Technical and Financial Analysis of a Dairy Farm at Shambat, Khartoum State-Sudan

By

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Dedication

To the soul of my father and father in law
Dear mother and brothers
My husband and my kids
My uncle
My friends

With love and respect

Afaf

Acknowledgments

First of all, unlimited thanks to the most Gracious and Merciful *"Allah"* who grant me everything to carryout this study.

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Abstract

Despite, the large animal wealth in Khartoum state, yet the state is still suffering from milk production and consumption gap.

The purpose of this study is to assess the financial and technical feasibility of establishing a typical dairy production farm in Khartoum state, as a model to be followed in order to enhance the milk production and reduce consumption gap in the State.

A field survey was conducted in two areas (Kuku and Shambat), whereas shambat is selected to represent the location of the project. Data were collected from 9 dairy farms belonging to two areas using structured questionnaire.

The secondary data was obtained from official documents and reports of the Ministry of Agriculture and Ministry of Animals Resource and fisheries and from relevant sources.

The study used the financial benefit-cost analysis for evaluating the financial feasibility of the project. It indicated that the project was financially feasible with a payback period (PBb) of 2 years, and with positive net present value (NPV), benefit-cost ratio (B/C) 1.6% and financial internal rate of return (IRR) of 47% with tax and 49% without tax.

The project also was proved to be feasible after subjecting it to the sensitivity analysis. When increasing the operating cost by 10% and reducing the total benefit by 10%, The (IRR) would be 41% and 39% respectively. The study recommended that investment in milk production farm will be feasible by integrating fodder agriculture and rotation system, adoption of artificial insemination technique and reducing the taxes.

بسم الله الرحمن الرحيم

الخـلاصـــه

تتوفر في ولايه الخرطوم أعداد كبيره من الثروة الحيوانيه بأنواعها المختلفه بـالرغم من هذه الوفرة إلا انه هنالك فجوه كبيره بين انتاج واستهلاك الالبان .

الهدف من هذه الدراسه التعرف علي الجدوي الماليه والفنيه لإنشاء مزرعـه بولايـه الخرطوم كنموذج يعتد به للمساهمه في سد الفجوه بين انتاج واستهلاك الألبان بالولايه.

اعتمدت الدراسه علي مسح ميداني تم إجراؤه في مزارع مختلفه بمنطقة حله كوكـو وبمنطقة شمبات . وقد تم تصميم إستبيان لجمع المعلومات الاوليه عن اسعار مدخلات الإنتاج والمنتجات من 9 من منتجي الالبان في نفس المنطقتين، ودعمت بمعلومات ثانويه من تقـارير وزارة الزراعه والثروة الحيوانيه والسمكيه ومصادر اخري ذات صله.

تم استخدام التحليل المالي لتقييم الجدوي الماليه والفنيه للمشروع عاليه حيث اعطـى صافي قيمه حاليه (NPV) موجبه ونسبه عائد الي التكاليف (B/C) 1.6% ، ومعـدل عائـد داخلي (IRR) بنسبة 47% و 49% في حاله استقطاع الضرائب وبدون إستقطاعها . وفتره استرداد رأس المال تتم في العام الثاني.

وبإجراء تحليل الحساسيه لهذا المشروع وذلك بزياده التكاليف الكليه بنسبه 10% مـع ثبات العائد و تخفيض العائد بنسبة 10% مع ثبات التكلفه الكليه وجد ان المشروع ايضا مجد ماليا.بنسب 41% و 39% علي التوالي.

أوصت هذه الدراسه إن الاستثمار في مزارع إنتاج الالبان يكون مجديا مالياً بإدخـال زراعه الاعلاف وإدخال نظام الدورات الزراعيه وتبني إستخدام تقنيه التلقـيح الاصـطناعي وتخفيض الضرائب.

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Abbreviation

ODI	: Overseas Development Institute.
IOE	: International Organizations for Epizootic.
FAO	: Food and Agriculture Organization.
USA	: United State of America.
BNDC	: Blue Nile Dairy Company
FIRR	: Financial Internal Rate of Returns.
B/C	: Benefit Cost Ratio.
NPV	: Net Present Value.
TDN	: Total Digestible Nutrients.
TCP	: Total Crude Protein.
DMI	: Dry Matter Intake.
CP	: Crude Protein.
DP	: Digestible Protein.
DM	: Dry Matter.
Ca	: Calcium.
ME	: Metabolismable Energy.
P	: Phosphorus.

Chapter One

1- Introduction

1.1. Pre-amble :

Milk is a nutrient fluid product produced by livestock mammals for human consumption. Milk provides a primary source of protein and sugar material that is processed into dairy products. Dairy products include whole fluid milk, low-fat fluid milk, whole and non fat dry milk, butter, cheese, evaporated and condensed milk, frozen dairy products, fermented products such as sour cream and yogurt (Columbia University 2003). The demand on dairy production is to produce high quality milk with a composition corresponding to the consumer demand.

1.1.1 Composition of milk:

The composition of milk varies greatly among different mammals. Cow's milk is lower in Sugar and higher in protein and is composed of about 3.5% to 6% milk fat, 4% to 8.5% milk solids and about 88% water. Its main protein "80%" is casein, while whey proteins make up most of the rest (Wikipedia 2003).

1.1.2 Milk production in the World:

During the last decades milk production in many parts of the world has gone through a revolution which is still in progress. Milk is produced from fewer, but higher yielding cows. Structural changes have taken place in dairy farming decreasing their number and increasing their size with intensive use of high technology, becoming an ordinary tool for milking-farmers. The great improvements in dairy production were results of interaction among different individual undertakings which capitalized on advances in various disciplines. For example, genetic progress has resulted in increased lactation production from about 4000 kg 30 years ago to an average production of 7000 -12000 kg at present.

Similarly, developments in proper management and feeding for optimal milk production have been other examples.

In 2001 India, became the world leader in milk production. It had about three times as many dairy animals as in the USA with a production volume of 84 million tons compared to around 75 million tons in the USA (Milk production in India-FAO 2004).

1.1.3 Milk production system in the Sudan:

The production systems are divided into two types:-

1.1.3.1 Traditional system:

This system includes nomadic and semi-nomadic forms of production. The greater portion of livestock production in Sudan belongs to the nomadic and semi nomadic pastoralists. These groups constitute about 25 percent to 40 percent of the total population of the Sudan and own about 92 percent of the Sudan national herd.

The production of milk in this system is not the main objective. It is aimed mainly towards meat production and satisfying social values and aspirations of the nomadic and semi nomadic groups. In the rural areas, milk is used for local consumption and a surplus is used for manufacturing of cheese and butter-ghee (Socio-economic and marketing study September 2002).

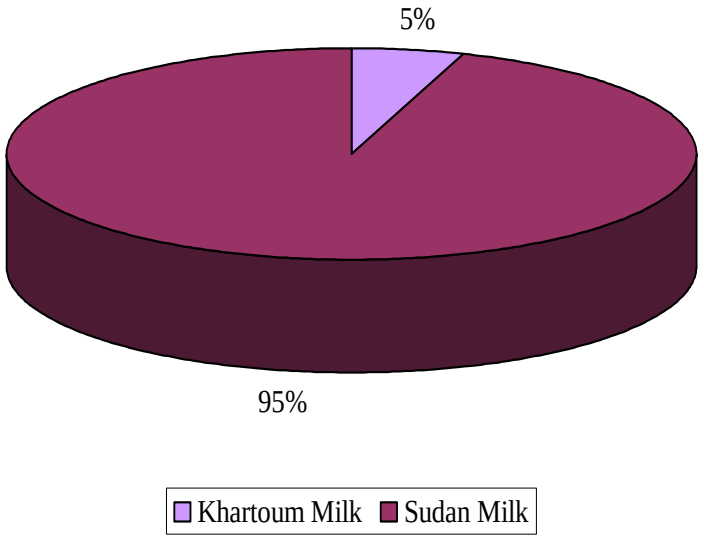
1.1.3.2 Intensive production system (the Modern System):-

Under the intensive production system, the producer follows modern dairy management practices to raise pure-breed or cross breed dairy animals of high yielding local and foreign mixed cattle. The animals are reared under improved environment condition “housing” given appropriate nutrition and receive the required veterinary services. These enable them to produce over 5000 kg of milk per lactation cycle. Under this system milk production is lucrative and feasible (Source: (Socio-economic and marketing study, 2002).

1.1.4 Milk production in Sudan:

Fresh milk is produced in Sudan from cattle, sheep goats and camel. In the year 2004, there were about 5384 million tons of milk from cattle, 475 million tons from sheep, 1500 tons from goats and 46 million tons from camels, together producing 7405 million tons of milk as indicated in Appendix (1.1). Khartoum State produced about 5% of total Sudan milk production (Fig1.1).

Fig: (1.1): Total milk production in Sudan and Khartoum state in (2004).



In Sudan, the sector of animal wealth have a low spending of the general over all spending of the government, accounting to about 3% compared to that of India spending which is about 23.4%. Also animal wealth sector complains from non-coordination of macro economic policies, agricultural policies in addition to the negligence of small producers, resulting in the decline of production, increases in the cost of production and consequently weaknesses of the competitive ability and

producer's income (Tag Eldin, Ministry of Animal Resources and Fisheries, 2005).

Artificial Insemination was introduced under Animal Research work in the Sudan since early 1970 .Kuku Research center was administrating this activity for the long time .However by 1994 Artificial Insemination was stopped in the public sector, and the private sector continued individual efforts in the respect, with no official support or extension services.

1.1.5 Milk production and consumption in Khartoum state:

Khartoum state is supplied by milk from the traditional sector, small modern sector farms and milk processing plants. Figure (1.2) shows that most of the milk comes from cows and goats (86% from cows, 10% from goats and 3% from sheep respectively for the period (1991 – 2005) (Socio-economic and marketing Study, September 2003). The estimate of milk production and consumption of Khartoum State are given in the figure (1.3).

The Figure indicates that for 2004, for instance, the total milk production in the State was about 423 thousand tons, and the demand was about 445 thousand tons. In the year 2005, the expected production was about 442 thousand tons and the demand was about 465thousand tons. The annual demand of milk increases annually in line with the respective annual increases of the population, at the rate of 04.4% and the rate of percapita consumption of 5.8 kg (Ministry of Animal Resources and Fisheries, 2005). Figure (1.4) gives the annual increase in the population censes in Khartoum State during 1990-2004.

Fig: (1.2) : Total Milk production in Khartoum State form various species of animal for 2005

