APPENDIX IV

ANIMAL HUSBANDRY

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CHAPTER 1 BACKGROUND

1.1 Livestock in Ethiopia

1.1.1 Breeds and Population

Ethiopia has the largest livestock populations, i.e. 78 million grazing animals, in the Eastern African Region. Agriculture contributes to more than 55% of the GDP, of which about 40% is dependent upon the livestock sector. Thus more than 20% of total GDP but if the value of the intermediate products of livestock such as draught, transport, manure, fuel, building materials were included, the livestock GDP would be about 60% of agricultural GDP. Furthermore, hides and skins accounted for between 12% and 16% of the total export value in 1990s.

The farm animal genetic resource base is very broad and usually well adapted to its local environment; virtually unrestricted "informal" movement across national frontiers means that some genetic resources are common to neighboring countries.

Ethiopia ranks first in Africa in the number of cattle and equines and second or third in sheep and goats. Ethiopia's livestock accounted for 17% of the total livestock in Africa, which is by far the largest in Africa. Cattle are overwhelmingly the most important species in terms of biomass, i.e. 62%, which may be an underestimate in this calculation because of the large population of oxen in the national herd. They are followed by goats and sheep combined to be 21%. The total of 35.7 million TLU (Tropical Livestock Unit : 270 kg live-weight) or about 0.62 TLU per person occupy the land at a density of 3.4 ha/TLU, which ranges from 30 ha/TLU in the pastoral lands to 0.2 ha/TLU in the heavily populated areas of the highlands.

Table IV.1.1 presents the estimated livestock population in Ethiopia. It is estimated that the highland areas above EL. 1,500 m contain 75% to 80 % each of the national cattle herd and sheep flock and about 30% of the national goat flock. The range land areas contain 20% to 25% of the national cattle herd and sheep flock plus 70% of the goats which support some 12% of the total human population.

For thousands of years, Ethiopian farmers have consciously and unconsciously selected locally adapted animals. Their characteristics now are more often relevant to survival and to minimizing the risk of total loss than to high levels of production. These traditional species and breeds still dominate the livestock sector in Ethiopia.

In view of its varied climate and topographic conditions, its ethnic composition and the size of its livestock population Ethiopia is clearly a major repository of farm animal resources and genetic diversity. Little has been done to characterize this diversity other than in superficial terms. "Breeds" are thus recognized on the basis of morphology or as the name of an ethnic group or locality.

Cattle are mostly unimproved indigenous *Zebu*, *Sanga* or Intermediate *Sanga/Zebu* types. Recognized breeds include *Boran, Fogera, Horro, Sheko, Abigar* and *Danakil*.

The Boran is renowned as a beef breed well beyond the boundaries of Ethiopia. In Oromia, the most common breed is Arsi, which is small and unproductive for milk. The live-weight is around 360 kg for males and 280 kg for females. European breeds, especially *Friesan* and *Jersey* have been imported for many years and crossed with indigenous cattle in attempts to improve the productivity of the latter.

Almost all sheep are indigenous types although several breeds have been identified. In Oromia, the fat tailed *Menz* and *Arsi* types predominate. They have generally evolved under harsh conditions of health, nutrition and climate and their output is low. Males weigh about 35 kg and females, about 25 kg. However, when crossed with *Corriedale*, output in the F1 generation has improved considerably. This does not appear to have been taken up by the small holder sector, however.

Several types of goats have been identified, of which the *Worre*, *Afar* and *Abergelle* predominate in the northern Rift Valley area of Oromia. They are generally small, with the male weighing between 30 to 40 kg and the female between 25 to 30 kg.

Camels are classified according to the tribes that own them and according to whether they are trotting (racing) camels or pack camels. Afar camels are small but extremely hardy and are kept almost entirely as milk producers. Camels are generally found in the pastoral regions but sometimes come up as far as the northern Rift Valley during the dry season. The Borana camel is employed as a pack, draught and dairy animal.

Equines are generally of mixed descent and used for pack work, in the case of donkeys and transport in the case of horses and mules. They are rarely used for farm draught animals.

The national poultry flock comprises some 99% indigenous birds that are mostly managed under a scavenging system with the remaining 1% being imported exotic breeds that are usually managed intensively.

1.1.2 Productivity

Productivity of ruminant livestock and poultry is low. Meat off-take is estimated at 7% for beef and 33-36% for sheep and goats with carcass weight of 100-110 kg and 8-10 kg. Cattle do not reach maturity until 3.5-4.0 years of age, calve every other year and produce 250-300 liters of milk per lactation. As a result of per capita consumption of meat and milk is low.

Per capita consumption of all meat and milk is 7.8 kg and 14.4. liters per annum, respectively (ILCA, 1991). Under- nutrition and malnutrition, poor genetic potential and diseases are the major constraints to increased livestock productivity in the country. Inadequate government services emanating from organizational problems, finance and inadequate trained manpower have also hampered progress in the sub-sector.

(1) Constraints to productivity from nutrition:

Ethiopia's climate varies from hot arid in the lowlands to cool semiarid/sub-humid in parts of the highlands. Primary vegetation production as a livestock feed resource is variable but generally low in both the highlands and the lowlands. Crop residues contribute about 11% of all livestock feed supply but are an extremely important feed resource in the highlands. However, except during the wet season of active growth, pasture plants in Ethiopia are of low nutritive value. The seasonal nature of the rainfall leads to variation in feed quantity and quality throughout the year. Production gains made during pasture growth are totally or partially lost during the dry season as feed supplies and quality declines. Apart from weight loss and mortality of animals under more severe conditions, fertility is also reduced due to poor nutrition. The degree of the problem is higher with longer dry periods. The seasonal feed deficiencies are exacerbated by lack of fodder conservation practices. Lack of assured land tenure plays a central role in the behavior of the farmers of the highlands and their apparent lack of adherence to good land husbandry. Virtually all peasant holdings are poorly managed. This is largely the cause of the environmental degradation that is apparent almost everywhere and provides a strong disincentive to carry out improvements or erosion control measures. The present practice of feeding crop residues (which are low in quality) during the dry season would do little to overcome the nutritional deficiencies of livestock in this period unless supplemented with better quality feeds.

The inherent low nutritive value of natural pastures and crop residues are presented in Table IV.1.2. In general, crude protein (CP) content of dry forages or roughages is about 6.2% and their fiber content is 69.1 %, while green forages and roughages have a mean crude protein content of 11.7% and fiber content of 62.6%. According to ARC, a minimum of 90g CP/kg of dry matters (DM) of diet is necessary for microbial synthesis. CP content less than 90g/kg DM of diet will result in reduction in degradation of cell wall and lowered feed intake. Most of the Ethiopian dry forages can only give about 62.09 CP/kg DM of diet, which is far below the requirement. Thus, when dry forages are used without supplements, the microbial requirements are rarely met.

Similar to the low CP content, the high fiber content of Ethiopian dry forages has a considerable contribution to a reduction in their fermentation rates, digestibility and voluntary intake. According to Van Soest (1967), NDF content above 55% can limit DM intake and generally the NDF content of the Ethiopian dry forages and roughages is well above 55 % (69%) which is high enough to limit voluntary intake.

Protein- and energy-rich concentrate supplements (Table IV.1.3) can be fed but for most livestock owners it is beyond their means to afford them. Livestock production systems are extensive and often nomadic pastoralism in the lowlands and sedentary mixed crop-livestock systems in the highlands. Only the developing periurban system, which mainly produces milk, includes these supplements in their livestock rations

because of the high return on milk production.

Agro-industrial by-products produced in Ethiopia include by-products from the sugar industry, oil cakes, milling by-products, slaughterhouse by-products and brewery by-products. Quantities of these do not appear to have been reliably recorded and generally there is no well-established and reliable information on the production of the various by-products. Furthermore, in spite of the important role that agro-industrial by-products play in livestock production, use of some by-products such as molasses, brewers grains and slaughter house by-products has been constrained by

- shortage or lack of storage and transport facilities, e.g.molasses
- lack of drying facilities, which make efficient distribution and storage possible, for by-products, e.g. brewers grains
- lack of or inadequate processing plants, e.g. for slaughter house by-products
- lack of knowledge on strategic and economic utilization of by-products.

Moreover, the commonly experienced problems with agro-industrial by-products, which are widely used, e.g. milling by-products such as wheat bran, are both high cost and unreliable supply. The high costs together with the other constraints has resulted in most peasant farmers not benefiting from these products as supplements to their livestock.

Thus, nutrition of livestock in Ethiopia plays a major role in limitation to productivity.

(2) Constraints to productivity from disease

Ethiopia's livestock suffer from a plethora of biological and physical health problems. They are attacked by wild and domestic animals, arthropods and microorganisms. Drought, coupled with high temperatures or excessive rain and high humidity impose stress, exacerbated by poor nutritional status, on animals that renders them more susceptible to disease. Poor husbandry practices and inadequate veterinary services are major factors favoring the expansion of livestock diseases.

Annual direct losses due to mortality are generally estimated at 8-10% of the national cattle herd, 14-16% of the sheep flock and 11-13% of the goat flock. Economic losses from morbidity and sub-clinical diseases that result in slow growth rates and reduced mature weights, poor reproductive performance and decreased work output cannot be calculated with any degree of certainty but it is almost certain that they exceed direct losses due to mortality. In addition to reducing the amount and quality of livestock products the prevalence of many infectious diseases excludes the country from many international markets and limits the capacity to increase foreign exchange earnings.

Black quarter, anthrax, haemorrhagic septicaemia, foot and mouth disease, sheep and goat pox, lumpy skin disease, African horse sickness, contagious bovine

pleuropneumonia (CBPP), Peste des petits ruminants (PPR), rabies, contagious caprine pleuropneumonia (CCPP), Newcastle disease, fowl cholera, cocciodisis, malignant catarrhal fever and camel pox were among diseases reported in 1997. Tsetse-transmitted trypanosomosis is enzooitc in the southwest and northwest.

A wide spectrum of tick diseases is present in Ethiopia and the causal agents of babesiosis, anaplasmosis, heart water and benign theileriosis are ubiquitous. In many areas these diseases are enzootically stable with the results that clinical cases are relatively rare.

Rinderpest has been eradicated from Ethiopia with the assistance of a national vaccination scheme but there remains the threat of re-introduction from Somalia and southern Sudan, where the disease persists and can be carried in by nomadic pastoralists's cattle. The other diseases smoulder in specific areas and vaccination is carried out when there is an outbreak in an area.

In the northern Rift Valley area, anthrax, blackquarter, CBBP, rabies, lumpy skin disease, haemorrhagic septicaemia, Newcaslte disease and coccdiosis are endemic with sporadic outbreaks but foot and mouth disease is not considered a major threat in this area.

The National Veterinary Institute (NVI) produces and supplies most of the vaccines needed in the country. Acaricide application using sprays is the method most commonly used by animal health posts and clinics for tick control. Because of the existence of enzootic stablity among indigenous stock the role of ticks as vectors of disease agents is of less significance than their effects on milk production and the quality of hides and skins. Animal health clinics have until now also been responsible for providing antihelminthic drugs, which are most required in irrigated areas and areas with large bodies of water, where animals graze and drink in large numbers and where flukes and roundworms are a serious menace. However, the drugs have become expensive and their access, increasingly unreliable. Cost recovery has recently been implemented but not enough to ensure reliable supplies.

While all classes of livestock may experience malnutrition during dry seasons and starvation in drought years, in the Rift Valley system, copper deficiency is recognized as a serious problem in lambs and kids (Roeder, 1980).

(3) Constraints to productivity from public extension and veterinary services

The Animal and Fisheries Resources Development and Regulatory Department of the Federal Ministry of Agriculture is the major public institution supporting this sector. The federal constitution resulting in handing over of many technical and financial functions to the Regional States has meant that weak support for the agricultural sector as a whole has weakened every further. Both federal and regional agriculture and livestock departments receive hopelessly inadequate budgets from the Government. The ratio of DA (development agent) to farmers in the East Shoa zone

is currently one to three hundred. Research services are largely divorced from the line structure of the Ministry and integration with extension services is minimal.

Extension and dissemination in livestock management has been further undermined by a government policy of a major thrust towards crop production. Field extension workers have, as a result, been largely occupied with matters concerning crops and not with livestock.

