattle breeds could be identified, their degree of superiority determined, elite nuclei herds built up and maintained, and

- Since feed is the major limiting factor, there should be expanded research on animal feeds and feeding in order to assess the quantity and quality of locally available feedstuffs as well as their value and suitability in low-cost rations balanced for milk production.

- The introduction and adaptation of purebred exotic breeds and the study of their management system should be further looked into.

REFERENCES


THE STATUS OF BEEF CATTLE RESEARCH IN ETHIOPIA
Alemu Gebrewold

SUMMARY
This paper used available facts to indicate the productivity of our cattle and define major constraints, to summarize results of beef cattle experiments and to put forward proposals for future research.

- There is no beef cattle research programme in Ethiopia, although Ethiopia has the largest cattle population in Africa. Ethiopia has one of the lowest beef production levels per animal, with animal off-take of only 7.2%, the lowest in Africa. Cows calve on average every 2 years.

- Total annual beef production is estimated at about 245,000 tonnes. Beef consumption is estimated to be 6 kg per capita. Meat is produced mainly from overworked oxen/cows and bulls.

- Major constraints that affect beef cattle production are undernutrition, diseases, husbandry system, sociological factors and marketing.

- Promising development strategies have been suggested.

- Cattle development is conducted by different institutions without any research component. Borena cattle are the best cattle so far identified in the country. Research results indicate that Borena beef traits are comparable to those of other known beef breeds. Fattening studies indicate that younger animals are more efficient (kg dry matter/kg liveweight gain) than older animals.

- Development of a national research programme is impeded by lack of national policy guidelines and coordination.

1 Introduction
Ethiopia is one of the developing countries whose economies are almost entirely dependent on agriculture. Plant and livestock production are the mainstay of the people, yet the livestock subsector of the economy has not had its due share of research and development effort.
For Ethiopia, with an estimated 27 million cattle and about 57% of its total land surface for grazing, cattle represent a major resource potential (Aust ACMD 1984, FAO 1980). Yet the contribution that this resource makes to the national income and export earnings is disproportionately small. This is mainly due to low productivity of the cattle caused by poor husbandry and management systems and to prevalence of diseases and malnutrition (Aust ACMD 1984, Alberro and Haile Mariam 1982). To realize and exploit this untapped resource, several studies have been launched (FAO 1983, IBRD/IDA 1972). Among these, the livestock subsector review (LSR) is the first comprehensive study of Ethiopia's livestock resources (Alberro and Haile Mariam 1982).

Ethiopia's livestock development projects under implementation and those intended to commence may not attain their intended goals and make a significant contribution to sustain long-range development of the beef cattle industry, unless and until a comprehensive beef research programme (management systems, breeding, grazing systems, fodder conservation, fattening systems) coupled with an extension system is emphasized and undertaken simultaneously.

### Table 1. Ethiopian cattle population

<table>
<thead>
<tr>
<th>Estimates (millions)</th>
<th>Reference</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>27.2</td>
<td>Report on the small scale agriculture</td>
<td>1976/77</td>
</tr>
</tbody>
</table>

The majority of Ethiopia's cattle are indigenous breeds. Most of the cattle are a small non-descript Zebu type resulting from extensive inbreeding, with some Sanga types existing in the north-eastern part of the country. Alberro and Haile Mariam (1982) reported the following main distinguishable cattle types: Abigar, Dankils, Arsi, Arab, Barko, Borena, Abyssinian Zebu, Arado, Fogera, Horro and Sheko. It is evident that all these cattle types are well adapted to the harsh environments where they are bred and that they play a significant role in the rural economics of their respective areas.

### Table 2. Demographic and livestock distribution in Ethiopia

<table>
<thead>
<tr>
<th>Ecological Area</th>
<th>Total Population (millions)</th>
<th>Human Population Density (head/km²)</th>
<th>Cattle Population Density (head/km²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highlands (above 1500 m)</td>
<td>469.1</td>
<td>18.7</td>
<td>70.8</td>
</tr>
<tr>
<td>Lowlands, pastoral &amp; sedentary</td>
<td>732.2</td>
<td>7.7</td>
<td>29.2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1221.3</td>
<td>18.0</td>
<td>71.7</td>
</tr>
</tbody>
</table>

### Table 3. Age and sex structure (%) of the highland herd

<table>
<thead>
<tr>
<th></th>
<th>Females calves</th>
<th>Males calves</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subtotal</td>
<td>27.5</td>
<td>56</td>
</tr>
<tr>
<td></td>
<td>5.8</td>
<td>6.2</td>
</tr>
<tr>
<td></td>
<td>6.2</td>
<td>12.8</td>
</tr>
<tr>
<td></td>
<td>5.6</td>
<td>4.6</td>
</tr>
<tr>
<td></td>
<td>3.6</td>
<td>4.6</td>
</tr>
<tr>
<td></td>
<td>56</td>
<td>96</td>
</tr>
</tbody>
</table>


Cattle production systems

Because of the great diversity in physical and socio-economic environments that prevail in Ethiopia, cattle husbandry systems vary from the most intensive to rather extensive ones depending on the farming zones (Agrotec 1974). In general, there are three livestock management systems in Ethiopia: animal production as subordinate to crops, animal production as complementary to crops and the nomadic (pastoralist) systems.

3.1 In the highlands (in the mixed farming zones) cattle are
3.1 In the highlands (in the mixed farming zones) cattle are primarily kept for traction purposes; milk and meat are by-products. In this farming zone, the cattle number per family is usually small. Cattle find their own feed by grazing on natural meadows, fallow and marginal lands, and crop residues after harvest. Grazing area is very limited.

3.2 In the plantation zones, cattle production is complementary to crops. Cattle are kept for milk and meat production. Farm yard manure is also an important by-product. The use of animal traction is minimal. Although transhumance to lower lands is practised for part of the year, production is intensive; cattle are stall fed the natural grass, supplemented with crop residues. Generally, good quality beef is produced.

3.3 The pastoralists (nomadic) are normally found in the lower altitudes where the annual rainfall is less than 700 mm/year. Cattle are kept primarily to provide milk for the family. Animal production usually concentrates around water points, and herd size per family is usually large. The condition of rangeland in these areas is heavily overgrazed.

Table 4. Estimated actual and potential meat production

<table>
<thead>
<tr>
<th>Total</th>
<th>Carcass wt. (kg)</th>
<th>Meat (t)</th>
<th>Carcass wt. (kg)</th>
<th>Meat (t)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Slaughter</td>
<td></td>
<td>Slaughter</td>
<td></td>
</tr>
<tr>
<td></td>
<td>No.</td>
<td></td>
<td>head wt. (t)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>('000)</td>
<td></td>
<td>('000)</td>
<td></td>
</tr>
</tbody>
</table>

Young males 100 100 150 15,000 100 200 20,000
Male calves 200 none none none none none none
Bull cows 3,357 678.6 85 57,672 1,357 100 13,700
Bulls 207 227 200 45,400 227 200 45,400
Oxen 1,015 1,015 125 126,875 1,015 135 137,025

Total 2,899 2,020.5 121 244,947 2,899 127 368,125


This zone provides a large proportion of the meat production of the country. Over the last few years pastoral herds have been hit by drought; it has been estimated that 42% of the total herd died in the recent drought.

4 Cattle productivity

In all characteristics of economic importance, Ethiopian cattle are very poor. Annual calving percentage is estimated to be about 50% and mortality rate 8.5%. Heifers do not calve before they are 3.5 to 4 years of age and every two years thereafter. Weight of adult females varies between breeds but, on the average, small breeds weigh 210 kg for females and 280 kg for males, while the larger breeds can weigh much as 500-600 kg. Draft, milk, meat and manure are the most important products, but average carcass weight is only 125 kg. Total annual estimated actual production is 245,000 tonnes compared with a potential of about 368,000 tonnes according to AACM (1984) (see Table 4). Most of this comes from aged cows/bulls and overworked oxen, and the beef quality is poor.

A mere 7.7 kg of beef is produced annually per head of cattle in Ethiopia compared with 10.7 kg in the Sudan, 14.1 kg in Kenya, 20.5 kg in Australia and Argentina and 78 kg in the USA. The estimated average off-take is about 7.2% (FAO 1980). The mean off-take for other African countries ranges from 8% to 12% (FAO 1980). Beef consumption in Ethiopia is only 6.7 kg/person/year.

Table 5. Legal live cattle exports from Ethiopia

<table>
<thead>
<tr>
<th>Year</th>
<th>No.</th>
<th>Price/head birr</th>
</tr>
</thead>
<tbody>
<tr>
<td>71/72</td>
<td>5,637</td>
<td>1,060,000</td>
</tr>
<tr>
<td>72/73</td>
<td>3,050</td>
<td>2,221</td>
</tr>
<tr>
<td>73/74</td>
<td>32,618</td>
<td>6,757,000</td>
</tr>
<tr>
<td>74/75</td>
<td>39,849</td>
<td>3,650,000</td>
</tr>
<tr>
<td>75/76</td>
<td>43,594</td>
<td>5,594,000</td>
</tr>
<tr>
<td>76/77</td>
<td>4,280</td>
<td>1,424,000</td>
</tr>
<tr>
<td>77/78</td>
<td>3,111</td>
<td>1,504,000</td>
</tr>
<tr>
<td>78/79</td>
<td>1,700</td>
<td>1,111,000</td>
</tr>
<tr>
<td>79/80</td>
<td>1,357,380</td>
<td></td>
</tr>
<tr>
<td>80/81</td>
<td>12,487</td>
<td>8,470,000</td>
</tr>
</tbody>
</table>


Table 6. Illegal exports of cattle (one year)

<table>
<thead>
<tr>
<th>Region</th>
<th>No.</th>
<th>Price/head birr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hareraye</td>
<td>214,000</td>
<td>90,136,800</td>
</tr>
<tr>
<td>Gibe</td>
<td>1,560</td>
<td>1,537,380</td>
</tr>
<tr>
<td>Bale</td>
<td>9,000</td>
<td>2,948,400</td>
</tr>
<tr>
<td>Gofa</td>
<td>800</td>
<td>236,960</td>
</tr>
</tbody>
</table>


a Based on average price of 428.2 birr per head obtained from legal export.
Economic importance

In spite of the fact that cattle productivity is low, it plays an important role in the livelihood of the 85% of Ethiopians who live and work in the rural areas. The significance of cattle cannot be overemphasized; apart from their use as a source of mechanical power to cultivate 5.3 million ha of crop land annually, they provide in the form of meat (214,000 tonnes) and milk the main source of animal protein, which has higher dietary value than protein of plant origin. It has been estimated that meat provides only 10% of the protein for human needs (Chilalo 1970). In addition, the by-products of the beef industry provide very valuable raw materials for industrial purposes (tanneries, biogas, slaughterhouse by-products as animal feed supplements). Export earnings are relatively low; this could be increased if illegal export were controlled (Tables 5-6).

Major constraints in cattle production and research

This paper points out some of the major constraints that hinder beef cattle development in Ethiopia.

6.1 Research

Cattle development is impeded by poor knowledge of Ethiopian cattle production systems. There is no beef research program. The major requirements for improved research are:

6.1.1 Trained manpower
6.1.2 Policy
6.1.3 Research facilities

6.2 Nutrition

Seasonality of feed supply is a major problem; it means that much of the livestock gained during the wet season is lost during the dry season.

6.3 Low prices and inadequate marketing systems

Low prices paid for beef in particular hinder improvements. There is no incentive to fatten animals.

6.4 Diseases

In general the occurrence of serious diseases limits production and off-take. The prevalence of contagious diseases is a major obstacle to gaining access to more lucrative world beef markets.

6.5 Breeding and management systems

In the peasant sector, where the vast majority of the cattle exist, the standard of animal husbandry is generally low. Diseases are not adequately prevented or treated.

Since controlled breeding is not practicable, much inbreeding has taken place and this has resulted in poor growth and development. Peasants often sell off unprofitable breeding animals. In beef, physiological maturity is not reached before 4 to 5 years of age, fertility is very low and consequently life-time productivity (for draft, meat, milk) is much reduced.

6.6 Sociological considerations

To many of the people (especially in the pastoralist zone), cattle are a sign of wealth and a status symbol. Preference is given to keeping their wealth on the hoof.

6.7 Marketing, processing and infrastructure

In general, cattle in Ethiopia are not kept for the primary purpose of producing marketable products; marketing and processing systems coupled with poor infrastructure are major constraints to increased production.

7 Developmental projects related to beef cattle production

There are several livestock development institutions and support services. The main ones are the Ministry of Agriculture (MOA), the Ministry of State Farms Development (MSFD) and the Ministry of Foreign Trade (MFT).

MOA is responsible for peasant agriculture development and provides advisory services. There are development projects run by MOA:

7.1 Adami Tulu, Abermo and Jedada ranches

The Adami Tulu ranch was established in 1959 on 1,680 ha of land, for pure breeding of Borena cattle. The objectives of this ranch were to evaluate beef production of Borena cattle under good conditions of feeding and management, to improve Borena cattle by selection and to work out management systems.

7.2 The Second Livestock Development Project

This project was launched with the objective of providing an integrated market and stock route system, slaughter facilities, cattle transport, etc., throughout the major cattle-producing and consuming regions of Ethiopia (Agrotec 1974, IBRD/IDA 1972).

7.3 The Third Livestock Development Project (1974-1984)

This project was designed to provide integrated rangeland management, veterinary services, water facilities and access roads to pastoralists of the southern, eastern and north-eastern regions of Ethiopia (IBRD/IDA 1975).
7.4 Pilot Small-Scale Cattle Fattening Project

This project is currently under preparation. The study will designate ARAD to evaluate livestock fattening systems, manage fattening programmes, develop animal condition scoring methods, evaluate the Beef quality of some breed types and evaluate animal condition scoring methods.

MSFD has the responsibility of managing and running existing commercial livestock development enterprises, meat factories and feedlots where it studies and develops greater use of cheap agro­
industrial by-products, more efficient feeding systems, and improved cattle handling systems. These also serve as pilot projects to give basic information on the operation of different feedlots in Ethiopia by establishing costs and revenues. The total capacity of these feedlots is about 18,500 head of cattle annually.

The Ministry of Foreign Trade (MFT) is responsible for the export of live animals and other by-products.

8 Research institutions and research results

8.1 Current status of research in beef cattle production

There is no defined beef cattle research programme in Ethiopia, and no breed type is kept solely for beef production. However, the task of identifying the characteristics of the various cattle types that exist in the country has been done only for Borena, Horro, Barka, and Arsi have been studied to some extent, and it is only on the Borena that any intensive study and improvement programmes have been undertaken.

8.2 Summary of research results

8.2.1 Reproductive performance

Obradovic and Abraham (1975) in a study of the potential of 47 Borena heifers at Adami Tulu ranch, reported average age at first calving 3.6—4.5 years, services per conception 2.5, gestation length 289 days and calving percentage of 94. At ARDU (CADU) (Eth. Livestock and Meat Board 1976) work done on Arsi cattle gave age at first calving 3.5—4.5 years, services per conception 2.5, gestation length 273 days, calving interval 395 days.

8.2.2 Growth rate performance

From birth to weaning: Several studies have been conducted to estimate the birth weight of some breed types, little work has been done to study and identity this, let alone to make a comprehensive evaluation of the characteristics of the various cattle types that exist in the country. To date out of the nine identified types only Borena, Horro, Barka, and Arsi have been studied to some extent, and it is only on the Borena that any intensive study and improvement programmes have been undertaken.

8.2.3 Pilot Small-Scale Cattle Fattening Project

The Ministry of Foreign Trade (MFT) is responsible for the export of live animals and other by-products.
(1976) indicate a weaning weight of 101 kg for males and 94 kg for females at the age of 180 days. In this study average daily gain was 470 g and the crossbreeds gained 1.27 kg per day. Higher weaning weights under experimental conditions than under range conditions indicates the potential for improvement.

8.2.3 Post-weaning performance

At one IAR station (Adami Tulu), weaned Borena calves were compared on three systems of feeding. The treatments evaluated were: pasture only, pasture plus concentrate and hay; concentrate, hay and grazing only. Grazing only gave the lowest weight gain (128 g/day) while the liveweight gain for the pasture + concentrate system was 196 g/day (about 485 g/day). At another IAR station (Beko) a similar study was conducted using Horro calves. The treatments evaluated were:

a) Hay ad libitum
b) Hay plus 0.5 kg concentrate per 100 kg liveweight
c) Silage plus concentrate

The results indicated that, although fed ad libitum, can meet maintenance requirements of Horro cattle. The other feeding regimes were sufficient not only for maintenance but also for certain levels of production.

The adult Borena is a well-built heavy animal; live weight reported by Obradovic and Abraham, 8.2.4 Fattening/finishing experiments

Several studies have been conducted to evaluate the beef qualities of the local cattle (mainly Borena and Horro) under different feeding systems and other institutions. In one trial conducted by IARC (1976) at Adami Tulu, liveweight and dressing percentage was found to be 347 kg with a range of 300-385 kg. Mature weight of Borena cows under range conditions was found in the ILCA (1981) study to be 314 kg.

The objective is to find out what combination of exotic and Zebu cross would best suit different environmental and management conditions in Ethiopia and to evaluate the beef quality of the local cattle (mainly Borena and Arsi) under different feeding systems at the IAR (1976) at Adami Tulu, liveweight and carcass systems were compared. The results showed a daily gain of 653, 549 and 564 g for bulls, steers and heifers respectively. Bulls gained about 90 g/day more than steers and heifers. Jeppson and Creek (1976) reported a comparison of Borena and Arsi cattle under feedlot conditions. The ration consisted of 48.6% molasses, 24%, concentrate, and hay plus concentrate respectively. The other feeding regimes were sufficient not only for maintenance but also for certain levels of production.

Several studies have been conducted to evaluate the beef qualities of the local cattle (mainly Borena and Arsi) under different feeding systems at the IAR (1976) at Adami Tulu. Liveweight and carcass systems were compared. The results showed a daily gain of 653, 549 and 564 g for bulls, steers and heifers respectively. Bulls gained about 90 g/day more than steers and heifers. Jeppson and Creek (1976) reported a comparison of Borena and Arsi cattle under feedlot conditions. The ration consisted of 48.6% molasses, 21.7% noug cake, 20% hay and 1.2% minerals. The results indicated that, although fed ad libitum, could meet maintenance requirements of Horro cattle. The other feeding regimes were sufficient not only for maintenance but also for certain levels of production.

Several studies have been conducted to evaluate the beef qualities of the local cattle (mainly Borena and Arsi) under different feeding systems at the IAR (1976) at Adami Tulu. Liveweight and carcass systems were compared. The results showed a daily gain of 653, 549 and 564 g for bulls, steers and heifers respectively. Bulls gained about 90 g/day more than steers and heifers. Jeppson and Creek (1976) reported a comparison of Borena and Arsi cattle under feedlot conditions. The ration consisted of 48.6% molasses, 21.7% noug cake, 20% hay and 1.2% minerals. The results indicated that, although fed ad libitum, could meet maintenance requirements of Horro cattle. The other feeding regimes were sufficient not only for maintenance but also for certain levels of production.

Several studies have been conducted to evaluate the beef qualities of the local cattle (mainly Borena and Arsi) under different feeding systems at the IAR (1976) at Adami Tulu. Liveweight and carcass systems were compared. The results showed a daily gain of 653, 549 and 564 g for bulls, steers and heifers respectively. Bulls gained about 90 g/day more than steers and heifers. Jeppson and Creek (1976) reported a comparison of Borena and Arsi cattle under feedlot conditions. The ration consisted of 48.6% molasses, 21.7% noug cake, 20% hay and 1.2% minerals. The results indicated that, although fed ad libitum, could meet maintenance requirements of Horro cattle. The other feeding regimes were sufficient not only for maintenance but also for certain levels of production.

Several studies have been conducted to evaluate the beef qualities of the local cattle (mainly Borena and Arsi) under different feeding systems at the IAR (1976) at Adami Tulu. Liveweight and carcass systems were compared. The results showed a daily gain of 653, 549 and 564 g for bulls, steers and heifers respectively. Bulls gained about 90 g/day more than steers and heifers. Jeppson and Creek (1976) reported a comparison of Borena and Arsi cattle under feedlot conditions. The ration consisted of 48.6% molasses, 21.7% noug cake, 20% hay and 1.2% minerals. The results indicated that, although fed ad libitum, could meet maintenance requirements of Horro cattle. The other feeding regimes were sufficient not only for maintenance but also for certain levels of production.
Proposal for beef cattle development and strategies needed

The main objective for improvement of beef cattle production in Ethiopia is to increase the productivity per animal. Therefore, any development strategy must be considered in terms of (a) the existing cattle population in relation to feed and other resources and (b) the way these resources are currently utilized and what could be expected if these resources were properly exploited. Development of cattle production must focus mainly on removing or ameliorating the effects of some of these problems.