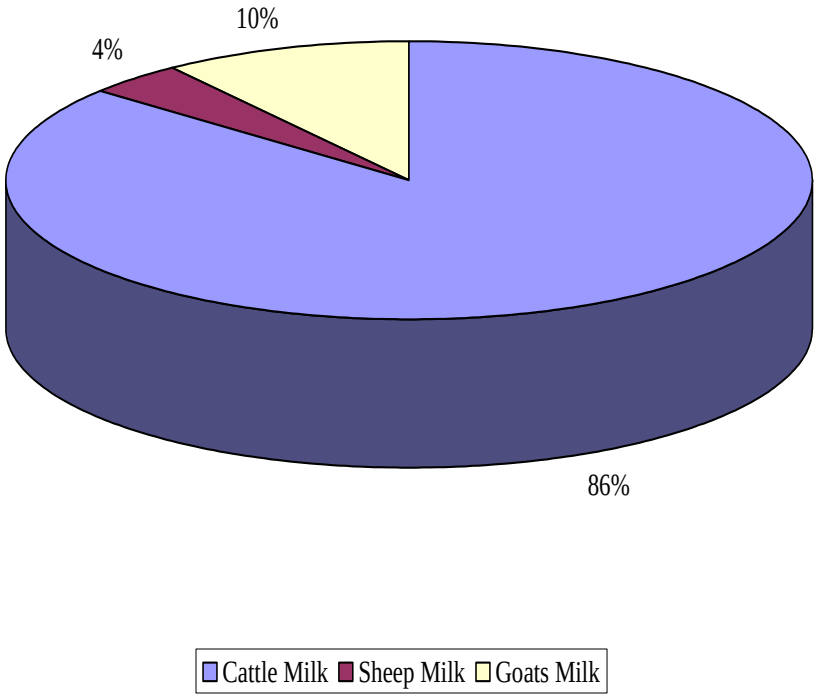


Fig. (1.3): Milk production and consumption in Khartoum State in 1995-2005

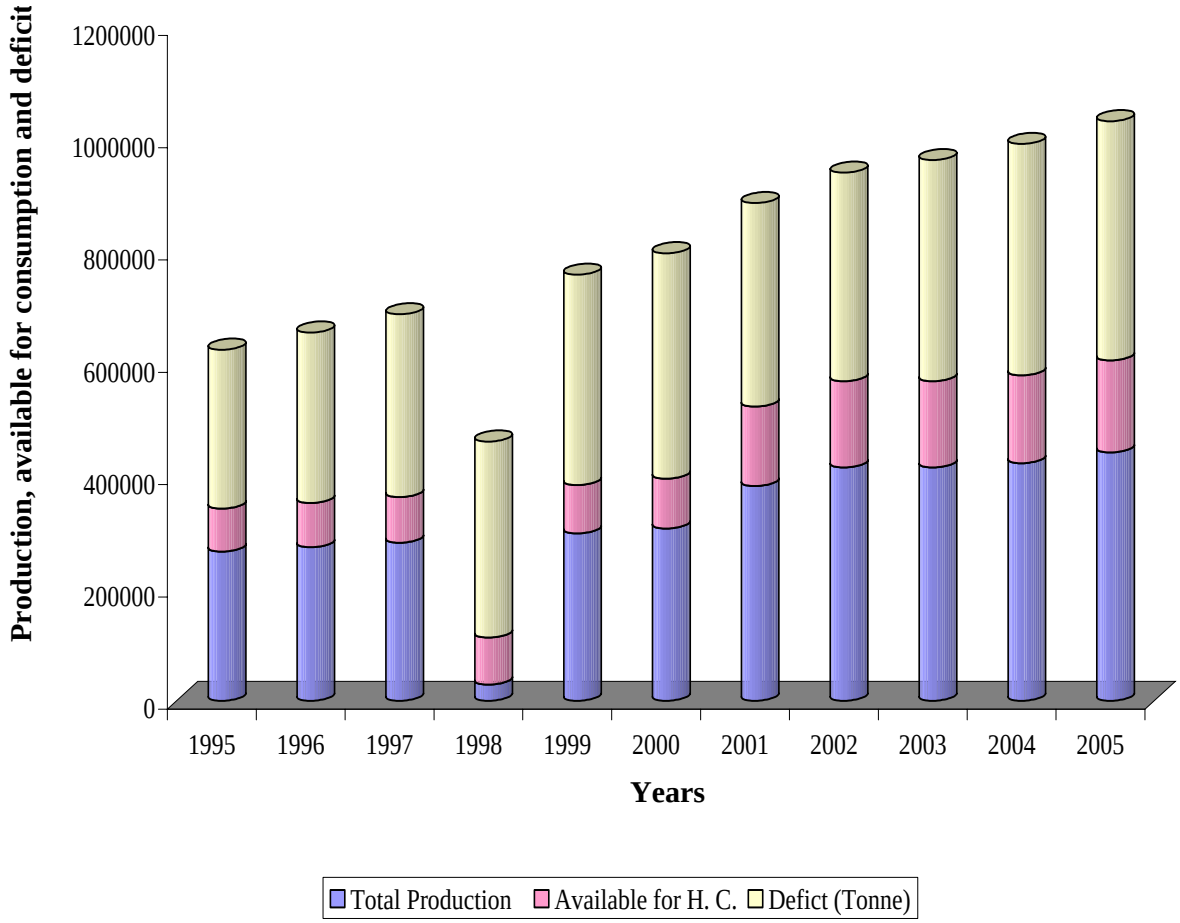
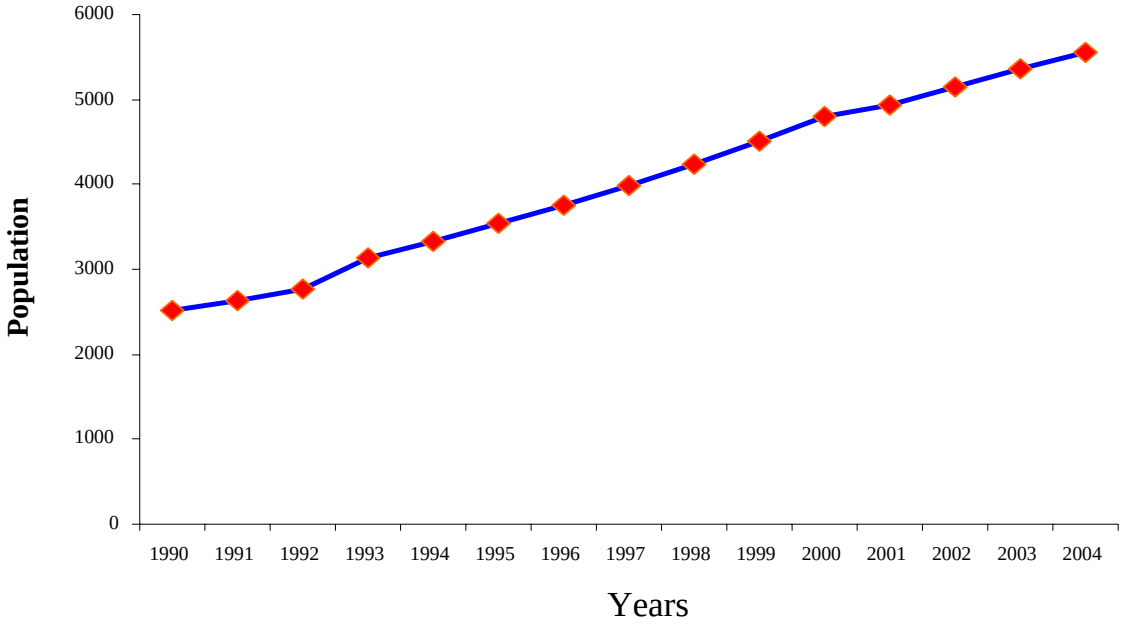


Fig. (1.4): Khartoum Population Period (1990/2004).



The human consumption amounted to about 37% of the total production while the young livestock suckle about 60% of total production. The remaining milk which amounted to about 3% may turn spoiled under high temperatures or other causes (Socio-economic and marketing study, 2002).

In Sudan, there are six milk factories with a total capacity of 312 tons per day, representing about 2.6 % of total milk production in Sudan. In Khartoum state, four factories having a capacity of (282 tons per day in day) represent about 47% of the total milk available for consumption (in Khartoum State and other State) (Ministry of Animal Resources, 2005). The gap is partially supplemented by imported of powder and liquid milk. The Figure (1-5) (1-6) Show milk production, consumption and gab in Khartoum State.

Fig. (1.5): Percentage of Milk Production, consumption gap in Khartoum state in 2004.

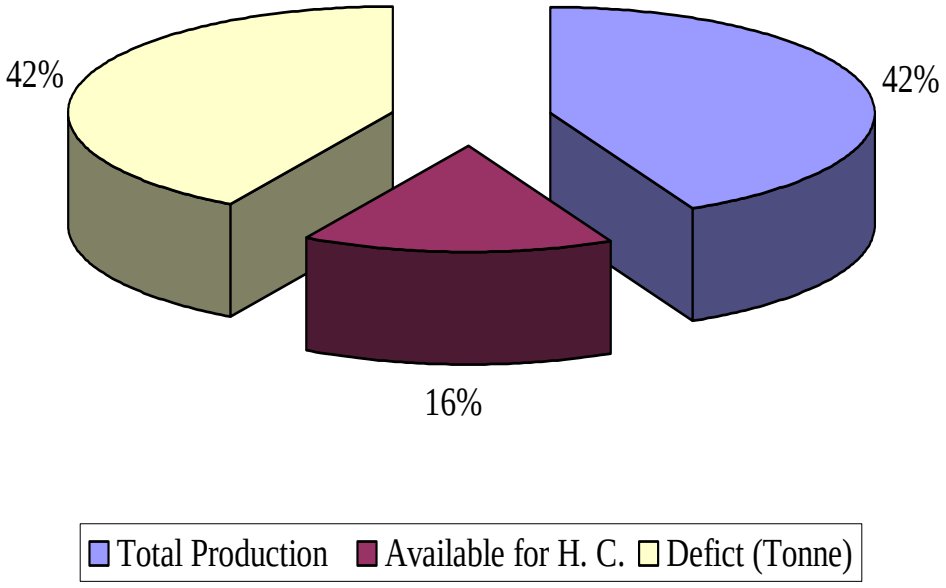
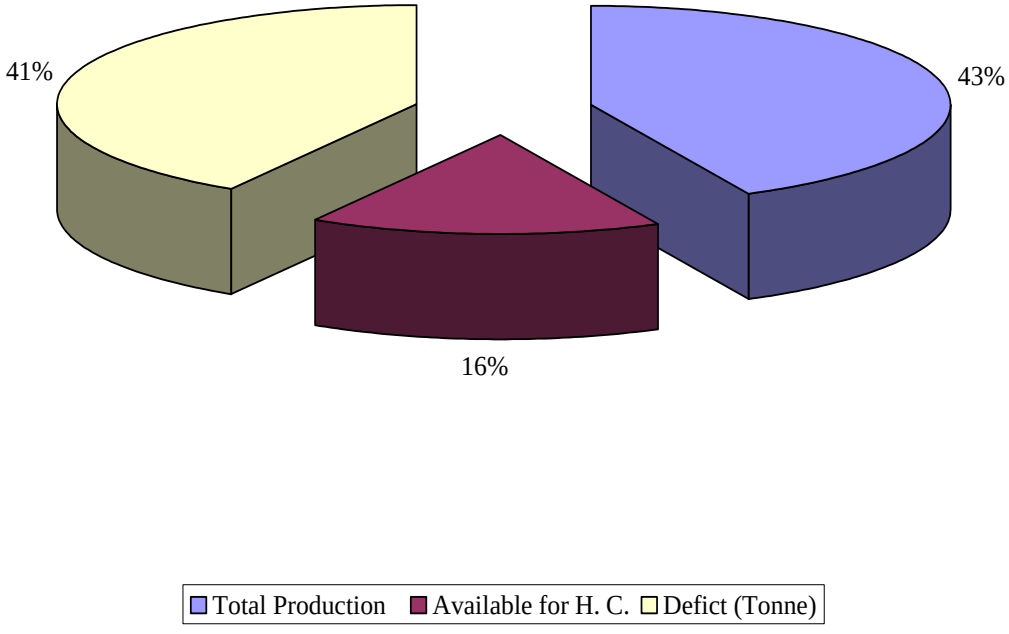


Fig. (1.6): Percentage of Milk Production, consumption gap in Khartoum state in 2005.



1.1.6. Prices of milk in Khartoum State:

The prices of substitutes for different kinds of dairy products have helped in increasing the demand for fresh milk despite increases in its prices. The prices of fresh milk in Khartoum have reached about SD 70 per pound (rattle) compared to SD 40 per pound few years ago. The fresh milk selling prices at the farm gate is about SD 50 per pound. The marketing channels absorb the differences between the farm gate and consumers prices (Khalil and Hassan, 2003). Table (1.1) shows the average consumer prices of milk in Khartoum State.

Table 1.1: Average consumer prices of milk production in Khartoum State (2000-2004)

Year	Fresh Milk SD/½ Liter	Powder Milk SD/400 Gr
2000	62	670
2001	68	745
2002	72	794
2003	75	798
2004	75	822

Source: Ministry of Animal Resources and Fisheries, 2005.

1 Liter = 2.25B

1.1.7 The development values and quantities of imported milk and their products (1992-2004):

In 1992 the imports of milk were about 224 tons and their value was about US$ 1962. These imports increased continuously till they reaching about 24694 tons in 2004 (table 1.4-1.5). The figure (1.7), (1.8) show the quantity of imported powder and liquid milk during 1996-2004 and 1990-2004 respectively.

Fig. (1.7): Annual imports of liquid milk in Sudan in (1996-2004).

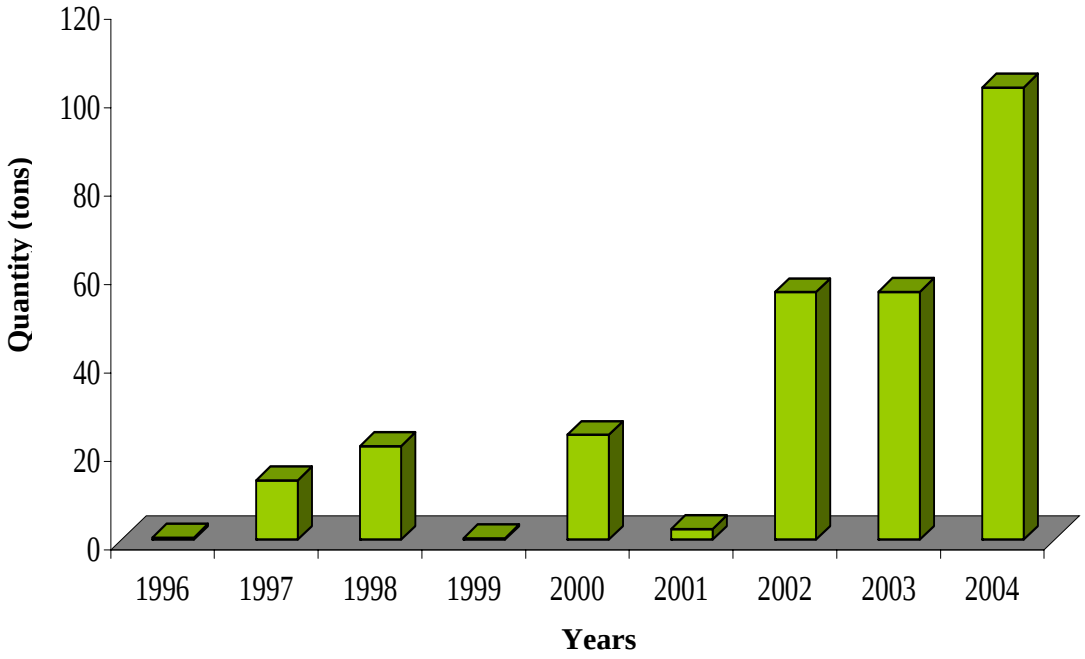
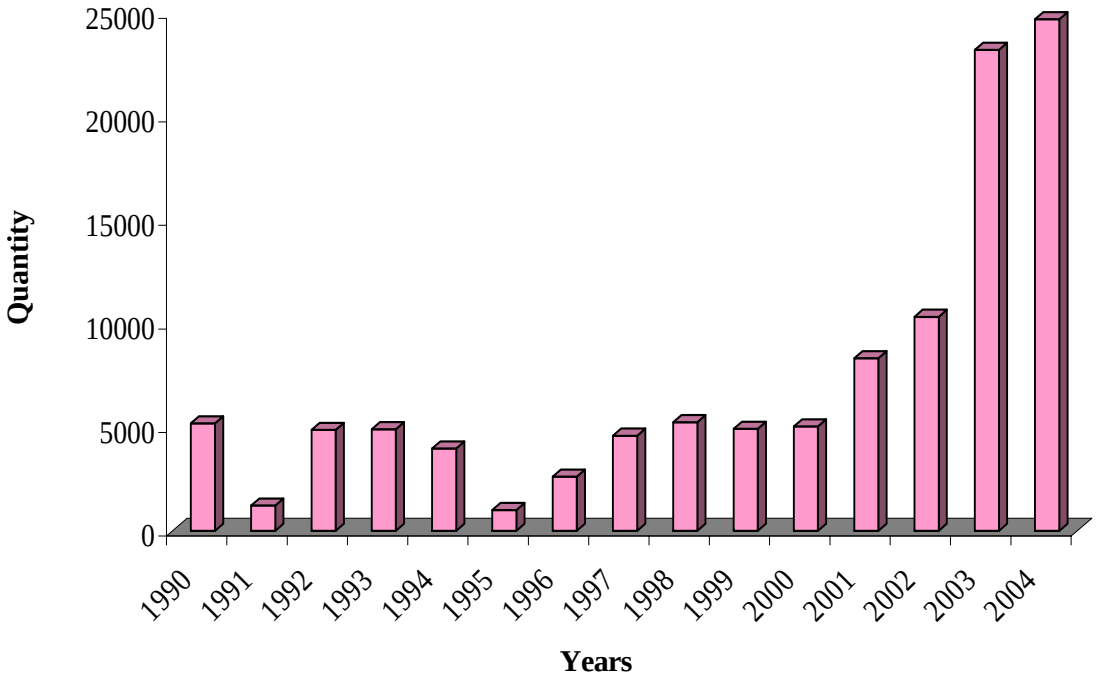


Fig. (1.8): Annual imports milk powder in Sudan in (1990-2004).



1.2 Problem Statement:

The demand for milk in Khartoum State increases with an increases of population growth rate as well as per-capita income, against reduced pasture. In spite of big potential natural resources of milk production in Khartoum state, yet it suffers from a milk gap between production and consumption. This was reflected in higher prices and increased imports of powder and liquid milk. Accordingly, this study attempts to investigate the financial and technical feasibility of milk production in Khartoum state.

1.3 Objectives of Study:

1.3.1 Main objective of the study:

The main objective of the study is to assess the financial and technical feasibility of establishing a typical milk production farm in Khartoum State. It is expected that the establishment of a mixed farm will help in reducing he milk gap in Khartoum state.

1.3.2 Specific objectives:

1. To assess the managerial technical capacity i.e. the technical feasibility of producing milk in a typical dairy mixed farm in connection with:

- Management of the farm,
- Types of animal raising,
- Marketing methods,
- Knowledge of feed requirement,
- Applying artificial insemination techniques in the farm.

2. To evaluate the financial feasibility of producing fodder in the typical dairy farm with respect to:

- Choice of fodder rotation,
- Cost of fodder production.