There has been a great deal of multilateral and bilateral support for livestock by the World and African Development Banks, by the European Union and by many bilateral donors. In addition to pastoralists and farmers there is considerable private sector activity in the marketing chain but Government still interferes in slaughter and processing, although the infrastructure is nominally to be privatized. A new livestock strategy has been prepared by the Government wishes to put more emphasis on development in the pastoral areas, on expansion of dairy production in the high and mid-altitude regions, which in three zones, has been the most successful livestock development program in the country and on the whole marketing system which has been comparatively ignored in the past.

(4) Comparative advantages in Ethiopia for livestock production

The comparative advantages of Ethiopia in livestock production are a long history of livestock raising, its very broad range of animal genetic resources, the low costs of production and , assuming problems with its neighbors can be overcome, proximity to regional markets.

1.2 Livestock Industry in Ethiopia

1.2.1 Overview of Livestock Industry in Ethiopia

Ethiopia is not self-sufficient in food, particularly in livestock products and is a net importer of agricultural produce. The latter situation is largely due to little importance attached to livestock as a primary agricultural industry; in fact, it could be classified as a secondary industry, meeting only 30% of the country's requirements. This is exacerbated by

- Prevalent of drought resulting in persistent loss of animals
- Large herds or flocks kept as insurance against drought or disease yet with little input in management or nutrition and especially in conservation of grazing resources. Average dressed weight of sheep only 10 kg from a 25kg mature animal compared with 20 kg from a 50 kg commercially produced lamb.
- Absence of an effective animal movement control system has greatly enhanced the widespread dissemination of dangerous diseases and posed serious difficulties in instituting sound disease control strategies. Various proclamations and legislation issued in the late sixties and early seventies failed to address new developments in animal health such as policy reforms, international commitments and technical requirements.

- Lack of infrastructure of transport, distribution and marketing of livestock products outside a radius of 150 km around Addis Ababa. Transport and distribution of milk is provided largely by the Dairy Development Enterprise to a small number of small-scale commercial farms, which have cross bred dairy cattle and use AI. These are concentrated largely in Selale to the north of the city.
- Little or no investment in commercialized livestock farming, while the prevalence of household supply of meat and milk in small urban and rural areas are still high. There, most consumers of meat still prefer to slaughter an animal in their own back yard, keep their own layers and milk their own cows. There are no longer any large beef feed lots and only a few large broiler and layer enterprises. Cultural strictures have prevented any development of the pig industry.
- Inadequate state support for upgrading of cattle in the small holder livestock sector, where cattle are raised mainly for draught power (cattle breeds are predominantly *Zebu* or *Borana*, neither of which are good milk producers). Accordingly, on a national basis, veterinary and animal husbandry extension services are poor compared to that of crop and horticultural extension.
- No farm tenure and natural pastures grazed on a communal basis, hence no collective will to care for, or improve, grazing lands, for improved productivity of animals. Most livestock owners are pastoralists to more or less degree. Land is given by Peasant Associations, under government administration, to the farmer. However, the farmer cannot sell it or borrow capital, using land as collateral although there are a small number of credit schemes which allow livestock as collateral or have been established among groups of women using their own funds. Generally, therefore, there are serious constraints on investments in farm improvements even if the will is there.

Notwithstanding these limitations to livestock development, local demand is high for meat and milk and livestock commodities fetch good prices on a free market: -broiler chicken, 18 Br/kg; beef, 12-25 Br/kg (price dependent on fat coverage); milk 2.50Br/lt

There is also a good market for both cattle and sheep in the Middle East, with 42,600 sheep exported to Saudi Arabia so far in 2000 (The Daily Monitor, 4th October 2000). Some 60% of all exported sheep and cattle from Berber to the Middle East come from Ethiopia. Beef is the preferred meat over mutton or chicken in Ethiopia. In addition, hides are highly valued for thriving industries in tanneries, shoe and leather coat manufacturing. Leather is exported to Europe and Japan. Appropriate slaughtering technology is therefore being encouraged in abattoirs and butcheries in order to preserve hides. There is also a good market for milk and milk products in Addis Ababa with the population of 2.5 million and the large towns with average population of 250,000, where no more than 30% of the demand is being met.

1.2.2 Beef and Draught Power

(1) Production

Mean output per unit of total weight carried is low. This is not only because a large proportion of the cattle herd in the highlands is draught animals but also because of slow growth rates and the fact that the animals are often in poor condition at slaughter. Dressing percentage of carcass weights to empty body weight is usually well below 50%. Carcass weights of cattle killed through official channels averaged 167 kg in the early 1990s with deboned meat representing 58% of the carcass weight or 28% of the live weight. Carcass weights of cattle killed "unofficially" are estimated at 135 kg. This results in poor output per livestock unit: 7 kg choice beef compared with 50 kg from a commercially produced exotic breed steer, with average dressed weights of 110 and 240kg respectively. In the lowlands, oxen are less important in the meat production equation but the other two factors also pertain in this area. In addition, economic losses in the official abattoirs resulting from condemnation of affected organs and carcasses due to hydatid cyst and cysticercosis are significant.

The main function of cattle in the highland mixed farm economies is undoubtedly the provision of power. The overwhelming demand for oxen in these systems has a distorting effect on all other cattle production functions, even in the lowlands which act as reservoirs of drought stock. Herd composition varies as a function of the need for draught. The national herd probably comprises about 25% oxen but the proportion varies in the range 2.6-32.1% depending on the importance of agriculture and ox fattening as presented in Table IV.1.4.

In spite of their importance in farming systems, oxen work only a short period. One estimate is of 120 days a year of which 93 ploughing, 21 threshing, 5 for transport and 1 for other work. The average working day for an ox is about 5 hours but it takes many breaks in this period. Power output per ox is low because of the generally weak condition they are in during the main working seasons and because they are of relatively light weight. In addition to these biological constraints on the work efficiency of oxen there are social ones that are associated in particular with the culture and tradition of the Ethiopian Highlands. Even during peak periods work oxen are used for only about 75% of the possible time and have to take enforced holidays on the several days a week when their owners are not allowed to do certain kinds of work for religious reasons (de Leeuw, 1992).

(2) Constraints

Very limited attempts have been made to upgrade beef breeds through cross breeding indigenous stock with exotic breeds. The largest and longest beef breeding program was the Boran improvement work of Ministry of Agriculture at Abernossa in 1960. The station initiated the breeding work with the introduction of 350 Boran females and 12 bulls from the Borana region of Ethiopia. The aim was to develop an

improved animal in terms of size and growth rate. However, relatively little use has been made of the records and no attempt has been made to follow a program of performance testing or a scheme to maximize selection. This illustrates the lack of interest by livestock owners in beef as a production system since the predominant use for males is as draught oxen.

The market for beef by most Ethiopian consumers is very fatty meat, such as would be achieved through old, fattened oxen. Thus the system of fattening old oxen suits the market and there is little demand, except from a small population of urbanites, for the tender, low-fat beef from feed-lot finished, young steers.

(3) Marketing.

There are no large commercial abattoirs, only small butcheries which buy animals on the open market and a municipal abattoir in Addis Ababa which handles 700 animals a day when it has capacity for only 150 a day. To facilitate marketing stock routes, holding areas and market places have been developed. Estimates indicate that 83% of the cattle and 94% of sheep and goats offtake in the country are backyard slaughters (FAO, 1992). In order to discourage such practices and facilitate efficient and hygienic slaughter services, 87 municipal abattoirs have been constructed through different programs. Further, to add value to meat, six industrial meat plants and one abattoir have been established near to the major livestock surplus areas. These industrial facilities with annual slaughter capacity for 324,000 head of cattle and 240,000 head of sheep and goats produce a range of products for urban supermarkets and hotels and to a limited extent, for export.

Livestock marketing typically follows a 3-tiered system with small (less than 500), medium (500-1000) large (above 1000 head of cattle /week) markets through which animals pass from farmer to small traders and then larger traders. Although livestock may be sold or purchased at different places, a total of 124 markets (FLDP, 1991) have been designated as permanent livestock markets in the country. Livestock are sold by bargaining between buyers and sellers for individuals or group of animals.

There are two types of domestic market flows, namely concentrated flows centered on Addis Ababa, Dire Dawa areas and to a lesser extent to Gondar, and second, a diffused movement in which livestock move between adjacent surplus and deficit areas throughout the country (FLDP, 1991). Movement of livestock through the domestic marketing chain is principally by marketing while exports leave by sea, air and rail. However, Ethiopia has a very weak export market for cattle, though the potential is immense. So far, the effort made to penetrate the export market has remained very low and unsuccessful. The Middle East countries import live cattle from afar as Australia, New Zealand and Argentina, whereas Ethiopia at a very close range is only able to sell intermittently, since disease very often halts movement of livestock in this direction. Another reason is very likely that the quality (tenderness) of beef is greater from these three countries than from Ethiopia.

Despite continued efforts made by the government to improve and develop livestock (in particular, cattle) marketing infrastructure, there are many deficiencies, which have not been addressed. These shortcomings are:

- poorly equipped and disorganized livestock markets, perimeter fencing, water supplies, scales, offices, public latrines;
- shortage of specialized transport vehicles;
- absence of market information and promotion
- under- utilization of developed stock routes; instead, traditional routes which are parallel to the highways are followed;
- absence of livestock holding areas for the private sector;
- inadequate number of abattoirs/slaughter houses compared with the off-take size and
- under-utilized capacity of meat processing plants.

Demand for meat increases during religious festivals, wedding seasons and harvesting periods. During the Lent (fasting), there is a period of low demand.

Preference for meat type follows the distribution of livestock. In the highlands, where goats are not common they are less in demand, while sheep, which are common, are preferred. Both sheep and goats are consumed in the rangelands. Beef is popular in all areas, preferred to sheep in the highlands but consumption occurs according to availability in the region.

(4) Research and development.

Post weaning growth of local Boran and Horro breeds and their crosses with Friesan, Jersey and Simmental exotic breeds have been recorded under a variety of management conditions. Average daily gains varied widely between 0.28 kg and 0.59 kg according to different factors considered. Friesan and Simmental crosses consistently grew faster than the indigenous breeds. Under fattening experiment using native hay and concentrate crosses of Simmental, Friesan and Jersey steers gained an average of .132, 1.29 and 1.1.4 kg body weight per day, respectively, whereas pure Boran and Barca steers gained 0.65 and 0.73 kg per day, respectively on the same ration (O'Donovan *et al.,* 1978).

These results suggest that improved off-take and quality of beef can be obtained from crossbred oxen produced through the dairy production sector. In Salale, a cross-bred ox can fetch up to 7000 Birr compared with 700-900 Birr for an indigenous ox on the livestock market.

Under the present land tenure system and increasing pressure on grazing, it is not likely that productivity of natural pastures can be improved through grazing management schemes or planting improved pasture grass species in the small holder sector.

There is potential for large commercial cattle breeding or feed lot ranches if land is made available for purchase by private farmers and tenure is secure. Then it would be

possible to carry out correct pasture management and operate feedlots on grain and agro-industrial by-products as well carry out strict veterinary control and herd health programs. From this, beef of a quality high enough to attract export markets can be produced. Establishment of private, large scale commercial oriented breeding ranches should be encouraged and supported not only for the improvement of supply of beef but also as good markets for off-take of breeding cows from the pastoral areas which would be bred to exotic bulls such as Simmental or Aberdeen Angus. This allows for reasonable and stable prices to be offered to peasant livestock owners and would encourage reduction in herd sizes leading to reduced pressure on grazing. In the same vein, large scale feed lot owners would pay good prices for cross-bred weaners or young bulls, so guaranteeing a stable income to such cattle owners. Stability of such markets decreases the need for cattle owners to keep large herds as insurance against drought or crop failure and this in turn decreases the environmental degradation brought about through overgrazing.