9 Nutrition improvement
9.1 Reduction of cattle numbers
9.2 Dry season supplementation
9.3 Use of improved forage crops
9.4 Use of energy and protein feed based on agro-industrial by-products

9.2 Cattle breeding
9.2.1 Survey and identification of cattle types in the country
9.2.2 Study of the performance characteristics of the main breeds/types
9.2.3 Improvement of those identified in 5.2.2 by sire selection - use of AI

9.3 Cattle management systems
9.3.1 Controlled breeding
9.3.2 Restricted calving season - synchronization of calving season with the period of highest feed availability
9.3.3 Rearing of young stock
9.3.4 Cattle transportation system
9.3.5 Highland versus lowland production - stratification
9.3.6 Recording systems - animal identification essential
9.3.7 Shelter and housing
9.3.8 Stocking rates

9.4 Health improvement
9.4.1 Creation of disease-free zone (to meet export requirements)

9.5 Marketing improvement
9.5.1 Minimum price per kg liveweight
9.5.2 Premium payment for quality

10 Possible strategy of coordination and delineation of responsibility among the different institutions engaged in beef development versus research

10.1 Need for national research policy

In order that any research institution can carry out realistic work, it must work within the framework of a national research policy. This policy should clearly define, in general terms, priorities for animal research in the country. This policy will indicate the relative importance of cattle versus other livestock and whether emphasis should be given to beef or milk production or for both, whether production is export or local market oriented. Once a national research policy is established the next step is to draw up guidelines for research in cattle production. In order to facilitate the research work, formation of a livestock committee is vital. This committee has an important function in ensuring that only those projects and researches that are in line with that the policy and established guidelines are approved for implementation.

10.2 The role of each institution

The implementation of research programmes and the coordination and delineation of responsibilities among the different institutions is not too difficult once the policy and guidelines have been established and once there exist firm control and monitoring of the operation. The role of each institution, its terms of reference, duties and responsibilities should, therefore, be clearly defined as well as the nature and scope of cooperation among all the organizations.

A functional livestock committee could do much to ensure that research conforms to the policy and guidelines established and to see that each institution plays its expected role.

Although the nature of livestock research is more complicated than research in agriculture, a similar approach to that of the National Crop Improvement Programme could be adopted for livestock improvement.

Within the existing organizations engaged in cattle production, a viable programme could be worked out that did not delay and impede development. A study of the performance characteristics of the main indigenous types of Ethiopian cattle could, for example, be organized as follows:
Institutions to undertake the study | Research site | Breeds of cattle to be studied
--- | --- | ---
MDA | Abarnosa | Borana, Popera, Aphi
IAR | Andasa, Adami Tulu, Bako, Dire Dawa | Arsi, Horro, Nagaden
MSFD | Alemaya, Barka, Borena, Kuruftu, Ogaden | Borena, Arsi, Horro, Barks

8 fattening experiments should be carried out using standardized ration.

This type of work would give a chance to study the performance potential of some of our cow breeds. Furthermore, in each developmental project, if research elements were included, very valuable information could be obtained.

REFERENCES


THE STATUS OF SHEEP AND GOAT RESEARCH AND DEVELOPMENT IN ETHIOPIA
Kassahun Awgichew1

SUMMARY
An attempt has been made to describe the status of the sheep and goat industry in the country. Some of the weaknesses in the sheep and goat industry have been discussed. The major constraints facing the sheep and goat industry were concluded to be inadequate nutrition, inadequate research and development, poor genetic potential of the local stock, social factors, structural constraints, and the shortages of high-level trained manpower.

Some proposals for future development and research programmes in the sheep and goat industry were also discussed.

The role to be played by major organizations was described, as envisaged by the Sheep and Goat Committee formed in December 1979 and January 1980 after meetings of people involved in livestock research and development work in the country. The need for coordination among different organizations involved in sheep and goat programmes was also emphasized.

1 Background information
Ethiopia, with its estimated 24 million sheep and 18 million goats, together with its great variation in agro-climatic zones, represents a good reservoir of sheep and goat genotypes (FAO 1981, Galal 1980, MOA 1984, Wiener 1975). The sheep fall into many breeds and types whose habitat extends from tropical to cool temperate environments. Although very little is known about the goats, most are found in the lowlands.

It has been suggested (Galal 1983) that the present fat-tailed Ethiopian sheep breeds or types may have replaced the original African long-thin-tailed sheep by migrating from Asia across the Bab-el Mandab straits.

A few of the Ethiopian sheep breeds/types have been described to date. These are the Adal, Black Head Somali, Horro, Menz and Barka.

1.1 Sheep and goat population and distribution
Figures most frequently quoted for the size of the population of sheep and goats in Ethiopia are 24 and 18 million respectively. The highlands, which receive more than 700 mm of annual rainfall, support 92% of the human population, 75% of the national sheep flock and 27% of the goats. The highlands, which receive more than 700 mm of annual rainfall, are inhabited by 68% of the population with 25% of the national sheep flock and 73% of the goats (Galal 1980; Galal, pers. comm.; Eth. Nat. Sheep R & D Policy 1974).

Sheep are mostly concentrated in the central highlands, and Shewa administrative Region is believed to have the largest number (Table 1). Three northern areas of Shewa (Menz and Gidea, Merhabete and Monega) alone have more than 8 million sheep (MOA 1984a, b, c).

Goats are more or less widely distributed and most are found in Tigray, Shewa, Gonder, Harerge and Welo which have 10.7%, 19.3%, 14.3%, 10.6%, and 10.5% of the national flock respectively (MOA 1984a).

However, the percentage distribution of these small ruminants described in the AACM report (MOA 1984a) contains some discrepancy since the sheep and goats in Eritrea administrative region are not considered.

The distribution of sheep and goats by age and sex (Table 2) shows that the percentage distribution of males and females below the age of one year is about the same. Although the proportion of males in both sheep and goats decreases above one year of age, still there seem to be more male animals than required.

The average number of sheep and goats per holding is estimated to be 3.8 and 3.5 head respectively. It is reported (MOA 1984a, b; Eth. Nat. Sheep R & D policy 1974) that 71% of both sheep and goats are run on holdings between 0.1 and 2.0 hectares in size, excluding Eritrea, Tigrai and the semidesert areas. It is reported (Galal 1983) that the percentage distribution of males and females below the age of one year is about the same. Although the proportion of males in both sheep and goats decreases above one year of age, still there seem to be more male animals than required.

The average number of sheep and goats per holding is estimated to be 3.8 and 3.5 head respectively. It is reported (MOA 1984a, b; Eth. Nat. Sheep R & D policy 1974) that 71% of both sheep and goats are run on holdings between 0.1 and 2.0 hectares in size, excluding Eritrea, Tigrai and the semidesert areas. It is reported (Galal 1983) that the percentage distribution of males and females below the age of one year is about the same. Although the proportion of males in both sheep and goats decreases above one year of age, still there seem to be more male animals than required.

Table 1. Distribution of sheep and goats by region (MOA 1984a)

<table>
<thead>
<tr>
<th>Region</th>
<th>Sheep</th>
<th>Goats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beja</td>
<td>3.6</td>
<td>3.3</td>
</tr>
<tr>
<td>Bale</td>
<td>2.3</td>
<td>2.4</td>
</tr>
<tr>
<td>Gamo Gofa</td>
<td>4.4</td>
<td>4.5</td>
</tr>
<tr>
<td>Gaysay</td>
<td>4.4</td>
<td>4.5</td>
</tr>
<tr>
<td>Godama</td>
<td>4.4</td>
<td>4.5</td>
</tr>
<tr>
<td>Harage</td>
<td>4.4</td>
<td>4.5</td>
</tr>
<tr>
<td>Illubabor</td>
<td>4.4</td>
<td>4.5</td>
</tr>
<tr>
<td>Kebe</td>
<td>4.4</td>
<td>4.5</td>
</tr>
<tr>
<td>Kefa</td>
<td>4.4</td>
<td>4.5</td>
</tr>
<tr>
<td>Sheoba</td>
<td>4.4</td>
<td>4.5</td>
</tr>
<tr>
<td>Sidamo</td>
<td>4.4</td>
<td>4.5</td>
</tr>
<tr>
<td>Tigrai</td>
<td>4.4</td>
<td>4.5</td>
</tr>
<tr>
<td>Welo</td>
<td>4.4</td>
<td>4.5</td>
</tr>
</tbody>
</table>


1 /Research Officer, Institute of Agricultural Research.
1.2 Production systems

There are very few organized breeding or husbandry systems at a national level. The small size of the flock, particularly in the highlands, is a major constraint that predisposes towards inbreeding and diminishes the possibility of deliberate selection (FAO 1981, Wiener 1975).

One example of a sheep production pattern in the country is that seen around Debre Berhan, Menz, north-western Welo and some areas in Gonder, where there is a cottage wearing industry based on local wool production.

In the Ogaden, unlike most of the rest of the country, sheep production is a more specialized business (FAO 1981, Galal 1980). Here mating is usually around November; both sheep and goat husbandry practices are more defined and some clans specialize in stud breeding of the Black Head Somali sheep.

At present, the rural population is being reorganized by the formation of peasant associations and service and producers cooperatives. This process should alleviate the constraint caused by the smallness of flock sizes, particularly in the highlands and in some other parts of the country.

Table 2. Distribution of sheep and goats by age and sex

<table>
<thead>
<tr>
<th>Age and sex group</th>
<th>Sheep</th>
<th>Goats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under one year of age:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>18.2</td>
<td>18.4</td>
</tr>
<tr>
<td>female</td>
<td>19.0</td>
<td>19.8</td>
</tr>
<tr>
<td>Over one year of age:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>13.9</td>
<td>16.0</td>
</tr>
<tr>
<td>female</td>
<td>48.0</td>
<td>45.8</td>
</tr>
<tr>
<td>Total</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>


1.3 Economic importance of sheep and goat production and their productivity

Sheep play a significant role in the national economy. In most areas sheep are reared for meat with the exception of some wool breeds, notably Menz. The lowland people sometimes milk their ewes for home consumption.

Goats play an equivalent role in the country's agricultural economy. Goats, particularly in the lowlands, are kept for both meat and milk production. In the pastoral areas and in some highland regions it is socially acceptable to consume milk from goats.

Despite the low productivity of the local stock, it is estimated that about 132,000 tonnes of sheep and goat meat are produced annually (Table 3) (MOA 1984a).

Table 3. Sheep and goat meat production and consumption in Ethiopia (1980)

<table>
<thead>
<tr>
<th>Production (tonnes) Kg/capita</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mutton and lamb</td>
</tr>
<tr>
<td>77,000</td>
</tr>
<tr>
<td>2.3</td>
</tr>
<tr>
<td>Goat meat</td>
</tr>
<tr>
<td>55,000</td>
</tr>
<tr>
<td>1.6</td>
</tr>
<tr>
<td>Total</td>
</tr>
<tr>
<td>132,000</td>
</tr>
<tr>
<td>3.9</td>
</tr>
</tbody>
</table>

Source: UNDP, 1982. Data book on land use and agriculture, Ethiopia, vol. 1, UNDP, Addis Ababa. Table 3A, p. 120.

There is not enough information regarding the causes of the low productivity of local sheep and goats. It could be the result of environment or low genetic potential or a combination of the two factors. (FAO 1981).

The majority of Ethiopian sheep are hair type. There are, however, a few wool-bearing types in the highlands like Menz, but these produce less than 0.5 kg per head per year.

The off-take rate for sheep is about 30% (Charette and Dion 1984). However, a slightly higher off-take rate (32.2%) has been reported (Galal 1982). Goats have an off-take rate of 36% (Charette and Dion 1984). Carcass weights for both sheep and goats range from 9 to 10 kg (FAO 1981, MOA 1984a, b, c). The mean carcass yield in the national flock is about 3 kg against a world average of about 5 kg (FAO 1981, Galal 1980). There is a large disparity in per capita red meat availability between the highlands and the lowlands: 9.3 and 75.0 kg per head per year, respectively. This shows that the lowland pastoral areas could play a big role in that the lowland pastoral areas could play a big role in providing meat for both domestic and export markets. The supplying meat for both domestic and export markets. The supply of meat for both domestic and export markets. There is also a considerable demand for fat-tailed sheep, which comprise the majority of the breeds in Ethiopia. The Ministry of State Farms exports live animals as well as carcasses to the above regions. There are also some private enterprises exporting live animals.
The high demand for Ethiopian sheep in the above region could be one of the most important factors encouraging the development of the sheep and goat industry in Ethiopia. It is known that the supply cannot meet the demand and for this reason the Middle East, the Arabian Peninsula and the Gulf State countries are obliged to look for other sources to import both live animals and carcass meat. Two major sheep-producing countries, Australia and New Zealand, are now successful with these countries, should make its supply more constant and the quality uniformly high.

2 Organization or institutions engaged in sheep and goat development and research in the country

2.1 Institute of Agricultural Research (IAR)

In late 1975, the IAR initiated a programme to identify some of the major sheep breeds or types in the country. The procedure followed was to establish flocks from the breeds to be studied and to study their performance characteristics in order to determine appropriate utilization and improvement schemes. To date, three sheep breeds have been included in the programme: the Adal, the Black Head Somali and the Horro, with in addition, one goat flock, the Adal goat. The Adal sheep and the Adal goat are being studied at Kelkerever Research Station, where the Horro breed is being studied at Bako Research Station.

There is a plan to include the Menz sheep in the programme but this has not been implemented yet. The Ministry of Agriculture and IICA are already studying this breed.

Some of the production and reproduction traits of both sheep and goat flocks kept at IAR stations are summarized in Table 4. Some performance results of the Menz sheep are also included in the table.

2.2 Ministry of Agriculture

2.2.1 The ministry has the largest sheep breeding station in the country at Debre Berhan. The programme has been extended to Amed Geya in Menz recently (MOA 1984). The farm at Debre Berhan has been and is distributing stocks of different mixtures of the Menz and Black Head Somali breeds across the country. Recently, Awassi crosses are also being produced for distribution of improved stock to sheep farmers. The Awassi sheep is also being crossed with the Horro on the station.

Table 4. Summary of performance of sheep and goat breeds kept at experimental stations of IAR (Mean SE)

<table>
<thead>
<tr>
<th>Trait</th>
<th>Sheep</th>
<th>Goat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth wt, kg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(90 days)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adal</td>
<td>2.5(0.04)</td>
<td></td>
</tr>
<tr>
<td>BHS</td>
<td>2.7(0.10)</td>
<td></td>
</tr>
<tr>
<td>Horro</td>
<td>2.9(0.03)</td>
<td></td>
</tr>
<tr>
<td>Menz</td>
<td>2.2(0.11)</td>
<td></td>
</tr>
<tr>
<td>6-month wt, kg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adal</td>
<td>13.0(0.50)</td>
<td></td>
</tr>
<tr>
<td>BHS</td>
<td>14.2(0.50)</td>
<td></td>
</tr>
<tr>
<td>Horro</td>
<td>15.0(0.20)</td>
<td></td>
</tr>
<tr>
<td>Menz</td>
<td>10.9(0.80)</td>
<td></td>
</tr>
<tr>
<td>Yearling wt, kg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adal</td>
<td>18.4(0.50)</td>
<td></td>
</tr>
<tr>
<td>BHS</td>
<td>17.7(0.70)</td>
<td></td>
</tr>
<tr>
<td>Horro</td>
<td>19.7(0.30)</td>
<td></td>
</tr>
<tr>
<td>Menz</td>
<td>10.9(0.80)</td>
<td></td>
</tr>
<tr>
<td>Ewe</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Birth wt, kg</td>
<td>31.6(0.60)</td>
<td></td>
</tr>
<tr>
<td>Weaning weight (90 days)</td>
<td>31.1(0.60)</td>
<td></td>
</tr>
<tr>
<td>Conception rate (%)</td>
<td>78</td>
<td>63</td>
</tr>
<tr>
<td>Lambing/kidding rate (%)</td>
<td>55</td>
<td>57</td>
</tr>
<tr>
<td>12-week milk yield</td>
<td>26.3(0.6)</td>
<td>37.8(1.50)</td>
</tr>
</tbody>
</table>

Source: Galal (1983); Galal, pers. comm.

Lambing percentage for the Menz sheep was reported to be around 109 (Galal 1983). Nevertheless more recently ILCA has observed a much higher lambing percentage for the breed (personal communication).

2.2.2 Arsi Rural Development Unit (ARDU). This regional development project has been involved in sheep breeding and crossbreeding for some time. Local sheep from various regions were collected and studied at ARDU. These breeds include the Arsi, Bonga, and Horro, and Black Head Somali and Menz breeds. Initially, crosses were maintained at F2 level. Since there has been no further introduction of similar breeds from outside and since the number present of each cross is very small, the sheep is likely to increase to an undesirable level (personal communication).

The major activity present at the study of local sheep on the ARDU station is the study of local Arsi sheep. This project could also be part of the national sheep project proposed in early 1980. In two lambing seasons Arsi sheep averaged about 2.5 kg and weaning weight at 120 days for one season was about 15.0 kg. Like the Debre Berhan station, ARDU was also distributing to farmers crosses with Hampshire, Merino, and Blue de Meina. Improved local Arsi sheep have been also given out to farmers.
2.3 International Livestock Centre for Africa (ILCA)

ILCA started its sheep programme very recently. It is carrying out a management study on the Menz sheep. Preliminary results show that the productivity of Menz sheep can be improved greatly by improving management practices alone. ILCA has reported a lambing percentage of about 160%, which is comparable with that of the Horro breed results reported by IAR.

In addition to its own sheep programme, ILCA has agreed to help the sheep programmes of the Ministry of Agriculture and IAR; with the Ministry of Agriculture, it has agreed to a joint sheep recording and selection project (FAO 1981). ILCA also helps IAR in its analysis and has agreed to coordinate the Menz sheep programme to avoid duplication of effort.

2.4 Other organizations or institutions

Other organizations and institutions, notably the Alemany College of Agriculture and some junior colleges, were involved in sheep programmes. The current status of these programmes is not clearly known. It is essential to have an adequate exchange of information between organizations and institutions undertaking more or less similar programmes.

The Ministry of State Farms Development is also undertaking some sheep and goat production development programmes, though these do not include any research for the moment. It buys sheep and goats from various parts of the country and feeds them for a certain period of time before shipment. It is, however, planning to develop ranches in the future to keep various classes of livestock for finishing before either exporting live or slaughtering.

3 Major constraints in sheep and goat production

Although Ethiopia has about 15% of the sheep and goats of the African continent and ranks high both in Africa and in the world at large considering numbers alone, the productivity per animal is too low (FAO 1980, MOA 1984, Wiener 1975). Some of the major constraints that hinder the exploitation of such a large resource to develop the agricultural economy of the country are listed below.

3.1 Nutrition

The standard of feeding animals in the country is very low. One report (3) has estimated that there is up to 40% feed deficit of the total requirement. The problem of feed shortage is made worse by the seasonality of the availability of pasture in the highlands and the erratic rainfall in the lowlands.

3.2 Marketing

Major constraints include the absence of organized marketing structures; trekking for long distances before slaughter; lack of capital; seasonality in demand; financing; and the role played by middlemen. Very little margin is left for the producer: the farmer or the pastoralist hence lacks any incentive to produce better finished animals.

Despite the proximity of Ethiopia to high-income and high-mutton-consuming countries, the export market suffers from the lack of ambition and consistent policy (Galal 1980). In the past this has encouraged illegal exportation of animals across several borders with a loss of revenue for the country. Table 5 shows the number of sheep and goats estimated to have been exported illegally to Somalia, Republic of Djibouti, the Sudan and Kenya in one year alone.

Table 5. Illegal export of sheep and goats (one year)

<table>
<thead>
<tr>
<th>Region</th>
<th>Sheep and goats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harare</td>
<td>620,000</td>
</tr>
<tr>
<td>Sidama</td>
<td>108,700</td>
</tr>
<tr>
<td>Bale</td>
<td>25,500</td>
</tr>
<tr>
<td>Gamo Gofa</td>
<td>4,500</td>
</tr>
<tr>
<td>Total</td>
<td>758,200</td>
</tr>
</tbody>
</table>


3.3 Disease

Disease is also considered to be a major constraint to sheep and goat development. It is estimated that about 14.5% and 11.4% of sheep and goats respectively die every year, of which the majority are young animals (Charette and Plon 1984).

3.4 Potential of the local sheep and goats

It is not only the exact number of sheep and goats in the country that is unknown to planners, development and research workers: their productivity also is virtually unknown.

3.5 Social factors

In some areas of the country there exists a prejudice against the consumption of goat milk and meat. People keep a very large number of unproductive animals for social prestige.
3.6 Structural constraint

The small numbers in the flocks of sheep and goats, particularly in the highlands, makes it difficult to implement any improvement programme. Producers' cooperatives and state farms can play a major role in the aggregation of flocks. This will also enhance channels for introduction of improvement and more advanced systems of management.