3. To evaluate financial feasibility of producing milk in the typical dairy farm with respect to:

- Cost of production,
- Returns of production
- Estimates of the NPV, FIRR, and the B/C ratios.

1.4 Hypotheses:

Given the above objectives, the following hypotheses were tested:

1. The cost of milk production has increased due to the increase in the cost of factors of production, especially the cost of feeds.
2. Cultivating green fodder in the farm would have a large impact on reducing the cost of fodder and reducing the cost of milk production.
3. The improvement of reproductive Physiological make up of the cows through artificial insemination would increase the number of improved milking cows' species.
4. The quantity of concentrates, roughages and type of animal breed would determine the amount of milk produced in the project.
5. Good management ensures sustained supply of milk production through out the life cycle of the dairy farm project.
6. The revenue from milk is reduced as the result expected increased competition

1.5 Research methodology:

1. The Methodology To a chive the study objects and hypothecs project formulation method is employed to assess the project financial and technical feasibility by calculating feasibility indicter which is NRV, B/C, FIRR

2. Primary data: Use of personal interviews, field survey for 9 farms in Shambat and Kuku.

3 Secondary data: used of published data form the Ministry of Animal Resources, Government and non-government agencies.

1.6 Organization of the study:

The study consists of five chapters. Chapter one introduces milk production in Sudan and in Khartoum State. It also discusses the research problem, the objectives, the hypotheses and the methodology of the study. Chapter two reviews milk biological and economical aspects and characteristics and its relevance to food security. Chapter three presents the methodology of feasibility studies. Chapter four gives the technical aspects of the project. Chapter five discusses the results of analysis of the project, conclusions and recommendations.

Chapter Two

2-Literature Review

2.1 Food security concept and definition:

Food security has been defined by the WB (1986) as "food security". Food security is achieved when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and preferences for an active and healthy life" (FAO, 1996). This definition recognized that food security entails availability, accessibility and provision of adequate nutrition to people. It also indicated that poverty has been a major cause of food insecurity and that sustainable progress in poverty eradication is critical to improving access to food.

However, conflict, terrorism, corruption and environmental degradation have also contributed significantly to food insecurity. From this concept, another related concept was as inferred, food "self-sufficiency" concept. This new concept was based on the premise that those who were able to produce enough food can afford to secure food. Nevertheless, the food security concept in totality has highlighted the importance of employment and markets; it also scores the need for safety-nets and market protection for those unemployed and other vulnerable groups. But it was always argued that some forms of protection such as consumer subsides would have a disruptive effect on the proper functioning of markets and undermine comparative advantage, and therefore, it would be better if market liberalization would domain (FAO, 2004).

2.2The value and derivatives of milk:

Milk is a liquid secreted by the mammary glands of females mammals as a feed for their young. Milk is an almost complete diet,

which consists of proteins, fats, salts, milk sugar "lactose" and vitamins A, C, D, certain vitamins B and lesser amount of others. Also, it is a natural and excellent source of protein, calcium, phosphorus and vitamins. It is nutritious tasty and versatile.

Some milk products available to the consumer are butter, cheese, powdered day milk, evaporated and condensed milk, Powder cream, ice cream, cottage cheese, yogurt, and sour cream and other. Because milk is so nutritious, it will continue to be an important food, especially in the diets of babies, children, teenagers, pregnant women, and nursing mothers.

One of the most important health qualities of milk is the amount of calcium, which it contains. So milk is the leading source of calcium, and unless milk and milk products are consumed regularly, people may suffer from deficiency of calcium (Ouirn, 2000).

The milk of cows is most widely used by humans, but milk of goats, ewes, buffaloes, camels, asses, zebras, reindeers, llamas and are also used (Columbia University 2003).

The composition of the milk varies with the species, breed, feed, and condition of the animal. Jersey and Guernsey cows produce milk of high butter fat content, Holsteins produce larger quantities of milk but with the lower butter fat content (Columbia University 2003).

2.3. Milk production systems in the world:

2.3.1. Production system in the United State:

In the USA milk comes from breeds of cattle genetically selected for milk production. At one time in the U.S cattle were selected simultaneously for beef and milk production. This is still the case in many parts of the World. The common dairy breeds in the US have been selected almost exclusively for milk production for many generations.

In the US, most milk is produced by cows raised under intensive production system of ties tall barns, free stall brans, and open lots. They are more intensively managed systems feeding cows' on rations that are relatively high in concentrates and storage forage. Other cows are raised on pasture-based system, which are the primary production system in several dairy producing countries in the world such as New Zealand-pasture-based system. These systems often strive to optimize rather than maximize milk production while paying more attention to control of input costs. Some producers use a combination of the two systems, as they reduce cost and still allow for feeding of concentrates to improve milk production levels.

2.3.2. Milk production systems in tropical Latin America:

2.3.2.1. Dual purpose cattle production systems:

Dual purpose cattle production systems are those in which income is divided approximately equally between milk and beef. They predominate in many parts of Latin America. Their salient characteristics are that almost invariably the calves are raised on cows by some form of restricted suckling. Usually milk is done only once per day and the major feed resources are obtained from pastures, fiber-rich crop residues, and by-products with minimum use of supplements.

The genetic resources vary enormously but the most popular animals for this system are cross-bred derived ones from the European Bostaurus types (predominantly, Brown Swiss and Holstein species), and Bosindicus (Zebu cattle).

The dual purpose system arose through the need to increase the income from typically extensive beef production systems. However, the first stage of choosing potential cows for high milk production comes from those with appropriate genetic potential with suitable temperament. The next step is usually to introduce a sire from recognized dairy breed,

in order to increase dairy traits. Further innovation may follow including improvement of pastures, supplementation of cows and calves with concentrates and other feed ingredients, milking the cows twice per day with occasional machine milking.

More recently, dual purpose systems have been advocated as an appropriate way to integrate cattle into intensive mixed farms. The argument used was that such systems enable better use of available resources being well understood by farmers, who developed them in the first place and that they were able to satisfy the demand balance ratio for both milk and beef (Restreppo, Murgueitio and Preston, year2005).

2.3.2.2. Mixed farming production system:

An intensive livestock production system developed in Colombia by CIPAV has been proposed as a sustainable solution for Latin American humid tropics as an example of integration and multiple uses of local resources. The system is based on a high productive and adopted crop, inter-grown with multi purpose trees and water plants, as a source of biomass, to provide feed for cattle and other animal species and as food and fuel for humans. This system consists of several subsystems that can be introduced separately or integrated in form. It is directed at resource-poor farmers and also has been adapted to commercial scale farmers. The components of the model are biomass (crops), ruminants mono-gastric, water decontamination, and fuel subsystems. The system can be based on crop or may use residues and by-products of tropical crops (CIDAV).

2.3.3 Small holder dairy production system in eastern and southern Africa:

The dairy production for the market in eastern and southern Africa has some common characteristics. In all countries, except South Africa and Zimbabwe, milk production is dominated by small holders. With the

exception of Sudan and Somalia, where camels make a major contribution, cattle is by far the largest source of marketed milk.

In eastern and southern Africa, there are three milk production systems pastoralist herding system, herds kept by agro- pastoralists system, and crops-livestock farming system.

Small holders dairy system in eastern and southern Africa tend to concentrate on the sub- humid high lands, the water semi-arid and drier sub-humid areas, and near to or within urban consumption centers. Less production occurs only in those regions where there is concentration of traditional consumers and good market infrastructure. The majority of the rural systems producing marketed milk in east and south Africa are the integrated crop-dairy farming systems, which benefit from the positive synergies between the dairy enterprises, staple food crops (generally maize), and cash crops. Most milk production cows in east and south Africa are concentrated in Sudan, Kenya, Ethiopia, Somalia and Tanzania, being the top five countries producing about two-third of the total cows' milk production in the continent. During (1985-1998), these eastern African countries demonstrated different patterns of change in cows' milk production and import. This was because, unlike the cattle population in Kenya, the large cattle population of Sudan, Ethiopia and Eritrea had relatively limited number of exotic dairy cattle in their crosses (Muriuki and Thrope, Year2005).

2.3.4 Animal production systems in Sudan:-

The major production systems are:

2.3.4.1 Nomadic system:

Livestock, mainly cattle's and sheeps with some goats are raised entirely on natural rangelands. Households move with their animals and have no permanent base on which to grow crops. They spend the rainy season in the northern semi-desert zone and during the dry season, move

further south into the savannah. They derive income from the sale of animals, meat and milk in the form of white cheese and ghee.

2.3.4.2. Transhumant system:

In the transhumant agro-pastoral system, household depend mainly on livestock, mostly cattle, with some sheep and goats, in addition to some cropping. In western Sudan, households migrate north during the rainy season and return to the savannah during the dry season. In the central and eastern States, migration is towards the Nile during the rainy season and back during the dry season.

2.3.4.3. Sedentary system:

The sedentary system exists where there is rain fed and arable farming in settled village. Some livestock, mainly small ruminants, are kept, but the animals are less important than the crops. Sorghum, Sesame, and cotton are grown on clay soil, and millet and groundnuts on sandy soils.

2.3.4.4 Migratory agro- pastoral system:

A migratory agro pastoral system is found in Southern Sudan, where livestock is raised in traditional rain fed agriculture systems in settled villages. Livestock is moved away from the Nile during flooding periods and move back when floods recede.

2.3.4.5. Sendentary irrigated crop-livestock system:

Permanently settled farmers in the irrigated parts of central Sudan grow cotton, sorghum, groundnuts, and wheat, and also raise livestock, especially small ruminants. Livestock, although less important than crops, provides a supplementary source of income, which is used to hire labor for agricultural work before harvest. Productivity is low and animals depend heavily on crop residues, industrial by-products and grazing limited areas of fallow and the sides of irrigation canals. Intensive cow's

milk production is becoming more common within large irrigation schemes, being promising for future expansion of livestock production.

2.3.4.6. Other systems:

Other animal production systems include ranching, feed lot operations and urban backyard livestock production. Ranching is a recent trend in Sudan. Animals are raised for meat on natural rangelands in western Sudan in Kordafan and Darfur states, and in Butana and in Kassala state. Poor range management within ranches is, however, a major constraint. Feed lots have existed for over 30 years in Sudan Animals, mainly beef cattles and sheeps, are brought on the hoof from western Sudan and fattened in Khartoum State on sorghum grain, oilseed cakes and roughage, with gains of up to 1kg/ day in cattle and 0.35 kg in sheep near and within urban areas goats and poultry fed on household waste are kept for domestic supply.

Source: (Fadlalla and Ahmed, 2004 Agricultural Research Council, Animal Resource Research Corporation).

2.3.5. Milk production system in Khartoum state:

There are two main systems that supply milk to Khartoum State.

These are:

1. the modern dairy production system
2. the traditional diary production system

The differences between these systems lie in the mode and relation of production.

2.3.5.1. The modern dairy production system:

2.3.5.1.1. The private sector dairy farms:

These are fewer numbers and adopt improved animal husbandry practices, with regard to housing, feeding, breeding, and milking. Due to the advanced practices on these farms, milk production reached an average of 60 pounds per cow per day.

The largest farm is these spheres are:

i. Khartoum dairy products company "Butana" milk producers.
ii. The dairy land company project " dairy land" milk producers
iii. The military Agricultural Corporation.

2.3.5.1.2. The cooperative sector dairy farming:

With the aim of the replacement of traditional pastoralist by better systems, the most important of them is “Kuku Dairy Production Scheme" which was established in 1958 by the Ministry of Animal Resource for settlement of nomadic tribes of Al Butana Region. It was composed of five milk production cooperative Societies; i.e. Hillat Kuku; Abu Dilling; Maygoma; HagYousif an Wad Manwalla Societies. The milk producers were organized in these cooperative Societies. Each cooperative. Member had been given 10 feddan for each 12 milking cows. He was provided with irrigation water and agriculture machinery service, at nominal price. The scheme's management also provides milk producers with veterinary and artificial insemination services.

2.3.5.1.3. The public sector dairy farms:

This farms are mainly research station which are established to improve the characteristics and potentialities of the local cattle. The university of Khartoum dairy farm is the oldest among theses dairy research station. Due to some filarial and managerial problems, it contribution to milk supply in Khartoum state is very meager. The modern dairy farms supply their clients with fresh milk, reconstituted milk, and milk products.

2.3.5.2. The traditional dairy production system:

This type of production system possesses some of necessary requirements that are demanded by the regulation of Department of

animal production of Khartoum State. The majority of them take the following forms :

2.3.5.2.1. Back yards units:

The back yard units are attached to the owner-home and are managed by the house-hold. The animals are kept for commercial fresh milk production.

2.3.5.2.2. Dakkas:

A “dakka" is an open space at borders of the towns of villages where dairy farmers rear and breed livestock for production of milk and meat (El Sadig, 1998).

2.3.5.2.3. The dairy production unit:

These are milk production units that contain an area for fodder production. The traditional dairy farms supply their consumers with fresh milk and some milk products (El Sadig, 1998).

2.4 The Milk production sector problems in Khartoum state:

1. Financing:

Banks consider financing the milk sector as non-encouraging since it has a slow rate of return. The banks are always interested in financing quick cost recovery activities with no concern towards the developmental repercussions of these activities.

2. High cost of establishment of productive unit:

Milk production suffers from high cost due to high increases in labor wages, electricity rates, fuel prices that makes the dairy business not encouraging for investment.

3. In adequate fodder resources and limited varieties of feed supply:

The most important pillars of the animal-husbandry are: nutrition, high feeds prices especially green fodder, fluctuations in maize, cottonseed cackes, Mollase, groundnut cakes pricesand imposed fees.

4. The artificial insemination:

The lack of finance and support from the country for the development of the artificial insemination project and the low genetic potential of indigenous livestock is one of important constraints of livestock production.

5. Taxes and fees:

Taxes and fees on the animal wealth sector are high and thus discourage investment in dairy activities (Kalil et al., 2003).

6. Marketing:

Absence of efficient marketing system in form of good roads, transporting vehicles, refrigeration facilities needed to keep milk fresh until reaching consumers safely (Kalil et al., 2003).

7. Poor livestock statistics.

8. Most of milk producer are located far away from the consumption centers

2.5. Milk marketing:

2.5.1. Introduction

Traditional milk production activities represent about 90% to 95% of the total milk production in Sudan. Owing to remoteness of production areas from consumption centers and difficulty of transporting fresh milk within the country, powder milk was imported to fill the supply demand gap in those consumption areas. Also imported liquid milk encouraged by low customs duties increased the competitiveness of foreign milk supply against domestic milk supply (Kalil et al., 2003).

2.5.2. Milk marketing channels:

Milk marketing channels differ according to the type of production.

However, existing marketing channels can be summarized as follows:

2.5.2.1. Channels of direct milk distribution:

This channel includes the milk produced daily and directly distributed to consumers. This usually takes place in farms around cities. Also some companies sell their milk production directly to the consumers as in the case of the Military Corporation and Kenana Sugar Farm (Kalil et al., 2003).