For the small holder livestock owner, development can concentrate on both improving beef quality through cross breeding such as in the dairy-farming areas and on improving nutrition to beef cattle (oxen).This can be done by:

- Developing and strengthening improved techniques on efficient collection, treatment, storage and utilization of crop residues and agro-industrial by-products;
- Production of high-yielding and high-quality forages on a protected area of the arable land, which can be conserved to ensure year-round feed availability. Where irrigation is available, irrigated forages should be promoted.
- Promote the utilization of various techniques such as inter-cropping legumes with furrow crops such as maize or sorghum.
- Establishment and operation of mobile abattoirs and meat factories at suitable sites to process as much meat and meat products as possible.
- Providing effective training to farmers on marketing, in particular selection of channels most beneficial to them.

1.2.3 Dairy

(1) Production

Ethiopia is not self-sufficient in milk and has to import large quantities, i.e. 486,500 tons in 1998 of milk and milk products at a cost of nearly US$500 million. At the same time, average per capita consumption has fallen from 30 kg (whole milk equivalent) in 1970 to 27 kg in 1990.

The dairy cow is an efficient converter of fibrous feeds into milk, the most nutritious food known to mankind. Milk and milk products are valuable sources of protein and are essential to the well being and development of children. In terms of nutrients and protein production for human consumption, dairying is more efficient than either beef or sheep farming. The principal opportunities of dairy development results from a growing demand combined with an existing large livestock population and related

husbandry skills. Dairy production in the mixed farming system is attractive, since it offers the opportunity to diversify operation, to spread risks and to provide a regular income.

This explains why dairy production as a means of meeting human nutritional needs and improving the farmer's income and living standards has taken priority in the livestock development strategy presently being formulated by the Ethiopian Government.

Indigenous cow reproductive careers in all of Ethiopia's livestock production systems are characterized by late ages at first parturition, long intervals between births of successive calves and low numbers of calves per lifetime. Overall calving rates assessed in several studies at 45-55 % a year implying a calving interval of two years. Calving is seasonal in most areas of the country and differs between regions; although the picture is not absolutely clear it is most likely that conception is related to rainfall and thus to the availability of feed and cow nutritional status.

Five (5) species of indigenous animals have been evaluated for their dairy merit, although this was carried out under controlled management as presented in Table IV.1.5.

The low level of milk production from indigenous breeds/types led to a cross-breeding work in research and development program, aimed at increasing the milking capabilities of local cattle. Different institutions were involved in cross-breeding studies. It was shown at Alemaya University of Agriculture that under optimum levels of feeding and management, average milk production of pure Friesan and 50% cross-bred cows were 4654 (range 3675 to 6340 kg) and 2904 (range 2086 to 4116 kg) in a 305 day lactation period, respectively (Wells *et al.,* 1969)

In an IAR trial, three indigenous breeds used in the initial investigation were crossed with three exotic breeds (Friesan, Jersey and Simmental). Comparisons were made at four (4) locations

Holetta in the cool highlands, Bako in the sub-humid mid-altitude zone, Adami Tulu in the semi-arid mid-altitude zone and Melkawerer in the lowlands. The effect of sire and dam breeds, and genotype x environment interactions, were assessed from contemporary comparison of local, F1, F2 and ¾ exotic genotypes. The result showed that Friesan, Simmentaal and Jersey crosses with exotic blood levels of 50 to 62.5 are appropriate for smallholder dairy production under Ethiopian conditions (Beyene, 1992), as presented in Table IV.1.6.

Under farm conditions, estimates of mean daily milk off-take for human consumption are about 1.3 kg from local cattle and about 3.8 kg from cross-breds. It is likely that mean daily off-take is inversely correlated with the number of breeding females in the herd and the number of cows in milk. FAO estimates that almost 750,000 tons of milk are produced per year from the national herd. The Ministry of Agriculture estimates that only 0.3 % of the national herd is improved or cross-bred dairy animals. In the areas of the country (by far the largest) where there is no dairy development,

milk is essentially a by-product of the traditional draught /beef herd with seasonal production peaks coinciding with the main rainy periods.

The major development in cross-bred dairy cattle is attributed to the introduction of artificial insemination (AI). The first importation of exotic semen occurred in the late 60's. All institutions involved in cross-breeding experiment or development work has used AI, but the most significant development was the establishment of the Artificial Insemination Center (NAIC) in 1981. The NAIC was established with the objective of promoting and coordinating AI activities aimed at improving dairy production in the country. From 1984 to the end of 1991, the center collected a total of 257,000 doses from 73 bulls, mostly of Friesan origin. The center has projected capacity to do 40,000 inseminations per year. In addition to the Kaliti center, which runs two liquid nitrogen plants, two bull studs, a modern semen processing laboratory, NAIC operates a sub-center at Assela, with a small liquid nitrogen plant and a stud for young bulls.

The second source of cross-bred cattle has been the MOA distribution scheme. Multiplication centers have been located at Arssi Rural Development Unit, Cillalo Agricultural Development Unit and Abernossa Ranch, where Boran cows are inseminated with Friesan semen. Between these three farms, a total of 8000 cross bred-heifers (50%) have been produced and distributed.

In an attempt to overcome the huge deficit in milk and milk products in the country, the government established in 1970, the Dairy Development Enterprise (DDE). This comprised ten state dairy farms, all within 120 km of Addis Ababa, supplying a dairy processing factor in Addis Ababa. The state dairy farms manage an average of 90 milking cows, of between 75 and 87% Friesan cross Zebu. The average production per farm is 750 liters a day. Judging from a visit to one of the farms management is good and the operation is viable as feed is based on improved pastures and irrigated forages and silage; however, the profitability is constrained by central control and poor producer price for milk. The DDE is due to be privatized and potential for viability of each farm when managed by a private investor is very good, provided the formal collection and marketing sector remains stable, i.e. the processing factory is updated and efficiently managed by a private investor.

In the peri-urban perimeters, especially around Addis Ababa, Debre Zeit and Nazareth, private dairy farms with an average of 50 cross-bred cows are becoming established. These are farms usually owned by retired businessmen or civil servants and little is known of their numbers or impact on the market but at this stage it is not likely to meet more than 1% of the demand. It is assumed that butter and cheese are produced on the farms and retailed in the urban centers. Also, in the cities and towns themselves, there are many households which keep one or two, usually cross-bred, cows in their backyards. Milk and dairy products is sold from these houses on the streets and again, little is known of the size of this informal sector. In terms of public health, there appears to be little or no control over the production and sale of milk

and dairy products.

Bilateral assistance from such countries as Canada, Finland, Norway, Sweden, Switzerland and the United Kingdom has been a very important factor in the introduction of new breeds and technologies for the purpose of dairy development. The contribution of NGOs, in particular in support of small holder dairying, field animal health services and pastoral community development has been a major factor in development.

A Smallholder Dairy Development Project supported financially and technically by Finland has been in operation from 1996 until recently, when Finnish support ended. The objective has been to raise the standard of living of smallholder rural families by introducing improved dairy farming systems and marketing innovations. The project addresses production through the introduction of cross-bred animals (mainly through AI and "project bulls"), encouraging better feeding and management (forage, tree crops , water, veterinary drugs and services) and the provision of infrastructure, equipment and training to empower farmers to collect, process and sell a full range of dairy products including fresh milk, butter, skimmed milk and cottage cheese on the open market. Farmers were first provided with cross-bred heifers bred at state farms, at a highly subsidized price of Birr 1500 as compared with Birr 3000-5000 on the open market. Subsequently, as dairy farming expanded within a community, heifers, bulls and oxen all became available from farmers themselves but at the open market prices. The dynamic of this is particularly evident in Salale where the smallholder dairy development project has been the most successful. There, after only five years, 15,000 farmers are now dairy producers with 40,000 cross-bred milking cows. Project bulls were given to farmers on a credit scheme whereby the bull had to provide free service until 50 calves were born. Full ownership of the bull was then handed to the farmer who could then charge for the service or even sell the bull to buy another one to prevent in-breeding. The Dairy Development Programme is active in 15 wareda (districts) in Amhara, Oromiya and SNNPRS. More than 75% of farmers apparently achieve lactation yields of over 1800 liters. Farmers generally milk once a day in the morning for milk delivery to their marketing cooperative and in the evening for the calf and family use.

While donor support for the DDP has ended, the Smallholder Dairy Development Program continues in the relevant regional agricultural bureaux. Technical support for established projects is funded through revolving funds sourced from credit schemes for the farmers and remains of high standard. However, new projects require sourcing of new donor funds.

The International Livestock Research Institute (ILRI) at Debre Zeit has been actively involved in small-holder dairy production through producing and distributing appropriate species and accessions of forages to the dairy project areas, research in feeding and management of cross bred cows and calves and dairy technology and in training of farmer groups in testing and processing of milk. In this way, ILRI has

provided good support to the SDDP.

(2) Constraints

The two major constraints to significant expansion of smallholder dairy development are supply of cross-bred heifers and feed.

Notwithstanding the marked increase in cross bred cattle within the communities presently involved in the dairy development program, national demand for cross-bred heifers still exceeds supply and far exceeds what the state farms can supply. The state farms tend to supply heifers to new project communities to allow establishment of dairy projects. Imports of cross-breds from Kenya have been stopped due to the perceived risk of importing East Coast Fever.

The major constraint with feed for dairy cattle is not the lack of feeds but lack of knowledge on how to produce and conserve high quality forages, treatment and storage of crop residues and use of agro-industrial products as supplementary feeds for consistent, high quality rations throughout the year. Dry season feeding is a big challenge, particularly in the marginal areas with low or erratic rainfall, and where arable land for forage production is severely limited. This can be overcome with the use of irrigation on high yielding, high quality forage crops and the use of effective, low-cost conservation techniques. The technology requires a high input of extension and dissemination, which is a constraint in itself with the lack of trained extension field workers.

(3) Marketing.

Demand for fresh milk in urban areas is strong and will continue to increase with the high rate of population growth in cities and towns. According to a dairy marketing survey study's projection (DDE,1994) in Addis Ababa alone, there is about 43,000 litres of excess demand for liquid milk over the next five years daily.

In the highland periurban dairy farming system (around cities), milk is mainly channeled through an informal (traditional) marketing sub-system in which producers sell directly to consumers and the formal (official) marketing sub-system where milk collection, processing and distribution is carried out systematically. The organized marketing sub-system is dominated by the Dairy Development Enterprise (DDE), which has the largest dairy processing factory in Ethiopia, situated in Addis Ababa. This factory produces fresh milk, yoghurt, cheese (including Gouda cheese), butter and cream. The factory - which is on the privatization list along with the state farms- can process 60,000 litres of milk a day but due to inefficiencies and aging machinery, daily processing only handles about 8,000 liters a day. Recently a private processor (Sabeta Agro Industries - Mama milk) has also begun operations. Both processors offer chilling centers in the main dairying areas, where milk can be delivered and stored for collection; however producer price is low and not attractive to small holder dairy farmers.

In the rural areas, access to markets was always the major constraint to small holder dairy development. Consequently, the SDDP promoted local processing and marketing by groups (marketing cooperatives) of small-holders on the dairy projects, by assisting farmer groups to build "milk units", where their milk can be delivered, processed and sold to traders, passing transporters and the public in general. Local processing and marketing of dairy products provides the cash and encouragement needed to ensure that development is sustainable and offer greater returns than producer prices paid by the two major processors in Addis Ababa. Prices paid for raw milk by the farmer-owned processing units varies by district but is somewhat in excess of Birr 2/litre, which is a viable price for improved dairying. In addition, the farmers belonging to the marketing cooperative (which sells though a processing center built by the cooperative known as a milk unit) share in the profits made by their unit on sales of butter, cheese and yoghurt. The milk unit generally employs two farmers who are trained through the SDDP on milk testing, processing and business management, to operate the milk unit. Representative committees, who are elected by the producers, set prices for raw and processed milk and dairy products. This prevents exploitation by the "middle man" or traders who buy cheese and butter from the milk units to sell in Addis Ababa.

(4) Research and Development

The main aims of research in the field of dairying are:

- Providing guidelines for dairy breeding (based on cross breeding) policy for different agro-ecological regions;
- Developing feeding systems that would allow effective dairy production in the low-potential areas of the country through:
  a) identifying and developing improved forage species suitable to semi-arid and arid environments
  b) identifying and developing pasture and forage species for irrigation;
  c) improving utilization technology of crop residues
  d) improving utilization of various techniques such as inter-cropping, under-sowing and water harvesting to increase forage crop production.
- Determining improved labor saving low-cost technology for processing milk.