There could be complementarity (stratification) between the lowlands and the highlands in which the range areas of the lowlands could specialize in producing lambs which may result from natural selection (Galal 1980). The major obstacle here is the smallness of flock sizes which predominate at a high rate of inbreeding and reduces chances for deliberate selection.

3.7 Breeding activities

It is almost impossible to expect any genetic improvement with the present structure other than that which may result from natural selection (Galal 1980). The major obstacle here is the smallness of flock sizes which predominate at a high rate of inbreeding and reduces chances for deliberate selection.

3.8 Shortage of high-level qualified personnel

This is not specific to sheep and goat production alone; the whole livestock sector suffers from this scarcity.

4. Proposals for future development and research programmes

- A population census should be made to determine the number of sheep and goats in the country, and their major characteristics should be documented. This would help to formulate genetic improvement programmes.

- Sufficient knowledge is needed of the local sheep and goat breeds for assessing whether their present low productivity is due to low genetic potential, poor environmental conditions or the interaction of the two.

- Any work done in sheep and goat production by various organizations or institutions and the experience gained together with the information obtained should be shared among those working in the field.

- The Institute of Agricultural Research, the Ministry of Agriculture, the A.A. University and its colleges, and ILCA should coordinate their sheep and goat programmes so that all available data can be analysed and conclusions drawn. This will enhance the formulation of national genetic improvement plans. Such a scheme could include selection within breeds and crossing the local with exotic or improved local or both to enhance growth rates, carcass quality, wool and milk production.

- Concerned organizations should collaborate more closely in the distribution of crossbred and exotic breeds in such a way that this is done in conformity with an established plan. This is to avoid undesirable and/or irreversible genetic changes.

- The nutritional aspects of sheep and goat production should receive due attention in line with other classes of livestock. This has not been the case up to now, especially in comparison with dairy cattle.

- Effort is also needed to improve the nutritional status of the national flocks by research to identify and introduce suitable pasture and forage crops, to use agricultural by-products, and to establish feeding regimes that ensure that available feed resources are reserved for animals which will utilize them more efficiently.

- Aggregation of flocks through producers' cooperatives, state farms, etc., should be encouraged in order to facilitate genetic improvement and to provide flocks of a larger size which would warrant financial inputs and improved management practices.

- A stratified sheep industry should be considered in selected areas as a long-term plan.

- A market structure in which sheep and goats are purchased on the basis of common characteristics should be established and higher price should be paid for better quality animals.

- A coordinated approach is needed to alleviate the very few trained and experienced research workers in sheep and goat production who can, carry out research and analyze the data are even scarcer. In particular need are people who can design experiments, have some knowledge of computing and can analyze data on sheep and goats. More effort is needed by organizations and institutions to develop the trained manpower needed in this sector.

- The Ministry of Agriculture should have liaison offices attached to various organizations and institutions with livestock improvement programmes to serve as a bridge for a two-way flow of information. Up to now extension work in livestock has not been given its due share of resources.

57
It has been said earlier that a common feature among all organizations dealing in sheep and goats is the severe shortage of staff trained in the field. It is, therefore, necessary that these organizations make use of the existing trained manpower by coordinating their work and sharing responsibilities. Such a need was spelled out in the meetings held at IAR and Debre Zeit in December 1979 and January 1980.

The Sheep and Goat Committees formed during those meetings has discussed the role to be played by different organizations in implementing a national sheep and goat research and development plan. Activities to be carried out by the concerned organizations are as follows.

5.1 Institute of Agricultural Research

5.1.1 Play a leading role in developing a research plan at a national level with only occasional supervision.

5.1.2 Take a major part in analysing and drawing interpretations from the main trials carried out in the country.

5.1.3 Carry out its own research programmes that are of national interest.

5.1.4 Make available its surplus genetically improved and tested stocks to be given to farmers.

The role envisaged for IAR is not as the coordinator of all activities because this will be far beyond its structural staffing, administrative and mandatory capabilities.

5.2 Addis Ababa University and Educational Institutions

5.2.1 Establish nucleus flocks of sheep or goats or both in their region.

5.2.2 Carry out grazing, finishing and fattening trials.

5.2.3 Utilize their laboratories for feed and other related analyses.

5.2.4 Undertake training and extension work.

5.2.5 Conduct disease investigation trials.

The role to be played by the university and the colleges is expected to be as central and national as that of IAR.

5.3 Ministry of Agriculture

5.3.1 Play a coordinating role in research, nationally and regionally, and the main role in development.

5.3.2 Greatly strengthen its livestock extension services and improve the communication between research workers and farmers or producers and vice versa.

5.3.3 Effectively use developmental units like ARDU to:

a) Test stocks produced by other organizations
b) Carry out grazing trials
c) Multiply proven livestock
d) Carry out disease investigation programmes

5.4 Ministry of State Farms Development

Since state farms should be maintained as economically viable units, they should not be involved in trials that are considered to be profit risks. Nevertheless, State Farms could be the sites where rations developed are tried and modified, performance test sites, or at a later stage a stratum in a stratified production system.

REFERENCES


1984b. Livestock sub-sector review, draft final, annexes vol. 3. MOA, Addis Ababa.


PART II
THE STATUS OF POULTRY RESEARCH AND DEVELOPMENT IN ETHIOPIA
Alemu Sidah

1 Introduction
This paper presents some of the highlights of poultry production in Ethiopia. The presentation includes background information, development strategies and research situation in the field of poultry production of the country. Some of the main constraints faced in the development are noted and attempts are also made to indicate the need and direction of poultry development and research.

2 Background
2.1 Concept of poultry production in Ethiopia
In many of the industrialized countries of the world, the word "poultry" refers to all domesticated birds that are kept for the production of meat and eggs for human consumption. It includes domestic hens, turkeys, ducks, geese, quail, guinea fowls and other birds. The types of birds raised, of course, differ from country to country. But in Ethiopia the word "poultry" is synonymous with the word "chicken" because other domesticated birds mentioned are almost unknown to the majority of the people. So the discussion in this paper is generally devoted to chickens. Turkeys and ducks were introduced by some foreigners, but at present they are rarely seen. Guineas and partridges are common in their natural habitat, though some guinea fowls are kept in captivity as a hobby for the production of eggs and meat.

2.2 Origin and classification of chickens
Chickens are the most numerous domesticated birds in the world as well as in Ethiopia. Zoologically, the chicken belongs to the genus Gallus and family Phasianidae. The wild ancestor of the domestic chicken originated in South-East Asia. Among the four wild G. gallus species, or the red jungle fowl, has the widest distribution and is believed to be the chief ancestor of the modern chicken. The scientific literature indicates that the chicken has been domesticated since 2000 B.C. and has been subjected to selective breeding
for size, colour patterns, conformation and egg-laying ability during much of its domesticated history. As a result, there are 12 classes, 60 breeds and 200 varieties of chicken in the world. The "class" of chicken designates groups of breeds which have been developed in certain regions or geographical areas. The four popular and economically important ones are Asiatic, Mediterranean, English and the American.

3 Poultry raising in Ethiopia

Poultry raising has a long line of tradition in Ethiopia. May people, both in rural parts and in urban centres of the country, have engaged in the activity of keeping small numbers of chickens in their backyards to produce eggs and poultry meat for home consumption and to earn some incidental income. In general, housing, feeding or other production facilities are not provided for the chickens which are expected to scavenge to exist and possibly furnish a few eggs. The chickens that are raised in the country are mostly indigenous breeds.

From the observation so far made, the indigenous birds are very low producers of eggs and meat. The annual egg production of the native hen is about 40-60 and the weight of one egg lies between 39 and 46 g compared with improved layers that have an annual production of over 240 eggs with an average weight of 58 g per egg. The low production of eggs is partly attributed to the "broody" characteristics of the local bird. In meat production, the indigenous male bird reaches a weight of 1.52 kg in about one year while the present-day commercial "broiler" reaches market weight of about 1.6-1.8 kg within 46-52 day. Consequently, the indigenous birds are not suitable for expanded commercial poultry production. In this traditional system, the eggs are hatched by the natural method using the broody local hen.

3.1 Chicken population

As mentioned, chickens are found in all parts of Ethiopia, though the density differs from region to region. Different organizations have made estimates of chicken populations in the country, and the generally accepted estimate is about 53 million.

The Small Scale Agriculture Sample Census was conducted by the Ministry of Agriculture in 1976/77 (Eth. Min. Agric. Settlem. 1977). The finding of the "Small Scale Census" in per cent of total chicken put in order of the highest to the lowest concentration is indicated in Table 1.

According to this census, the highest numbers of chicken are found in the regions of Shewa, Gondar, Tigray, Gojam, and the lowest in Gomu-Gofa; of the total 53 million chickens of the country, indigenous birds comprise over 99%, while the remaining 1% is improved modern breeds.

<table>
<thead>
<tr>
<th>Region</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shewa</td>
<td>13.9</td>
</tr>
<tr>
<td>Gondar</td>
<td>12.9</td>
</tr>
<tr>
<td>Wollo</td>
<td>12.9</td>
</tr>
<tr>
<td>Tigray</td>
<td>11.6</td>
</tr>
<tr>
<td>Gojam</td>
<td>10.6</td>
</tr>
<tr>
<td>Sidamo</td>
<td>8.4</td>
</tr>
<tr>
<td>Kaffa</td>
<td>7.9</td>
</tr>
<tr>
<td>Wellega</td>
<td>6.7</td>
</tr>
<tr>
<td>Abaro</td>
<td>6.5</td>
</tr>
<tr>
<td>Bale</td>
<td>2.6</td>
</tr>
<tr>
<td>Gojam</td>
<td>0.0</td>
</tr>
<tr>
<td>Illubabor</td>
<td>0.0</td>
</tr>
</tbody>
</table>

3.2 Total production and consumption of eggs and poultry meat

Generally, poultry meat and egg production depend less on chicken population than on the productivity of the stock. In Ethiopia, practically the entire production of eggs and meat is derived from the indigenous flock and as a result the total production is low. According to the 1981 FAO Production Year Book, the indigenous birds of the country produced 72,800 tonnes of eggs and 66,600 tonnes of poultry meat. The contribution of improved breeds is estimated to be 1,500 tonnes of eggs and 500 tonnes of poultry meat.

Chicken meat and eggs are readily consumed by all people in Ethiopia. Generally, 13.9% of the population is engaged in poultry raising. The contribution of improved breeds is estimated to be 1,500 tonnes of eggs and 500 tonnes of poultry meat.
priority for human consumption and this does not leave a surplus for poultry feeding. Other carbohydrate-rich feed ingredients available include molasses, flour mill by-products and grain rejects.

The animal protein ingredients that are available include meat meal, blood meal, and meat and bone meal mixture. A variety of different oilseed cakes rich in plant proteins are produced in most parts of Ethiopia. The main one used as a poultry feed ingredient is noug cake while groundnut, sunflower and rape-seed cakes are also available.

3.4 Feed processing

Prepared poultry feeds are available from Shola, Kaliti and Akaki feed mills near Addis Ababa. These three mills are operated by the Poultry Development and Animal Feed Processing Enterprise under the Ministry of State Farms Development. At present, the Shola feed mill is exclusively used for the production of poultry feed, Kaliti feed mill produces both poultry feed and other animal feeds, while the Akaki mill is for dairy feed production.

The agricultural colleges, the Debre Zeit Experiment Station, the comprehensive projects and a few private farms also have some feed-mixing facilities.

3.5 Feed prices

The prices of mixed poultry feed at the mills for 1984 are given in the following table. Broiler feed is not prepared at present and chick feed is used instead.

<table>
<thead>
<tr>
<th>Type of feed</th>
<th>Price/quarter in birr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chick starter</td>
<td>34.6</td>
</tr>
<tr>
<td>Pullet grower</td>
<td>29.9</td>
</tr>
<tr>
<td>Layer</td>
<td>31.9</td>
</tr>
</tbody>
</table>

The prices include a 2% turnover tax and feed purchasers have to provide their own bags.

3.6 Poultry disease situation

Different poultry diseases have been recorded in Ethiopia, the major causes of economic loss being Newcastle disease, vitamin deficiencies, coccidiosis and respiratory diseases (chronic respiratory disease and laying trachitis). Other diseases such as cholera, fowl typhoid, Marks disease and leucosis have been known to cause severe losses.

3.7 Marketing and demand

Eggs: In general there are problems in transporting eggs and chickens from the rural parts of the country to the major centres of consumption. Collector agents organize large numbers of eggs for bigger markets in towns and cities. Since the production of table eggs and hatching eggs are not differentiated in the traditional system of poultry production, many cocks are kept with hens and consequently all the eggs are fertile. Where longer distances are involved to reach the market, the quality of the eggs deteriorates markedly.

There is no egg grading system and there are no marketing regulations or price controls for either eggs or chickens. Eggs are generally sold by number, and bigger and higher quality eggs are sold at the same price as smaller eggs. Demand for eggs, especially in the urban centres, appears strong.

3.8 Chicken meat

Almost all birds are sold alive and the weight ranges from 0.75 to 1.5 kg. However, in the cities, the acceptance of dressed chickens is improving and the demand is also increasing.

At present there is a minor export trade in chickens and eggs to nearby Djibouti. Other countries have indicated their interest in importing eggs and poultry meat from Ethiopia, but it is difficult to supply the required quantity.

3.9 Poultry houses and equipment

Constructing poultry houses for the indigenous birds is not generally practised in the traditional system of poultry production. However, building materials are available and basic poultry house equipment such as waterer and egg-laying nests could also be made locally. More sophisticated items have to be imported.

4 Review of poultry development and research activities

4.1 Poultry development

There is no recorded information to indicate when and by whom the first improved breeds of chickens were introduced to Ethiopia. Some people believe that missionaries brought some of the improved breeds with them. However, over the years, many exotic breeds of poultry have been introduced into the country by different organizations and different people. The main breeds include:

1. White Leghorn
2. Brown Leghorn
3. Rhode Island Red
4. New Hampshire
5. Cornish
6. Australorp

65

66
These breeds have been kept for the production of eggs and meat and are also used to upgrade the indigenous chickens by crossbreeding.

The establishment of Azbo and Jimma Agricultural High Schools, the Alemaya College of Agriculture, the Debre Zeit Experiment Station and the Shola Poultry Farm played very significant roles in introducing improved breeds of chickens to Ethiopia. The agriculture colleges and the enterprise also have hatchery facilities, with the exception of the Poultry Development Enterprise, the "deep litter" system is generally used.

The Poultry Development Enterprise has farms at Shola, Lenen and Dembi. Shola Farm has fully automated cage laying houses with a capacity of 60,000 layers and houses with a capacity of 45,000 layers are at Dembi. The total output of eggs reached over 15 million per year. The performance of layers has also improved and the present average annual egg production per hen is 230 eggs.

The second major output is broiler production at Lenen. The farm has a capacity of fattening 360,000 broilers in four cycles per year.

The enterprise also has a breeding farm with a capacity of 20,000 broiler and 20,000 layer parent stocks. It has rearing facilities for 120,000 commercial and 20,000 parent stock chicks annually.

The hatchery unit of the enterprise at Dembi has expanded and has a capacity of 1.7-2 million chicks annually.

4.2 Poultry extension

The poultry extension programme is run by the Animal Breeding and Animal Feeds Development Department of the Ministry of Agriculture. It has the following objectives.

a) To provide farmers with training and information on improved poultry production systems (housing, feeding, management).

b) To introduce improved breeds of chickens to poultry producers at cost in the form of pullets, cockerels, chicks and hatching eggs.

c) To improve the animal protein level in the diet of the people. The rapid growth rate and short generation interval of chickens make poultry production an ideal operation to meet the animal protein needs.

d) To raise the income of the peasants, thereby contributing to the overall economy.

e) To upgrade indigenous chickens by cross-breeding with improved breeds.

From 1977 (E.C.) to December 1985 over 55,000 pullets and 37,000 cockerels were distributed.

4.3 Poultry research

There is no organizational or financial support for poultry research though institutions such as Alemaya College, Debre Zeit Experiment Station and junior colleges (mainly the Awasa Junior College) and the National Veterinary Institute have conducted some research in the past.

The Alemaya College and Debre Zeit Experiment Station have conducted some feeding and crossbreeding trials and breed adaptation investigations. The Awasa Junior College and the National Veterinary Institute have also done an assessment of the performance of indigenous chickens while the National Veterinary Institute has recorded poultry diseases found in Ethiopia.

5 Major constraints

The major constraints to further development of the poultry industry are as follows:

5.1 Shortage and high cost of balanced poultry feed

5.2 Lack of laboratory facilities for chemical analysis of ingredients and of the formulated feeds

5.3 Lack of trained manpower, especially in the fields of poultry diseases and nutrition

5.4 Non-existence of grading and marketing regulations for poultry meat and eggs
5.5 Lack of research works to solve the problems of commercial poultry production in Ethiopia

6 Future poultry development plans

Plans for the development of poultry production, both in state farms and farmers' producers cooperatives have been indicated in the "Ten-Year Perspective Plan of Ethiopia". The Poultry Development and Animal Feed Processing Enterprise will expand egg and broiler production by establishing poultry farms in different regions of the country.

According to this plan, the enterprise will have a total of 1.5 million layers, an output of 9.5 million broilers per annum, a total hatchery capacity of 10 million chicks per year and five poultry slaughter plants at the end of the 10 years.

The peasant poultry sector is also planned to expand. Due emphasis will be given to concentrating poultry production around urban centres and densely populated areas. The flock size of the cooperatives will be 550, 1100, 1650 and 2200 birds, of which 10% are males. At the end of 10 years the following number of different sizes are envisaged.

<table>
<thead>
<tr>
<th>Flock size</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>550 birds</td>
<td>98</td>
</tr>
<tr>
<td>1,100 birds</td>
<td>62</td>
</tr>
<tr>
<td>1,650 birds</td>
<td>35</td>
</tr>
<tr>
<td>2,200 birds</td>
<td>16</td>
</tr>
</tbody>
</table>

In addition, eight poultry multiplication centres will be established in different parts of the country. Each centre will have breeding flocks, hatchery, rearing facilities and feed processing plant to supply poultry producers with improved birds and balanced feed.

7 Conclusion and remarks

Poultry fits well into a mixed farming pattern of agriculture, particularly in those areas where soil is infertile. Its importance as a factor contributing to a nutritious balanced human diet or as an income-generating venture should not be overlooked. So research must pay more attention to poultry, and areas that urgently need investigation are listed below:

a) Use of alternative feed ingredients, which would replace grains
b) Suitable types of housing
c) Adaptability of various breeds and crossbreeds for eggs and meat production
d) Performance evaluation of indigenous chickens
e) Survey of poultry diseases and study of their control and prevention

REFERENCES

ANIMAL TRACTION RESEARCH IN ETHIOPIA
Abiye Astatke

Introduction
The use of domestic animals to provide tractive power for cultivation predates history; the development of agriculture is linked with the domestication of animals and the increase of power for cultivation. Records suggest that as early as 2000 B.C., domestic animals were used to cultivate the increasing areas of land necessary to feed increasing populations.

Providing more food to keep pace with the expansion of the human population remains a problem in many countries throughout the world today. While the number of tractors employed in agriculture is increasing at a rapid rate, the peasant/smallholder system of the highlands of Ethiopia prevents the adoption of large-scale mechanical-powered farming systems.

Soil over 80 percent of Ethiopia's total population of 40 million people are directly engaged in agriculture and of these the majority are in the highlands, by contrast, the major proportion of cultivated area in the country is in the lowland arid and semi-arid regions.

The traditional cattle economy of the highlands is directed towards providing ploughing oxen, and, as byproducts, milk or meat production. Figures are not available for Ethiopia but work in other areas of Africa suggests that anything from 5 to as high as 16, total cattle (i.e. breeding and growing stock) are needed to maintain one pair of ploughing oxen in the field. If even the lower figure is accepted, it is obvious that the system has serious drawbacks in today's situation of rapidly increasing human population and food requirements.

Encroachment of cropping into grazing lands and the increasing number of animals for draught purposes and their followers on restricted areas results in overgrazing and soil erosion.

The areas traditionally cultivated are the lower parts of the hillsides. Fertile valley areas are normally avoided because of flooding in the height of the rain and cropping difficulties due to the vertisol type of soil. Soil conservation measures are not used and severe erosion has resulted in the degradation of large areas which can no longer support agriculture. The soil erosion problem is aggravated in the steep valley sides by the traditional practice of cutting furrows down the slope after planting crops, to allow excess water to drain away.

The maresha has certain advantages in the existing system: apart from the metal point it is entirely home produced from materials ready to hand; it is light in weight and is easily carried by the farmer to and from his field; its power requirement does not exceed that of a pair of local Zebu oxen; and it is versatile in the sense that it can be used on different types of soils.