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2.5.2.2. Sale through mediators:

This channel is the most widely known. Middlemen start collecting milk from milk farms and markets and then transport the commodity to consumers, groceries and houses. This milk is fresh and not cooled. This channel uses cars and donkeys. These transportation systems do not comply with the hygienic requirements of the Ministry of Health. This milk is subjected to high bacterial infection and mixing with water and cereal flour, and sometimes powder milk.

The dairy factories such as BNDC and Dairy Land distribute milk in packs directly to grocery, restaurants and cafes out lets. They use refrigerated vehicles for the distribution, and the milk flow through this system represents about 5% to 7% of the total milk distribution in the big cities and major rural areas (figure 2.1and figure 2.2) (Kalid and Ahmed, 2003).

2.6. Milk industry:

Despite the antiquity of the human knowledge about milk and their products and the dependence on milk for food, the common ways of production, collection, transfer, manufacture, and marketing remained primitive until the end of the 18^{th} century. By the middle of the 19^{th} century with the advent of scientific improvement, new dairy factories were established in Europe. This was accompanied with modern equipment for sorting, pasteurization and sterilization, contributing effectively to the availability of quality and hygienic milk and dairy

products and increasing the consumer confidence on the milk products (Kalid and Ahmed 2003).

2.7 Milk industry in the Sudan and the current situation:

Sudan milk industry started in the last century by the establishment of the first dairy farm, the Blgrifia Farm, in Khartoum in 1907. Then the first Society for dairy farmers in Kuku village was established in 1951, followed by Babnousa Factory in Darfur, El Obied Milk Factory, (1970) and Barakat Milk and Al Bagir Milk Factory belonging to the Arab Company for Agricultural Production and Manufacturing, the Butana Milk Production, and the Blue Nile Dairy Company Milk (BNCD) (table 2.3).

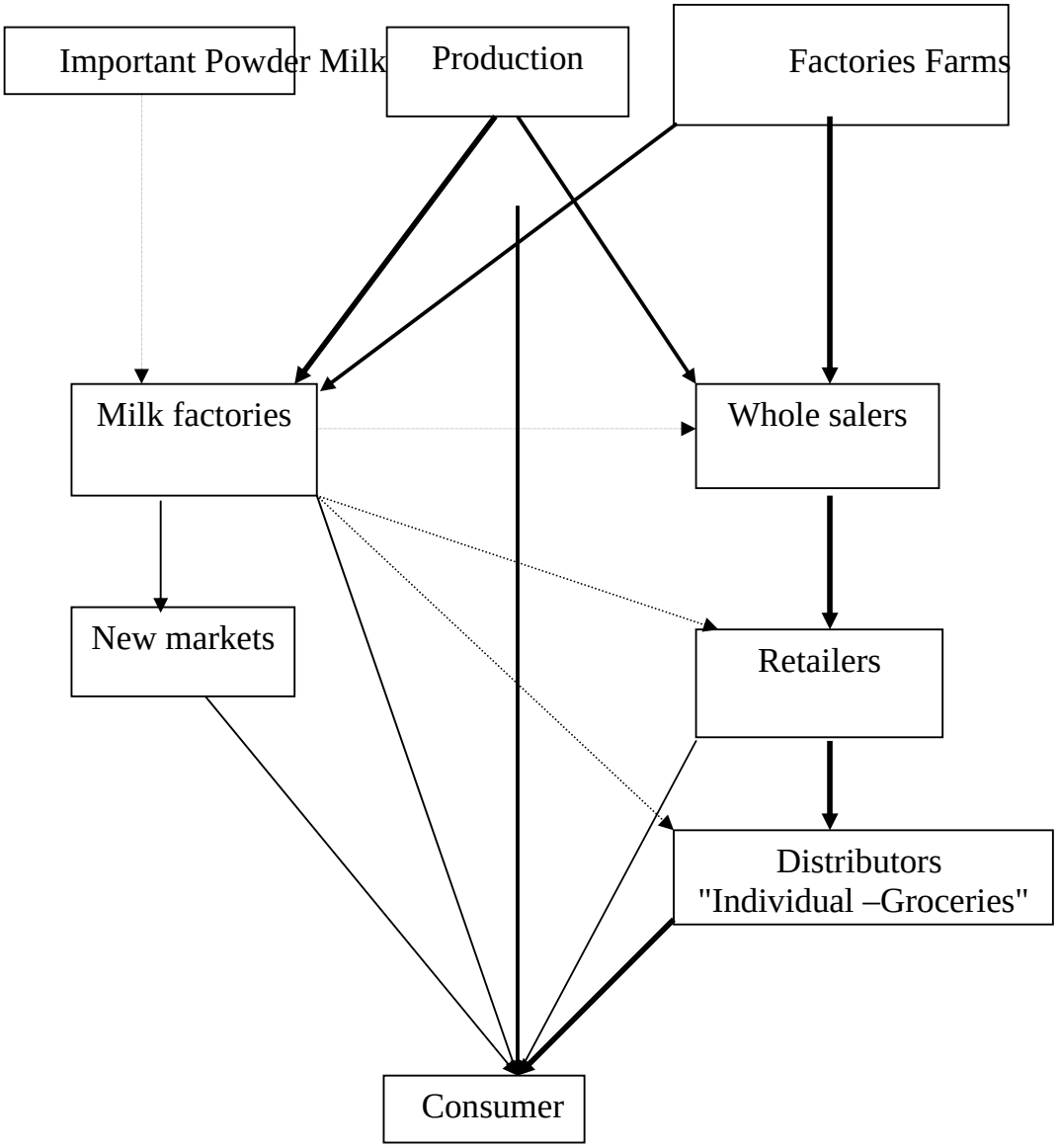
Table (2.1): Milk factories, production energy and operational rates:

Factory	Establishment	State	Manufacturing	Operational energy	Note
Kafouri milk	1908	Khartoum	10	2-1	Stopped
Kuku milk	1961	Khartoum	30	5-10	Under qualification
Babanousa milk	1970	West Kurodufan	-	-	Did not work
El-obied milk	1984	North Kurodfan	20	-	-
Barakat milk	1981	Gezira	20	2-4	-
Butana milk	1984	Khartoum	60	8-5	-
Blue Nile	1997	Khartou	30	10-15	-

milk		m			
Dairy Land milk	1985	Khartou m	160	2.-7	-

Sources: (i) Arab Organization for Agriculture Development, and (ii) Development of Marketing Production for the Small Farmer, Ahmed and others, August, 2003.

2.1. Milk marketing channel:



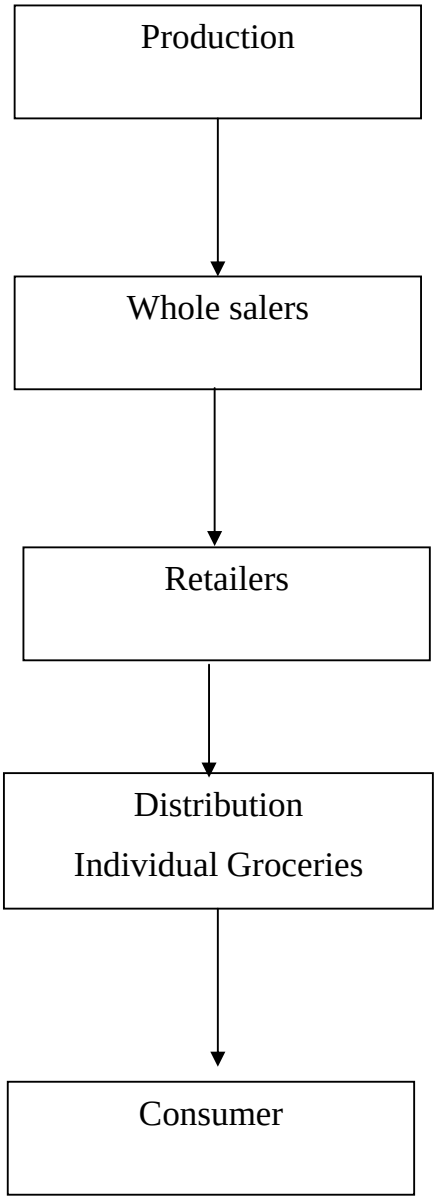
Source: Arab Organization for Agriculture Development

Study: development of marketing production for the small farmer.

Dr. Ahmed Kalid Ahmed

Dr. Hassab Sayed Ahmed AbuZeid.

Milk distribution channels in the project:



Compiled by the author

2.8 Projections of milk production in the Sudan:-

Sudan's strategy for this sector is to sustain increases in milk production to satisfy domestic demand and to enhance food security and human nutrition. In the long term, the country wishes to exploit its milk production potential to the level that there will be a surplus for export (expected to be about 50%) (Dairy Sub Sector Development project- Socio-Economic and Marketing study, 2002).

Table (2.2): The projected supply and demand for milk in Khartoum State (2001-2011) (Tones)

Year	Projected Production	Supply to human consumption	Projected Demand	Projected Deficit
2001	328619	121589	521423	-399834
2002	351622	130100	568351	-438251
2003	376136	139170	619503	-480333
2004	402273	148841	675258	-526417
2005	430432	159260	736031	-576771
2006	460562	170408	802274	-631866
2007	492801	182336	874479	-692143
2008	527297	195100	953182	-758082
2009	580027	214610	1038680	-824070
2010	620623	229931	1132160	-902529
2011	664067	245705	1234040	-988335

Source: Dairy sub sector development project – socio economic and marketing study sep. 2002. Mission Estimations.

Chapter Three

Methodology of Feasibility Study

3.1 Definition:-

Feasibility studies aim to test the extent of the viability of the project (new project or the expansion in an existing project). It includes several aspects (the legal, marketing, financial, technical and economical) and it aims to provide adequate information which affect decision making that match the project targets.

3.2 Feasibility Studies Benefits:-

1- Helping in making good and wise investment decision,
2- Achieving economic efficiency in the use of the domestic resources.
3- Enabling investors to get finance for the project.
4- Assisting investors in choosing among investment opportunities.
5- Helping in the reform of the project.

3.3 Kinds of Feasibility Studies:-

The feasibility studies classification is based on many considerations:

3.3.1 Functional Classification:

The discrimination between the feasibility studies according to the different nature of the studies:

- Technical and engineering feasibility studies: aims at the estimation of the whole project technical needs.
- Marketing feasibility studies: aims at estimation of the size of the expected demand for the project products and the choice of the pricing policies and distribution channels.
- Financing feasibility study: aims at the evaluation of the financial structure and cost of the project.

3.3.2 Utilitarian Classification:

The classification is based on the beneficiary side, and these include investors and the society represented in the country.

3.3.3 Analytical Classification:

It includes:-

1- Detailed feasibility study.

2- Tentative feasibility study.

3.3.3.1 Tentative Feasibility Study:-

It is an exploratory study to the investment idea, and depends on it in deciding doing the detailed feasibility study or stops it. Tentative feasibility study cares for:

- Defining the legal hindrances.
- Defining the general climate for the investment.
- Defining the general feature of the investment idea.

3.4 Marketing Study:-

This study takes place in two stages:-

1- The recognition of the features of the market at this time and forecasting the future through:-

- Knowledge of the degree of the government intervention.
- The degree of competition in the market.
- Knowledge of the prices of the alternative and complementary products.
- Availability of transportation.
- The population rate and their classification according to the race, age and income level.

2- Collection of data and marketing information :-

By the collection of primary or secondary data which consist of:-

- The market problems related to the alternative and complementary products.
- The prices of the alternative complementary commodities and their characteristics.
- The governmental policies related to products of the suggested project.
- The income of the targeted consumer section.
- The distribution channels.
- The size of the gap between supply and demand.

3- Estimation of demand size of the products:

- The predication in the state of new products:-If the product was new, this product require marketing test (distributing samples then study the market reaction, or by offering samples to whole sellers and retailer or to consumers and study their reaction and responses toward this products.

4- Ways of prediction of known products to the consumer:-

a- The description models:-mode of experts who carry out the market study depending on experience and the personal estimation.

b- The quantity and statistic models:-Estimation of the demand size of the products based on the main assumption that the past reflects the future, which is reflected by a rise in the straight line equation:-

$$Y= A+BX$$

Where:-

Y= Quantity demanded of the product in question

B= the staircase of change in the sales (coefficient parameter)

X= the demand factors

The two variables (X) and (Y) are given but (A) and (B) are unknown and must be found through:

$$Y = NA + B\sum X$$

$$xY = Ax + B\sum x^2$$

3.5 Financial Analysis and General Rules:-

For financial analysis of the project, the cash flow (that differs with different of the project kinds) must be presented for all project lifecycle and aims at maximizing of the current value of the net cash flow in the future.

Financial analysis includes:-

1. Defining and estimation of the cost :-

It is an annual measure throughout the economic lifecycle of any project by incorporating both of the initial investment cost and the operational (annual fixed and variable) cost.

The fixed cost includes:-

   a. Initial investment cost:-value of land, building, equipment, vehicles, and infrastructure, the legal fees and the feasibility study fees. It also includes the replacement of the initial fixed assets through the project lifecycle, when assets depreciate.

2. Estimation of the operational cost:-This is divided into the annual fixed cost and variable cost, and this division allows for the estimation of the operational cost in the different stages of the project cycle.
3. Estimation of incomes:-The income may result from the commodities sales that are expected to take place during specific accounting periods.

4. The cash flow:-It is the summary of the cost and expected revenue flows through the project life cycle and it is basis for calculating the project viability.
5. The net cash flow:-It is difference between the revenue and the cost cash flows of the project. Usually negative in the intial year of the project (in the foundation stage) then becomes positive by the beginning of the net cash flows (Huait Allah, 2003).

3.6 The Technical Study:-

It aims at testing of the suitable styles of production for the project, including the choice of the geographical location of the project site and the estimation of the cost related to the implementation of the project.

3.7 Financial Feasibility Study:

It is basically defining the financial and economic projects validity and it takes place by comparing of entries and deducting outflows to obtain a profit. Generally, there are two common methods used in financial analysis. These are:

1. Undiscounted measures: It is popularly used and depends on comparison of the benefit stream and cost stream on annual basis without taking into account the effect of time on the value of money during the project cycle. Although it encounters several measures, yet the most applicable one is the payback period analysis. The Payback period (PBP) is the time from the beginning of the project until the net value of the incremental production stream repays back the total amount of the capital investment. The payback period is a common rough estimation of choosing among investments **(Gittinger, 1998)**

2. Discounted measures:-The technique of discounted measure permits us to determine whether to accept implementation of the project or not by estimating financial time flows over many years. The most common discounted measures is to subtract year by year the cost from benefit to

arrive at the incremental net benefit cash flow, and then to discount that at a specific discount factor. This approach gives one of three discounted cash flow measures of the project: (i) the present worth of the cost and benefit streams separately and (ii) then divide the present value of benefit stream by the present worth of cost streams to obtain benefit to cost ratio, (iii) the internal rate of return (Gittinger 1998).

(a) Net present value (NPV):

It is the most straight forward discounted cash flow measure of the project. It is computed by finding the difference between the present worth of the benefit stream less the present worth of the cost stream. The value should be positive.