1.2.4 Sheep and Goats

(1) Production

Sheep:

Reproductive performance is usually well below the optimum and the genetic potential. Nutrition and disease, especially internal parasites, are constraints to better reproductive performance. Late ages at first parturition, long intervals between lambings and low life output of young are problems similar to those of cattle but most Ethiopian sheep have very small litter sizes. A large proportion of barren or infertile ewes (perhaps 20% overall) also reduces reproductive performance in the national flock. Poor reproductive performance has repercussions on flock structure as owners

maintain older animals, especially in the lowlands, in a desperate attempt to get more lambs: although this practice may be marginally beneficial to individuals it has a negative community effect as it contributes to the maintenance of unproductive animals and to overstocking.

Milk is a minor product of sheep in the highland mixed farming areas but is of varying importance in the pastoral areas. Sheep milk is so valuable in the Afar homelands that most male lambs are killed at birth- with consequent effects on flock structure and subsequent off-take for meat - in order that more milk can be available for human use.

Weight gain is relatively rapid in the early stages of growth but overall can be considered to be poor; Afar sheep gain only 90 g / day to six months of age. Carcass weights represent about 40-50% of empty live weight in sheep of average to fair condition but may be as low as 35% in animals in poor condition. For most breeds, the average carcass weight is thus in the range 10-12 kg with exceptional carcasses weighing 15-18 kg.

Mortality rates in young stock are high. Pre-weaning mortality of 25-30 % are not unusual. Annual mortality rates in animals in animals 6-15 months old may be as high as 15-18 %. Adult mortality averages about 8-10 % per year.

Goats:

Goat reproductive performance is usually better than that of sheep. Ages at first parturition may be 18 months. Because of their feeding habits goats are less affected by nutritional fluctuations than sheep and tend to have shorter intervals (8-10 months) between parturitions. Litter sizes may average 1.4 young over the national flock with the Nubian types in the north being especially prolific. The Afar goat has a very small litter size.

Local does in parts of the highlands where they are milked produce about 55-60 litres of milk over that taken by the kids in a lactation period of 130-140 days. Children are given priority for goat milk. However, it does not appear to have any part to play in the semi-arid areas at mid-altitude. In the highlands, the use of exotic bucks on local goats, for example the Anglo-Nubian as practiced by the FARM-Africa project, more than doubles milk yield in F1 females and most of this is sold to increase household incomes.

Native goats other than Afar have birth weights of about 2.6 kg. In the Highlands, goat live-weight average daily gain is 120 kg up to 12.6 kg at 6 months. ADG of Afar goats on the other hand is only 45 kg /day to six months of age.

Mortality rates in young stock are very high. Pre-weaning mortality of 30-35 % are not unusual as in sheep, up to 20% in animals 6-15 months old.

(2) Constraints

The major constraint to commercialized goat or sheep production is cultural. Goats

and sheep are kept for insurance against drought and sold in hard times and in the holiday season. Therefore, in most of the country, especially the lowlands, it is unlikely that goats and sheep would be given any priority for feed or any managed feeding program. Some goat milk projects in the highlands have shown farmer adoption (FARM-AFRICA, 1991), with the use of cross -bred goats (Sanaan cross Horrar). However, cross -bred goats are not adaptable to a harsh environment and need to be maintained under intensive conditions. Cost of forage production may not be met through sales of milk. Additionally, it is not yet evident as to whether these projects are sustainable due to marketing constraints, although in some communities in the highlands, goat milk fetches a good price.

(3) Marketing

The marketing system follows the same as for beef, except that sheep have a more favorable export market than cattle. Recorded sheep and goat exports during the 1980's were up to 500,000 head a year; these came predominantly form the northern and eastern pastoral areas and were routed through Assab to Soudi Arabia. However, exports have fluctuated enormously, being affected by civil unrest, war, disease outbreaks and fluctuations in shadow rates of exchange..

The highland peoples have strong preference for mutton over goat meat and especially meat from the Highland sheep breeds. Conversely, first preference in the lowland areas is for goat meat followed by mutton from the pastoral sheep strains and especially from the Somali Black Head. As a consequence, there is little trade between the highlands and lowlands in sheep and goats. Small ruminant off-take - seemingly based on skin off-take figures - is estimated at 27% for sheep and 35% for goats. Addis Ababa is served by about 33 informal sheep and goat markets. More than 16,000 sheep and goats passed through the main markets in 1997/1998. No recording system is in place for sheep and goats but prices in February 1999 were Birr 100-200 per head at Addis Ababa markets depending on weight and condition; sheep account for about 90% of all small ruminant sales in Addis Ababa.

Hides and skin:

Hides and skins are the major by-product of the Ethiopian livestock sector. Skins have historically contributed strongly to national export earnings and Highlands sheep skins in particular enjoy an international reputation for high quality. Cattle hides are the basis of an important domestic shoe and leather industry. Export of unprocessed skins is forbidden by law in the interest of adding value and creating jobs. So the bulk of the commercial supply is taken through to the wet blue or pickled stage at 15 industrial tanneries which have a combined annual capacity of 30 million pieces before shipping to overseas buyers.

Total raw hide production is estimated at 2 million pieces annually, of which 1 million enter the central market. Some 8 million sheep skins are produced of which 7 million are commercially processed as well as 6 million goat skins of which just under 5

million are industrially tanned.

Hides and skins and leather exports are extremely important trade items. Their contribution to foreign exchange earnings is second only to coffee although the actual contribution dropped from 20-35 % in the 1980's to about 12% in the mid 1990's. Some reasons for the deterioration include the Asian economic crisis, strengthening of environmental laws in Europe, warmer winters in Europe and elsewhere and most importantly, a deterioration in Ethiopian hide and skin quality. Some 50% of skins are down graded or rejected with skin damage by external parasites being a major problem. This reflects the deterioration in veterinary services throughout the regions since the weakening of budgets through regional government services.

(4) Research and Development.

Small ruminant research has always been a secondary component to cattle research With the limitations imposed on commercialized mutton or goat meat through cultural constraints, the only potential for improved productivity has lain in breeding research which is ongoing today and little in nutrition. Recognition has been made of the contribution of browse to goats and the interaction of goats and camels with trees established for environmental conservation and this is likely to be included in future research strategy.

Three national institutions are involved in sheep breeding work, namely MOA and Ethiopian Agricultural Research Organization (EARO). There is a sheep breeding station at Debre Berhan. The main objectives of the station are to:

- Study the performance of indigenous and cross bred sheep;
- Produce larger sheep through systematic selection;
- Test the adaptability of various exotic breeds
- Cross the exotic breeds with indigenous sheep to upgrade performance, and
- Provide selected and improved cross-bred exotic rams (F1 or above) to sheep farmers.

The breeding program here focuses on a basic flock of Menz sheep crossed with Corriedale, Hampshire and Awassi rams.

Cross bred sheep are capable of substantially higher growth rates and wool production but the expression of their superior potential is heavily dependent on feed supplementation during seasons of low pasture availability.

EARO and FARM AFRICA in collaboration with Alemaya University of Agriculture and Awassa Junior College of Agriculture are working on goat breeding. Saanen goats have been crossed with indigenous highland goats but although milk production is significantly higher in the cross- bred goat, studies so far show that it is not adapted to the harsh environment in which indigenous goats are raised. No research has been carried out to date on intensive production of cross-bred goats with rations based on green and conserved forages.

1.2.5 Poultry

(1) Production

The national poultry flock comprises some 99% indigenous birds that are mostly managed under a scavenging system with the remaining 1 % being imported exotic breeds that are usually managed intensively. An average of six (6) indigenous birds is kept by every household. Traditionally, women are responsible for the flock and sales of eggs, which, if they have no cows to produce milk, is usually their only source of cash income. There are growing numbers of small-scale (50-500 birds) egg and broiler producers in the peri-urban areas but many are not sustainable due to poor management and lack of organized marketing and business management, leading to a high turnover in the business of this sector. Other poultry enterprises (1 %) are large scale producers owned either by the state or large investors, where pure-bred exotic breeds of birds are produced and managed. These have been imported over several years and include White and Brown Leghorns, Rhode Island Reds, New Hampshires, Cornish, Australong and Light Sussex. This sector provides large-sized eggs and broilers for the urban market, mainly the supermarket and hotel chains. Virtually all poultry is for chicken and their eggs- there appears to be no market for ducks, turkeys or guinea fowl and thus little production in these breeds.

(2) Constraints

Indigenous birds are very broody and produce only 40-60 eggs per bird per annum. Their productivity therefore is low. It takes up to a year to reach 2 kg, by which time meat quality in terms of tenderness is low. Productivity is further inhibited by disease, in particular, internal parasites, although indigenous birds are generally resistant to most viral and bacterial diseases.

Exotic breeds, however, while markedly more productive and efficient in converting feed to eggs and meat, are highly susceptible to the many diseases that are endemic in Ethiopia and cannot be kept under traditional systems.

For high production, a balanced and consistent ration is required. Energy and protein concentrates are expensive and this system of feeding is only viable in large scale production systems.

(3) Marketing

Egg production is estimated at 73,800 tons or about 57 eggs per person per year. The 60,000 tons of poultry meat produced annually is equivalent to about 2 kg per person. The price of eggs in Addis Ababa is Birr1 for three eggs, whereas that of mature live birds for slaughter is Birr 20. Aside from the large-scale commercial sector, marketing is almost entirely informal. Clearly, there is an enormous deficit between supply and demand for broiler chickens and eggs, which can only be met if the majority of small scale farmers improve production through up-grading the breed of their layers and through improved nutrition and health.

(4) Research and Development

Much of the past and present research has been and is devoted to identifying suitable cross-bred chickens which can produce up to 150 eggs per annum and 2 kg carcass weight in three months, and low-cost feeds, using agro-industrial by-products or residues of milled grain.

The Rhode Island Red cross-bred has been shown to be the most resistant as well as productive, although not as productive as the White Leghorn cross. MOA has established seven multiplication centers at Awassa, Bedele, Kombolcha,Nazareth, Andassa, Mekele and Adelle, from which either fertilized eggs, cross-bred day-old chicks, pullets or cockerels are distributed to farmers as part of an extension package with some feed and vaccines. Dissemination of technology, however, is poor and success rates so far have been disappointing due to lack of uptake of correct management practices.

CHAPTER 2 ANIMAL HUSBANDRY IN THE STUDY AREA

2.1 General

2.1.1 Population of livestock species

Livestock kept in the study area are oxen, female cattle, goats, sheep, horses, donkey and poultry. Their population of and the animals raised are summarized below.

Livestock Population of Dugda Bora Wareda

Livestock Species	Total Number	Numbers by Average Household
Oxen	70,930	3.2
Female cattle	135,370	6.0
Goats	60,772	2.7
Sheep	28,473	1.3
Horses	525	0.02
Donkeys	12,164	0.5
Poultry	240,178	10.7

Source : OADB Wareda Office (Oct. 2000)

In the study area, there are 22,502 households giving the numbers of animals raised by an average household as presented in the above table. Out of various livestock, oxen are one of the most important animals for farmers. Although the overall average of 3.2 heads of oxen are kept by an average household, they are widely ranged. Out of 22,502 households, 5,278 households or 23.5%, nearly a quarter, do not keep oxen. The number of households in possession of oxen is summarized below.

Household Numbers by Oxen Raised

No. of Oxen	0	1	2	3	4	5	6	6<	Total
No. of HH	5,278	4,106	4,400	3,278	2,261	1,264	988	927	22,502
% in Total HH	23.5	18.2	19.6	14.6	10.0	5.6	4.4	4.1	100.0

2.1.2 Vegetation

Natural vegetaion provide grazing sources to local animals. The trees and grass species prevailing in the study area were identified by the livestock expert of OADB Dugda Bora. They are listed in Tables IV.2.1 and IV.2.2.

Many of the Acacia species provide valuable browse to goats but due to deforestation, the density of these trees has diminshed considerable. Where grass has been preserved for oxen -grazing, *Hyparrhenia ruffa*, a tall grass, is predominant. Due to deterioration of the rangelands, palatable and digestible species have disappeared in most places and been replaced by unpalatable and undigestible species of low nutritional value.