It has also major disadvantages. The depth of penetration varies with soil type and condition and with the power of oxen available. It may be as low as 20-30 mm on vertisol type soils or as much as 80 mm on lighter soils or following previous cultivation. Usually a number of passes varying from two to four or more is made in different directions before land is ready for seeding. The time required for land preparation varies from 75 to 150 hr/ha depending on the soil type (Abiye and Matthew 1983). When seeds are broadcast, and then covered by a final pass with the maresha, they are covered unevenly and germination is thus reduced. It is to overcome the crop emergence problem that farmers generally use seed rates much higher than recommended by research institutes.

In the traditional farming system of Ethiopia, oxen work for only a limited period each year. Gryseels et al. (1984) has shown that farmers in highland Ethiopia work their oxen only for some 450 pair-hours, taken as the work potential of draught cattle in India (Pathak and Gill 1984). Possible
reasons for this low rate of use include religious observances, lack of feed for the oxen, and non-use of oxen for pack or transport work.  

3 IICA's research programme in animal traction  
Research on draught animal utilisation is an important part of the work in the highlands programme. The research takes three aspects into consideration, namely: the type of animals being utilised, the equipment used, and the soil cultivated in smallholder farming systems.

A major objective of this research has been to develop minimum power cost systems. Some alternatives which are available to farmers that are appropriate to the farmer's size, draught animals in addition to the productivity of crops as investigated. The supplementary with extra feed to cover the extra cost of work has been minimised and in most cases by a pair of crossbred cows without affecting milk yield or calving interval.

The research on the use of a simple local Zebu ox for cultivation with the modified maresha was intended to benefit the large number of smallholder farmers with less than two hectares. The present drought in Ethiopia has decreased the number of draught animals and, the acceptance of this technology by farmers has increased. Any improvement in this technology efficiency could lead to a reduction in oxen number and their support stock and allow land to be released for cropping or for keeping more productive breeds in good condition.

Currently draught animals are only used for seedbed preparation for 50-60 days per year. The programme began by investigating into alternative uses of draught oxen for construction, including the use of a pair of crossbred cows. The programme and testing implements was the agricultural engineering and training in their use. Crossbred cows have been sold to farmers interested in using animal-drawn scoops by two interested Peasant association at Debre Zeit station; a trial has been set up to determine how these cows perform in real farm situations when used for work and motorised units. Crossbred cows as Chilalo Agricultural Development Unit (CADU). Oxen and donkey carts, wooden spike-tooth harrows and mouldboard ploughs for cultivation have been developed and tested by the unit and sold to surrounding farmers.  

The number of farmers involved with the single ox trial at Debre Zeit is 32 and almost the same number are involved at Debre Berhan. These are “innovative” farmers taking their own risks. The programme assesses attempts made in their use. Crossbred cows have been sold to farmers interested in using animal-drawn scoops by two interested Peasant associations at Debre Zeit station; a trial has been set up to determine how these cows perform in real farm situations when used for work and motorised units. Crossbred cows as Chilalo Agricultural Development Unit (CADU). Oxen and donkey carts, wooden spike-tooth harrows and mouldboard ploughs for cultivation have been developed and tested by the unit and sold to surrounding farmers.

When a research project has been completed and has been found to have the potential for positive impact on the farming system, innovation is tested by smallholder farmers living near one or the other of the IICA stations, Debre Zeit and Debre Berhan, whichever is ecologically more appropriate to the technology under test.

The number of farmers involved with the single ox trial at Debre Berhan was 32, and almost the same number are involved at Debre Zeit. These are “innovative” farmers taking their own risks. The programme assesses attempts made in their use. Crossbred cows have been sold to farmers interested in using animal-drawn scoops by two interested Peasant associations at Debre Zeit station; a trial has been set up to determine how these cows perform in real farm situations when used for work and motorised units. Crossbred cows as Chilalo Agricultural Development Unit (CADU). Oxen and donkey carts, wooden spike-tooth harrows and mouldboard ploughs for cultivation have been developed and tested by the unit and sold to surrounding farmers.

4 National institutions involved in animal traction research

There are several institution in the country working on some aspect of animal traction development. Most of the research is concentrated on developing animal-drawn implements for the farmers.  

Previously, the most active institution in developing and testing implements was the agricultural engineering section of Arsi Rural Development Unit (ARDU). Oxen and donkey carts, wooden spike-tooth harrows and mouldboard ploughs for cultivation have been developed and tested by the section.

Two years' trials on soil preparation, using ARDU mouldboard ploughs for primary cultivation in combination with spike-tooth harrows for secondary cultivation and covering, showed no significant differences in yield and in comparison with the traditional with no significant differences in yield. In trials conducted at Debre Zeit with crossbred cows and in the traditional system done by the maresha (CAME 1971). A number of mouldboard ploughs and harrows have been produced by the unit and sold to surrounding farmers.

The success of ARDU in creating an impact on the surrounding farmers was basically due to its infrastructure. 

The implements developed and tested were produced in large numbers by the manufacturing section of the unit and distributed to farmers through its extension workers. 

Information on the performance of the implements in the field was fed back to the researchers, which helped them in identifying and working on the problems faced by farmers. 

-74
Other institutions involved in animal traction research are the Institute of Agricultural Research through its livestock sections and Forage Research Department and the Agricultural Engineering Department of Alema College. The Agricultural Engineering Department mostly deals in the development of implements while the Livestock and Forage Research Department of IAR in its cattle crossbreeding programme primarily to improve dairy production hopes to study the potential of the different crossbred oxen for draught use.

A modest start was made in 1976 however, because of shortage of staff and lack of facilities, many of the programmes originally envisaged have not been completed. Attempts were made by IAR to study the efficiency of various types of ox-drawn equipment at Melka-werer Research station. A package of implements that included the mouldboard plough, the spike-tooth harrow, inter-row cultivators, a ridger and a planter for cotton production under irrigation were tried, it was concluded that a gross income of 3600 birr per family was possible with the use of the modern implements (IAR 1980).

A section set up three years ago by the government to facilitate the modernization of farm implements is the Farm Implement Division in the Agricultural Development Department under the Ministry of Agriculture. The responsibility of this division includes the improvement of agricultural implements, development of more efficient yokes and harnesses, a study on the use of equines as an agricultural power source and the improvement of cultural practices in agriculture. However, not much has been done because of financial and trained manpower shortages.

An Animal Traction Network was formed between IAR, ARDU and ILCA for the study of different breeds of crossbred oxen.

Conclusion
Even though researchers concentrate on one specific aspect of a problem there is plenty of scope for research on draught power use. The power source (animals used), the implements and the soil should be considered, as well as the economic and technological level of the farmer. All institutions and organizations working on whatever aspect of animal traction in the country should be coordinated to avoid duplication of work and to identify research priorities.

REFERENCES


Draught for arable operations is usually considered the principal, if not the only, use of domestic animals in the provision of energy. Research on draught is again gaining momentum in the face of the world energy crisis. Research on other types of power output by animals has been almost entirely neglected. Is this justified, in view of the economic importance of draught operations?

Some of the advantages of animals over machines in the Ethiopian economy are their low initial cost; their suitability for small units with low output; the fact that they are self-perpetuating if both males and females are used; the concomitant facts that they do not require spare parts and thus their running costs are low, and finally that no foreign exchange is involved.

From a review of the available literature on Ethiopia, it appears that very little research into, or attempt to develop, non-draught sources of the power has taken place. Some of the organizations within the country that are involved in research or development of mechanization are:

Institute of Agricultural Research
Arsi Rural Development Unit
Nomad Development Project
Angar Gutin Project
Farm Machinery Division
International Livestock Centre for Africa

Undoubtedly other development and some charitable organizations have mechanization (in the general sense) as one of the aims of their projects.

Some "development" has taken place. Perhaps the best-known example is the formal efforts of ARDU to introduce donkey carts and cart-mounted water tanks into their zone of action. Other developments, such as the "ghari" in many Ethiopian towns and primitive oil mills in the northern lowlands may have been more or less spontaneous.

Some "development" has taken place. Perhaps the best-known example is the formal efforts of ARDU to introduce donkey carts and cart-mounted water tanks into their zone of action. Other developments, such as the "ghari" in many Ethiopian towns and primitive oil mills in the northern lowlands may have been more or less spontaneous.

In addition, some organizations and individuals have attempted to establish, quantitatively as well as qualitatively, the value and role of animals for transport or other purposes. One such recent attempt, the results of which are unfortunately not available, is Berhan in collaboration with the ILCA Ethiopian Highlands Programme. That study aimed at determining the value of goods entering the town on transport animals.

An earlier study in Makalle had essentially the same objectives. There it was established that for normal transport purposes 95% of the animals were donkeys and, as can be seen from Figure 1, approximately 50% of all loads entering the town were firewood. Other produce included vegetables, oil, and animal feed. As can be seen in Figure 1, the greatest number of loads arrive in the evening. From these kinds of data, it was possible to calculate the consumption of fuelwood and basic commodities.
An additional study was made of the important salt trade. Camels and mules are also involved in this transport business. Load rates were established for each species (Table 1). From these loads, combined with a ratio count of each species and figures from the excise post at which all animals passing had to pay taxes, it was possible to calculate the amount of salt transported in total and by each species each year (Table 2). It is then possible to make estimates (Table 3) of the gross output per animal (which is important to the owner) and per kilogram of liveweight of animal (which is more important to the resource manager and to the economist where input/output ratios need to be known).

Table 1. Load rates for three domestic animals in the northern Ethiopia salt trade

<table>
<thead>
<tr>
<th>Species</th>
<th>Mean</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Camel</td>
<td>90</td>
<td>48-120</td>
</tr>
<tr>
<td>Mule</td>
<td>77</td>
<td>48-108</td>
</tr>
<tr>
<td>Donkey</td>
<td>49</td>
<td>48-84</td>
</tr>
</tbody>
</table>

Similar types of data (Figure 2 and Table 4) collected from other areas of Africa help to show similarities or differences in provision of services and could assist in determining research or development priorities.

Table 2. Some economic parameters for the northern Ethiopian salt trade

<table>
<thead>
<tr>
<th>Excise duty to excise (‘000 birr) (%)</th>
<th>Annual Salt journeys carried (*000) (tonne)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Camel</td>
<td>199</td>
</tr>
<tr>
<td>Mule</td>
<td>172</td>
</tr>
<tr>
<td>Donkey</td>
<td>61</td>
</tr>
</tbody>
</table>

Table 3. Gross output per animal and per kilogram of animal for different transport activities in northern Ethiopia in 1974

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Per animal (birr)</th>
<th>Per kg liveweight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Camel salt</td>
<td>1174</td>
<td>3.82</td>
</tr>
<tr>
<td>Mule salt</td>
<td>1006</td>
<td>6.29</td>
</tr>
<tr>
<td>Donkey salt</td>
<td>644</td>
<td>5.98</td>
</tr>
<tr>
<td>Donkey fuelwood</td>
<td>555</td>
<td>5.19</td>
</tr>
</tbody>
</table>

The lack of knowledge of the energy requirements for work and therefore the nutritional needs of working animals is a major constraint to their economic use. Recently, some work on energy requirements has been carried out at Edinburgh University. From the preliminary results, which indicate a cost of 3.3 J per kg transported per horizontal meter, it would appear that energy requirements for transport are not very high, at least at sea level. What the costs might be at 2500 or 3000 are not known but they may be considerably more. In addition to the technical constraints, there are social ones, associated in particular with the culture and tradition of the Ethiopian highlands. Work oxen, on a year-round basis, are used very inefficiently (Table 5) and even during the peak period are used for only about 75% of the possible time. If farmers could be persuaded that oxen could...
fulfill some other, out-of-ploughing-season jobs, total resource use would be more effective.

Table 5. Efficiency of work oxen use by six farmers in the CADU area

<table>
<thead>
<tr>
<th>No. oxen owned</th>
<th>Actual Hours</th>
<th>Potential Hours</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>3.5</td>
<td>208</td>
<td>27.1</td>
</tr>
<tr>
<td>Maximum</td>
<td>6.0</td>
<td>342</td>
<td>26.0</td>
</tr>
<tr>
<td>Minimum</td>
<td>2.0</td>
<td>108</td>
<td>24.7</td>
</tr>
</tbody>
</table>

Even where animals are currently used to provide sources of energy for other operations, traditional methods are not very efficient. In addition to the obvious change from pack to cart (permitting a 10-fold increase in the load factor for donkeys, for example) the use of capstans for seed decorticating, oil milling, lifting water and threshing and use of sledges for transport and threshing would also improve efficiency. As an example, Table 6 details savings in man and oxen hours and in costs and indicates the increase in output using these different animal-power technologies.

Table 6. Time expenditure and costs of three different animal-powered threshing methods.

<table>
<thead>
<tr>
<th>Men</th>
<th>Oxen</th>
<th>Batch</th>
<th>Cost in birr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trampling</td>
<td>3</td>
<td>9</td>
<td>200</td>
</tr>
<tr>
<td>Sled</td>
<td>3</td>
<td>7</td>
<td>100</td>
</tr>
<tr>
<td>Thresher</td>
<td>2</td>
<td>4</td>
<td>8</td>
</tr>
</tbody>
</table>

The scope for improvement thus appears to be enormous. Improvements would be in cost, energy and resource saving. The differences of implementation of research and development are no excuse for or failure to make better use of this important and largely untapped resource.

PART III
THE STATUS OF FISHERY RESEARCH AND DEVELOPMENT IN ETHIOPIA
Tesfaye Wudineh

1 Background

Ethiopia has substantial fishery resources, both in the inland lakes and rivers and in the more productive southern part of the Red Sea (Steinitz 1973) where it has about 1000 km of coast with a wide continental shelf. The total area of the lakes covers about 7000 km² (Atkins 1965) and the continental shelf on the Red Sea coast extends over 60,350 km² (Hayashi 1977).

All the major lakes, except Lake Tana, lie within the Rift Valley system. Lake Tana with an area of 4120 km² is the largest in the country. Of the Rift Valley lakes, the largest is Lake Abaya, 1160 km², which contains more diverse fish species including the carnivorous Nile perch, Bagrus and Clarias spp.

Small lakes such asHora, Bishoftu, Babogaya, and Haiq also contain fish resources which could make a significant contribution to the nutrition of the surrounding people. Despite the large amount of fish resources the country possesses, no serious attempt was made in developing the industry until very recently. Thus surveys and researches in the field are relatively scarce and inconclusive.

1.1 Red Sea fishery

Fishery surveys were carried out in the Ethiopian Red Sea coast by Ben-Yami (1964, 1968), Kaseroff (1967) Atkins et al (1965) and Grofit (1971). These surveys include fish distribution and abundance, fishing methods development, and fish preservation and processing methods.

Most of the surveys indicate the presence of a large stock of pelagic fish, mainly sardines and anchovies, which are seasonal, but also a substantial quantity of schooling fish of the tuna and mackerel type were reported by Kaseroff (1967).

The schools were probably composed of little tunas (Thunnus alettaeatus), frigate mackerel (Lutra thazard), looptail tuna (Thynnus larivale), Scoporousa sp., and Indian mackerel (Rastrelliger kanagura).
Kaseroff (1967) suggested that catch could be improved if purse-seines and live-bait fishing were employed but also indicated the need for further study in the field.

During trawl fishing surveys, Ben-Yani (1964) observed that single hauls of up to 1500 kg gross weight were common. Recent bottom trawl surveys by an ICORAD team (1964) also gave catch per hour of up to 2400 kg, but most were in the range of 400–800 kg/hr. The catch of offshore trawling consisted mainly of flatfish, Scophthalmus maximus, S. undulatus, S. tubulosa, and thread-finn hake (Ommatias longissima). Other important fishes of the trawl catch included snappers, groupers, Bdlethericus sp. and barracudas. Sharks and rays are common in near areas.

It is known that the Red Sea is not very productive by world standards. However, the southern portion with a wider continental shelf is more productive than the northern part, the demarcation line being 20 degrees north (Steinitz 1973).

Very few surveys of the overall resources and productivity of the Ethiopian coastal fishery of the Red Sea have been carried out so far. Some public reports and reports available. Limnological and fishery studies were conducted by an Italian expedition team as early as 1937/38 with the results published in 1941 (cited by Riedel 1991). A reconnaissance survey of L. Abaya was carried out by Reidel (1961), and further surveys and researches were made by Tanaka (1974) and Schroder (1984).

A fishing survey of Lake Tana was carried out by Ben-Yani (1964) who estimated that single hauls of up to 20,000 tonnes/year. Atkins (1965) made a fishery survey of the Rift Valley lakes in order to prepare an investment proposal for fishery development. Based on various reports and comparing the productivity of the Rift Valley lakes to other East African lakes, they conservatively estimated the potential productivity of the Red Sea coastal waters based on the works of Ben-Yani (1964, 1968), Kaseroff (1967), other earlier surveys and his own findings from fishing trials and observations. The estimate indicates a total potential yield of 63,500 tonnes per year, of which 50,000 tonnes/yr would be anchovy and sardine. It is stressed, however, that this estimate is at best only approximate, and that further detailed research needs to be carried out to arrive at a more reliable and conclusive result.

1.2 Inland fishery

The situation of the lake fishery is no different from the Red Sea fisheries in that few public surveys and reports available. Limnological and fishery studies were conducted by an Italian expedition team as early as 1937/38 with the results published in 1941 (cited by Riedel 1991). A reconnaissance survey of L. Abaya was carried out by Reidel (1961), and further surveys and researches were made by Tanaka (1974) and Schroder (1984).

A fishing survey of Lake Tana was carried out by Ben-Yani (1964) who estimated that single hauls of up to 20,000 tonnes/year. Atkins (1965) made a fishery survey of the Rift Valley lakes in order to prepare an investment proposal for fishery development. Based on various reports and comparing the productivity of the Rift Valley lakes to other East African lakes, they conservatively estimated the potential yield of the lakes as 30,000–50,000 tonnes/year (Table 1). The most common species in all lakes, is

**Oreochromis niloticus**, though *Lates niloticus* (Nile perch), *Bacarrus docmac*, *Clarias sp*. and *Cyprinus carpio* (common carp) are also important on the market.

Recently a fishery resource assessment study of lakes Zewai and Abaya was conducted for a year as part of the EEC fishery development project. The results of this work, pre­liminary and based on analysis of statistical data, comparison with other similar situations, and my own findings and observations made. Thus Grofit (1971) estimated the potential yield as 12,000 tonnes/year for Lake Zewai and 7000 tonnes/year for Lake Abaya. Atkins (1965) roughly estimated a potential yield of 2000 tonnes/year for Lake Zewai and up to 1000 tonnes/year for Lake Abaya. L. Abaya probably yield more than the present estimate provided proper protection is given to the spawning fish which are being destroyed by the present fishing method, beach seining. However, the low pro­ductivity of L. Abaya is explained by the presence of a very strong ferric oxide suspension which limits the primary production (Schroder 1984); however, this was not observed by Atkins (1965) or Tanaka. Indications need for further, more elaborate, scientific research on the fisheries of all the lakes.

1.3 Fish culture

The Fishery Department has a small fish culture re­search station and laboratory at Sobota. The main activity carried out at the station is the production of fish fry for distribution to the built reservoirs, dams, ponds and natural lakes and rivers as required. Other activities include research in artificial food selection and formula­tion, study of pond stocking rates, use of natural fertilizers such as cattle dung and chicken droppings for ponds, and artificial breeding of carp by hormone induction to produce fry for stocking. The laboratory is used for analyzing and examining water and fish samples collected from lakes, rivers and ponds.

Several exotic fish species have been imported from different countries, including grass carp, silver carp, crucian carp and goldfish from Japan and *Clarias* from Ghana. Some of these exotic species have been introduced into a number of reservoirs and ponds. The goldfish are cultured along with the native fish.

The Fishery Department has been the only body concerned with fishery development and research activities. However, the University of Addis Ababa has recently post­graduate students in limnology and freshwater fish biology. Also introduced by the fish biology laboratory is steelhead trout and other trout species reared in Lake Awasa by the Biological Department of AAU and the Awasa Agricultural College. Also Addis University has started offering courses in marine biology and is in the process of establishing a marine biology laboratory at Hassava.
Development constraints

The potential fisheries resource is considerable, with significant development prospects. However, a comprehensive resource study and updated information are required to introduce new development schemes. The shortage of trained manpower in this field and the lack of training institutions and facilities in the country have limited such studies. Training people in specialized fields of fish biology, ecology, economics, limnology, fish culture and fish technology is essential. Training people in specialized fields of fish biology, limnology, fish culture and fish technology is essential: fishing technology and methods in most areas are still primitive; fish preservation and processing technology is not developed; the distribution and marketing system needs a lot of improvement.

In general, the low level of technical competence in various fields of fisheries, the lack of knowledge about resources, the lack of appropriate technology or trained manpower, inadequate administrative support and the lack of the necessary infrastructure are the main constraints to the development of fisheries.