(b) Benefit–Cost Ratio:- (B/C ratio):-

This ratio is obtained when the present worth of the benefits stream is divided by the present worth of the cost stream. The benefit–cost ratio must be more than 1 (Gittinger, 1998).

(c) Internal Rate of Return (IRR):-

It uses the incremental net benefit cash flow to find the discount rate that makes the net present worth of the incremental net benefit cash flow equal zero. Following is the rule for interpolating the value of the internal rate of return:

IRR= Lower Discount Rate + Difference between the two Discount Rates + ((Net Present Value at lower Discount Rate / (sum of Net Present Value at both Discount Rates ignoring signs))

The formal mathematical formulation of the discounted measures of the project:

$$\sum_{t=1}^{t=n} \frac{B_t - C_t}{(1+i)^t} \textbf{ NPV:}$$

$$\sum_{t=1}^{t=n} \frac{B_t - C_t}{(1+i)^t} = 0 \textbf{ IRR:}$$

$$\sum_{t=1}^{t=n} \frac{C_t}{(1+i)^t} / \sum_{t=1}^{t=n} \frac{B_t}{(1+i)^t}$$ **Benefit-cost ratio:**

$$\sum_{t=1}^{t=n} \frac{K_t}{(1+i)^t} / \sum_{t=1}^{t=n} \frac{N_t}{(1+i)^t}$$ Net benefit-investment (N/K) ratio:

In the four mathematical formulations:

Bt = benefit in each year

Ct = cost in each year

Nt = incremental net benefit in each year after stream has turned positive

Kt = incremental net benefit initial years when stream is negative

t= 1, 2… n

n= number of years

i= interest (discount) rate.

3.8 Sensitivity Analysis:-

The computation of the benefit /cost ratio, the net present value, and the internal rate of return in the financial analysis are based on assessing the most probable out come of many events. Naturally, any weakness in this assessment can cause considerable error, particularly in agricultural project in which the farmer has virtually no control over his environment.

The data used to analyze agricultural project are affected by varying degree of uncertainty in predicting price as well as production. Sensitivity analysis can be applied to one factor at a time, such as a decrease in the price of out put or an increase in the cost of input or total cost of the project (Gittinger, 1998).

Chapter Four

4-Technical Feasibility of the Dairy Farm

4.1 Pre-amble:

Big cities in Sudan in general and Khartoum three town capital in particular suffer from a constant under supply of fresh milk. Although detailed statistics are lacking, it is estimated that more than 50% of milk and milk products consumption is currently being covered through food aid and international trade. Further more, it is projected that the milk gap shall be widened in the future if the current production rates are not changed (Maglad and other, 1987).

In an attempt to take small share in reducing the milk gap in Khartoum State, livestock and dairy farms investment are to be encouraged for increasing milk supply. For this purpose, we intended to introduce this study of milk production farm to see how we can contribute in reducing the gap.

4.2. Location:

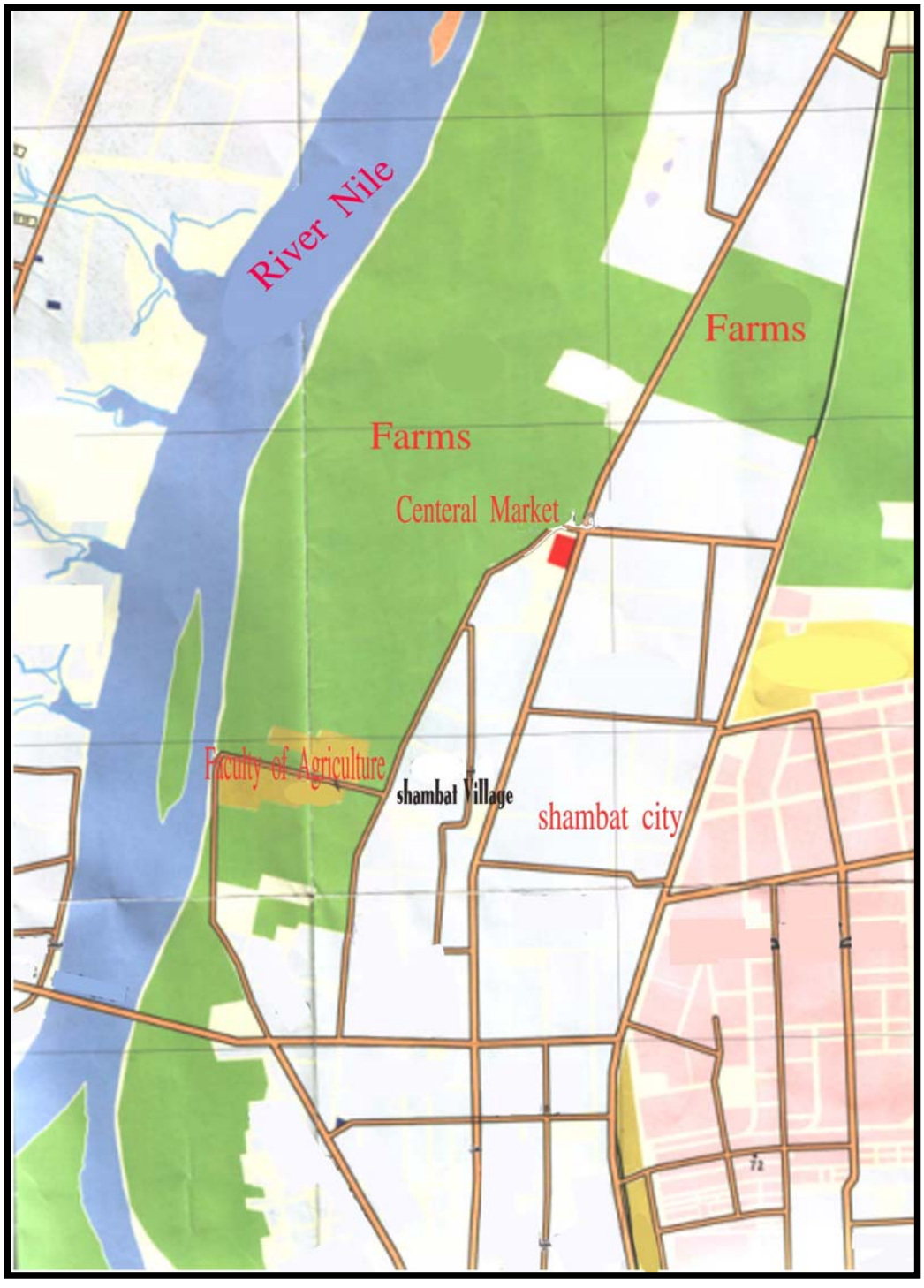
The project area is located at Shambat with latitude of 15° -40° N and Longitude of 32-32° E and 375 meters above sea level. The area lies on heavy alkaline soil with pH estimated at 8.05 and clay content determined as 64%. Figure (1.) shows the project plan and plan of area of study.

4.3. The project specifications:

Shambat area has many favorably advantages which could be viewed as:

- It is endowed by fertile land.
- Availability of inputs of agricultural production.
- Existence of central markets and marketing facilities.
- Has got a big number of animals and animal production activities.

The Area Of Study



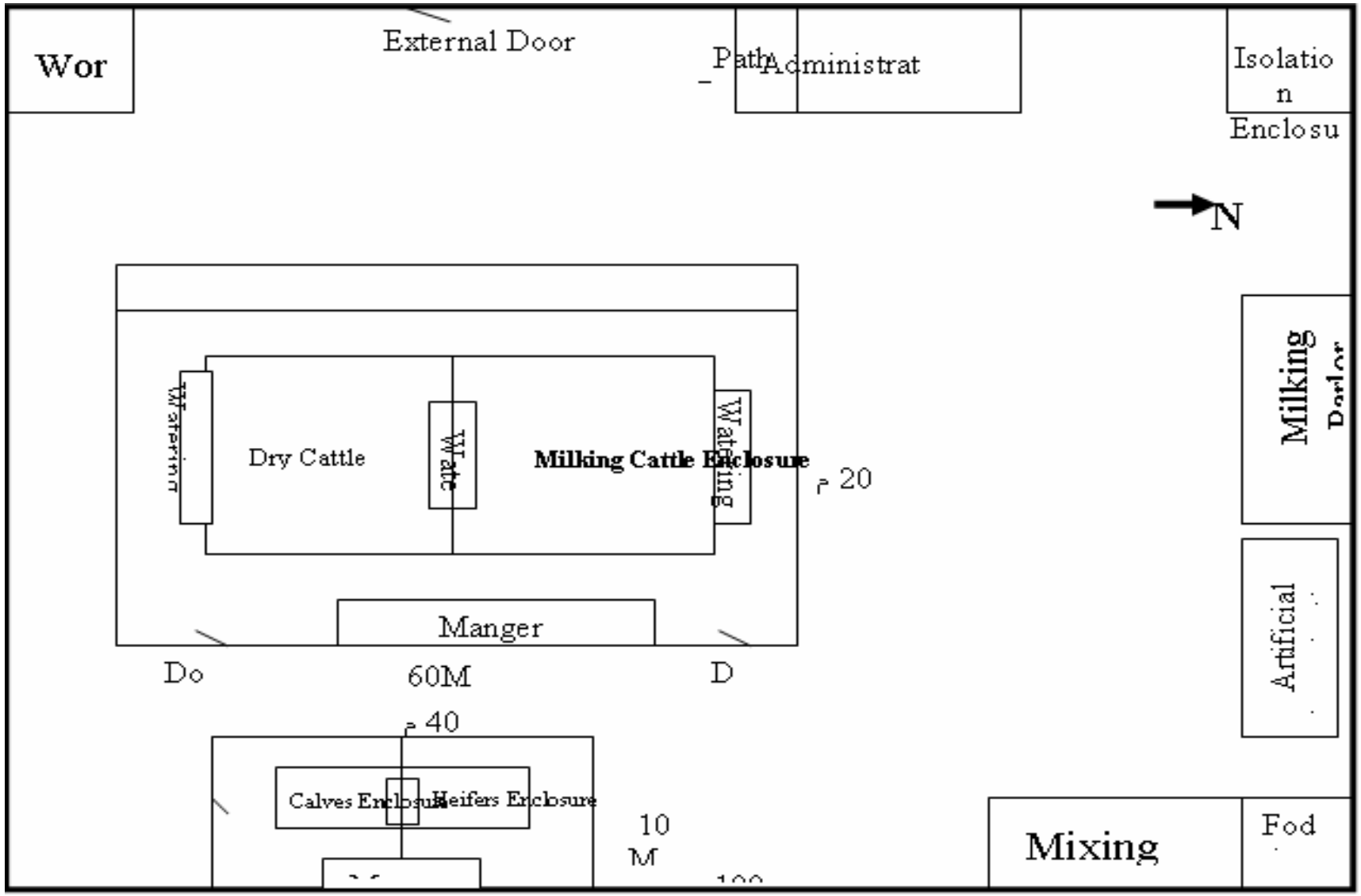


Fig (2) the layout plan of the project

4.3.1 Project components:

The project has two components:

a. A farm of an area of 22 feddans for forage productions.
b. A dairy herd which starts with 50 cross dairy cows and will build up to 80 cows.

4.3.1.1 Dairy herd: The farm will provide cereal (Maize, Abu 70) and legumes forages (Lubia, Berseem) annually. The quantities will be more than needed for feeding 50 cross bred dairy cows and its followers. The surplus fodder will be sold to help in alleviating the shortage of feed for livestock in Urban Khartoum.

4.3.1.2 The fodder farm: The 50 cross bred herds dairy cows will build up to 80 cross bred dairy cows. This will take 8 years from year 10 of the project lifecycle, then the herd will be stabilized in its number and is expected to produce annually:

- 297 tons of fresh milk.
- 42 heads of males culled cattle.
- 1620 M3 of farm yard manure.

4.4 Dairy husbandry:-

4.4.1 Introduction

There are three possible alternatives for establishing the basic herd for milk production. These are:

- Buying local cows or heifers.
- Up grading the indigenous cows by crossing naturally with pure bred foreign bulls or by the use of artificial insemination.
- Importation of foreign pure bred high producing dairy cows. The selection of the breed is determined by two factors mainly by its suitability to the prevailing environmental condition and by economic of milk production.

Results of research conducted in the University of Khartoum and livestock research stations indicated that cross breed up to a level of 50% to 62% of exogenous blood combined productive and adaptive characteristics comparable to those of exotic and indigenous parent stock (Magladand other 1987).

4.4.2 Size of dairy herd

4.4.2.1 Herd build-up calculations:

Pregnant dairy herd heifers will be bought from the market and will be inseminated artificially from the second year. In this study the exogenous blood of heifers is assumed to be 62.5% exogenous. The main factors that determine how fast dairy cattle will increase are:

- Reproductive cabability of the herd.
- Percentage of calves dropped which are heifers.
- Loss of calves and heifers.
- Rate of removal (replacement) of cows from the herd.

The rate of growth of the dairy herd in the project area was estimated by using the following coefficients.

- 80% calving rate.
- 50% of calves dropped are females.
- 10% mortality rate among calves from zero to 12 months.
- 5% mortality rate and culled rate among calves 13-24 months.

Based on the coefficient listed above, the rate of herd increases was calculated and results concerning the total number of cows and distribution of animals during the project years are presented in table (4.1) and table (4.2). Table (4-1) indicates that 50 cows or pregnant three years old heifers are bought in the first years of the project and they will be in their first lactation period. From the second year, the animals will be inseminated and calved annually. After the fifth lactation they will be culled. Of the fourth year of the project 19 first generation crossbred

heifers will enter the milking herd and the total number of cows will then increase to 65. From this year, they will be entering to the heifer annually in the milking herd. As the crossbred heifers are used for the replacement of old low producing cows, they will be distributed into 5 lactation groups. At the start of the sixth year of the project, all of the old cows will be culled and for that the total number of cows will decrease to 46 cows.

Table 4.1: The distribution of animals during the project years

Years	**Age and number of cows at the end of the year**					**Total numbers**	**Lactating Cows**
	1	2	3	4	5		
1	50	-	-	-	-	50	50
2	-	48	-	-	-	48	38
3	-	-	47	-	-	47	37
4	19	-	-	46	-	65	52
5	15	18	-	-	45	78	62
6	15	14	17	-	-	46	37
7	19	14	14	16	-	62	50
8	19	18	14	13	16	80	64
9	15	18	17	14	13	77	62
10	19	14	17	16	14	80	64
11	19	18	13	16	14	80	64
12	19	18	17	12	14	80	64
13	19	18	16	15	12	80	64
14-25	19	18	16	14	13	80	64

* Fertility rate is 80% in the herd
** Regular calving all over they ear.
*** Maximum 14 month between calving.
**** Culling for mature cows after 5th calving.
Source: 1-Compiled by author 2-Animal Research Center, (Kuku).