2.1.3 Grazing Capacity and Stocking Rate

Table IV.2.3 presents the land use for each PA of Dugda Bora, showing the grazing land available, grazing condition and stocking rate.

Grazing condition was a subjective assessment given by the district livestock expert and veterinary assistant and was classified as good, medium and poor. Figure IV.2.1 shows the map of PA's within Dugda Bora, which have been designated their status for grazing capacity. This does not relate to the rainfall distribution within the Wareda. This appeared to be related less to natural grazing capacity of the area than to the level of grazing management in the PA. It appears that in those PA where grazing is designated good, the community keeps areas of natural pasture from uncontrolled grazing so that oxen can be put there to gain condition before ploughing commences. In view of the highly over-grazed condition of the natural pasture it is probably the only means by which grazing capacity can be assessed.

Grazing land does not include what is designated as bush and woodland, although it must be remembered that this (albeit severely deforested) provides browse to goats.

It can be seen from the table that, when it is considered that this type of vegetation, in a semi-arid agro-ecological region, should be stocked at rate of 8 ha per TLU. However, the whole area is severely overgrazed. Livestock pressure is very high at less than 0.25 ha per TLU. The proximity of each PA to the lake was, like the grazing status, a subjective assessment.

2.1.4 Crop Residues

Table IV.2.4 shows the quantity of crop residue estimated to be produced from an average sized cropping land in Dugda Bora. Ratio of residue yield to grain yield was taken from figures provided by ILCA, 1993. Planted areas and yields of each crop were taken from a report provided by the OADB Dugda Bora. This is variable between farmers and PA's but provides an average estimate over the whole Wareda.

It is estimated that a total of 2.6 tons of crop residue is produced from 1.5 ha of farmland per annum. There are no farmers who cut and store their crop residues immediately after harvesting but allow uncontrolled grazing of crop residues after stacking teff hay. After grazing the rest of the crop residues, the remainder- maize stalks, mostly, are cut and stacked in the back yard but no treatment with Urea or molasses is applied. However, some farmers feed their oxen the maize stalks treated with brewers' grain- the residue from home brewed beer.

2.1.5 Nutrient Intake and Nutritional Status of Livestock

Tables IV.2.5 and IV.2.6 show the estimated nutrient requirement of the total grazing livestock per day and to what extent the grazing and crop residues meet that

requirement per day. Although crop residues are only fed after harvesting, it has to be put into an annual provision of nutrients and averaged out per day.

2.1.6 Animal Breeding

Livestock breeds are predominantly indigenous and breeding is uncontrolled.

2.1.7 Animal Health

There is one veterinary clinic at woreda level and one health post, with ten veterinary crushes distributed around the woreda. This is grossly inadequate and according to the veterinary office, at least ten more health posts should be established around the woreda

Table IV.2.7 shows the planned and actual activities of the veterinary woreda office over three years, where in virtually all activities, the actual number achieved was well below the targeted number.

In particular, vaccination and dosing levels are totally inadequate. According to the veterinary office, prophylactic drugs and chemicals have become unreliable and costly. Recently, a cost recovery exercise commenced to allow better consistency in supplies.

The most prevalent disease outbreaks in Dugda Bora appear to be Anthrax, Black Leg (Quarter Evil), Pasteurellosis and Lumpy Skin Disease in cattle; sheep and goat pox in sheep and goats and African Horse Sickness in horses. Table IV.2.8 shows the number of outbreaks, the locations where they occurred and number of locations where vaccinations were carried out. Clearly, vaccinations are only carried on in reaction to outbreaks and not as herd prophylaxis.

Tick borne disease only occur infrequently probably due to the enzootic stability achieved in the indigenous population of livestock.

Spraying or applying acaricide with a soft cloth is carried out when tick burdens are heaviest, in the late rains, mainly to prevent damage to hides or severe loss in body condition.

Internal parasites are a major cause of mortality in this area because of the large population of animals that congregate around bodies of water during the dry season. Dosing is an essential activity, especially at the beginning and end of the dry season and especially in sheep and cattle. In poultry, Newcastle disease occurs sporadically but the most important cause of mortality in poultry is coccidiosis in young pullets or cockerels.

2.2 Livestock Questionnaire Survey

2.2.1 Introduction

(1) Method of Selection of Farmers

Agro-ecological, climatic and geographic conditions vary widely across Dugda Bora. It was deemed necessary therefore to select PA's according to a set of parameters that would take into account this variation as much as possible, given the limited number that was allowed within the logistical framework of the questionnaire survey. It was decided that the parameters, which would do this, were two, namely rainfall and accordingly grazing capacity and proximity to the Ziway lake. Proximity to the lake gave advantages in both water and grazing during the dry season to those farmers near the lake. Both these parameters had an influence, it was thought, on livestock numbers and productivity of livestock, which consequently contributes to income of the farmers.

No formal data had ever been collected on grazing capacity of the PA's. Therefore, it is left to the district livestock experts and the veterinary assistant to make a subjective assessment of the grazing capacity of each PA and its proximity to the lake based on their extensive knowledge of the area.

The grazing was classified as good, medium or poor as shown in Figure IV.2.1. The proximity was classified as near the lake or far from the lake. This amounted to the following six (6) categories:

1) Good grazing, near the lake (code GGNL)
2) Good grazing, far from the lake (code GGFL)
3) Medium grazing, near the lake (code MGNL)
4) Medium grazing, far from the lake (code MGFL)
5) Poor grazing, near the lake (code PGNL)
6) Poor grazing, far from the lake (code PGFL)

To take into account the variation within and between PA's in each category, three PA's were selected for each of the above-mentioned categories (6 categories x 3 PAs). This was not made at random as some PA's were discarded for the exercise for logistical reasons. Twenty (2) farmers within each PA were randomly selected by the DA responsible for the PA, to answer the questionnaires. The total respondents were expected to be 360 (20 farmers x 6 categories x 3 PAs). In most cases, one DA would have at least two PA's for which he was responsible. Before the exercise started, two meetings were held between the study team and the DA's to go over the questions carefully to ensure they were understood by both the DA's and the farmers and correct any misleading questions.

(2) Objectives of the Questionnaire

The full content of the questionnaire is presented in **Attachment-1** with the following five (5) objectives.

- ✓ To obtain statistics about the members of the household, their livestock and the market value of their livestock and livestock products;
- ✓ To achieve an understanding of the role played by livestock on the farm and the value attached to them by the farmer;
- ✓ To achieve a broad understanding of the management systems used by farmers of their livestock;
- ✓ To determine constraints on livestock development through cultural, management and marketing factors
- ✓ To determine the potential for livestock development through management and marketing factors as well as through farmer perception of their capabilities and interests

If an answer was obtuse or clearly the question had not been understood, the answer was discarded in the analysis of data.

2.2.2 General Livestock Management

(1) Household Members

This question was asked to ascertain the members of a family, firstly to find how many potential laborers. Adults were taken to be over eighteen years of age. There were in a family for farm work and secondly the number of children needing to be fed in relation to average livestock product output.

Analysis of data on members comprising a household showed that there was a mean of 3 adults per household ranging 0 to 18 with a standard deviation 2.3. However, it transpired after the questionnaires were carried out that girls marry as young as 13 and boys as young as 16. Thus the results showing number of adults in the household were 0 are likely to have meant there were parents under the age of 18 years in that household. The mean number of children was 3.4 (s.d. 2.7, range 0 to 23). Figures IV.2.2 and IV.2.3 show the distribution of adults and children in all PA's.

(2) Land areas for ploughing

Table IV.2.9 shows the distribution of land in each PA, and that for the group. The mean area of land ploughed for all farms was 3.5 ha. (s.d. 2.3 ha, range 0.5 to 12 ha).

With the exception of one PA, Topho Choroke, which has very large cropping areas, there appears to be no difference in mean size of cropping land between groups , nor between minimum and maximum sizes. This indicates that grazing capacity and proximity to lake has no bearing on size of cropping area; this seems to be related to other factors. Of interest, however, is the mean hectarage of the cropping land, which

is higher than the 1.5 ha provided as an average size by the OADB survey. This suggests that at least one hectare on average is fallow land, which could be planted to forages under irrigation or rain-fed legumes.

(3) Grazing Management of Livestock.

Tables IV.2.10 and IV.2.11 show the grazing management and grazing patterns of livestock in the rainy season and dry season. In the rains, there are some farmers who supplement their cattle on grazing but the type of supplement was not specified except in seven cases where rapeseed cake, been seed cake, wheat bran and brewers waste from local beer were reported to be used. Presumably the remainder of the crop residues from the previous harvest) and the partition between grazing only or grazing with supplement appears to be variable within and between groups. The grazing pattern showed that with the exception of areas far from the lake with good grazing, where there appears to be total dependence on grazing in the PA or at the river, the PA's in general showed no particular dependence on a particular area. In most of these PA's, grazing was divided between "home" grazing in the PA and grazing by the lake or river.

In the dry season, the pattern is clearer in that those PA's far from the lake depend more heavily on crop residues and hay than those near the lake. The PA's near the lake appear to depend almost exclusively on grazing at the lake, with the exception of two, where the river is also used, while those PA's far from the lake depend more heavily on grazing at the river. The following table shows the grazing pattern within the whole district, based on the knowledge of livestock expert .

Grazing Patterns in Dugda Bora

Names of rivers and lakes	PA numbers
Meki river	1-6,11-16,25-30,37,38,
Ziway lake	7-10,29-40,
Awash river	17-19,21-24,41-43,48,49
Bora lake	19-21,44,45,50
Elen lake	45-49,53,54
Koka lake	51-54

Source: Dugda Bora Wareda Livestock Expert

(4) Forage Production

There were no farmers who reported growing herbaceous forages in the survey. However, the livestock expert knew of about seventeen farmers in five PA's, who grew cowpea in their backyard. Some 5% of all farmers interviewed had *Leucaena* trees numbering between 10 and 40, and this was spread over all PA's. The farmers

reported feeding one branch a day, on average, to their oxen. The livestock expert also reported being aware of possibly ten farmers in the Wareda, who also grew *Sesbania* trees. Overall, the number of farmers growing forages or tree forages appears to be insignificant in terms of supplementing their livestock with good quality feed in the dry season.

(5) Crop Residues and Hay Production.

All farmers reported storing teff hay but the remainder of the crop residues are left standing for uncontrolled grazing by the livestock, which takes up to one month on average. The rest of the ungrazed residue (maize and sorghum stalks) are cut and stacked on the ground. There is no treatment of crop residue

(6) Drinking Water

Some 90% of the PA's depend on the river or lake water for their livestock watering. Only 10 % report using troughs supplied from wells or ponds. This means that during the dry season, the cattle from the PA's far from water sources have to walk for up to ten hours a day to and from watering sources.

(7) Use of Manure

An average estimated quantity of 10% of the manure produced in the night pen is reported to be used as fuel and remainder is used in the cropping areas. The use of maize stalks in the production of mulch does not appear to be a common practice.

(8) Livestock Health and Mortality.

The survey shows that mortality in all groups is low, with a mean of 0.5 (range 0 to 6) per annum. Most deaths appear to occur at the end of the rains, which is the normal time in the tropics and are partly attributed to "disease" and partly to nutritional causes.

Clearly farmers far from the lake use prophylaxis significantly more than those near the lake but even within this group, tick control is not considered an important measure, when most farmers only apply tick acaricide once, when the tick burden is at its heaviest (January). Surprisingly, dosing for internal parasites, which should be a greater challenge for those animals near the lake (where fluke is an important cause of weakening condition, is carried out more in animals far from the lake. Overall, it appears that herd prophylaxis is not adequate, probably for reasons given under the general information on the Wareda and could be improved through an increase in animal health posts.

2.2.3 Production and Marketing

(1) Cattle- Draught Power

The population of cattle is presented in Table IV.2.12. Low cattle population is apparently predominant in drought prone areas, near the lake, regardless of grazing

status. Of note is the larger numbers of farmers with large herds (over 10 head) in areas where rainfall is high.