The Fishery Department has very limited technical and financial resources to improve the situation in the short term; thus the assistance and cooperation of training and research institutes in the country is indispensable.

Future plans in development

The Fishery Department has a plan to increase production of the Red Sea through the improvement and supply of fishing and fishing gear. Fishermen will be trained in the operation of improved fishing boats and fishing technique and the handling and preservation of their catches through projects financed by the United Nations Environment Programme and the United Nations Development Programme. As fishing methods are improved and catches increase it will be necessary to study the fish stock to get better and reliable information for future investment plans. Close cooperation with Asmara University will be essential to plan and expand the research in line with the development programme of the Fishery Department.

The department also plans to establish a fishery research station at Zewi and conduct research and fish population studies of all the important Rift Valley lakes. There are plans to expand the Sabata Fish Culture Research Station in collaboration with the Biology Department of AAU. Training people in limnology and various aspects of fish biology and fish culture both at the AAU and abroad is foreseen.
Research requirements

The Fishery Department, Ministry of Agriculture, is the only government body directly responsible for the development and proper utilization of fishery resources and also the introduction of fish farming in rural areas. To execute its responsibilities, the department needs basic information that should be sought through studies and research, which include:

a) Basic research in fish biology such as feeding habits, fecundity, growth rates, migration patterns and population study which provide vital information for the proper management of a fishery and for investment programmes.

b) Research in primary productivity of the various water bodies.

c) Research in fishing methods and gear improvement.

d) Research in fish processing and preservation methods.

e) Research in fish culture.

Because of its lack of trained manpower and adequate facilities the Fishery Department can do only a small part of the works listed above. It is necessary, therefore, that cooperation between research institutes, Addis Ababa, Asmara universities and the Fishery Department be established. Fishery research programmes in these institutes could then be integrated with the development requirements of the Fishery Department.

REFERENCES


Livestock in Ethiopia appears an important investment but it is an underutilized resource which offers a high potential for improvement. Traditionally animals either derive their ration from seasonally and spatially variable plant materials or they are supplemented by crop residue feeding. Energy and protein are the most limiting nutrients, and deficiencies of some minerals, like copper and zinc, have been suggested.

Enormous quantities of crop residues and agro-industrial by-products are annually produced in the country. However, they are poorly utilized because of their low cost, wide availability and the absence of alternative uses. The efficient utilization of these feed resources is of maximum national importance.

Animal nutrition research is relatively new in Ethiopia. Nevertheless, it has become necessary to tap the vast potential of livestock industry through animal nutrition research. Due to the low productive potential of livestock populations the factors that contribute to low productivity, undernutrition and malnutrition are major (AACM 1984). Except for a few specialized dairy farms and some feedlots, livestock are not fed concentrates or fodder but derive their ration from generally overgrazed pasture, sometimes supported by crop residue feeding. Hence animals can hardly meet their energy and protein requirement. With regard to minerals, copper and zinc are suggested to be deficient in some parts of Ethiopia (Faye et al 1983).

To alleviate low standards of feeding and exploit the untapped livestock population, research and development work should be channeled towards animal nutrition. Moreover the current demand for livestock and livestock products suggests there is a need to improve the productivity of livestock population through improved feeding (ILCA 1983).

Estimates (AACM 1984) indicate that, of the total feed resources available to livestock in the highland farming areas, permanent pastures provide 32.8 million tonnes DM, cereal crop residues 6.5 million tonnes DM, cereal aftermath grazing 1.8 million tonnes DM, pulse residues 0.4 million tonnes DM and other by-products 0.2 million tonnes DM. The feed resource available to livestock in the pastoral areas derives entirely from grazing and browsing (AACM 1984). Of the cereal crop residues those of tef, barley and wheat are the major by-products of grain production and provide the bulk of the ration of many animals. About 6.5 million tonnes of straw are annually produced (AACM 1984), which corresponds to some 975 million feed units (FU) (0.15 FU/kg). The 0.4 million tonnes of dried haulms could provide an extra 10 million FU (0.25 FU/kg) (FAO 1973). Sweet potato tops and banana wastes also provide some 60,000 tonnes and 5,000 tonnes DM per year respectively (AACM 1984). Among the various by-products available in Ethiopia, sugarcane molasses deserves special attention. Molasses production in 1981/82 was 51,100 tonnes of which 29,000 tonnes was exported (AACM 1984). If entirely used for beef cattle fattening (Meyreles et al. 1983) 47,000 tonnes could permit the finishing of at least 50,000 head and produce some 5000 tonnes of supplementary beef on carcass basis (FAO 1973). At full sugar-cane production it should be possible to fatten about 100,000 head per year (FAO 1973). Sugar-cane cultivation could also provide 78,000 tonnes DM per year of sugar-cane tops, which could be utilised as roughage for feeding cattle (AACM 1984).

Dried cakes generally constitute an excellent concentrate feed for ruminant livestock and the production potential is estimated to be 138,000 tonnes per year (AACM 1984). About 6.5 million tonnes of straw are annually produced (AACM 1984), which corresponds to some 975 million feed units (FU) (0.15 FU/kg). The 0.4 million tonnes of dried haulms could provide an extra 10 million FU (0.25 FU/kg) (FAO 1973). Sweet potato tops and banana wastes also provide some 60,000 tonnes and 5,000 tonnes DM per year respectively (AACM 1984). Among the various by-products available in Ethiopia, sugarcane molasses deserves special attention. Molasses production in 1981/82 was 51,100 tonnes of which 29,000 tonnes was exported (AACM 1984). If entirely used for beef cattle fattening (Meyreles et al. 1983) 47,000 tonnes could permit the finishing of at least 50,000 head and produce some 5000 tonnes of supplementary beef on carcass basis (FAO 1973). At full sugar-cane production it should be possible to fatten about 100,000 head per year (FAO 1973). Sugar-cane cultivation could also provide 78,000 tonnes DM per year of sugar-cane tops, which could be utilised as roughage for feeding cattle (AACM 1984).

One feed unit (FU) is equivalent to the energy provided by the digestion of 1 kg of barley grain.
The potential feed resources indicate that enormous quantities of crop residues and agro-industrial by-products which can be used for the formulation of least-cost rations are annually produced in the country. However, most of the available feedstuffs are poorly utilized as stock feeds. It is inconceivable that at a time when so many people suffer from famine so many products should be wasted. Hence nutrition research must be intensified and the study of these feed resources and their proper utilization should be emphasized.

2 Research institutions and their results

Like elsewhere in the warm climate regions of the world (McDowell 1972) animal nutrition research on Ethiopia is still at an early stage of development.

Animal nutrition research was officially included in the duties of IAR at its foundation in 1966; however, it does not seem to have received as much attention as it deserves. The various institutions that have dealt with animal nutrition research in Ethiopia and whose results have been partially or fully published are:

- Institute of Agricultural Research
- Addis Ababa University/Alemaya College of Agriculture
- Chilalo Awraja Development Unit
- International Livestock Centre for Africa

2.1 Institute of Agricultural Research

The Institute of Agricultural Research has been undertaking laboratory evaluation and estimation of the nutritive value of Ethiopian feedstuffs from major agro-ecological zones of the country. To date a total of 982 samples have been collected and most have been analyzed for dry matter, ether extract, total ash, crude protein neutral detergent fiber and detergent soluble cell contents, lignin, and acid detergent fiber.

A good foundation was laid by Beyene Chichaibelu et al. (1976) as far as laboratory evaluation of Ethiopian feedstuffs is concerned. In their study a total of 38 Ethiopian feedstuffs and formula feeds were intensively evaluated and their nutritive values estimated by employing appropriate formulas and summative equations. The results of this study identified a number of nutritionally acceptable and inexpensive feeds that would permit the formulation of least-cost nutrition rations for different classes of livestock, including poultry.

Feeding values of five different crop residues for cattle fattening have been investigated, using native steers fed for 116 days. The crop residues were tef straw, wheat straw, oat hay, oat silage and native pasture hay. The experimental ration was composed of 50% of the crop residue, 20% molasses, 25% noug cake, 4% bone meal/meat meal mixtures and 1% salt plus vitamin supplements. The results (IAR 1976) showed that tef straw had a better feeding value than the other crop residues and gave the lowest feed cost per kilogram liveweight.

A fattening trial of 160 days duration utilizing crop residues was carried out at Adami Tulu using 40 native steers (IAR 1976). The crop residues tested — haricot bean haulms, maize stover, tef straw and maize cobs — each comprised 50% of the ration. The remaining 50% was composed of 20% molasses, 25% noug cake, 4% bone meal/meat mixture, 1% salt plus a vitamin supplement. Animals fed maize cobs had higher daily gains and lower feed cost than those on the other rations.

The effects of different concentrate levels on fattening performance were investigated using 25 Horro bulls at Bako for 120 days. Concentrate levels of 0, 2, 3, 4 and 5 kg/day were tested the concentrate mixture consisted of maize 46%, sorghum 30%, noug cake 20%, bone meal and salt 2% each. All animals received as roughage 5 kg/day mixture of maize and sorghum silage plus hay ad libitum. Liveweight gains increased with increasing concentrate consumption up to 4 kg/day and appeared to plateau thereafter; 3 kg of concentrate per animal per day seemed to be the best economic level of concentrate feeding (IAR 1976).

Utilization of ensiled sisal wastes as livestock feed was investigated at Awasa (IAR 1976) using the following fermentation treatments:

a) Sisal waste (control), no additive
b) Sisal waste plus 3% molasses on fresh weight basis (1 part molasses diluted with 3 parts of water)
c) Sisal waste treated with 3% MUM (1 part diluted with 3 parts of water)

It was concluded that sisal waste could be ensiled successfully if treated with additives, supplying for development of lactic acid-producing bacteria. The addition of urea in MUM substantially increased the crude protein (nitrogen) content of the sisal silage.

Permanence studies of sisal waste/maize stover silages have been carried out to detect growth with additives supplying for development of lactic acid-producing bacteria. The addition of urea in MUM substantially increased the crude protein (nitrogen) content of the sisal silage (IAR 1976).
Different feeding regimes during the dry season were investigated using two herds of indigenous Merino lambs at Balto (Galal et al., 1976). Two different feeding regimes were used: supplementing the pastures during diets were significant; average daily gain composition the average crude protein intake was 154 g for in crude protein intake were correlated with differences in daily gain. Rates 9.49% for diets A, B and C respectively. As experimental diets with 15:85, 26:74 and 41:59 hay-to-concentrate ratios were investigated at Holetta (Galal et al., 1979) using three experimental diets with 15:85, 26:74 and 41:59 hay-to-concentrate ratios. As the roughage-concentrate ratio increased in the diet, average daily gain decreased significantly. Differences among treatments in average daily gain was 141 q, 86 q and 49 g for diets A, B, and C, respectively. Based on the average daily gain, consumption and diet composition the average crude protein intake of diet A, 149 g, was lower than 170 g and 110 g. for diet C. Differences in crude protein intake were correlated with differences in daily gain.

Different feeding regimes indicated the dry season were investigated using two herds of indigenous Merino lambs at Balto (Galal et al., 1976). Two different feeding regimes were used: supplementing the pastures during diets were significant; average daily gain composition the average crude protein intake was 154 g for in crude protein intake were correlated with differences in daily gain. Rates 9.49% for diets A, B and C respectively. As experimental diets with 15:85, 26:74 and 41:59 hay-to-concentrate ratios were investigated at Holetta (Galal et al., 1979) using three experimental diets with 15:85, 26:74 and 41:59 hay-to-concentrate ratios. As the roughage-concentrate ratio increased in the diet, average daily gain decreased significantly. Differences among treatments in average daily gain was 141 q, 86 q and 49 g for diets A, B, and C, respectively. Based on the average daily gain, consumption and diet composition the average crude protein intake of diet A, 149 q, was lower than 170 g and 110 g. for diet C. Differences in crude protein intake were correlated with differences in daily gain.

Different feeding regimes indicated the dry season were investigated using two herds of indigenous Merino lambs at Balto (Galal et al., 1976). Two different feeding regimes were used: supplementing the pastures during diets were significant; average daily gain composition the average crude protein intake was 154 g for in crude protein intake were correlated with differences in daily gain. Rates 9.49% for diets A, B and C respectively. As experimental diets with 15:85, 26:74 and 41:59 hay-to-concentrate ratios were investigated at Holetta (Galal et al., 1979) using three experimental diets with 15:85, 26:74 and 41:59 hay-to-concentrate ratios. As the roughage-concentrate ratio increased in the diet, average daily gain decreased significantly. Differences among treatments in average daily gain was 141 q, 86 q and 49 g for diets A, B, and C, respectively. Based on the average daily gain, consumption and diet composition the average crude protein intake of diet A, 149 q, was lower than 170 g and 110 g. for diet C. Differences in crude protein intake were correlated with differences in daily gain.

Different feeding regimes indicated the dry season were investigated using two herds of indigenous Merino lambs at Balto (Galal et al., 1976). Two different feeding regimes were used: supplementing the pastures during diets were significant; average daily gain composition the average crude protein intake was 154 g for in crude protein intake were correlated with differences in daily gain. Rates 9.49% for diets A, B and C respectively. As experimental diets with 15:85, 26:74 and 41:59 hay-to-concentrate ratios were investigated at Holetta (Galal et al., 1979) using three experimental diets with 15:85, 26:74 and 41:59 hay-to-concentrate ratios. As the roughage-concentrate ratio increased in the diet, average daily gain decreased significantly. Differences among treatments in average daily gain was 141 q, 86 q and 49 g for diets A, B, and C, respectively. Based on the average daily gain, consumption and diet composition the average crude protein intake of diet A, 149 q, was lower than 170 g and 110 g. for diet C. Differences in crude protein intake were correlated with differences in daily gain.

Different feeding regimes indicated the dry season were investigated using two herds of indigenous Merino lambs at Balto (Galal et al., 1976). Two different feeding regimes were used: supplementing the pastures during diets were significant; average daily gain composition the average crude protein intake was 154 g for in crude protein intake were correlated with differences in daily gain. Rates 9.49% for diets A, B and C respectively. As experimental diets with 15:85, 26:74 and 41:59 hay-to-concentrate ratios were investigated at Holetta (Galal et al., 1979) using three experimental diets with 15:85, 26:74 and 41:59 hay-to-concentrate ratios. As the roughage-concentrate ratio increased in the diet, average daily gain decreased significantly. Differences among treatments in average daily gain was 141 q, 86 q and 49 g for diets A, B, and C, respectively. Based on the average daily gain, consumption and diet composition the average crude protein intake of diet A, 149 q, was lower than 170 g and 110 g. for diet C. Differences in crude protein intake were correlated with differences in daily gain.

Different feeding regimes indicated the dry season were investigated using two herds of indigenous Merino lambs at Balto (Galal et al., 1976). Two different feeding regimes were used: supplementing the pastures during diets were significant; average daily gain composition the average crude protein intake was 154 g for in crude protein intake were correlated with differences in daily gain. Rates 9.49% for diets A, B and C respectively. As experimental diets with 15:85, 26:74 and 41:59 hay-to-concentrate ratios were investigated at Holetta (Galal et al., 1979) using three experimental diets with 15:85, 26:74 and 41:59 hay-to-concentrate ratios. As the roughage-concentrate ratio increased in the diet, average daily gain decreased significantly. Differences among treatments in average daily gain was 141 q, 86 q and 49 g for diets A, B, and C, respectively. Based on the average daily gain, consumption and diet composition the average crude protein intake of diet A, 149 q, was lower than 170 g and 110 g. for diet C. Differences in crude protein intake were correlated with differences in daily gain.

Different feeding regimes indicated the dry season were investigated using two herds of indigenous Merino lambs at Balto (Galal et al., 1976). Two different feeding regimes were used: supplementing the pastures during diets were significant; average daily gain composition the average crude protein intake was 154 g for in crude protein intake were correlated with differences in daily gain. Rates 9.49% for diets A, B and C respectively. As experimental diets with 15:85, 26:74 and 41:59 hay-to-concentrate ratios were investigated at Holetta (Galal et al., 1979) using three experimental diets with 15:85, 26:74 and 41:59 hay-to-concentrate ratios. As the roughage-concentrate ratio increased in the diet, average daily gain decreased significantly. Differences among treatments in average daily gain was 141 q, 86 q and 49 g for diets A, B, and C, respectively. Based on the average daily gain, consumption and diet composition the average crude protein intake of diet A, 149 q, was lower than 170 g and 110 g. for diet C. Differences in crude protein intake were correlated with differences in daily gain.

Different feeding regimes indicated the dry season were investigated using two herds of indigenous Merino lambs at Balto (Galal et al., 1976). Two different feeding regimes were used: supplementing the pastures during diets were significant; average daily gain composition the average crude protein intake was 154 g for in crude protein intake were correlated with differences in daily gain. Rates 9.49% for diets A, B and C respectively. As experimental diets with 15:85, 26:74 and 41:59 hay-to-concentrate ratios were investigated at Holetta (Galal et al., 1979) using three experimental diets with 15:85, 26:74 and 41:59 hay-to-concentrate ratios. As the roughage-concentrate ratio increased in the diet, average daily gain decreased significantly. Differences among treatments in average daily gain was 141 q, 86 q and 49 g for diets A, B, and C, respectively. Based on the average daily gain, consumption and diet composition the average crude protein intake of diet A, 149 q, was lower than 170 g and 110 g. for diet C. Differences in crude protein intake were correlated with differences in daily gain.
The nutritive value for beef cattle fattening of rations composed of by-products was studied at Debbo Zelt (AAU 1979). Eight experimental rations consisting of wheat bran, roughage, and molasses in different proportions were evaluated with and without hay. The experimental animals were fed 7 kg of concentrate per head per day and hay was provided ad libitum for the roughage-fed group. The agricultural and agro-industrial by-products could be utilized efficiently in fattening rations provided the optimum ratio of the ingredients was determined. The effect of the roughage-supplemented and un-supplemented rations indicated that optimal results were obtained when hay was included in the diet from energy- and protein-rich feeds but should also contain roughage.

Feeding trials conducted at Debbo Zelt experimental and research center studied the effect of the addition of Trifolium hay, fed with wheat or tef straw, to growing animals, and the addition of Trifolium significantly increased the intake and digestibility of most chemical components as the proportion of Trifolium increased (ILCA 1982, 1983). A high intake by cattle but the fat percentage of milk from cows fed on oat forages fell from a norm of 4.1 to less than 2.5% after 3 weeks. The results of chemical analysis and animal evaluation of local species of Trifolium indicated that Trifolium was a useful supplement for dairy cows (ILCA 1982).

Nitrogen intake per unit metabolic weight increased from 3.1 to 7.5 g and its daily weight gain was raised from 318 to 704 g when tef straw and oat straw were either fed individually or combined and fed to sheep (ILCA 1983). The possible synergistic effects in the utilization of coarse roughage when graded levels of ryegrass showed a high intake by cattle but the fat content of milk from those based on tef. In a similar study, the effect of the addition of faba bean (Vicia faba) haulms to tef and wheat straw showed that tef straw was significantly superior to wheat straw in the utilization of Trifolium and noug meal together to growing animals, and the addition of Trifolium significantly increased total DM intake in diets based on wheat straw but not those based on tef. In a similar study, the effect of the addition of Trifolium and noug meal significantly improved the intake and digestibility of most chemical components as the proportion of Trifolium increased (ILCA 1982, 1983).

The nutritive value for beef cattle fattening of rations composed of by-products was studied at Debbo Zelt (AAU 1979). Eight experimental rations consisting of wheat bran, roughage, and molasses in different proportions were evaluated with and without hay. The experimental animals were fed 7 kg of concentrate per head per day and hay was provided ad libitum for the roughage-fed group. The agricultural and agro-industrial by-products could be utilized efficiently in fattening rations provided the optimum ratio of the ingredients was determined. The effect of the roughage-supplemented and un-supplemented rations indicated that optimal results were obtained when hay was included in the diet from energy- and protein-rich feeds but should also contain roughage.

An observational trial to determine the value of urea as a supplement to lactating dairy cows offered hay ad libitum found that cows fed a concentrate ration produced 6 litres/day while cows fed 6.3 litres/day (ILCA 1983).

The nutritive value for beef cattle fattening of rations composed of by-products was studied at Debbo Zelt (AAU 1979). Eight experimental rations consisting of wheat bran, roughage, and molasses in different proportions were evaluated with and without hay. The experimental animals were fed 7 kg of concentrate per head per day and hay was provided ad libitum for the roughage-fed group. The agricultural and agro-industrial by-products could be utilized efficiently in fattening rations provided the optimum ratio of the ingredients was determined. The effect of the roughage-supplemented and un-supplemented rations indicated that optimal results were obtained when hay was included in the diet from energy- and protein-rich feeds but should also contain roughage.