Table 4.2: The number of heifers and its age during the project years

Years	Number of heifer according to the age toward the end of the year			Total numbers	Lactating Cows
	1	2	3		
1	20	-	-	20	3
2	16	19	-	35	1
3	16	15	17	48	1
4	20	15	14	49	4
5	20	19	14	53	8
6	16	19	18	53	1
7	20	15	18	53	3
8	20	19	14	53	8
9	20	19	18	57	8
10	20	19	18	57	8
11	20	19	18	57	8
12	20	19	18	57	8
13	20	19	18	57	8
14-25	20	19	18	57	8

* Heifers will calf at the end of third years of age.
- 50% of calves dropped are females.
- 10% mortality rate among calves from zero – 12 months.
- 5% mortality rate among calves 13 – 24 months.
- 2% mortality rate among older heifers and cows.

Source: 1-Compiled by author 2-Animal Research Center, (Kuku).

4.4.2.2. Herd Stable Phase:

The distribution of animal units (AU) during the project years is shown in table (4.3). The number of animal units will increase from 55 to 105 AU by the 10^{th} year of the project and continues on at this level.

During this stable period, the herd structure and production become stable. The male calves will be sent to the market for sale with replacement of heifers taking place at the 5th year and milking cows are culled at the end of their fifth lactation. Dairy cattle are removed from the milking herd because of various reasons such as dairy purposes, low production, abortion, sterility, disease, or death. In this conjunction, research has shown that about 2% of the cows shall be culled annually.

Table 4.3: The distribution of animals units (AU) during the project years

Years	Cows	Calves 1 year	Heifers 2 year	Heifers 3 year	Total numbers
1	50	5	-	-	55
2	48	4	9	-	61
3	47	4	7	13	71
4	65	5	8	10	88
5	78	5	10	10	113
6	46	4	10	14	74
7	62	5	8	14	89
8	80	5	9	9	103
9	77	5	9	14	105
10	80	5	9	14	108
11	80	5	9	14	108
12	80	5	9	14	108
13	80	5	9	14	108
14	80	5	9	14	108
14-25	80	5	9	14	108

* Au = Cows = 1 unit.
Heifer 1 =year ¼ unit.
Heifer 2 =year ½ unit.
Heifer 3 =year ¾ unit.

1-Compiled by author Source:
2-Animal Research Center, (Kuku).

4.4.3. Feed Requirement:

Profits in dairying depend to a considerable extent on the careful selection of feed and providing the milking herd with suitable ration. Under most condition, the cost of feed makes over half of the total cost of producing milk. The most important factors involved in formulated rations for dairy cow are follows:

- Quality and amount consumed of forage.
- Size and body condition of cow.
- Level of milk production and percentage of milk fat.
- Stage of gestation.
- Relative cost of nutrients in forage versus grain in relation to milk price.

The relative proportion of several types of forage fed is determined by what can best be grown on the farm or purchased at the lowest cost per unit of energy and protein. To obtain proper balance between feed consumption and milk production abilities, the total ration should contain 12 to 14% Crude protein (CP) or 9 to 10% digestible protein (DP), 65 to 72% TDN, 17% crude fiber, 0.44 to 0.60 Calcium and 0.31 to 0.4% phosphor(Source: Animal research center, Kuku).

4.4.4 Dairy Nutrients Requirement:

The dairy nutrient requirements of various classes of the dairy cattle are shown in table (4.4), (4.5). The dairy herd will be fed on the forage produced in the farm. The forage production will allow feeding the cereal fodder (Maize–Abu 70) and leguminous fodder (Lubia- Alfa Alfa). The remaining nutrients will be met by feeding a concentrate diet. The total green fodder requirements during the project years in shown in table (4.6), and total dry fodder during the project years is shown in table (4.7),

the concentrate diet supplement is shown in table (4.8). Ingredients and chemical composition of dry cows concentrate is shown in table (4.9), (4.10). The requirements for the concentrate diet supplements increased from 131 (tons) in year 1 to almost 203 tons in year.

Table 4.4: Daily nutrients requirement of dairy herd

Items	DMI Kg	TDN Kg	TCP gm	Ca gm	P gm
Calves, birth to weaning	0.9	0.9	150	9	6
Heifers, 3-6 month	2.1	1.6	283	16	10
Heifers, 6-12 month	4.0	2.7	484	22	13
Heifers, 12-18 month	6.3	3.8	680	26	18
Heifers, 18-24 month	7.3	4.2	720	27	20
Male calve, 3-6 month	2.8	2.1	410	14	9

Source: Feasibility Study of Soba Mixed Farming Project in Republic of the Sudan, September 1987.

Table 4.5: Daily nutrients requirement of dairy cows

Crossbred (400 kg)	TDN Kg	TCP Kg	DCP gm	Ca gm	P gm
Maintenance	3.15	373	250	18	16
Per kg milk (4.0%)	0.326	87	56	2.8	1.7
Per 8 kg milk	2.61	696	448	22.4	13.6
Total	5.76	1069	698	40.4	29.6
Maintenance pregnancy	4.10	702	430	31	22

Source: Feasibility Study of Soba Mixed Farming Project in Republic of the Sudan, September 1987.

Table 4.6: Total green fodders requirement during the project years,

(Dry matter - tons)

Years	Lactating Cows	Dry cows	Male calves 3-6 month	Female calves 3-1year	Heifers 1 year	Heifers 2 year	Heifers 3 year	Total (tons)
1	305	75	**11**	**20**	**58**	**-**	-	469
2	232	15	9	16	47	76	-	395
3	445	15	9	16	47	60	93	685
4	317	20	11	20	58	60	77	486
5	378	24	11	20	58	76	77	644
6	564	14	9	16	47	76	99	325
7	305	18	11	20	58	60	99	571
8	390	24	11	20	58	76	99	678
9	387	23	11	20	58	76	77	652
10	390	24	11	20	58	76	99	678
11	390	24	11	20	58	76	99	678
12	390	24	11	20	58	76	99	678
13	390	24	11	20	58	76	99	678
14	390	24	11	20	58	76	99	678
14-25	390	24	11	20	58	76	99	678

* Lactating cows (20 kg/day).
* Dry cows (25 kg/day).
* Heifers 3 years (15 kg/day).
* Heifers 2 years (11 kg/day).
* Heifers 1 year (8 kg/day).
* Calves (6 kg/day).

Source: 1-Compiled by author
2-Animal Research Center, (Kuku).

Table 4.7: Total dry fodders requirement during the project years,

(Dry matter - tons)

Years	Lactating Cows	Dry cows	Male calves 3-6 month	Female calves 3-1year	Heifers 1 year	Heifers 2 year	Heifers 3 year	Total (tons)
1	183	36	7	22	37	-	56	341
2	139	7	6	18	29	49	46	294
3	267	7	6	18	29	38	46	411
4	190	9	7	22	37	38	59	362
5	227	12	7	22	37	49	59	413
6	135	7	6	18	29	49	59	303
7	183	9	7	22	37	38	46	342
8	234	12	7	22	37	38	59	709
9	224	11	7	22	37	38	59	398
10	234	12	7	22	37	38	59	409
11	234	12	7	22	37	38	59	409
12	234	12	7	22	37	38	59	409
13	234	12	7	22	37	38	59	409
14	234	12	7	22	37	38	59	409
14-25	234	12	7	22	37	38	59	409

* Lactating cows and dry cows 12 kg daily.
* Heifers 3 years (9 kg/day).
* Heifers 2 years (7 kg/day).
* Heifers 1 year (5 kg/day).
* Calves 3-12 month (4 kg/day).

Source: 1-Compiled by author
2-Animal Research Center, (Kuku).

Table 4.8: Total concentrate diets supplement requirement during the project years, (Tons)

Years	Lactating Cows	Dry cows	Male calves 3-6 month	Heifers 1 year	Heifers 2 year	Heifers 3 year	Total (tons)
1	92	15	**2**	**22**	**-**	-	131
2	70	3	1	18	28	-	120
3	134	3	1	18	22	31	209
4	95	4	2	22	22	26	171
5	113	5	1	22	28	26	195
6	68	3	2	18	28	33	152
7	92	4	2	22	22	33	175
8	117	5	2	22	28	26	200
9	113	5	2	22	28	33	203
10	117	5	2	22	28	33	200
11	117	5	2	22	28	33	200
12	117	5	2	22	28	33	200
13	117	5	2	22	28	33	200
14	117	5	2	22	28	33	200
14-25	117	5	2	22	28	33	200

Source: Compiled by the author

Table 4.9: Generalized feed formula for the production of compound feeds for cattle

Feed	Ration Composition (kg/tons)	
	Calf	**Dairy**
Molasses	50	50
Sorghum	545	485
Wheat bran	175	100
Cotton seed cake	50	200
Groundnut cake	20	100
Groundnut hulls	-	-
Limestone flour	20	25
Salt	10	15
Vitamins/mineral	25	25

Research Animal Nutrition center 2005.

Table 4.10: Nutrient composition

CP (g/kg)	168	173
ME ® (Mj/kg)	11.3	11.2
Ca (mg/kg)	10.0	11.0
Salt (mg/kg)	10.0	16.0

Source: The nutrient composition of Sudanese animal feeds. Central Animal Nutrition Research Laboratory Animal Production Research Centre, Kuku, January 1999.

4.4.5 Dairy cows requirement from minerals:

Dairy cow daily loose most of Minerals in milk, in urine and dung, so it needs to supplement these losses. The most important minerals are calcium, phosphorus, magnesium, and Sodium. (Table 4.11) represents dairy cows requirement from essential mineral according to production and type of production. The concentrated ration for diary cows must contain 2–3% of mineral. Mineral must be mixed properly and applied to the food or water. Concentration of mineral in food may lead to big health damage to the animal, which may lead to death. Dry blood, bones marrow, and limes are considered enriched source of Calcium cake and legumes like groundnut, since it contains high percentage of phosphor and little calcium (University of Florida- IFAS Extension, year 2000).

Table 4.11: Daily minerals requirement of dairy cows

Cow weight kg	**Calcium quantity**	**phosphor**	**magnesium**	**sodium quantity of miners for supplementation g/day**
400	14	9	8	7
500	8	26	11	9
Fat rate in milk (fat percentage)	Quantity of mineral for production by g or ever 10 liter of milk			
4%	28	17	6	6
5%	30	17	6	6
Pregnancy last two month	Quantity mineral in pregnancy by g per day for last two months of pregnancy			
	2	2	9	17

Source: Adam sediage, 2002.

4.4.6 Dairy cows requirement of vitamins:

Vitamin A is commonly obtained by herbivores from carotene and cartenoid plants, but is normally stored in the liver as the actual Vitamin. It is essential for maintenance of epithelial tissues in normal

condition and as a key substance for the visual cycle concerned with retinal cones of the eye and hence causes night blindness when deficient. Vitamin B Complex deficiencies are most unlikely expected in the first two month of life or in very high- producing cows. The only exception is referred to under the heading cobalt, which is necessary for animals to make their own vitamin B12. Vitamin C although essential, it can be synthesized by the animal. Vitamin D can be found in mature plants that have high vitamin D content. Hay left lying in the fields may actually improve in vitamin D level. Vitamin E is required by animals to maintain all types of muscles in proper condition. Vitamin k is concerned with prothrombin formation and thus with normal blood clotting (Barrett and Larkin, 1994).

4.4.7 Water requirements

Livestock needs fresh drinking water for normal health and high Yield. The total salt content of water is the most important characteristics in determining the suitability of water for livestock and it is also the easiest water quality data to obtain. The water requirement of livestock are the total quality of water required by animals for their metabolic processes as well as for the heat regulations of their body. They vary according to a number of factors such as food intake, quality of food and water temperature.

For our purpose, the water requirement is calculated on the assumption that the daily water requirement for lactating cows and other animal unit as 75 liters. Table (4.12) shows the annual water requirement during the project years.

Table 4.12 Livestock water requirement during the project Total years (cubic meters/day)

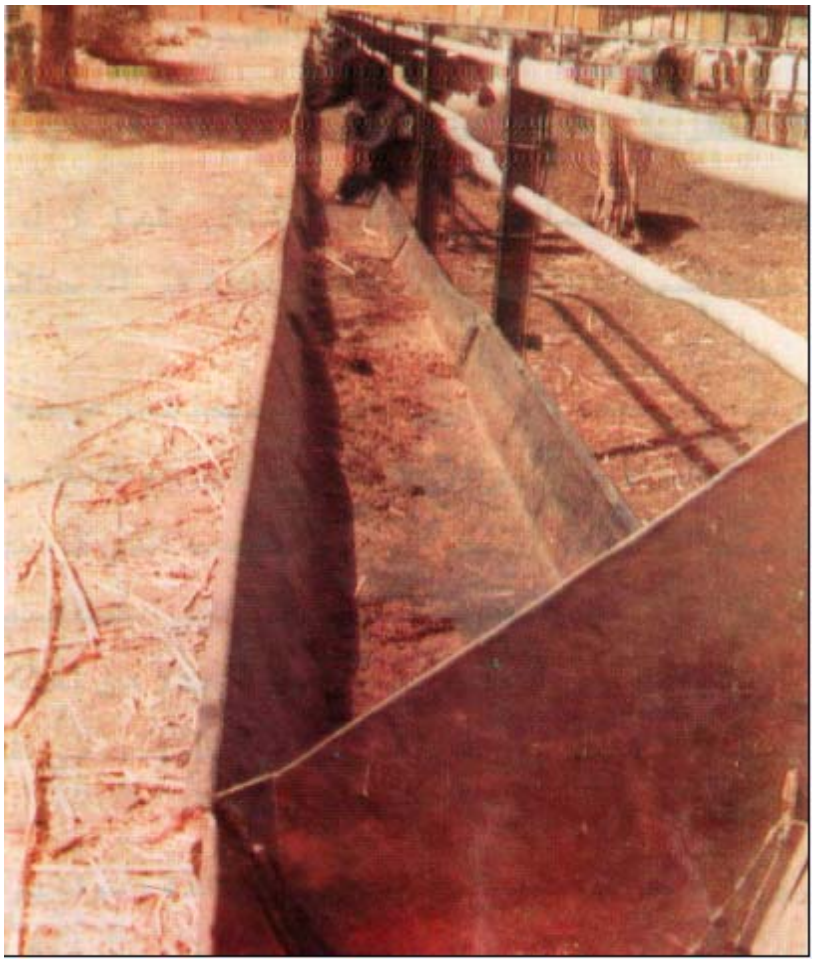
Years	Milking Cows	Dry cows	Total
1	5000	2250	7250
2	3800	3375	7175
3	3700	4575	8275
4	5200	4875	10075
5	6200	4650	10850
6	3700	4875	8575
7	5000	5175	10175
8	6400	5100	11500
9	6400	5475	11675
10	6400	5475	11875
11	6400	5475	11875
12	6400	5475	11875
13	6400	5475	11875
14	6400	5475	11875
14-25	6400	5475	11875