The population of oxen is presented in Table IV.2.13. Number of oxen in the herd appears to be, as expected, related to total size of herd. There are farmers with no oxen or only one ox, while others have large numbers of oxen. These are rented out at ploughing and threshing and are a source of income to the owners. 85% of farmers without oxen pay rent of an average of 190 birr (range 120 to 300 birr) for one ox and an average of 600 birr for two oxen. The remainder of the farmers without oxen appear to be able to borrow their oxen, possibly in return for labour or hay.

Almost all farmers keep young males for draught purposes. However a small number apparently keep them for fattening for sale. The use of crop residues for rearing oxen is more prevalent in the PA's far from the lake, although the tendency is to depend more on grazing in the areas with good grazing. Some farmers sell weaners on the open market every year (average 0.8, range 0 to 5). Frequency of sales appears to be similar for all PA's. The frequency for total PA's is shown below.

Frequency of Weaners Sold on Open Market Annually

No. Weaners Sold	% Farmers
0	56
1	21
2	13
3	5
4	3
5	0.5

The average price of a weaner is 360 birr (range 245 to 900) on the open market. Farmers who have sold their oxen after the last season and have no replacement oxen have to buy them on the open market about two months before the ploughing season starts. This is because they are, according to the farmers, often thin and weak at the time of purchase and have to be fed for some time before they can be used for ploughing. This is one reason why, in PA's where grazing was denoted as "good", areas of grazing land are kept free of livestock for oxen to graze in preparation for ploughing

(2) Cattle- beef

All farmers feed their oxen after the ploughing and threshing season is over, for sale on the open market. The feeding strategy for fattening them appears to vary considerably with PA and does not appear to bear any relation to grazing status or proximity to the lake. In all groups, the majority of farmers appear to depend on both grazing and crop residues for fattening their oxen, but there are some that depend only on grazing and some only on crop residues. Of note, however is that farmers perception of whether their fattened oxen are "very fat" or "litte fat" show that in

general, where grazing is good, the farmers consider their oxen to be very fat. Crop residues alone, in view of their poor quality, are not likely to produce a well finished animal. Oxen are normally sold after three months of feeding, in December to February. The average price for an ox sold on the open market is 780 birr (range 650 to 1700). This provides the farmer with the money to buy seed and fertiliser and in some cases, more oxen for ploughing for the next season. However, the cost of an ox, which, according to the farmers are mostly thin and weak when bought, is an average of 588 birr (range 450 to 900) and for those who have to buy more draught oxen, there is little in the way of extra income for other farm inputs for the next season.

(3) Cattle- milk

The population of cow is presented in Table IV.2.14. Mean number of cows is proportional to mean size of the herd but numbers are surprisingly low in those in the maximum range considering how large the herds can be. This suggests that aside from the oxen, there are large numbers of young cattle in the large herds. Of note is the fact that there are farms with no cows (and who, therefore, have no milk) in all groups. This substantiates the general understanding that oxen take priority under present management conditions. In fact, cows are reported to be second in importance to oxen. Farmers never use cows for draught purposes; they are kept only for breeding and milk.

Most farmers (78%) depend on a "village" bull to serve their cows, some (36%) have their own bulls and a very small percentage (5%) use AI, in order to produce cross bred cows. It is difficult to estimate the true number of cross bred cows in Wareda- according to the livestock expert, there are 8 farmers with cross bred heifers or cows, of which there are only 24 in total. Yet the report from the livestock extension expert of the OADB reports a total number of 340 in the Wareda. Three interviewees reported owning one cross-bred cow each.

Cows tend to calve at the end of the rains (September to December), when grazing and crop residues are in reasonable supply, and there is milk for the calf, but calving times appear quite widely distributed nevertheless. If cows calve in the wet season or towards the end of the dry season, the calf is more susceptible to disease and malnutrition. This therefore is likely to be the reason for high calf mortality.

The average number of calves born per herd last year and the year before was 1.6 (range 0 to 12). Since the average number of cows is 3.18, this suggests a calving rate of only 50%, which in turn suggests that there is a calf born every second year on average, to each cow and that only half the cows in a herd are lactating every year. The average number of calves that died last year was 0.8 (range 0 to 12) and the year before, 0.6 (range 0 to 8). This suggests a high calf mortality of around 50% of calves born each year. This is likely considering that many calves are deprived of their full milk requirement by the farmers, who take most of the milk for their own use as reported by the district livestock expert.

Most (87.6%) of farmers keep their heifers for sale and as replacement heifers.. There are an average of 2 heifers in each herd (range 0 to 15). The following table shows the distribution of heifers within all herds.

Frequency of Distribution of Heifers within Total Herds

No. Heifers	% Farmers
0	28.2
1	26.7
2	15.4
3	11.4
4	5.5
5	3.7
6	2.9
6<	6.1

Most (64%) of farmers sell at least one heifer annually. An average of 1.3 heifers are sold per farm (range 0 to 20), at an average price of 282 birr (range 175 to 800). Frequency of sales are shown in the following table. This suggests that only one heifer on average is kept as a breeding and milking cow.

Frequency of Sales of Heifers within Total Herds

No. Heifers Sold	% Farmers
0	36.5
1	27.4
2	20.2
3	9.9
4	4.4
4<	2.0

Cows lactate for an average of 6.5 months (range 4 to 8 months), giving an average of 1.5 litres a day (range 0.5 to 3). This yield appears to be consistent throughout lactation. Per week, the average amount of fresh milk kept for family use (children) is only 0.75 litres (about 0.1 litres a day) ranging from 0 to 4 litres. An average of 2.5 litres (range 0 to 10 litres) are kept for making butter for sale (yoghurt, or soured milk, is made from the skimmed milk and fed to the children, or made into *Ibe* (also known as *Ayeeb*) cheese. An average amount of 2.4 litres are made into Ibe cheese for sale per week. The average price of butter is 17.5 birr/kg (range 0 to 45) and cheese is 5.2 birr/kg (range 0 to 30). It is notable that butter and cheese sold through the dairy development programme milk units (marketing cooperatives) sell for 28 and 35 birr/kg respectively.

All farmers expressed a wish to sell more cheese and butter through the use of cross bred cows but were apparently unaware of the need to produce high quality forage for sustained milk yield and optimum fertility.

(4) Sheep and Goats.

The average number of sheep over all PA's in the PRA is 4.6 (range 0 to 40). The average number of goats over all PA's in the PRA is 5.4 (range 0 to 35). Distribution of sheep and goat population appear to be similar throughout all PA's. The reasons reported by all farmers as the reasons for keeping these livestock species is (in order of importance):

1. Cash for household requirements
2. Fear of death through disease or drought of livestock (insurance)
3. To buy other animals

Sheep and goats are not milked, nor are they eaten by the household, even on holiday occasions.

An average number of 2 sheep are sold annually (range 0 to 20) for an average price of 100.75 birr per sheep (range 11 to 200). An average number of 2.5 goats are sold annually (range 0 to 35). The average price for goats is 85 birr (range 45 to 100). While sheep and goats are not managed well, particularly in nutrition, they are dosed for internal parasites twice a year by 67% of farmers in all PA's. However, kid and lamb mortality is high in all PA's (average 55%).

The following table shows the distribution of sheep, goats and sheep and goat sales among owners in all PA's.

Distribution of Sheep and Goat Ownership and Sales in all PA's

	% sheep owners	% goat owners	%sales of sheep and goats
0	49.5	38.2	35.9
1	1.4	3.2	11.6
2	3.6	3.9	18.8
3	3.6	4.6	12.7
4	5.0	4.6	9.4
5	3.6	4.6	4.7
6	3.6	5.7	2.5
7	1.8	1.4	1.1
8	4.3	3.6	1.8
9	1.1	2.1	0.4
10	6.1	7.5	1.1
10 <	14.6	49.0	0.4

(5) Donkeys and horses.

No farmers reported owning horses or mules. The average number of donkeys per farm is 1.2 (range 0 to 6). An average of 0.3 donkeys are sold per farm annually (range 0 to 6) at an average price of 254 birr (range 180 to 445). Donkeys are kept for pack transport but there are some sold every year.

Distribution of Ownership and Sales of Donkeys in all PA's

No.	% owners	% owners who sold
0	30.6	78.3
1	40.1	17.1
2	15.1	3.9
3	9.1	-
4	2.6	-
5	2.2	-
6	0.4	0.7

(6) Poultry-eggs

An average number of 8.9 hens (range 0 to 50) are owned by each household in all PA's. From these hens, an average of 3.5 eggs per day are produced (range 0 to 35). This provides a laying average of less than 50%, which is low. The average number of eggs given to the family to eat per day is 1.7 (range 0 to 40), while the number of eggs sold every week averages 7 (range 0 to 49) at an average price of 0.25 birr/egg (4 eggs per birr). Chickens are not eaten by the family except at very special occasions like weddings and are normally eaten with *injira* as "*doro wot*".

No supplement is given to poultry; they are left to scavenge. All farmers expressed an interest in increasing the number of eggs to sell but were not able to say how they could feed cross-bred poultry as they were themselves short of grain.

CHAPTER 3 CONSRAINTS AND PROSPECTS

3.1 Major Constraints to Livestock Production

The same constraints that apply throughout Ethiopia to livestock production and development apply in Dugda Bora, i.e. low productivity of indigenous livestock, poor nutrition, disease and poor marketing organization. The problem of nutrition is exacerbated in Dugda Bora by the particularly excessive stocking rate, although this may be mitigated to some extent by the access to grazing by the lakes and rivers in the dry season. Mortality of adult animals is low, despite poor herd health management, but mortality among young stock is high, calving rate in cows is poor, and growth in cattle is poor.

1) Taking the average of numbers of each livestock species and livestock products sold, the income per annum can be estimated as presented in Table IV.3.1. The annual average income is estimated to be 3,339 birr, which amounts to an average income per month of 278 birr or US$ 34. This is very low for an average household with three children. Intensification of livestock on to at least a partially zero-grazed system of production. This is only possible through a year-round supply of farm-grown forages, fed as green chop in the rains and as conserved forage through the year. The supply of high quality forage is only possible in this area through irrigation. However, the use of this system, together with the use of livestock which have been cross-bred with exotic breeds, provides an opportunity for profit-oriented production. This can be achieved through dairy production. When profits are high enough, farmers would be less concerned with keeping unproductive livestock as insurance and would sell them to buy cross-bred heifers. This reduces even further the number of cattle per herd.

2) Re-forestation of lands which have been severely denuded of browse trees. Goats in particular are browsers and if trees are planted to prevent erosion in degraded areas and de-forested areas, goats would decrease grazing activity in preference for browse. This would reduce grazing pressure.

3) Planting of improved pasture species in contours and suitable species in wetlands (e.g. Torpedo grass). This would involve community participation in preventing uncontrolled grazing on these areas until the grass is well established.

At a stocking rate of an average of 0.25 ha per TLU, severe environmental degradation through, erosion, bush encroachment and loss of topsoil is inevitable, particularly in a fragile environment such as exists in Dugda Bora. The only way further degradation is going to be minimized is through:

3.2 Livestock Development Potentials

Irrigation provides the potential for ruminant livestock development because through irrigation, high yielding, good quality forages can be produced for year-round feeding. However, in selecting the system of production that would be likely to be successful in terms of profit, adoption by farmers and sustainability, the factors to be considered are:

1) Farmer knowledge and interest: It is important to adoption and commitment to a production system that farmers are familiar with production orientation. In the case of Dugda Bora Woreda, feed lot beef with young steers is not a mode of production familiar to them, nor is goat milk, nor is lamb or mutton production. Modes of production that are in use are milk and egg production from cattle and hens, allowing a foundation of development on which to build.

2) Adopting new technologies has been shown to be feasible when it can be shown that a production system is very profitable and will not only bring significantly increased income to the farmer but at low risk and high sustainability. The main lesson to be learnt from previous projects are that heavy imposed structures do not serve the best needs of the nation and are unable to continue after project financing is terminated, that incremental recurrent costs should be kept to a minimum and that farmers will quickly adopt technologies that provide rapid and clearly perceived increased in production and profitability.

3) A production system will be more easily adopted when returns are short term. Income from milk and eggs is regular and returns are regular and frequent (usually weekly) This is important when financial reserves are low and the farmer depends on a regular cash flow.. Beef on the other hand is long term- it would be two years from birth of a calf before income can be realized from commercial production and if animal dies, there has been no return on the animal before that event.