The effects of Trifolium hay, fed with wheat or tef straw and urea or noug (Guizot ia abyssinica) meal, on weight gains of growing animals were tested at the feeding station to study the feed value of locally available feedstuffs for swine production (HSIU 1969). The experiments were carried out at the experimental station to study the feed value of locally available feedstuffs for swine production (HSIU 1969). The possible synergistic effects in the utilization of coarse roughage when graded levels of ryegrass showed a high intake by cattle but the fat content of milk from those based on tef. In a similar study, the effect of the addition of faba bean (Vicia faba) haulms to tef and wheat straw showed that tef straw was significantly superior to wheat straw in the utilization of Trifolium and noug meal together to growing animals, and the addition of Trifolium significantly increased total DM intake in diets based on wheat straw but not those based on tef. In a similar study, the effect of the addition of Trifolium and noug meal significantly improved the intake and digestibility of most chemical components as the proportion of Trifolium increased (ILCA 1982, 1983).

In feeding Trifolium and noug meal together to growing animals, and the addition of Trifolium significantly increased total DM intake in diets based on wheat straw but not those based on tef. In a similar study, the effect of the addition of Trifolium and noug meal significantly improved the intake and digestibility of most chemical components as the proportion of Trifolium increased (ILCA 1982, 1983).

With special emphasis on the use of noug cake, the effects of Trifolium, Tef straw and noug cake in different proportions, bone meal and salt as the proportion of T.; tembense increased (ILCA 1982, 1983).

The nutritive value for beef cattle fattening of rations composed of by-products was studied at Debbo Zelt (AAU 1979). Eight experimental rations consisting of wheat bran, roughage, and molasses in different proportions were evaluated with and without hay. The experimental animals were fed 7 kg of concentrate per head per day and hay was provided ad libitum for the roughage-fed group. The agricultural and agro-industrial by-products could be utilized efficiently in fattening rations provided the optimum ratio of the ingredients was determined. The effect of the roughage-supplemented and un-supplemented rations indicated that optimal results were obtained when hay was included in the diet from energy- and protein-rich feeds but should also contain roughage.

With special emphasis on the use of noug cake, the effects of Trifolium, Tef straw and noug cake in different proportions, bone meal and salt as the proportion of T.; tembense increased (ILCA 1982, 1983).

In feeding Trifolium and noug meal together to growing animals, and the addition of Trifolium significantly increased total DM intake in diets based on wheat straw but not those based on tef. In a similar study, the effect of the addition of Trifolium and noug meal significantly improved the intake and digestibility of most chemical components as the proportion of Trifolium increased (ILCA 1982, 1983).

With special emphasis on the use of noug cake, the effects of Trifolium, Tef straw and noug cake in different proportions, bone meal and salt as the proportion of T.; tembense increased (ILCA 1982, 1983).

In feeding Trifolium and noug meal together to growing animals, and the addition of Trifolium significantly increased total DM intake in diets based on wheat straw but not those based on tef. In a similar study, the effect of the addition of Trifolium and noug meal significantly improved the intake and digestibility of most chemical components as the proportion of Trifolium increased (ILCA 1982, 1983).

With special emphasis on the use of noug cake, the effects of Trifolium, Tef straw and noug cake in different proportions, bone meal and salt as the proportion of T.; tembense increased (ILCA 1982, 1983).

With special emphasis on the use of noug cake, the effects of Trifolium, Tef straw and noug cake in different proportions, bone meal and salt as the proportion of T.; tembense increased (ILCA 1982, 1983).

With special emphasis on the use of noug cake, the effects of Trifolium, Tef straw and noug cake in different proportions, bone meal and salt as the proportion of T.; tembense increased (ILCA 1982, 1983).
More relevant chemical systems of feed evaluation are re
duired to make a relatively accurate prediction of the
nutritive value to the animal, and chemical analysis data
need to be combined with biological evaluation. However,
little attempt has been made as far as animal evaluation of
Ethiopian feedstuffs is concerned.

The findings of various researchers (Oyenuga 1958,
Elliot and Topps 1963, Shenkute 1972) have raised doubt as to
the reliability of tables of nutrient requirements
recommended for different types of feeds when applied to
tropical cattle and feeds. The work of Elliot and Topps
(1963) indicated that feeds were critically the nutrient
requirements of African cattle. Some attempts have been made
in Kenya to determine the protein and energy requirements of
East African Borena cattle (Karue 1977) but no attempt has been
made in Ethiopia to determine nutrient requirement of
local or acclimatized exotic animals.

In summary, the need to have full information on our
feedstuffs and nutrient requirements of our animals is a gap
which is not yet bridged. This signals how far animal
nutrition research in Ethiopia is lagging behind national
development needs.

3 Major constraints

3.1 Lack of national coordination

Individual researchers in different institutions
conduct their trials under conditions that are unattractive.
There is inadequate communication and discussion of research
conducted by different institutions. No national priorities
have been set up to guide institutions and individuals in
selecting research topics.

3.2 Lack of basic facilities

Among national institutions, only IAR has laboratory
facilities for chemical determinations of nutrients pertinent to
biodegradability. Alemaya Agricultural College has
facilities for analysis of limited chemical entities in a limited
number of samples. Except Alemaya Agricultural
College, national institutions lack animal feeding
facilities, especially metabolic cages for precise nutrition
research.

3.3 Shortage of trained personnel

Both the number of staff and the level of experience
are inadequate to make any significant progress in all
national institutions, particularly at IAR.

3.4 Financial constraint

Inadequate funds are allocated to animal nutrition
research by most national institutions.

4 Suggested strategies in animal nutrition research

4.1 Coordination of institutions engaged in animal nutrition
research. It is suggested that immediate efforts should
be concentrated on developing effective coordination
amongst researchers in various organizations in the task
of utilizing existing resources to the best advantage.

4.2 Encouraging the establishment of a national animal
nutrition laboratory staffed with well-trained
nutritionists in order to:

a) perform the necessary analysis of available
feedstuffs
b) develop suitable, well-balanced, economical rations
and ration supplements for different classes of
livestock
c) conduct demonstration trials to show the better
performance and greater economic efficiency that
can be obtained with improved rations and
supplements

4.3 Coordinating the compilation of data on the nutritional
composition of feedstuffs available in country.

4.4 Stimulating research on the improvement of the nutritive
value of crop residues, either by using legumes or by
chemical treatment to improve feed value.

4.5 Stimulating research on the nutritional requirements of
various species of important livestock; influence of
genetic and environmental differences/monitoring
nutritional deficiencies; and level of supplementation.

4.6 Approaching international organizations to get
international technical cooperation.

REFERENCES

Addis Ababa University. Debre Zeit College and Research
Center. 1979. Animal science research reports for
the period 1971-1978. AAU, Addis Abeba.

Australian Agricultural Consulting and Management Company.
AACM, Addis Abeba.

98


Euldson, O. (n.d.). Inventory of available feedstuffs and feeding system in Chilalo Awdaja Minor Research Tasks at CAAD. No. 5.


1 Introduction

The livestock industry plays an important role in the Ethiopian economy and has a crucial role in the peasant farming system. Currently productivity per animal unit is very low and underfeeding of the livestock sector to the overall economy is much less than it should be. One of the major constraints for the development of the livestock industry is feed inadequacy. Both overgrazing and malnutrition are major problems for the greater part of the country and for most of the time.

At present, feed resources are almost entirely based on natural pasture and to a lesser extent on crop residues. With the exception of sorghum, barley, and wheat until recently, and large-scale dairy farms, which use a certain amount of cultivated forages, the country is practically devoid of feed. It is estimated that natural pastures provide 90% or more of the feed and grazing grounds. Grazing occurs on permanent grazing areas, on fallow land and on cropland during the dry season. The mid-altitude subhumid zone, maize and sorghum stovers provide a considerable quantity of low-quality roughage. In some areas in the highlands wet bottenland, pastures are conserved as hay. In the lowlands, fodder conservation is almost unknown.

Conventional pasture research in Ethiopia was initiated in the mid-1960s. Since then a variety of pasture and fodder crops have been introduced. The potential of some pastoral crops has been evaluated in various ecological zones, and a number of agronomic and management trials have been conducted. However, still there are insignificant areas of introduced pastures and forage crops in Ethiopia. The maize and sorghum stovers provide a considerable quantity of low-quality roughage. In some areas in the highlands wet bottenland, pastures are conserved as hay. In the lowlands, fodder conservation is almost unknown.

2 Natural Pasture

2.1 Extent and productivity

In general, arable agriculture is the dominant land use where the average annual rainfall exceeds 600 to 700 mm. The better soils are used for cropping, and a number of agronomic and management trials have been conducted. However, in most parts of the country, seasonal areas of introduced pastures and forage crops in Ethiopia. The natural pastures are poorly managed throughout the country.

Overgrazing has resulted in serious land degradation, disappearance of valuable grasses and legumes, and spread of unpalatable species. Most overgrazed grasslands, particularly in the highlands, are dominated by Pennisetum schimperi, a coarse unpalatable grass which is grazed only in the last extreme. In some areas, it covers as much as 80% of the ground, thereby reducing the effective production to a small fraction of the potential (Blair 1970).

Although the amount of grazing areas seems to be large, the quality and quantity of the pasture is very low. Natural pastures are frequently burnt to encourage regrowth in the subsequent rains. In semi-arid areas surplus herbage is burnt during the dry season to increase with increasing altitude, and there is a wide range of valuable grass and legume species occurring naturally. The highlands are rich in pasture species, and especially in legumes. The proportion of legumes tends to increase with increasing altitude, and there is a wide range of valuable grass and legume species occurring naturally. The highlands are rich in pasture species, and especially in legumes. The proportion of legumes tends to increase with increasing altitude, and there is a wide range of valuable grass and legume species occurring naturally.
of annual and perennial Trifolium species and annual Medicago species, particularly above 2000 m.

At lower altitudes the native legumes are less abundant and commonly have a sprawling growth habit.

2.2 Research on natural pasture

Despite the fact that natural pasture is the prime supporter of the enormous animal resources, research on natural pasture management and improvement is minimal. Research results on natural pasture are inconclusive as far as applicability is concerned. On the other hand many useful interim indications and results have been found.

Fertilizer trials conducted by the Institute of Agricultural Research (IAR) and the Arsi Rural Development Unit (ARDU) at different locations in the highlands indicate that there is generally response to both nitrogen and phosphate fertilizers at very low rates (23 kg N/ha) significantly improved dry matter yield over the control, while phosphorus significantly raised the crude protein content (Forman 1975. Astatke 1983). ARDO's study suggested that the time of fertilizer application was crucial, particularly in high rainfall areas; the best time of application was before the peak of the rainy season. Studies conducted by IAR also indicate that the yield and quality of natural pasture could be improved by applying manure at the rate of 10 t/ha (IAR 1969).

To improve the vegetation composition and the nutritional value of degraded natural pastures, oversowing legumes and grasses has been tried in both highland and mid-altitude areas. Results indicated that vetches (Vicia dasvearpa and V. atropurpurea) and local clovers were successful in the highlands but none of the oversewn grasses established. In the mid-altitude areas, Desmodium uncinatum showed superior establishment, while Rhodes grass and Siratro are potential species for oversowing. In all cases the oversowing had to be done early before the start of the rainy season, and slight disturbance was advantageous over undisturbed sod (IAR 1982).

Grazing management studies on natural as well as cultivated pastures are minimal. This is mainly because grazing experiments require a lot of land and are relatively costly in terms of money and time. Grazing studies on natural pasture are minimal. This is mainly because grazing experiments require a lot of land and are relatively costly in terms of money and time. Preliminary study at Holetta indicated that highland pastures under relatively good conditions could be stocked at 2 to 3 LSU/ha from July to December. A two-year study at the same location also indicated that optimum stocking rate for year-round grazing was 10 to 15 sheep/ha (IAR 1962a, 1982b). In both studies, regardless of the stocking rate, hay supplementation was necessary during the dry period in order to keep the animals in good condition.

3 Cultivated pasture and fodder crops

3.1 Tested pasture species

Over the past 15 years several annual and perennial forage species have been tested in different ecological zones ranging in altitude from 500 to 3000 m above sea level. Research results and development testing have identified many species of herbage suitable for the various ecological conditions in the country. Climatic conditions as well as soil quality and rainfall availability are important factors. Table 1 also shows evidence of which species are suitable for the various ecological conditions in the country. Tropical species can be grown in the lowlands and in the highlands up to 2100 m; temperate species grow above 2100 m up to 3000 m. In general the introduced species yield higher than the naturally occurring species. The improved species are being widely grown in all parts of the country and have higher nutritional value. In addition the length of green feed period/growing season is longer for cultivated pastures than for native pastures.

The most promising species for the major zones are listed in Table 1. In addition to a number of species and lines of stylo, other tropical legumes, fodder shrubs, native, clovers, etc., are being tested by the International Livestock Centre for Africa (ILCA).
Although the list of species that could be successfully grown in Ethiopia seems to be long, only a very few of the species are in use. Out of the above tested and selected species, fodder oats (Avena sativa), vetches (Vicia faba L.) and fodder beets (Beta vulgaris L.) have gained acceptance and popularity in the highlands. In the mid-altitude and lowland areas, two widely used species are Rhodes grass (Chloris gayana) and alfalfa (Medicago sativa).

3.2 Establishment

For successful pasture and fodder crop establishment, thorough land preparation is essential. Large-scale development requires at least two stages of ploughing and harrowing. Depending on the soil type more than two operations may be required in some areas. This is often true in highland regions.

Establishment of pastures is relatively difficult in the highlands due to the high variability of the climatic conditions and unfavourable soil types. During the wet season waterlogged conditions, relatively low soil temperature, and reduced long- and short-wave radiation limit the establishment and subsequent growth of perennial pasture species in the highlands (Male 1995). So, in order to take advantage of favorable environmental conditions for seedling establishment and growth and to minimize weed competition, pasture seedlings are usually planted in the small rains (March and April). Seedlings must be established during the same period for more than 30 kg/ha increased dry matter production sixfold over the present N fertilizer prices. Although the list of species that could be successfully established by using root splits, herbaceous and leguminous species, such as oats or vetch, are usually planted in June, except maize and sorghum which are planted in April and May.

In perennial pasture seedlings, weeds are usually controlled by mowing or topping. This method reduces the chances of control, especially against broadleaf weeds. Conventional methods of controlling pasture are tedious and labor-demanding, especially in the highlands. Low-cost establishment methods such as undersowing or overseeding could be more economical than traditional methods. Both cereal and forage species were undersown with alfalfa, annual clovers, tall fescue, perennial rye grass, setaria and phalaris. The studies have been conducted in both the highlands and the low-altitude zone using the best food and forage crops for the regions.

In the highlands (Holetta Research Station) wheat and barley were undersown with alfalfa, annual clovers, tall fescue, perennial rye grass, setaria and phalaris. The establishment of both cereal and forage species was done at the same time. All undersown forage crops successfully established except alfalfa, and there was no significant maize yield reduction. A similar study conducted in a low rainfall area (less than 700 mm annual rainfall) was unsuccessful.

Another important method of establishing some perennial grasses is by using vegetative parts. Establishment of temperate species in the highlands is extremely difficult, particularly for those species that flower in the same year. Therefore, seedling studies have been conducted in a low rainfall area (less than 700 mm annual rainfall) with mixed success. These species were easily established by using root splits.

3.3 Management

Established pastures deteriorate rapidly and are easily invaded by weeds if proper management is not taken. To keep them in good condition encroaching annual weeds must be removed. Studies by IAR and ARDU indicate that the application of nitrogenous fertilizer on pure grass pastures in the highlands (20 kg/ha in split application; i.e., one-third of the first harvest, which is usually cut after mid-July, is used for making silage. During this time weather conditions do not permit haymaking. The aftermath growth is then used to make hay, sometimes in October. Total yield of Rhodes grass
for two harvests may be 10 to 12 t/ha dry matter. Following hay making the pasture field provides considerable grazing for about two months (November and December). In irrigated areas of the lowlands, alfalfa and Rhodes grass are very important. About eight harvests for Rhodes grass and 8 to 10 harvests per year for alfalfa are common and yields range up to 40 to 55 t/ha dry matter per year, about four times higher than the yield under rainfed conditions. In the irrigated areas Rhodes grass and alfalfa pastures are mainly used for grazing, hay and green feeding.

In the highlands, costs and vetch are very useful for green feed, hay and silage. Since oats and vetch are highly compatible they make a good combination. Because of ease of establishment and management some individual dairy farmers have now started growing oats for their animals. Annual yield of oats/vetch mixture is 6 to 10 t/ha dry matter. Because of ease of establishment and management some individual dairy farmers have now started growing oats for their animals. Annual yield of oats/vetch mixture is 6 to 10 t/ha dry matter. Another high-yielding and popular annual crop for the high-altitude areas is fodder beet. Beet is usually direct planted in the small rains or seedlings are raised in a nursery and transplanted during the main rains. In suitable and fertile soils yield of 20 t/ha dry matter can be achieved. Storage is not a problem, since the tubers can be left in the field and dug out when needed. Fodder beet is particularly suitable for individual farmers since it can be grown as a backyard crop.

Maize and sorghum are grown on some state dairy farms and research stations for silage and green feeding. In the mid-altitude subhumid zones maize and sorghum stovers provide a considerable quantity of low-quality roughage. Cereal straws of barley, wheat, and rice crop residues (horses, oats, and vetch) are also important components of dry season livestock diets in the highlands.

**5. Seed production**

Information on pasture seed production is limited in Ethiopia. Despite increasing demand for fodder and feed, seeds, this area has received little attention so far. Many of the species that grow in Ethiopia seem to have no problem of flowering and seed setting and small quantities of seed are often collected from experimental plots and uncontrolled stands of bulk fields. Preliminary work on vetch indicated that seed yields can be increased by supporting the plant on frames or fences which allow multiple harvest.

4 Application of scientific information

There is now an active expansion in the number of dairy producers cooperatives in the highlands and mid-altitude areas. These newly-emerging cooperatives have communally owned herds of crossbreed cattle which require better feeding. Hence there is growing interest in, and use of, improved species of pastures and fodder crops. Crops such as oats, vetch, fodder beet and in some cases alfalfa and Rhodes grass are grown for hay and green feeding. There is an increasing demand for seeds of these species, and it is not yet satisfied. In contrast, individual farmers are slow to accept improved species or practices. This is mainly because they give more priority to feed crop production and are reluctant to devote extra land and scarce labour to forage production. This situation was worsened by the lack of seeds of desired species and the lack of low-cost seed packages.

In Arai region, where there has been a strong extension programme, commercial vegetable species have been found. In this region of Ethiopia the package includes sale of crosses, production of fodder and feed to farmers. The package sells various vegetables, including cabbage, broccoli, cauliflower, onions and garlic, among others. The seed is mainly restricted to research stations and state farms. Common silage crops are maize, oats/vetch and in some cases Rhodes grass and even native pasture.

Extensively used forage crops in state farms are oats and set- clement areas of oats, Rhodes grass and alfalfa. These areas are mainly used to feed as hay or green feed. Species are not readily fed to animals as hay or green feed. Because of the lack of supply, there is a restriction to research stations and state farms. Common silage crops are maize, oats/vetch and in some cases Rhodes grass and even native pasture.

The use of improved forages in the present and state sector has increased from 1978 to 1984. The total amount of forage feed distributed by the Ministry of Agriculture was only 150,000 tons in 1978, which increased to 570,000 kg in 1984.

Table 2 shows major forage seeds distributed by the ministry.

Table 2. A partial list of forage seeds distributed for demonstration and development (kg)

<table>
<thead>
<tr>
<th>Year</th>
<th>Oats</th>
<th>Fodder beet</th>
<th>Rhodes grass</th>
<th>Columbine</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980</td>
<td>2,320</td>
<td>8,085</td>
<td>15,013</td>
<td>24,750</td>
</tr>
<tr>
<td>1981</td>
<td>3,120</td>
<td>11,170</td>
<td>14,105</td>
<td>100</td>
</tr>
<tr>
<td>1982</td>
<td>3,710</td>
<td>10,000</td>
<td>13,000</td>
<td>100</td>
</tr>
<tr>
<td>1983</td>
<td>4,000</td>
<td>14,000</td>
<td>15,145</td>
<td>100</td>
</tr>
</tbody>
</table>


5 Organizations engaged in forage research and/or development

5.1 Institute of Agricultural Research (IAR)

The Institute of Agricultural Research operates at three main stations (locally Holta, Dake and Melkawi, representative the highlands, the subhumid mid-altitude zones, and...
the arid and irrigated lowlands respectively. The forage sections of IAR undertake studies in species evaluation, management techniques, fertilizer responses, cereal forage crop rotations, seed production, pasture irrigation, pasture management and improvement, and Leucaena management. In 1984 there were 33 forage activities. All research is based on small plots.

5.2 Aral Rural Development Unit (ARDU)

The research activity of ARDU is similar to that of IAR but also has a strong extension component. ARDU has had considerable impact on forage development in Aral, particularly in crossbreed cattle production systems.