* 100 liters per milking cow

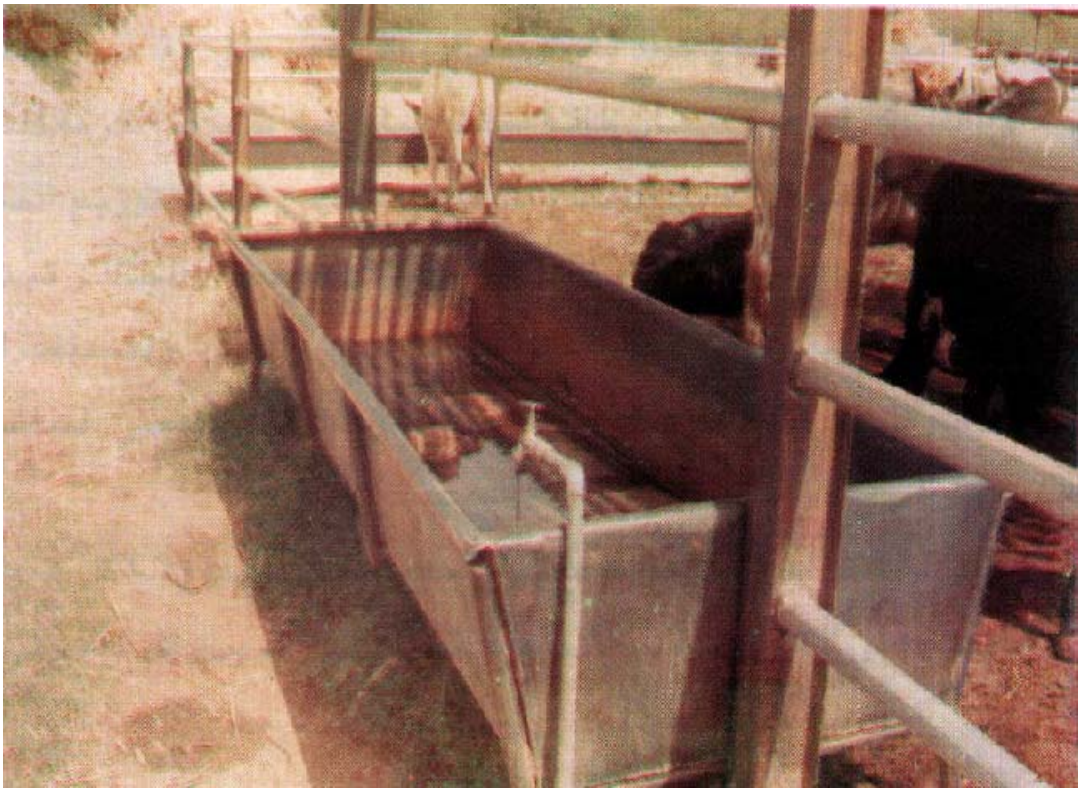
** Liters per dry cows are Au.

Source: compiled by the author From source- Maglad, 1987

Fencing Manger Figure 4 – 1



Watering Trough Figure 4 – 2



4.4.8 Herd production:

The main out put of the milking herds are:

(a) Fresh milk,

(b) Culled heifers and cows,

(c) Fattened 6 month males,

(d) Farm yard manure.

4.4.8.1 Fresh Milk Production:

It is assumed that the dairy cows will produce 60 liters of milk per lactation of 305 days. The table (4.13) shows the total production during the project years.

Table 4.13: The production of milk during the project years

Year	Milk for suckling calves	Fresh milk for sale	Total production of milk
1	6	238	244
2	5	180	185
3	5	176	181
4	6	248	254
5	6	297	303
6	5	176	181
7	6	238	244
8	6	297	303
9	6	297	303
10	6	297	303
11	6	297	303
12	6	297	303
13	6	297	303
14	6	297	303
14-25	6	297	303

* Milk for suckling calves is (kg/day) for 3 month

Source: compiled by the author from data available from Animal research center, Kuku, year 2005 (for price) .

4.4.8.2 Culled heifers and cows:

Table (4.14) shows the number of culled animals during the project years. All old cows will be removed from the herd starting at the 6th year of the project when 45 cows will be culled. Female Calves 1 – 2 years will be culled at 3% starting at the second year of the project. The replacement heifers will be sold for breeding purposes (as seeds). Also six month calves will be sold every a year. They will be sold for meat production purposes.

Table 4.14: Number of culled animals during the project years:-

Year	Cows	Male Calve year	Female Calve	Total
1	-	20	3	23
2	-	16	1	17
3	-	16	1	17
4	-	20	4	24
5	-	20	8	28
6	45	16	1	62
7	-	20	3	23
8	16	20	8	44
9	13	20	8	41
10	14	20	8	42
11	14	20	8	42
12	14	20	8	42
13	12	20	8	42
14	13	20	8	42

Source: Compiled by the author.

4.4.8.3 Farm yard manure:

Manure production is a by-product of livestock enterprise. It has several uses, the most important of which is its ability to improve the soil texture and fertility. Table (4.15) shows the total amount of manure produced during the project years. These amounts were calculated on the assumption that each livestock unit produces 15 cubic meters annually (Maglad and others, 1987).

(e) Production of farm yard manure during the project years in (SD000/ Cubic meters).

Table 4.15: Farm yard manure production

Years	Manure (SD 000/cubic meters)
1	825
2	915
3	615
4	1065
5	1320
6	1695
7	1110
8	1335
9	1545
10	1575
11	1620
12	1620
13	1620
14	1620

* Each A U produces 15 M^3.
Price is (SD 1000 /M^3).

Source: Compiled by the author.

4.4.9 Herd management:

4.4.9.1 Animal Housing:

The types of animal housing vary according to capital investment and climate conditions. However, they should be roomy and well ventilated. They should be lighted and elevated to facilitate draining. The yarding housing system for livestock is suggested for this project as it is cheap and suits the dry hot weather of the project area. The typical dimensions of the ground plan of cattle of various ages are shown in table (4.16).

Table 4.16: Floor space for various classes of cattle

Cattle type	Total area M^2	Shaded area $(M)^2$
Milking cows	10	3.3
Replacement heifers	7.5	2.5
Heifer 1-2 years	6.0	2.0
Heifer 3-12 months	4.5	1.5
Male calves 13-12 months	4.8	2.3
Sucking calves	2.0	1.0

Source: Compiled by the auther from feasibility study of soba mixed farm (Maglad and other, 1987).

4.4.9.2 Fencing:

It is suggested that the fencing of animal yards will be made of section steels and iron pipes so as ensure freedom of injury of animals. The vertical poles will be made of 12 cm, section steels fixed to ground by concentrate at 2 maters distances. The horizontal parts will be of 2 inches steel pipes arranged into 3 horizontal rows 40 cm apart.

4.4.9.3 Cows Yard for Milking Cows:

Cow yards system represent a more flexible and comfortable housing system for cows. The yard area consists of a sleeping area, preferably littered, and an exercise and feeding area the floor should be porous to allow liquid to percolate through the floor. A shade is built to protect the cows from intense summer sun are provided to help in maintaining milk production and reproductive capability. The shade area will be oriented in a north- south direction to promote dry of wet spots and control of flies (Maglad and others, 1987). The yard of barn is designed for at lest 80 cows (16 dry cows and 64 milking cows) based on about 10 square meters per cow. The designed total area is 1200 square meters (60 × 20), which is shaded. The shade area will lie along the whole western lengths and will be 400 square meters (267 square meters for milking cows and 133 square meters for the dry cows). There will be a partition between them. The roof will be made up from hay (traditional Sudanese roof). The margins will be from steel Scuttle butt. The depth of margins is 50 cm and is situated along the out side of the yard so that feeding can be done without entering the yard. The length will be 8 meters long, therefore allowing at least space of 0.85 meters per cow. The watering through are made of 20 liters barrel plastics fixed to the ground by steel frame and supplied by pipes which is connected to the water system.

4.4.9.4 Yards for Heifers and Calves over 3 Month Old:

The design of these yards are similar to these milking cows, but in area of about (30 m× 10m).

- **Suckling calves:** Calves are best housed in individual calf pens with solid partition wall to reduce drought. The partition between the calf pens is made of steel pipes. There are about (100m2).
- **Hand Milking Unit:** The unit contains milking places, feed store and milking room. The milking places have concentrate feeding and the two milking places will ensure that each cow will have sufficient time to be eating her concentrate share.

4.4.9.5 Feeding Methods:

The fodder will be cut and fed either green or dry to the animal in their yards. The concentrate portion of the milking cows' diet will be fed at milking times.

4.4.9.6 Managements of Sucking Calves:

The calves will be housed in individual sand bedded pens from birth through three months of age. They will receive their dams' colostrums by sucking soon after birth and for the first 3 days of their life. Then they will receive by buckets their daily milk and they will be weaned at the end of their 3 months of age.

4.4.9.7 Management for Optimal Fertility:

a. Heifers: The heifers' calves will be isolated and grouped together when they reach a reasonable size (250-300 kg) and will be observed closely for oestrus signs- when they are on heat they will be inseminated artificially.
b. Cows: The cows shall be inseminated after parturition by at least 60 days. Insemination will be carried artificially. Artificially insemination (AI) is processes by which sperm are collected from the male processes stored and artificially introduced into the female reproductive tract for the purpose of conception. Artificial

insemination has become one of the most important techniques ever devised for the genetic improvement from farm animals. It has been most widely used for breeding dairy cattle and has made bulls of high genetic merit available to all.

c. **Advantages and disadvantage artificial insemination:-**The greatest advantage of artificial insemination (Al) is that it makes possible maximum use of superior sires. Natural service would probably limit the use of one bull to less than 100 mating per year. Exposure of sires to infectious genital diseased is prevented by use of artificial insemination, which reduces the danger of spreading of diseases on young ones. Time required for establishing reliable disease-proof for young bulls is reduced through artificial insemination. Other advantages include early detection of infertile bulls, use of old, or crippled bulls and elimination of danger from handling unruly bulls. There are a few disadvantages of artificial insemination which can be over-come through proper management. A human detection of heat is required. Success or failure of artificial insemination depends on how well this task is performed. Artificial insemination requires more labor, facilities, and managerial skill than natural services. Proper implementation of artificial insemination requires special training, skill and practice. Utilization of few sires, as occurs with artificial insemination can reduce the genetic base. The artificial insemination industry and dairy cattle breeders should be made every effort to sample as many young sires as possible.

4.4.9.8 Records and Record Keeping and Tracability:

It is important to have record keeping and to know methods of recording. Milk and breeding records should be under taken on a regular basis. They will provide a potent management improvement method.

Records of birth parents, feeding, health and growth performance should also be under taken.

4.4.9.9 Milking Practice and Milking Hygiene:

The cow will be milked twice daily by hand at approximately 12 hours interval. The yield of each cow should be recorded to reflect the potential of the cow and to help in the decision of feeding and culling.

The concentration portion of the diet will be offered during milking. Milking techniques and hygienic measures are related to both- milking quality and incidence of infection particularly mastitis. The under should be cleaned before milking. Calves should never be used to lubricate the teats for let down, particularly for the crossed cows. Concentrate feeding during milking, the arrival of the scheduled time of milking and the sound of milking utensils are quite sufficient to train the cows to be milked in the absence augments the milking stimulus., Soon after milking, the milking should be put in the milk cans and covered.

4.4.9.10 Dairy Cattle Diseases and their Control:

- **Viral Diseases:**
  i. **Render Pest:** This is an acute and highly contagious disease primarily attacking cattle. The disease came into the Sudan in 1891 across the Ethiopian and Ugandan borders. The OIE declared that Sudan as free from render pest (during the year 2005) so no vaccination was supplied for this disease.
  ii. **Foot and Mouth Disease**: Foot and mouth disease is acute and highly contagious disease, affecting chiefly cloven–footed animals. The diseases have been known in the Sudan since 1903, and continued to appear in sporadic out breaks particularly in Khartoum State. The disease inflicts heavy causalities among exotic breeds, and all young calves. It also affects negatively milk productivity and rates of growth. Strict

quarantine measure include vaccination is the most effective control method of the disease.

iii. **Blue Tongue Disease:** This is a non-contagious insect transmitted viral disease of cattle and other ruminants. To immunize against this disease, measure taken to reduce bites on susceptible cattle by reducing biting insects.

- **Bacterial and Rickett Snail Diseases:**

i. **Contagious bovine pleropneumonia** (C. B. P. D). It is a highly contagious pneumonic disease caused by mycoplasma mycoide bacteria. According to reports the disease appeared in the Sudan in 1902 and took epidemic proportions in 1933. The policy adopted to combat the disease was restriction of cattle movement in and out of infected areas and carrying out of annual vaccination of all cattle in the area that are not showing the disease symptoms.

ii. **Hemorrhagic septicemia: (H. S):** This is an acute disease that affects cattle and other ruminants. The disease was first reported in Sudan in 1933 in the northern parts of the Gezira province, in 1936 in Kassala and in 1943 in Kordofan province. The most effective method or the disease control is regular annual vaccination of cattle.

iii. **Anthrax:** This is an acute, infections febrile disease which attacks virtually all animal and man and is caused by Bacillus anthraces. It was reported that the disease was first observed in 1920 in Singa. Apparently having entered from Ethiopia, and from there it spread to all parts of the country to reach epidemic proportions in 1945. Now days the disease is under full control. The disease is pest controlled by regular animal vaccination.

iv. **Black Quarter (Black leg):** It is an acute infection disease affecting cattle and sheep. It is caused by Clostridium Chauvei and is characterized by inflammation of muscles, severe toxemias, and high mortality rates. The disease was observed in 1939 when cases where reported in Kordafan and in 1943 an out break was reported in other provinces including Kordafan province. At present the disease is under full control. The most effective method for controlling the disease is regular annual vaccination of herds.

v. **Brucellosis: (Contagious Abortion, Bangis Disease):** This specific contagious disease primarily affects cattle and other small ruminants. It is caused by bacteria of the Brucella group and is characterized by abortion in the female, to lesser extent or chitis and infection of the accessory sex glands in the male and infertility in the both sexes. No practical effective control method is available. Eventual control of the disease in particular areas depends upon testing and elimination of reactors.

vi. **Mastitis:** Mastitis is of great economic importance among dairy cows. However, the disease may affect other species of animals. Mastitis is an inflammatory dry disease of the mammary gland and is caused by bacteria or mycotic pathogens.

vii. **Tuberculosis:** This disease is prevalent particularly in diary cattle. The source of infection is believed to be other cattle. Adult animals are infected by inhalation of air-borne dust particles as well as contaminated feed and water facilities. Young calves may be infected by drinking unpasreurized infected milk.

- **Protozoa:**

i. **Coccidiosis:** The disease was common among young cattle from 1 to 2 months to 1 year of age. Particularly, high losses of calves have been reported in calves kept in confinement during winter. The

control disease is based on controlling the intake of sporeulated Do cysts or spore-cysts by young animals so that when the infection becomes established, it is immunized proportionally without causing clinical signs of the disease. Good feeding practices, good management, and attention to the principles of animal sanitation accomplish this purpose. Young susceptible calves should be provided with quarters that are clean and dry, and feeding and watering devices should be kept clean and protected from feacal contamination.