4) There must be a ready and accessible market. In Dugda Bora, eggs, butter, cheese and milk sell easily and the markets (Meki, Ziway, Ela, Ombole, Alem Tena are reachable within a morning by most farmers on market day. There is no market for goats milk as this is not popular in this area, nor is there any market for young beef or lamb (lack of formal beef marketing in this area).

On the basis of these considerations and of the results of analysis of the farm interview, there are two development projects which can be proposed. These projects comprise dairy production based on irrigated forages and egg production.

3.3 Advantages of Meki Area for Dairy Farming

The Meki area has several advantages for this development option as mentioned below.

1) Given the right conditions for agro-business, dairy farming with cross-bred cattle is profitable since it creates a number of avenues for income. They include milk, dairy products, sale of heifers, sale of cross-bred oxen for draught and beef and sale of cull cows for beef, all of which fetch much higher prices than indigenous cattle. Therefore, there is potentially a good return on labor and financial investment by the farmer, since, with irrigation, forage supply is guaranteed, therefore risks are low.

2) Meki town lies on a good road from Addis Ababa through to Ziway and Nazareth, hence transport for produce and inputs has no constraints.

3) There are several large towns in and around the Meki area such as Ziway, Mojo and Nazareth constituting a good market for dairy produce.

4) With the warm climate, and irrigation, high yields of forage crops should be realized on a small plot of land (0.5 ha) and this, together with treated crop residues, would provide the nutrient requirements of two cross-bred cows each yielding an average of 10 liters a day milk, and two oxen, on limited grazing. ILRI is willing to provide *Napier* accessions suitable for the area for nurseries from which to supply farmers, *Lablab* seed is available and urea and molasses are available for crop residue treatment. Seed for forage legume trees is also available.

5) There is a state farm near to Meki, which produces cross-bred heifers. It has been indicated that up to twenty heifers a year would be available for purchase by farmers.

6) The Small-holder Dairy Development Program (SDDP) has good technical support for dairy development with experience based on projects in other areas. ILRI, based at Debre Zeit, has had much experience with research in the fields of forage production, dairy cattle feeding, fertility and clean milk production. In addition, ILRI offers training courses in AI, paraveterinary courses, milk hygiene and milk quality testing for farmers, technicians and livestock experts. The EARO has researched the most appropriate cross-breed to use in the area.

7) Deforestation and overgrazing has had a devastating effect on the natural resources but there is little chance of rectifying this without alternative sources of both forage for livestock and fuel for the household. By operating a limited zero-grazing system for oxen and dairy cows, pressure will be taken off the vegetation, providing it with some chance for recovery and by using manure collected from restricted livestock, it will be possible to use biogas for light and fuel in the house, so reducing deforestation. Increased manure supplies also improve soil quality for cropping.

8) Women are empowered though income from dairying. It has been shown in *Salale* that since they milk and feed the cows, women are given equal partnership in administering all funds coming in through the dairy operation (milk and dairy products, sales of heifers and cross bred oxen) and in decisions concerning the sales of dairy livestock.

CHAPTER 4 PROPOSED LIVESTOCK DEVELOPMENT PROGRAMS

4.1 Dairy Development with Cross-bred Cows

4.1.1 Phased Development

It is proposed that the establishment of a dairy development program be implemented in three phases:

1) Awareness, dissemination and participatory planning.
2) Trial operation
3) Production and marketing

4.1.2 Awareness, Dissemination and Participatory Planning

It is proposed that the community be invited to select farmers who are interested in dairy farming. These farmers will be given tours of the ILRI research station in Debre Zeit, the Adami Tulu research station and the Modjo state dairy farm, in order to promote their awareness of the potential of dairying. The farmers will then be taken to Salale to attend a field day at selected dairy farms there and to spend the night with dairy farmers, to discuss the benefits and constraints of dairy farming. This should provide farmers with a good insight into the realities of dairy farming for a small holder. The farmers and their community leaders can then be invited to select the site for one demonstration unit and milk unit for the verification study.

4.1.3 Trial Operation

A trial operation will allow for verifiable indicators of the potential success of a program before a budget is considered for full implementation of a project. It is proposed that the trial operation will comprise one demonstration unit and one milk unit, which are described below. Six (6) prospective farmers, selected by the community, in the vicinity of each of the demonstration units should participate in the trial. The farmers will be included using conditions and guidelines provided by the SDDP, whereby they must provide 0.5 ha each for forage production, a milking shed and storeroom and construct a pond to store water for irrigation. They will then be given a cross-bred heifer on credit along the lines used in other SDDP projects. Participatory farmers must agree to assist with monitoring production of forages and productivity of their cow and oxen as well as cost-benefit analyses.

If the trail proves that there is good potential for dairy production in the Meki area then the demonstration unit will be taken as the model for other demonstration units in the most suitable areas for dairying. Such areas will need to have good prospects for irrigation and be close to good roads for siting milk units. Milk units can be built by the farmers as and when there are sufficient numbers to ensure consistent supplies of milk in adequate quantities for a profitable business.

4.1.4 Demonstration Unit

While there is apparently a strong interest in obtaining and milking cross bred cows in Meki, there is little experience of dairy farming based on forage production and conservation and on treated crop residue as well as on collective processing and marketing in this area. Awareness of the importance of these essential components to successful dairy farming must be promoted in the community and this can be done by visits to dairy farms and institutions. However, sustainable training is also essential- the farmer needs to know that all steps of every process in the dairy operation can be seen and discussed when it is needed and this is provided by a demonstration unit. Field extension workers, new to dairy farming, can receive not only training but be trained in training. A strong extension program is vital for success of this program. Irrigated forage production is an even newer concept for any area of Ethiopia and, more than any other component of this proposed program, must be demonstrated.

Hence, it is proposed that initiation of dairy development in Meki is based on the establishment of a number of demonstration units, possibly one for every five PA. The demonstration units serve a number of functions:

- To provide demonstration and training in harvesting water from water catchment areas with construction of ponds and canals to forage and crop lands..
- To provide a nursery of suitable forages from which farmers can obtain their requirements of root splits for planting in their own plots and seeds for herbaceous and tree legume forages.
- To provide training to DA s and to farmers on establishing, irrigating, managing and harvesting herbaceous and tree legume forages through demonstration ("hands- on" practice).
- To provide training and demonstration on ensiling forage.
- To provide training and demonstrations to DA s and to farmers on dairy cow feeding, hygienic milking practices, heat detection and health management.
- To provide training and demonstrations on improvement of nutrient quality of crop residue through treatment with urea and molasses.
- To provide training and demonstrations on the construction and operation of biogas units.
- To provide AI and veterinary services.

The model Demonstration Unit is illustrated in Figure IV.4.1. It is proposed that the demonstration unit be constructed and established along the following lines:

(1) Forage Production

Establishment of a forage plot as a nursery for suitable forages. It is proposed that 0.5 ha be planted to suitable accessions of Napiers, and once established over one season, it will be possible to provide selected farmers forage root splits. The unit will stock seed for recommended forage legume trees and herbaceous legumes, in particular, Lablab. In the first year, 0.3 ha will be planted to Napier, intercropped with lablab and 0.2 ha to intercropped maize and lablab. This is to make allowance for establishment of the Napiers which takes one year before full yield is realized.

Irrigation will be provided from a small catchment dam made to harvest rain water (up to 6000 m^3 is possible) and, during the verification trial, from a small pump which sends water to an overhead tank. Either or both will supply water by gravity to the forage plot, to cattle watering troughs and to the household. It is expected that the forage crop will be rain-fed for establishment and the first harvest and will be irrigated (25 mm per week) for two months in the dry season for the second and third harvest. Three cuttings should be adequate for the annual forage requirement for two cross-bred cows, two oxen and for supplement on grazing for the remainder of the livestock.

(2) Facilities

The milking shed, storeroom, cattle crush, calf houses and demonstrator's house will constructed. The milking shed will be built according to specifications laid down by the SDDP for the smallholder dairy farmer's milking shed. The storeroom, which has to be rodent proof, will be built to store 2500 bags of silage and the forage chopper between use. The demonstrator's house will be built according to design already existing for present DA's houses. Two very simple portable calf houses will be built adjacent to the milking shed. A cattle crush will be constructed for AI and veterinary services.

(3) Harvesting and Ensiling Forages

From three weeks into the rains and during the rains, forages can be cut and carried to the cattle. However, for the dry season, it will necessary to conserve the forage. A low-cost silage technology has been developed and proved successful. It comprises the cutting of forage by hand, feeding the forage into a mobile diesel driven forage chopper (which can ox-drawn between farms) and packing up to 15 kg into a impermeable plastic bag, 1metre by 50 cm. The chopped material is pushed as tightly as possible into the bag and the bag tied tightly with twine to seal the forage material. The silage, consisting of Napier or maize and lablab would have a protein content of 12-14% CP and 9.5 MJ ME. Two bags a day can be fed to a cross bred cow and one bag a day to an ox. The bags are easily portable for anyone in the family to feed the cattle and there is little labor involved once the forage is ensiled. The bags should last for up to three seasons. Farmers will be invited to assist in the ensilage process to ensure they understand the full operation.

(4) Management of Dairy Cow

It is proposed that two cross- bred dairy heifers in calf be kept at the demonstration center, once there is forage available to feed them. Farmers will be invited to view feeding and management of the heifers from calving through lactation and management of their calves. Clean milk production, mastitis prevention measures, record keeping, heat detection and prophylaxis will be emphasized. Posters will be put up on the walls of the unit and leaflets written in both Amharic and Oromo languages distributed to farmer who attend to expedite understanding of the management operation.

(5) Treatment and Storage of Crop Residues

By the time the first forage harvest is completed and the cows installed, harvesting of the cereal crops should be virtually over and the crop residues ready for treatment. It is proposed that since teff hay is stored in compact hay stacks, layers of hay should be sprayed with a back pack sprayer with a urea and molasses and water mix in

proportions of one part urea to 100 parts hay. With the compression provided by the hay stack, some fermentation will take place and digestibility and nutrient quality of the teff hay will be improved significantly. Maize and haricot bean residue can be chopped through the forage chopper and stored in a pit, also spraying layers as they are stored, then covered with plastic sheeting and soil for up to three weeks. Crop residue can be fed out at 1.2 kg per day to the dairy cow and 0.5 kg to the ox as supplement to their forage diet. Farmers will be invited to attend demonstrations of crop residue treatment and feeding.

(6) AI and Vaccinations

These will be provided as fee paying services. It is possible that a bull could be kept at the center and cows brought to the center when they are showing heat. This has to be considered as an alternative option to AI.

The trial operation will comprise one demonstration unit and one milk unit, sited according to a joint decision of the community and experts. During operation of this unit, a number of trials can be carried out:

- ✓ The need for a pump to provide river water as well as water provided by the catchment area pond to meet the irrigation, household and cattle watering requirements.
- ✓ The yields, nutrient quality and fermentation quality of silages produced under irrigation of intercropped Napier and maize with lablab over three harvests.
- ✓ The nutrient quality of crop residues treated using the methods proposed.
- ✓ The performance of cross-bred cattle selected according to results of research by Adamitulu research station on a forage and treated residue diet.

4.1.5 Milk Unit

One reason reported for poor performance of some dairy program is the lack of attention to marketing of milk and dairy produce. It is therefore important that, in the verification trial, marketing be treated as an important component.

It is proposed that a milk unit, built as an extension of one demonstration center, and constructed according to specifications laid down by the SDDP, be placed within reasonable distance of the demonstration center. The milk from the demonstration center would be processed into butter, cheese and yoghurt there but also, farmers would be invited to bring their own milk and become involved in the operation and administration of the milk unit. This is to promote awareness of the value of organized processing and marketing for maximum benefit to the farmer. The verification study will thus provide for measuring the profitability of dairy farming through both production and marketing.

The verification study while providing evidence required to justify a dairy development program in Meki, also provides the foundation for such a program, allowing time for effective implementation of the principles of successful and profitable dairy farming.