5.3 International Livestock Centre for Africa (ILCA)

ILCA has several programmes with a significant supportive role for forage development in Ethiopia. These are the Forage Legume Agronomy Programme, the Highlands Programme and the Systems Research Programme.

5.4 Feed and Nutrition Division, Ministry of Agriculture

The division's objectives with respect to forage are to establish policy guidelines and regulations for pasture/forage development, and to provide support to extension to promote the use of fodder crops and pasture within cooperatives. Three major activities of the division are:

a) Species adaptation trials on 117 sites ranging in altitude from 1500 to 3000 m above sea level
b) Demonstration of forage crops at 65 fenced sites on cooperative fields and government ranches. Each site has an area of 1 hectare, of which 0.25 ha is used for sown species and 0.75 ha for natural pasture
c) Distribution of fodder seeds to producer cooperatives. In 1984 the division distributed 25,670 kg of miscellaneous forage seeds for demonstration and development

5.5 Rangeland Development Project (RDP), Ministry of Agriculture

The Rangeland Development Project is responsible for the development of south-eastern and northern rangelands.

5.6 Ministry of State Farms Development (MSFD)

The livestock sector of the Ministry of State Farms conducts some applied research on sowing date, seed rate and forage usage on some of its livestock farms. Some of the farms grow oats, maize, alfalfa and Rhodes grass on a large scale for livestock feeding.

5.7 Soil and Water Conservation Department (SWCD)

The department was established in 1981 and has commenced work on 26 of the 35 million hectares that require urgent attention. The erosion control programme will involve construction of earth check dams for damming some steeper eroding slopes and the planting of forages to revegetate the surface and impede water flow. To make the proposals more attractive and acceptable to livestock producers a useful range of grasses, legumes and leguminous fodder trees are included in the planting programme. The forages will be used on a cut-and-carry basis.

5.8 Relief and Rehabilitation Commission (RRC)

The RRC has some forage development activities in settlement areas. Major species used by RRC are alfalfa and Rhodes grass. There are also reserve natural pasture areas in many of the settlement sites.

5.9 Ethiopian Seed Enterprise (ESE)

The enterprise has started producing small quantities of oats and vetch seeds. In 1984, the enterprise planted 40 ha of oats and vetch for seed production.

5.10 Forage Network in Ethiopia (FNE)

FNE was established in 1980 and includes 13 organizations that have an interest in forage development. The network's objective is to promote better quality forage research. FNE has the valuable function of increasing communication among forage scientists. With the help of ILCA, the network publishes a quarterly newsletter.

6 Manor constraints in forage research and development

6.1 Lack of coordination

There is little coordination among research institutions and organizations or between research and development organizations. Most research projects are based on locally perceived problems; there is little or no feedback from development and peasant sectors. Furthermore, the link between research and extension is extremely weak.

6.2 Shortage of seeds of required species

Since there is no forage seed-producing agency there is an acute shortage of seed, which limits forage development.

109
6.3 Shortage of qualified personnel in forage research

Presently there is a clear shortage of qualified forage researchers to tackle the numerous problems in forages.

6.4 Lack of low-cost packages for smallholders

Forage development must be based on very low financial costs to peasants if it is to have significant impact. Currently it is very doubtful whether such packages exist.

7 Research priority areas

Considering the available information on pasture research and development in Ethiopia, the following areas need further investigation.

7.1 It has been stressed that one of the major constraints for forage development is shortage of seeds of desired species. Ideal sites for seed production need to be identified and the agronomic techniques need to be thoroughly investigated. Identification of suitable seed production areas will not be a difficult task since there are 117 adaptation trial sites under the Ministry of Agriculture, in addition to those under IAR. Special attention should be paid to alfalfa seed production.

7.2 Low-cost establishment techniques must be developed to encourage farmers to use improved forages. Studies such as undersowing need to be strengthened, refined and developed for various ecological zones and farming practices.

7.3 Information regarding the economics of improved forages is seriously lacking. Recommended forage species need to be assessed in terms of production of milk, meat, etc. and an economically viable system of feeding has to be developed. This type of research can be best done on state farms where most of the required resources are already available, in order to cover the various ecological zones.

7.4 Ethiopia has a diverse climate and consequently it has a wide range of naturally occurring forage species. Collection and evaluation of indigenous species may prove useful for future forage development schemes. Special attention should be paid to alfalfa seed production.

7.5 It has been pointed out that natural pastures are major resources in the country. Since the pastures are deteriorating in both quantity and quality, pasture management and improvement programmes should be initiated in major livestock production areas. There are already some programmes within IAR and ILCA, but there should be more of such programmes.

7.6 Forage legumes provide high-quality feed for livestock and also contribute significant amounts of biologically fixed nitrogen to the soil. In Ethiopia, there are a number of well-adapted introduced legumes and also a variety of legumes native to the country. However, so far no substantial studies have been conducted to assess the potential of the most promising species, which are therefore not yet integrated into crop production systems. Research along this line, and establishment of a soil microbiological laboratory to identify and evaluate rhizobial strains, could be very beneficial.

7.7 Weeds are a serious problem in large-scale pasture development, especially under irrigation. Hence, herbicides must be screened and economical methods of controlling weeds should be developed. This will be beneficial for the major species such as alfalfa and Rhodes grass.

8 Formation of a forage team

Many of the problems mentioned in forage research and development require an integrated multi-disciplinary approach. Hence as proposed earlier during the IAR Project Review Meeting, a strong working team composed of scientists from forage agronomy, soils, weeds, plant pathology, entomology, animal nutrition, animal production and socio-economics should be formed.

REFERENCES


THE STATUS OF RANGELAND MANAGEMENT RESEARCH AND DEVELOPMENT IN ETHIOPIA

Girma Bisrat1

SUMMARY

The rangelands of Ethiopia cover about 61% of the land mass and receive rainfall from 200 to 700 mm. This rainfall is bimodal, torrential and erratic in nature. The assessment of the land resources of the pastoral areas indicates that generally the climate in all these areas is harsh, with low, unreliable and unevenly distributed rainfall and with year-round high temperatures. The spatial and temporal variation of rainfall is very high.

1 Background

In spite of their great potential, the Ethiopian rangelands did not attract development attention until the mid-sixties. In 1965, the Ministry of Agriculture carried out the first Rangelands Development Project with financial support from USAID. The programme was conducted on a range area of 900 sq miles near Yabello in Sidamo with the objective of developing and preserving the range by introducing water development and range management techniques.

The experience gained from this project served as a vital takeoff point for the formulation of the Rangelands Development Project (RDP), commonly known as the Third Livestock Development Project (TLDP).

2 The ongoing range development project

The Rangelands Development Project went into effect in 1973 with financial assistance from both the World Bank and the African Development Bank. The project was designed to rehabilitate and develop the three range areas of the southern, north-eastern and eastern lowlands of the country.

1/Rangeland Development Project, Ministry of Agriculture.
Consequently, three subprojects were developed: the Southern Rangelands Development Unit (SORDU), Jijiga Rangelands Development Unit (JXRDU), and the Northeast Rangelands Development Unit (NERDU).

SORDU covered an area of 92,000 km² which included the whole of Borena and a large portion of Arero Awraja. It had an estimated population of 480,000 of which 350,000 were pastoral nomads composed of Borena, Gujji, Somali and Arsi ethnic groups, the Borena being the dominant one. Livestock numbers were estimated at 1 million cattle, 300,000 sheep/goats and 90,000 camels.

JXRDU covered a total area of 33,000 km². It included the whole of Jijiga, the eastern part of Gursum and the northern portion of Degahabour Awrajas. The population was estimated to be 350,000-500,000 people of which the majority were semi-nomadic pastoralists of Somali origin. Estimates of the livestock population range were 400,000-700,000 cattle, 500,000-900,000 sheep and 150,000 sheep and goats.

NERDU stretched over an area of 75,000 km² in the lowlands of Wollo and Tigray administrative regions. It had an estimated population of 40,000-50,000 pastoral Afar families. The pre-drought estimate of livestock population showed a figure of 350,000 sheep/goats and 64,000 camels.

Following the project appraisal in 1975, the subprojects received a total fund of 88,733,000 birr; of this sum 63% was a loan from International Development Agency (IDA), 13% from the African Development Bank (ADB) and the remaining 24% government contribution. The projects were administered independently, with their coordination office located within the Livestock and Meat Board (LMB) in Addis Ababa. Later when LMB was disbanded they were incorporated in the Animal Resources Development Department of the Ministry of Agriculture. Of the three subprojects, NERDU was discontinued because of security problems in the area and the rest were granted extension only up to June 1984. Some programme components financed by ADB will be continued until 1986.

3 Programme components of the ongoing range development project

3.1 Range management and water development

The range development component was intended mainly to establish a longer-term range improvement policy that would serve the Ethiopian rangelands. This was to be done by improving the traditional range management system of the pastoralists through the introduction of simple but modern management systems, which would simultaneously increase the productivity of the range and conserve the resources.

3.2 Veterinary services

One of the major components of the Rangelands Development Programme is the provision of veterinary and associated services.

The major aim under this component was to prevent and control the major diseases affecting livestock in the project areas. Table 1 indicates the major diseases affecting livestock in the rangelands.

<table>
<thead>
<tr>
<th>Cattle</th>
<th>Sheep and goats</th>
<th>Camels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rinderpest</td>
<td>Tickborne disease</td>
<td>Trypanosomiasis</td>
</tr>
<tr>
<td>Contagious bovine pleuropneumonia (CBPP)</td>
<td>Haemorraghic septicaemia Anthrax</td>
<td></td>
</tr>
<tr>
<td>Foot and mouth disease</td>
<td>Internal parasites</td>
<td></td>
</tr>
<tr>
<td>Brucellosis</td>
<td>Leseness</td>
<td></td>
</tr>
<tr>
<td>Trypanosomiasis</td>
<td>Contagious caprine pleuropneumonia</td>
<td></td>
</tr>
<tr>
<td>Endo and ectoparasites</td>
<td>Anthrax</td>
<td></td>
</tr>
<tr>
<td>Black leg</td>
<td>Haemorraghic septicaemia</td>
<td></td>
</tr>
</tbody>
</table>

Mass vaccination was carried out against rinderpest and CBPP. The records of operation clearly show that this attempt has been successful, particularly in the southern rangeland where there was no cooperation from the subproject office, calf losses due to rinderpest have been drastically reduced.

3.3 Road construction

The rangelands are generally characterized by an inadequate transport network which has become a hindrance to development. One of the interventions of the project was to construct roads to open up the areas for administration and trade purposes, and to create access corridors for veterinary, extension and other project staff and thus facilitate com-

115

Table 1. Major diseases affecting the various livestock species

<table>
<thead>
<tr>
<th>Cattle</th>
<th>Sheep and goats</th>
<th>Camels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rinderpest</td>
<td>Tickborne disease</td>
<td>Trypanosomiasis</td>
</tr>
<tr>
<td>Contagious bovine pleuropneumonia</td>
<td>Haemorraghic septicaemia Anthrax</td>
<td></td>
</tr>
<tr>
<td>Foot and mouth disease</td>
<td>Internal parasites</td>
<td></td>
</tr>
<tr>
<td>Brucellosis</td>
<td>Leseness</td>
<td></td>
</tr>
<tr>
<td>Trypanosomiasis</td>
<td>Contagious caprine pleuropneumonia</td>
<td></td>
</tr>
<tr>
<td>Endo and ectoparasites</td>
<td>Anthrax</td>
<td></td>
</tr>
<tr>
<td>Black leg</td>
<td>Haemorraghic septicaemia</td>
<td></td>
</tr>
</tbody>
</table>

Mass vaccination was carried out against rinderpest and CBPP. The records of operation clearly show that this attempt has been successful, particularly in the southern rangeland where there was no cooperation from the subproject office, calf losses due to rinderpest have been drastically reduced.

3.3 Road construction

The rangelands are generally characterized by an inadequate transport network which has become a hindrance to development. One of the interventions of the project was to construct roads to open up the areas for administration and trade purposes, and to create access corridors for veterinary, extension and other project staff and thus facilitate com-

116
communication on the rangelands. The roads are mainly two types: class C and class B.

Class B road is equivalent to Rural Standard RR 30. It is suitable for traffic of between 10 and 30 vehicles per day. It is capable of all-weather use by light vehicles but is closed to heavy vehicles during the wet seasons.

3.4 Ranches, feedlots and smallholder fattening schemes

In order to increase off-take from the rangelands and help in maintaining an even flow of animals to either commercial feedlots or smallholder fattening schemes, a system was designed to grow out young male animals from the ranges until they reached a suitable age and weight for final fattening. Owing to the peculiarities of each rangeland area different systems were designed to achieve the same objectives.

a) SORDU - Background ranches
   - Stocker feeder programme
b) JIRDU - Stocker feeder programme

3.5 Training and extension

Another important component of the Rangelands Development Programme was training for project staff at various levels and for pastoralists.

With regard to the pastoralists, the main element of the programme was the training of "veterinary scouts" from each "olla" or pastoral village. They were given short, intensive courses in disease identification, reporting and vaccination under supervision, so that they could help combat the diseases in their area. They were initially paid for rendering these services and the system currently in use in the settled highlands (i.e. service without cash payment) has been introduced.

Training tours of modern government ranches were also utilized to expose the pastoralists to modern range management techniques. The trained people were in essence expected to serve as an extension arm of the project by disseminating the new ideas and techniques they had acquired among their fellow pastoralists. Payment has now ceased and the system currently in use in the settled highlands (i.e. service without cash payment) has been introduced.

Despite the effort expended in implementing this programme, its impact as a whole has not been significant.

The training designed for project staff included both technical and administrative aspects. It was provided at various levels both inside and outside the country. Although it affected only a small percentage of the project staff its importance in upgrading their skills for more efficient work is undeniable. The chief constraints that prevented the accomplishment of the objectives were security problems and the shortage of training staff.

3.6 Trials and studies

The trial and studies component of the Rangelands Development Programme was designed to conduct both technical and socio-economic investigations in the areas of operation. These were to be undertaken in order to provide information that could be used to formulate solutions to problems encountered during the execution of the project and also to support decision-making for long-term projects regarding the implementation of similar projects in the future.

The technical aspect of the investigation was to focus on range management and associated works, chief among which were:

- assessment of range productivity and vegetative change
- selection and multiplication of drought-resistant fodder species
- establishment of "fodder banks"

The socio-economic investigation was to concentrate on collection of baseline data that would aid in monitoring changes brought about by the execution of the project. Such investigations were to include studies of:

- herd size and structure
- livestock offtake
- population density
- livestock migration pattern, frequency, timing, etc.

The launching of the Rangelands Development Project was not preceded by any comprehensive socio-economic or natural resource investigations. It was therefore felt - and rightly so - that such investigations should be undertaken concurrently with the implementation of the other components of the development programme.

Achievements

Over the eight-year period (1969-1978 E.C.) a good number of achievements have been recorded. For instance in the field of water development 77 ponds with a total capacity of 1,693,865 m³ have been constructed, 3 "birkas" and over 60 shallow wells have been dug. Over 16 million animals have been vaccinated and treated against major diseases. A total of 7674 young bulls have been bought and grown in the background cooperative ranches: 5423 steers and bulls have
been bought and distributed on credit to Sidamo, Hararghe, and Bale highland cultivators. Considerable attempts have been made to give basic training in livestock disease control, animal husbandry, and management of the range through formal and informal means.

Through the trial and studies programme in cooperation with the International Livestock Centre for Africa (ILCA), several studies have been carried out. These can be categorized in three broad fields, i.e. socio-economic, ecological, and livestock studies.

The following research reports are available at ILCA:
- Cheffa Valley study: land use, vegetation and agro-ecological description
- The Borera wells. Introduction, description and preliminary information of selected Borera wells in the southern rangelands development project area
- The ecology of Sarita and Dembela Wachu cooperative ranches
- The climatic risks to livestock production in the Ethiopian rangelands
- An aerial reconnaissance of livestock and human population in relation to land use and ecological conditions in the SORDU project area of southern Ethiopia
- Calf growth, milk off-take and estimated lactation yield of Borera cattle in the southern rangelands of Ethiopia
- Rangelands management and range condition: A study in the Medecho and Did Hara areas of the effects of rangelands utilization
- Livestock marketing in north-eastern Ethiopia
- Summary of 1980-1982 climatic data collected in the southern rangelands development unit
- The southern Afar: A household economic study
- The crucial centres: Water production and well efficiency in Borera
- Ecology and ecosystems of the Borera deep well area
- The marginal lands of western Sidamo
- The productivity and potential of the southern rangelands of Ethiopia
- Furthermore, adaptation trials with grass and leguminous species in and around Jijiga area were carried out, with:
  a. 3 species of Chloris
  b. 3 species of Buelgium
  c. 3 species of Sorghum
  d. 3 species of Melinis
  e. 3 species of Setaria
  f. 3 species of Panicum
  g. 3 species of Flaccospora
  h. 3 species of Cloracia
  i. 3 species of Phaseolus
  j. 1 species of Melilotus

Based on these trials 11 grass species and 12 legumes have been selected.

5 Constraints to development

Although the project had successes in many activities, it encountered a good number of constraints that hampered its normal progress. The most important ones were:

5.1 The security problem prevailing especially in JIRDU and NERDU areas

5.2 Lack of trained manpower

5.3 The unavailability of an organized livestock marketing system that could siphon off the excess livestock obtained through intensive veterinary service and water development.

6 Future development plans

6.1 Second phase of JIRDU

In order to have a second development phase for JIRDU a general assessment of the performance of the project has been made. Based on this assessment, it is proposed that the project should not be loaded up with too many components and that the second phase should include all the lowlands of Hararghe and Bale with the exception of Kolfo, Warber, Gode, and Elkere Areyjas. Accordingly, a study has been carried out by a team of consultants and a project document is under preparation. Preliminary discussion indicated that the main components of this project will be:

a. Road construction
b. Animal health
c. Stock route development
d. Range management and land use
e. Cooperative development
6.2 Follow-up phase of Sopro

Proposals for the continuation of the development of the southern area are classified along four lines of development.

6.2.1 Completion and consolidation of the current ongoing project activities
a) Water development

It is proposed to:
- Survey the success of completed ponds and prepare guidelines for future pond construction.
- Determine the impact of completed ponds.
- Identify a social structure in the eastern project area, which could be used to assist future pond construction.
- Establish the most suitable size of ponds that can be maintained by the users.
- Introduce proposals whereby future pond construction would be partly paid for by the pastoralists.

b) Road construction

- Complete trade road between Moyale and Bokol Mayo.
- Construct 500 km of unspecific access tracks in eastern project area.

c) Animal health

It is proposed to establish three more veterinary centres and assign a further 3 animal health assistants and 10 vaccinators and train a total of 200 rangers in animal health services. After the training the rangers will return to their ollas and assist in disease control services.

d) Ranches

It is proposed that a fourth ranch should be established on the basis of suitability of its site for a services cooperative centre. It is suggested that these ranches eventually become service cooperative headquarters, with the main aim of collecting and marketing members' livestock.

6.2.2 Investigational activities

A list of proposed activities to be included in this section is given hereunder.

- The use of chemicals to improve soil water retention capacity in pond construction
- Non-mechanized methods of pond maintenance
- The use of fire in range herbage improvement
- The introduction of legumes and olla manure for improving dry-season herbage quality
- The introduction of water spreading to increase forage production
- The introduction of the use of other materials than "okole"
- The introduction of feeding supplements to calves
- The introduction of drought-tolerant crops

6.2.3 Livestock Marketing

As was mentioned earlier, the ranches will be converted into service cooperative centres whose function will be the marketing of pastoral association members' surplus stock.

The marketing of the livestock is designed to be carried out in two ways:

a) Sale of stock at the ranch by auction or contract to traders, exporters or service cooperative from highland areas
b) Movement of stock by the project along stock routes to selected markets in the highland areas

6.2.4 Organization management

It is suggested that a new department be created with direct responsibility for the lowland areas and that the separate operation of the project be absorbed into the Ministry of Agriculture. It is proposed that the department should have the following sections:

a) Cooperative development and social affairs
b) Land-use planning
c) Water development

7 Proposals for range research

As was stated earlier, 61% of the total land area of Ethiopia is estimated to be rangeland, of which the environment and the resources are very fragile. To make the best use of this resource without upsetting the ecological balance, research planning for proper utilization is vital. Unfortunately very little has been done in the ecological or
socio-economic fields. For optimal use, avoiding irreversable degradation on the rangelands, much basic information is needed to achieve the necessary objectives. The following research proposals are suggested as of high priority.

7.1 The possibilities of introducing drought-resistant forage plants, through testing for adaptability and productivity

7.2 Studies in water conservation (surface and sub-surface)

7.3 Socio-economic studies aimed at cooperative development

7.4 Exploration of water-spreading activities where this is possible

7.5 Control of undesirable brush using mechanical, chemical, and biological methods

7.6 Stocking rate trials at various ecological sites (rangeland)

7.7 Livestock improvement studies within the range environment through the improvement of weaning weight, calving interval, herd management

7.8 Assess the potential of the rangelands and their vegetation cover

7.9 Evaluation of range condition and trend

7.10 The impact of water development on range ecology, and improvement in water conservation structures

7.11 Assessment of the browse potential of the area

7.12 Complete identification of grasses, shrubs and trees

7.13 Evaluation of the nutritive value of the grasses and browse of the rangeland

7.14 The advantage of trekking versus trucking animals to the main market centres

7.15 Livestock marketing

THE STATUS OF ANIMAL HEALTH RESEARCH IN ETHIOPIA

Feseha Gebreab

1 Background information

The zoosanitary situation in Ethiopia is alarming; diseases like rinderpest and contagious bovine pleuro-pneumonia are yet to be eradicated. Foot and mouth disease is spread throughout the country with sporadic occurrences, while cases of anthrax and blackleg are reported year by year. The lowlands are characterized by heavy tick infestation. Bacterial diseases like anthrax and heartwater are common. Of the protozoal diseases, theileriosis is a big threat, babesiosis is on the rise and trypanosomiasis is a major constraint in the south and south-west with further extension into the other parts of the country except the dry north-eastern areas. Internal parasites are abundant and provoke immense losses in a number of species in both a direct and an indirect manner. Diseases associated with nutritional disorders including copper and zinc deficiencies and plant poisoning are not rare in many areas. Modern poultry production is weakened by the presence of a large number of hazardous diseases (Feseha 1984).

Control measures are impeded by lack of functional organization, funds, and full knowledge of the prevalence, epidemiology and economical impact of the above-mentioned and a number of other diseases.

The Ethiopian Department of Veterinary Services (Ministry of Agriculture) has two broad objectives.

Objective number one is to assure the survival of the agricultural community by preventing excessive mortality in the livestock on which they depend; this to a great extent depends on the development and implementation of large vaccination programmes against selected diseases. The second, a remote objective in light of the characteristics of animal production in the country, focuses on the improvement of the general welfare of the community by making the livestock industry more productive. This involves a more intensive service which can give attention to the health problems affecting the herd and the individual animal.

1.1 The priority task of the Ethiopian veterinary services is combating hazardous prevalent infections and to a degree some parasitic diseases. This is realistic, in view of the facts that:

1/Dean, Faculty of Veterinary Medicine, Addis Ababa University.
In last two decades the Ethiopian veterinary services have declined in effectiveness and some earlier achievements are in danger of reversal (AACM 1984).

- The basic functional structure of an effective veterinary service has been dismantled (Feseha 1984).
- Drought has been recurrent since 1972 resulting in the movement of people and livestock and entailing permanent danger of the recurrence of former epizootics (rinderpest, CBPP).
- Herds cross from one country to another without control, resulting in problems with regard to health regulations.

1.2 A major setback for an effective disease control programme in Ethiopia is also the limited degree of development of disease survey, investigation and diagnostic works. A functional disease control system cannot be envisaged in the absence of basic data. Therefore the launching of an effective disease reporting, investigation, diagnosis, monitoring, and evaluation system is of paramount importance. These findings will form the basis of preventive medicine schemes. In short what is actually needed is information on which to base sound extension in a range of production systems.

1.3 For the realization of the tasks mentioned under 1.1 and 1.2 Ethiopia needs different infrastructures like skilled administrative organization, a reliable vaccine production laboratory, efficient field service units, effective laboratory diagnostic services and trained manpower. To lay concrete grounds for disease control programmes has been an area of focus since 1905, the year in which the Asmara Vaccine Production Laboratory was founded (Solomon 1977).

1.4 In the years after 1905 one vaccine production and four disease investigation laboratories and one livestock disease survey and control unit were established (Solomon 1977)

1.4.1 National Veterinary Institute, established in 1939 in Gulele Addis Ababa and moved to Debre Zeit in 1963

1.4.2 Shola (Addis Ababa) Regional Disease Investigation Laboratory, established in 1973

1.4.3 Bahir Dar Regional Disease Investigation Laboratory, established in 1979

1.4.4 Bedele Regional Disease Investigation Laboratory, established in 1980

1.4.5 Wolaita Regional Disease Investigation Laboratory, established in 1984

1.4.6 Tsetse and Trypanosomiasis Survey and Control Unit, established in 1973

1.5 Four other organizations were created outside the jurisdiction of the Ministry of Agriculture, with veterinary disease investigation and research work as part of their terms of reference. They are:

1.5.1 Institute of Pathobiology, Addis Ababa University

1.5.2 Central Medical Laboratory and Research Unit, Ministry of Health

1.5.3 Ex-NAMRU (Naval American Medical Research Unit)

1.5.4 Faculty of Veterinary Medicine, Addis Ababa University

These organizations provided the network for the promotion of disease investigation and research work along lines likely to contribute to the solution of problems of practical importance. Whether the institutions have performed well with rewarding impact on extension services is a matter for discussion. One thing is quite clear: the data available so far are not adequate as a basis for policy decisions.

2 Achievements

2.1 The National Veterinary Institute (NVI) at Debre Zeit, in its 22 years of existence, has been fully engaged in the production of vaccines for animal prophylaxis uses. It has grown from an initial output of 3 types of vaccines to 15 and from a volume of 4 million doses to 28 million. Its contribution to disease investigation and veterinary research is, however, limited; the few studies conducted were primarily geared to quantitative and qualitative improvement of some of the vaccines (Solomon 1977).

Examples of works done along this line are:

2.1.1 Preservation of CBPP freeze dried vaccine strain KH3J (Alamargot 1981)

2.1.2 Residual moisture evaluation in lyophilized vaccine by Karl Fisher's method (Alamargot 1981)

2.2 In regard to disease investigation and veterinary research NVI has conducted some prominent works which deserve mention. They are:

2.2.1 A survey of the tsetse flies in Ethiopia

2.2.2 A survey of tick species in Ethiopia
2.2.3 A survey of helminths and helminthiasis of domestic and wild animals in Ethiopia
2.2.4 Study of the pathology of the dendrimer
2.2.5 Study of the pathology of equines
2.2.6 Study of the distribution of foot and mouth disease virus in Ethiopia
2.2.7 Observations on the virus of African horse sickness
2.2.8 A survey of copper deficiency problems in Ethiopia

2.3 In view of the overriding production-oriented activities of NVI, the need for laboratories with specific duties of disease investigation and research was strongly felt. To this effect a number of regional laboratories were established. The Shola Disease Investigation Laboratory came into being in 1973 with the following objectives:
- To help in the diagnosis of obscure disease problems throughout the country upon the request of veterinary staff assigned to the regions.
- To carry out specific disease investigation projects in the 14 administrative regions.

The laboratory was staffed by experts from Britain whose service came to an end after four years. Notable works performed were:

2.3.1 A preliminary report on sway back (enzoetic ataxia) of lamb in the Ethiopian Rift Valley
2.3.2 Isolation of two serotypes of Pasteurella hemolytica
2.3.3 Immunosuppression associated with trypanosomiasis in cattle
2.3.4 Maintenance of draught oxen in tsetse and trypanosomiasis areas by using chemotherapeutic agents
2.3.5 Identification in Ethiopia of Trypanosoma congolense strains resistant to pentamidine

2.4 A comprehensive and commendable survey on tsetse and trypanosomiasis has been done by W.P. Langridge (1976).

2.5 The Bahr Dar Regional Laboratory was opened in 1979 with responsibility for looking at animal disease problems of the administrative regions of Wello, Gonder and Gojam. The laboratory was manned by veterinary experts from the People's Republic of China. During the few years of their assignment in Ethiopia, they did some work in traditional herbal medicines, parasitology and infectious diseases. To cite a few examples:

2.5.1 Twenty-two kinds of herbal medicines were prepared and clinically tested.
2.5.2 Bovine parasitism around Lake Tana was investigated.
2.5.3 An attempt was made to introduce the arts and skills of acupuncture.

2.6 The Bedele Regional Laboratory created in 1980 has spent the last four years strengthening its manpower, equipment and other capabilities that will enable it to carry on disease investigation and research activities.

2.7 Of the organizations engaged in disease investigation and veterinary research work outside the administrative framework of the Ministry of Agriculture, the Institute of Pathobiology is in the forefront. In its 10 years of existence it has dealt with a number of animal health problems, of which some are mentioned below:

2.7.1 A preliminary survey of bovine fascioliasis
2.7.2 Immuno-suppression in bovine trypanosomiasis
2.7.3 Preliminary studies on albumin metabolism in sheep infected with Schistosoma bovis
2.7.4 Some aspects of anaemia in bovine trypanosomiasis
2.7.5 Production of an irradiated-larvae vaccine against dictyocaulosis
2.8 During the brief period of its stay in Ethiopia the American Medical Research Unit conducted some work in veterinary medicine. To name two studies:
2.8.1 Leptospiria survey of rodents and domestic animals in Ethiopia
2.8.2 Arboviruses in wild birds of Ethiopia

2.9 The Central Medical Laboratory and Research Unit has had a veterinary public health unit since its establishment. The main preoccupation of the unit has, however, been limited to the diagnosis of rabies in dogs and the administration of post-exposure serotherapy to humans. Fragmented and inconclusive reports on the prevalence of rabies in dogs and humans have been released on a number of occasions.
Major constraints

3.1 Absence of a responsible organization to undertake well-conceived and planned research in veterinary problems

3.2 Absence of a coordinated effort amongst existing organizations to identify and tackle the major diseases that bring about significant economic losses.

3.3 Non availability of qualified personnel at all levels to build up capacity.

3.4 Lack of essential research infrastructures

3.5 Loose organization of the National Veterinary Institute forum to coordinate and implement integrated problem-oriented research projects. There is no coordination amongst organizations like the Institute of Agricultural Research, the National Veterinary Institute, the Institute of Pathobiology, the College of Agriculture, and the College of Veterinary Medicine and related disciplines. Research undertakings and findings are therefore fragmented and isolated from the development process.

4 Future plans

4.1 Improvement of livestock health: Animal diseases of great economic and public health importance are likely to have higher heritability than that of overall viability. The opportunity to improve these traits is therefore seized to bring to the attention of Ethiopian animal breeders the need to examine with greater seriousness the prevention and reduction in view of the fact that parturient paresis or "milk fever", a possibly highly curable cause, in two or three times higher in the Jersey than in other breeds.

4.2 Development of superior animals: Breeding work should be directed to high productivity, good reproductive ability and resistance to diseases.

4.3 Better management techniques: This implies the improvement of the natural resource base. The feed base is dominated by overgrazed grasslands and improved pastures and fodder crops. Furthermore, under present management standards, improved animals are producing below their genetic potential. This necessitates the establishment of a nationwide policy to bring to an end this continued degradation in favour of forest development, pasture and range improvement, increased feed production and water resource management.

5 Important and specific reasons for strengthening veterinary disease investigation and research work

5.1 Even if selection for breeding is ideal, the hygiene good, the management biologically suitable and the diet correct, diseases can never be completely eradicated. It requires years to bring under manageable control infectious diseases, digestive disorders and problems of reproduction, even under carefully monitored management of production processes.

5.2 Diseases that are potentially damaging and that have not been identified so far in Ethiopia include various calf-killing diseases, reproductive diseases such as genital vibriosis, trichomoniasis, some leptospiral serotypes and infectious bovine rhinotracheitis (AACM 1984).

5.3 Health problems associated with poisonous plants are very common in East Africa. The few works conducted in Ethiopia indicate the existence of bovine enzootic haematuria, bovine enzootic icterus, abortion in goats due to Calotropis procera, etc. With continuous degradation of the ecosystem animals will be forced to browse on normally unpalatable and inedible plants (Pegram 1979, Shola Lab 1978).

5.4 East Coast fever or theileriosis caused by Theileria parva is a big threat. If the tick vector Rhipicephalus appendiculatus and the protozoan parasite Theileria parva gain access to Ethiopia from neighbouring Kenya by the movement of stock, the likelihood exists of an ensuing mortality equal to that of a rinderpest epidemic (AACM 1984).

5.5 The southern Africa foot and mouth disease types SAT 1 and SAT 2 have not been reported so far in Ethiopia, but their existence in the Sudan and Kenya is known. Ethiopia is therefore vulnerable to these types in addition to types A, O and C, which have already been identified in Ethiopia.

5.6 Trypanosomiasis is a major problem spread over some 90,000 km² of virtually unused good agricultural land. The recent development of state farms and settlement over some 36,000 hectares in the Anger and Didessa valleys has probably reduced the extent of tsetse infestation, but on the other hand, the tsetse has been found on the edge of an escarpment at an altitude of over 2,000 meters (660 meters is the limit known so far) in the Finha area situated about 80 km west of Addis
Abeba. These developments suggest the need for intensive surveys of tsetse incidence and ecology throughout the area (Getachew 1983, FAO 1983).

**6. Strategy for future development**

6.1 Reorganize the research structure: A well-planned organizational structure can help overcome the constraints to effective research work. Related disciplines like animal production and health protection should work together through integration, collaboration or cooperation. It will allow sharing of resources, synchronizing of efforts and working for better and more complete results.

6.2 Formulate and implement of a well-conceived plan that will facilitate research works to enhance the socio-economic development of the state.

6.3 Recruit qualified manpower as a prerequisite for the building of research capabilities: manpower of an appropriate aptitude and caliber is second to none in importance. The continuous upgrading of the skills and talents of research workers through training should be given top priority.

6.4 Provide facilities for research and promoting networks where necessary.

6.5 Make stock owners participate in the process of developing the sector though their associations with the aim of improving the dialogue between professional staff and stock owners in order to facilitate the transfer of techniques.

6.6 Promote of scientific publishing.

6.7 Cooperate with research institutions in the developed countries and with international centres.

6.8 Provide proper incentives to the staff to stay with research.

**REFERENCES**

Australian Agricultural Consulting and Management Co. 1984. Livestock subsector review. AACM.


Animal Diseases Investigation and Research Coordinating Committee. 1976. September and October minutes.
THE STATUS OF LIVESTOCK MARKETS AND MARKETING IN ETHIOPIA

Sintayehu G/Mariam

The livestock markets in Ethiopia can generally be classified into three types. In the primary or producer markets, the sellers and buyers are mostly farmers and the animals marketed are usually young bulls, being replacements for breeding and cultivation purposes. The secondary or intermediate markets are collecting centres where the sellers are small traders and farmers, whereas the buyers are bigger traders and butchers. The animals offered in these markets are slaughter and replacement stock. The terminal or consumer markets are final markets for domestic purposes. The sellers are the most exclusively big traders and the buyers are predominantly butchers. The animals traded in these markets are slaughter types consisting primarily of culled-for-age oxen and barrow cows.

The system of marketing in Ethiopia is traditional: prices are determined by the forces of supply and demand and the season of the year—the animals are bought and sold solely on eye appraisal. The trading of animals over weighing scales and according to body condition is uncommon. One government agency buys animals over the scale, however because of its limited number of purchasing centres and the relatively small volume of its purchases, its impact in fixing prices on a price/kilo basis is insignificant.

Ethiopian livestock markets are characterized by their wide dispersion and their lack of marketing facilities. Most are not fenced and even the very few that have some sort of fences are simply open standing areas for stock and people. There are no feeding or watering facilities nor any covered sales areas. There is no market information available from the country’s markets. Stock producers do not normally have any idea of the price situation because of their being only occasional sellers or buyers and because prices are usually fixed by individual bargaining with the relatively highly mobile traders.

The large number of middlemen involved in each transaction has an important role in setting prices in favour of traders. Their profit margins are normally reflected in the lower prices paid to the producers.

The small number of stockowners do not have any experience in raising cattle for markets and consequently the types of animals offered are old oxen and culled or barren cows. The reason for selling their animals is often to alleviate personal problems and to meet unforeseen expenses. The other reason is for herd replacement. The percentage of producers who make strategic marketing decisions is very low.

A study to determine the various market characteristics was conducted in 1976 B.C., the study covering the period of livestock markets. The results of two preliminary studies were conducted in the livestock markets and have to be treated accordingly.

1 Survey of livestock markets

A study to determine the various market characteristics was conducted in 1976 B.C., the study covering the period of livestock markets. The results of two preliminary studies were conducted in the livestock markets and have to be treated accordingly.

1.1 Time of sale

The time of sale extended from 9 a.m. to 2 p.m. The weight of animals was sold and purchased in the morning as well as the time of sale advanced, the heaviest animals being sold and purchased early in the day, whereas the lighter ones were sold at the end of the day. The price per kilogram liveweight continued to rise until 11 noon (birr 1.55) to return to early morning prices by the closing hour (birr 1.2).

1.2 Weight of animals

The highest percentage of the animals (32%) were in the region 300 kg liveweight followed by the 250-350 kg liveweight range (14%), 250 kg liveweight (13%), 450 kg liveweight (12%) and 500 kg liveweight category. Prices per kilogram liveweight showed a continuous rise from 2.76-3.14 as increase in weight. The price by weight correlation coefficient was 0.8.

1.3 Sex of animals

Sex of the cattle sold were castrated males with females males only 17%. The mean weights of the males and females were similar. However, the price per kilogram liveweight was higher for males than females.
liveweight varied considerably: birr 1.33 for the males and 1.66 for the females.

1.4 Age of animals

Most of the animals (60%) were full mouth, while broken-mouth made up 19%. Though 6-tooth were lighter than the older stock they commanded the highest price per kilogram liveweight (birr 1.44). These were followed by the full mouth (1.37), and the lowest were those under 18 months, at birr 0.83/kg liveweight.

1.5 Breed of animal

Most of the animals (62%) presented in the markets were of the Highland Zebu breed followed by Horro and Borena. The per kilogram liveweight price was highest for Borena at birr 2.14, followed by the Highland breed at birr 1.33. Horro were sold at the lowest price, of birr 1.17.

1.6 Condition of animals

The condition of the animals was visually assessed as very good, average or poor. Over 50% of the animals were evaluated as average while good and poor conditioned animals were practically equal in number. There was a wide range of price per kilogram liveweight for the different categories. The prices per kilogram are tabulated below.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Liveweight (birr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very good</td>
<td>2.82</td>
</tr>
<tr>
<td>Good</td>
<td>1.65</td>
</tr>
<tr>
<td>Average</td>
<td>1.37</td>
</tr>
<tr>
<td>Poor</td>
<td>1.00</td>
</tr>
</tbody>
</table>

1.7 Type of buyers

As the markets selected were terminal or close to terminal or consumer markets, most of the cattle buyers (40%) were butchers, followed by traders (34%) and farmer buyers. Farmers tended to buy the heavier animals (289 kg) followed by the butchers (266) and other buyers (257). Traders on the average paid the highest price per kilogram liveweight (birr 1.44) followed by farmers (1.37), and the lowest prices were paid by farmers, birr 1.3.

1.8 Type of seller

The majority of the sellers (66%) were traders, followed by farmers (23%) and butchers (7%). The comparatively few other (unclassified) sellers sold the heaviest animals (310 kg). Traders sold the lightest animals (232 kg). As pointed out earlier, a high price-by-weight correlation was observed, other sellers getting birr 1.6/kg liveweight, butchers 1.57, farmers 1.3 and traders 1.29. Despite a wide difference in average weight between farmers' and traders' stocks, the price differential was very narrow, confirming the feeling that farmers, besides being occasional sellers, were poorer bargainers of prices.

2 Body weight losses during trekking

A simple survey was conducted to assess the amount of body weight that trade cattle lost during trekking. The survey was conducted from Tahsas (December) to Genbot (May) 1976 E.C. The cattle were weighed initially at Guder and later in Addis Ababa, a distance of 137 km. A total of 52 cattle were involved. Trekking started on Mondays and most of the animals were rushed to Addis for the Wednesday market, while the balance reached Addis on Fridays. In all cases there was little, if any, feed provided. The findings are tabulated below.

<table>
<thead>
<tr>
<th>Month</th>
<th>Range (kg)</th>
<th>Mean (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tahsas</td>
<td>2.3-9.4</td>
<td>5.0</td>
</tr>
<tr>
<td>Tiz</td>
<td>3.2-10.4</td>
<td>7.8</td>
</tr>
<tr>
<td>Yekatit</td>
<td>0-20</td>
<td>9.1</td>
</tr>
<tr>
<td>Genbot</td>
<td>3.5-7</td>
<td>5.4</td>
</tr>
</tbody>
</table>

There was an increase in per cent loss of body weight as the dry season progressed and feed got scarcer. With the advent of the rains in Genbot, losses started to decline. There was no indication that heavy animals lost more weight than small animals or vice versa. The mean prices on liveweight basis were birr 1.07/kg at Guder and birr 1.39/kg in Addis Ababa.