4.1.6 Production and Marketing- Dairy Development Program

The experience gained from the demonstration units will ensure efficient and cost-effective units, each unit managed by a demonstrator who receives booster training in all components of dairy farming from relevant institutions. It is proposed that the demonstrator is employed by the unit, with pay based on income derived from sales from the unit. The demonstration unit will be sustained by sales of milk and dairy products, heifers and oxen, forage and seeds, sales of urea and molasses, hire of the forage chopper (which is housed by the unit and sent by oxen to each farm when required) veterinary products and AI or bull service.

Each unit will be administered by a committee of dairy farmers, the demonstrator, the DA and a PA leader, with technical support from the SDDP of Oromia, OIDA, ILRI, the livestock experts of Dugda Bora and EARO when required. It is proposed that an elected member of each of the committee report to an advisory committee who meet once or twice a year to discuss and resolve relevant issues brought up by the unit committees. The advisory committee could comprise members of all the technical institutions and leaders of the community.

Cross-bred cattle should be available from the government farm breeding heifers, at twenty a year, on approval from the Oromia Bureau of Agriculture. At the same time, within two years, the program should take on a dynamic of its own, where farmers will be selling heifers themselves. It is thus anticipated that within five years, at least 2000 farmers will be fully operational with cross-bred cattle. This means that for every demonstration unit, there should be an average of 200 farmers who use the unit and who should have built and operated at least five milk units of their own.

4.1.7 Cost and Benefit Analysis

The preliminary cost and benefit analysis was made as presented in Table IV.4.1. They are summarized below.

1. Capital cost	Birr
1.1 Watering facilities	6,100
1.2 Buildings	4,700
1.3 Forage	1,530
1.4 Animals (Heifer x 2)	5,000
1.5 Milking cans and others	420
Total capital cost	17,650
2. Crop production foregone (loss)	1,074
3. Variable costs /year (three years)	869 (2,607)
4. Overhead cost	16,847
Total Cost	20,528
5. Gross Income	62,800
6. Net Income (Income/month)	42,272 (1,174)

4.2 Poultry Development with Cross-bred Hens

4.2.1 Introduction

In Ethiopia, egg production has great potential, for the following reasons:

1) it produces much needed protein food for the population, particularly children;
2) it serves as a source of income for many poor farmers who have no other livestock;
3) it shows rapid and regular cash return
4) it is suited to the conditions of many smallholders- feed cost, space requirement, low cost of animals;
5) chickens can be sold off easily at times of economic difficulty;
6) stock numbers can easily be increased as needed, due to their rapid rates of reproduction;
7) poultry can be maintained on a small amount of feed during droughts when the larger livestock suffer malnutrition and death- this makes them particularly useful in drought prone areas.
8) In an area where the environment is fragile and easily degraded by high stocking pressure from ruminants, poultry production can be intensified without any adverse effect on the environment;
9) poultry manure can be used both as fertilizer for vegetable gardens and as a source of protein in ruminant feeds (provided is it dried when fed).

Major constraints to development of poultry, as mentioned before, are

1) Poor extension services and technical support when farmers use cross-bred poultry
2) Poor marketing organization resulting in poor prices for eggs
3) High cost of feed for cross-bred layers;
4) Lack of veterinary drugs and services for prophylaxis

4.2.2 Advantages of the Meki Area

Meki has several advantages for this enterprise:

1) There is a large population of indigenous birds which can be cross-bred with exotic cockerels (provided the indigenous cockerels are removed), or which can be used to incubate fertilized eggs and care for young chicks;
2) The increasing population in the area along with intensification of crop production and uncontrolled grazing will continue to reduce grazing available to large animals. Poultry production will increase in importance as other livestock die off from malnutrition;
3) There are several large towns in the area which are easily accessible and a good road network between them and Addis Ababa- this allows traders good access to egg sale outlets;
4) Marketing can be organized so that eggs can be sold through the milk units which will be strategically placed throughout the woreda- this means that egg marketing can benefit from fixed prices decided by the egg producers' cooperatives;
5) There are large numbers of grain mills around Meki and therefore a good source of milling residue which is of reasonable nutritional value while at a very low cost. Bulk buying can be carried out by each demonstration unit and sold in turn to farmers in the proximity of each demonstration unit;
6) The demonstration unit can serve a dual purpose- that of dissemination of both dairy and poultry production technology and that of providing veterinary supplies and services for both dairy and poultry, thus providing essential extension and support services in both sectors;
7) One of the cross-bred poultry multiplication centers is reasonably closed to the Meki area at Nazareth, while there are a number of commercial breeders at Debre Zeit who could also sell pullets or fertilized eggs or day-old chicks (though at higher prices). The demonstration units can act as agents through buying large numbers to sell to groups of farmers at a time, so overcoming the transport constraint.

4.2.3 Phased Development

It is proposed that the establishment of a poultry development program be implemented in three phases:

1) Awareness, dissemination and participatory planning.
2) Trial operation
3) Production and marketing

4.2.4 Awareness, Dissemination and Participatory Planning

It is proposed that the community identify a group of farmers - up to fifty- who are interested in poultry farming. This group will then be taken to view the breeding and multiplication center at Nazareth, small scale and large scale commercial production farms and finally, successful small holder production enterprises. Following these

tours, the proposed verification study and purpose and operation of the demonstration unit can be explained to them and arrangements made for their participation in the study.

4.2.5 Trial Operation

The trial operation will comprise the monitoring and analysis of the viability of egg production from cross-bred hens based on grain residue and forage production. The demonstration unit proposed for the dairy development program also can be used for the poultry production project (i.e. serve two purposes) in the following ways:

a. dissemination on methods of production of alfalfa or cowpea under minimal irrigation in the household back yard for a year -round supply of protein,
b. supplying bought-in cross-bred pullets or day-old chicks and cockerels to farmers;
c. supplying grain residue bought in bulk from grinding mills;
d. formulating rations based on farm-grown forage and grain residue;
e. demonstrating ration formulation and feeding strategy ;
f. supplying vaccines and drugs;
g. demonstrating vaccination and prophylactic measures against disease and parasites;
h. supplying materials such as fencing and roofing for low-cost poultry housing;
i. demonstrating effective low-cost housing design and construction;
j. demonstrating correct chick-raising and hen-care management.

The demonstration unit would therefore have a poultry house in which twenty cross-bred hens are kept as well as a chick -raising house in which an indigenous broody hen can raise cross-bred chicks.

4.2.6 Production and Marketing

If the verification study proves that the proposed egg production system is successful and sustainable,(and a further five demonstration units are established for a three year study), the demonstration units will then become the nuclei for expansion of the poultry development, as well as the dairy development, program, provided these units are self-sustainable through sales of produce and commodities to the farmers.

Concurrently, it is important that eggs are sold at prices, which are viable to the farmers. Organized marketing should be encouraged among the producers so that they form marketing cooperatives and are then able to set optimum prices for their eggs. This will be greatly facilitated if the milk unit, which is the marketing outlet for butter and cheese, is also used as the sales center for eggs. Egg and dairy marketing cooperatives can combine in meeting the costs of the construction and maintenance of the building and staff salaries.

4.2.7 Cost and Benefit Analysis

Capital costs on production system is based on 5 pullets, one cockerel. The preliminary cost and benefit analysis was made as presented in Table IV.4.2. They are summarized below.

1. Capital cost	Birr
1.1 Pullets and cockerel	60
1.2 Cages	200
Total capital cost (10% interest)	263
2. Variable costs /year (three years)	166
3. Gross Income	660
4. Net Income	494

APPENDIX IV

ANIMAL HUSBANDRY

Tables

Table IV.1.1. Ethiopia's Livestock Populations and Their Importance

Unit : 1000 heads

Livestock Species	Total in Africa	Total in Ethiopia	% in Africa	Rank in Africa
Cattle	202,596	29,900	14.8	1
Sheep	212,674	21,853	10.3	3
Goat	180,304	16,850	9.3	2
Horse	4,795	2,750	57.4	1
Donkey	13,588	5,200	38.3	1
Mule	1,376	630	45.8	1
Camel	14,443	1,030	4.6	3
Pig	22,168	23	0.1	35
Poultry	1,115,000	55,000	4.9	4

Source: ILCA, 1991

Table IV.1.2. Nutrient Content of Different Classes of Feed Stuffs of Ethiopia on DM Basis

Feed class	DM (%)	CP g/kg	NDF (%)	ADF (%)	Lignin (%)	Hem. (%)
Dry forages and roughages	92.5	6.2	69.1	54.4	12.2	33.9
Green forages and roughages	42.8	11.7	62.6	42.7	7.7	24.9
Energy supplements	73.9	10.8	18.7	3.4	1.6	15.0
Protein supplements	81.1	35.5	33.3	28.2	7.4	7.9

Table IV.1.3. Energy and Protein -rich supplements in Ethiopia

Feed class	DM	CP	NDF	ADF	ME
Energy supplement					
Barley grain	90.2	10.8	33.9	9.0	12.9
Fodder beet	6.7	17.0	27.0	16.2	10.4
Maize grain	90.5	11.4	18.7	3.7	13.6
Oats grain	93.2	8.0	38.2	20.6	11.3
Protein supplement					
Alfalfa	34.9	25.9	33.9	9.0	9.5
Blood and Bone Meal		92.4	35.0	53.0	
Noug cake	93.1	35.5	33.3	28.2	9.8

Source: Seyoum *et al.,* 1989

Table IV.1.4. Examples of Cattle Herd Composition (%) in Various Regions

Region	Females	Males	Oxen
East Shewa	45.9	22.0	32.1
South Shewa	60.0	19.0	20.4
West Shewa	57.4	24.8	17.8
Borena	69.9	27.5	2.6
East Harerghe	62.7	26.4	11.0
Illubabor	43.0	26.3	30.6
Total	55.6	23.9	20.5

Source: GRM, 1994

Table IV.1.5 Milk Production Performance of Indigenous Cattle

Type	ARDU/CADU			IAR			DEBRE ZEIT		
	No.	Kg	Fat%	No.	Kg	Fat%	No.	Kg	Fat%
Arsi	184	298	5.6	-	-	-	-	-	-
Fogera	26	765	6.2	-	-	-	-	25	530
Horro	-	-	-	43	543	6.0	-	-	-
Boran	30	599	6.0	50	49.4	5.9	-	-	-
Barca	9	1,098	5.8	46	675	5.6	20	759	-

Source: Summarized from ARDU/CADU, IAR and Debre Zeit reports.
ARDU= Arssi Rural Development Unit
CADU= Chillalo Agricultural Development Unit
IAR= Institute of Agricultural Research (now under Ethiopian Agricultural Research Organization)

Table IV.1.6 Performance of F1 Cross bred Cows in IAR Experiment

Genotype	305-day yield (kg)	Fat %
Sire breed		
Friesan	1944	5.16
Jersey	1697	5.98
Simmental	1845	5.07
Dam breed		
Barca	1898	5.22
Boran	1854	5.41
Horro	1672	5.52

Source : Beyene, 1992

Table IV.2.1 Indigenous and Exotic Trees in Dugda Bora

Local name	Scientific name	Common name
Tedecha	*Acacia tortilis*	Acacia albida
Dere	*A. brevispica*	Millia
Bisana	*Croton macrostchys*	Moringa
Zibba	*Podo carpus*	Jacaranda
Shola ficus	*Ficus sycomorus*	Spatoda
Weira	Olive tree	Lusinia
Bora	*Capporis tomentasa*	Sesbania
Kurkura	*Ziziphus mauritania*	Gravicia
Duckuac	Cactus spp.	Eucalyptus tree
Keba	?	Neem
Abam	*Carissa edulis*	Turmantuli
Bofefe	?	
Sensec	?	
Berbi	?	
Dodota	Acacia spp. (*nyalotica*?)	
Bedeno	?	
Wacho	*Acacia seyal*	
Girar	*Acacia nubica*	
Lafto	*Acacia mellifera*	
Wanza	?	
Wadesta	*Erythrina melanacantha*	
Kophim	?	
Kontil	?	

Table IV.2.2 Grass Species in Dugda Bora

Indigenous name	Scientific name
Senbelet	*Hyparrhenia ruffa*
Serdo	*Cynodon dactylon*
Muga	*Cenchrus ciliaris*
Fila	?
Akirma	?
Gicha	? Chloris spp Setaria spp Paspalum spp Eragrostis spp