Table 4.17: Doses of vaccines needed to vaccinate dairy cattle of the project during the first 2 year of project operation

Year	Doses of vaccines needed					
	Rinder pest	**C.B.P.P.**	**H.S.**	**Sheep proc.**	**Anthrax**	**BQ**
1	70	70	70	70	70	70
2	83	83	83	83	83	83
3	95	95	95	95	95	95
4	114	114	114	114	114	114
5	131	131	131	131	131	131
6	99	99	99	99	99	99
7	115	115	115	115	115	115
8	133	133	133	133	133	133

* Vaccination is at cost 1.00 SD / head for all vaccines.

* OIE declares Sudan is free from Rinder pest. Thus No Rinder pest vaccinate.

* For five vaccination the cost id (75 SD/head)

Source: Veterinary Hospital- Compiled by the auther

4.5 Forage Farm:

4.5.1 Introduction:-

The intention is to convert this project into mixed farming system for both forage production and dairy development. The total area is 22

feddans, of which 20 feddans are for forage production and 2 feddans for streams and passages as well as for livestock housing.

To design a proper fodder crops rotation this will require the division of the area into equal four divisions. The four divisions, then, are used for rotation of summer and winter fodder crops in a such sequence that permits legume crops to alternate with cereal crops – this will maintain soil fertility and produce a balanced forage mixture that is required for dairy production.

4.5.2. Choice of Forage Crops:

Abu 70 (*Sorghum valgare*), maize (*Zea maize) Lubia (Vigna spp),* and Barseem (*Medicogo sativa*) are selected fore forage crops to be cultivated in a rotational manner. The selected forage crops, the time of sowing and harvesting are show in table (4.18).

Table 4.18: Forage crops, date of sowing and harvesting

Local name	Scientific name	Date of sowing	Date harvesting
Alfa Alfa-legume Barseem	Medicago sativa	14 November	30-15 day
Abu 70	Sorghum valgare	April	June
Lubia	Vigna SPP	March	July
Maize	Zea maize	October	December

Sources: Ministry of agriculture 2005

4.5.3. Forage Production Activities:

(a) Abu 70: this crop grows quickly and gives adequate yield with little or no fertilizer application. It gives about 14 tons of fresh weight. The yields of second and third tillers are low. So it is recommended to take one cut only.

(i) Land preparation:

- Plough with offset disc
- Cultivators or high disc harrow:
- Land leveling
- Ridges 80 cm apart to be drawn up.
- Manure to be added during ploughing

(ii) Planting: Seeds are planted at 2 to 3 cms depth in ridges. The seed rate is 35 kg per feddan. The fertilizer rate is 80 kg urea per feddans.

(iii) Irrigation, Weeding and Harvesting:

- 7-8 irrigations at 10 days intervals
- 3 Deep ploughing to control the spread of weeds and Urea fertilization also controls the spread of weeds.
- Harvest after 2 months.

(b) Lubia:

(i) Land preparation: Ploughing, leveling and establish ridges 80 cm apart.

(ii) Planting: Seeds are planted in holes at rate of 4 seeds per hole, 20 cm apart. Seeds rate is 60 kg per feddan.

(iii) Irrigation: Immediately after sowing, a rate of 10 days interval, with 8 irrigations are needed.

(c) Maize:

(i) Land preparation: Plough with deep disc harrow and leveling.

(ii) Planting:

- Seeds are broadcastled with fertilizer and then ridges. are established at 80 cm apart.
- Seed rate is 40 kg per feddan and planting is done in holes.

(iii) Irrigation and Harvesting:

- Irrigation at 10 -15 days apart.

- Harvesting 80 days after planting.
- Expected yield is 9 tons per feddan fresh weight.

(d) Barseem:

(i) Land Preparation:

- Plough with off set disc
- Cultivators or high disc harrow are used
- Land leveling.

(ii) Planting:

- The seed rate is 50 kg per feddan – no fertilizer is used.
- Date of sowing is 15 November

(iii) Irrigation and harvesting:

- 30 number watering is required annually
- The first cut is after 40 days and hence there will be continuous cuts after each 25 days. After 3 years the land are put under follow.

Irrigation water requirements, total quantities of seed needs and fertilizer are shown in tables (4.19), (4.20), (4.21).

Table 4.19: Irrigation water requirements

Forage crops	No. of watering	Quantity/watering M^3/F	Quantity/year $M^3/F/year$
Barseem	30	400	12000
Abu 70	7-8	400	3200
Lubia	8	300	2400
Maize	7-8	400	3200

Source: Ministry of Agriculture, 2005**.**

Table 4.20: Total quantities of seeds needed

Forage crops	Seed rate	Total area feddan	Total quantity of

	Kg/f		seeds (tons)
Barseem	50	5	250
Abu 70	60	5	300
Vigna	60	5	300
Maize	80	5	200

Sources Ministry of Agriculture, 2005

Table 4.21: Fertilizer requirements

Forage crops	Type and rate of fertilizer K/F	Total area feddan	Total amount of fertilizer (tons)
Barseem	-	5	-
Abu 70	50 kg/f/urea	5	250
Lubia	50 kg/f/superphes	5	250
Maize	50 kg/f/urea	5	250

Source Ministry of Agriculture, 2005

4.5.4. Proposed Forage Crop Rotation:-

In the proposed rotation, winter forage crops (Maize and Barseem) will alternate with summer crops (Lubia- Abu70) in a sequence. Maize in winter is followed by Lubia in summer and Abu 70 in summer followed by Barseem in winter. In this rotation the land will be occupied by forage corps most of year except for 1-2 month only, where land will be prepared.

4.5.5 Rotation Design:

The unit of rotation is 5 feddan. The rotation course and total area cultivated is shown in table (4.22). The total area is cultivated with fodder crops according to proposed rotation well as summarized in table 4 it should be noted that although the area devoted for fodder crop production in the project are is 20 feddan, the actual area intensified vertically according to proposed rotation reaches 30 feddan in some years.

Table.4.22: Suggested rotation and duration for cultivated forage and crops for the first ten years

Year	Unit area	The units of rotation				Total area (feddans)
		1	2	3	4	
1	5	A/B	L/M	A	L/M	35
2	5	B	A	L/M	A/B	30
3	5	B	L/M	A/B	B	30
4	5	A	L/M	B	B	25
5	5	L/M	A/B	B	A	30
6	5	A/B	B	A	L/M	30
7	5	B	B	L/M	A/B	30
8	5	B	L/M	A/B	B	30
9	5	A	L/M	B	B	25
10	5	L/M	A/B	B	A	30

Legand:
Barseem * B

Abu 70 A
Lubia L
Maize M

Compiled by the author

4.5.6. Irrigation Water Requirement:

Based on forage crops water requirement and water intervals, the total amount of annual water requirements are calculated as follows:

The water requirements for one irrigation = 7.5 $M^{3,}$

The average number of irrigations = 10 days,

The average quantity of water per feddan per year = 315 $M^{3,}$

The total quality of water Required for 20 feddans = 10 × 315 × 20 = 63000 $M^{3,}$

Chapter Five
5-Financial Cash Flow Analysis

5.1 Pre-amble :

This chapter presents the farm financial cash flow analysis that reflects feasibility and profitability of the project. Agriculture project analysis used annual differences between benefits and costs to calculate an indicator for the profitability of the project over its entire life. The indicator was estimated in terms of a financial internal rate of return net present value and benefit/cost ratio or pay back period. (Gittinger 1998).

5.2 The cost of the project :

5.2.1 Investment cost :

The table 5.1 show the total fixed investment cost for the establishment (in year one).

Table 5.1 : Capital cost (investment cost) :

Items	Cost SD(000)
1. Cost of cattle housing	3142.000
2. Cost of establishments	2151.750
3. Cost of electrically and connections	984.530
4. Cost of water and connection	204.600
5. Cost of digging a well	617.830
6. Cost of vehicles (One Vehicles)	1800.000
7. Cost of milk equipments and maneger	301.400
8. Cost of cows purchased	15000.000
9. Cost of green fodder for the first year	2779.744
Total	27011.854

Source : Compiled by the author

5.2.2 Operating cost :

Total operation cost in year one is estimated to be approximately SD 10 45 60 38. The concentrated feed alone represent about (50%) of the total operation costs. Items included in the operating cost summarized in table (5.2 -5.5) as follows

Table 5.2 : Cost of Concentrate diet supplement requirement of dairy : (Tons Dry mater)

Year	Concentrate Mix (Tons)	Cost (SD)
1	131	7244300
2	120	6636000
3	209	11557700
4	171	9456300
5	195	10783500
6	152	8405600
7	175	9677500
8	200	11060000
9	203	11225900
10	200	11060000
11	200	11060000
12	200	11060000
13	200	11060000
14-25	200	11060000

* Average pf Price in the market (55300 SD/Ton).
*Source: compiled by the author.

Table 5.3 : The cost of vaccines needed during the project years (SD)

Year	Number of Doses (IML)	Total cost of Vaccines (SD)
1	70	5250
2	83	6225
3	95	7125
4	114	8550
5	131	9825
6	99	7425
7	115	8625
8	133	9975

9	133	9975
10	133	9975
11	133	9975
12	133	9975
13	133	9975
14	133	9975
14-25	133	9975

* Compiled by the author from data from veterinary hospital

Table 5.4 : Artificial insemination Cost during the project :

Year	Number of Cows	Cost (SD)
1	50	150000
2	48	144000
3	47	141000
4	65	195000
5	78	234000
6	46	138000
7	62	186000
8	80	240000
9	77	231000
10	80	240000
11	80	240000
12	80	240000
13	80	240000
14	80	240000
14-25	80	240000

* Artificial insemination cost is 3000 SD/head.

* Source : Compiled by the author from data available in Artificial insemination center..

Table 5.5 : The cost of Treatment per head of cattle/year

Number	Type of disease	Drugs used	Cost (SD)
1	Hepatitis	Butalex orytetracy clin	13500 850
2	Warms	Albendazole	1200
3		Bloatzdoral	350
4	Ticks	Vapcatox	1100
5	Mastitis	Udderios Mastitis in Jedors	750 300
6	Diarrhoa	Diaelean powder	300
7	Anti inflomatories	Oxytetracy cline	400
8		Vitamins Tonovit.P	850
Total			13300

Source: Compiled by the author from data from veterinary hospital

5.3 Revenues :

The revenue from different items of production is shown in the tables (5.6-5.8) total revenue of the project in the first Year is about SD5.338 million.

Table 5.6: Value of milk production during the project years

Year	Fresh milk (tons)	Value of milk(SD)
1	238	32130
2	180	24300
3	176	23760
4	248	33480
5	297	40095
6	176	23760
7	238	32130
8	297	40095
9	297	40095
10	297	40095
11	297	40095
12	297	40095
13	297	40095
14	297	40095
14-25	297	40095

* Price of tons of milk is (1350 SD)

Source : Compiled by the author.

Table 5.7 : Revenues from culled animals (SD)

Year	Cows	Male Calve year	Female Calve	Total (SD)
1	-	1000000	300000	1300000
2	-	800000	1000000	900000
3	-	800000	1000000	900000
4	-	1000000	400000	1400000
5	-	1000000	800000	900000
6	6750000	800000	1000000	900000
7	-	1000000	300000	1300000
8	240000	1000000	800000	1800000
9	1950000	1000000	800000	1800000
10	2100000	1000000	800000	1800000
11	2100000	1000000	800000	1800000
12	2100000	1000000	800000	1800000
13	1800000	1000000	800000	1800000
14	1950000	1000000	800000	1800000
14-25	1950000	1000000	800000	1800000

150000 SD * Culled Cows Price
50000 ** Male Calves price
100000 *** Male Calves 1 year price
Source : Compiled by the auther .

Table 5.8 : Production of farm yard manure during the project years(Cubic meters) and its value

Year	Quantity (M^3)	Value of manure (SD)
1	825	825000
2	915	915000
3	615	615000
4	1065	1065000
5	1320	1320000
6	1695	1695000
7	1110	1110000
8	1335	1335000
9	1545	1545000
10	1575	1575000
11	1620	1620000
12	1620	1620000
13	1620	1620000
14	1620	1620000
14-15	1620	1620000
1		

* Each A. U produces 15 M^3.
Price is (1000 DS.M^3) –
AU. Animal unit.
Source : Compiled by the auther.

5.4 The financial analysis :

The financial analysis was based on the following assumptions :

1. Prices have been assumed to be constant through out the project life both costs and revenues are kept under similar conditions.
2. The scheme life span is assumed to be 25 years.

To conduct the financial analysis, a discount factors of 15% (The rate used by WB at the time of doing the study) was used to estimate the discounted the cash flow. The details of the cash flows and respective project indicators such as net present value, benefit, cost ratio payback period and IRR are give in Appendix (14, 15, 16).

5.5 A summary of the results of analysis indicated that the project was Technically and financial, feasible :

1. The NPV at the discount rate 15% was SD 64.373 million with tax and SD66.898million with out tax.
2. Benefit to cost rate was 1.6.
3. The internal rate of returns (IRR) was 47% with tax and 49% with out tax

5.6 Sensitivity analysis :

i. Increasing total cost by 10%.

TC = SD 37.468 million.

TC (after increasing total cost by 10) =SD38.514 million

After increasing the total cost by 10% the NPV wasSD58.313 million with tax and SD 55.993 million with out tax.

2. Benefit to cost ratio B/c = 1.5.
3. Internal rate of returns (IRR) was 43% with tax and 45% with out tax.

ii. Reducing total benefit by 10%.

After reducing the total benefits by 10% the Net present value (NPV) was SD 47.616 million with tax and SD49.747 million with out

tax. The Benefit to cost ratio B/C was 1.4 and the internal rate of returns (IRR) was 39% with tax and 41% with out tax.

5.7 Overall conclusion :

The project was found to be financially feasible under prevailing economic circumstances. However when applying sensitivity of increasing the operation cost by 10% and decreasing the revenue by 10%, the project was also found to be feasible and stable.

The sensitivity analysis showed more stability when adding more cost than reducing the benefit.

Chapter Six

6-Summary Conclusions and Recommendations

1.6 Summary:

In spite of large animal wealth in Sudan, supply of adequate milk is still a problem particularly in large cities like that of Khartoum State capital city.

Khartoum State has more than two hundred thousand of animal units (cattle, sheep, goats and little camels). This animal wealth produced about 442 tons of milk by the year 2005, which still does not cover the requirement of the people of Khartoum for milk. One reason is that Khartoum State population is large, estimated at about 5.7 million for the same year. The gap between milk production and consumption is estimated at about 41% of the total production of milk (the young animals suck 60% and humans consume 37% of the total production). The gap for milk was covered by imported powder and processed milk.

The objective of the study is to assess the technical and financial feasibility of establishing a typical milk production farm in Khartoum State as a form of the potential interventions in supplying milk to promote bridging the gap between supply and consumption of milk in Khartoum State. The specific objectives were to asses the managerial and technical capacity and to evaluate the financial feasibility of producing fodder and milk in that proposed typical dairy farm.

The study used primary data collected by using a structured questionnaire and interviews. The survey was conducted in the two areas of Kuku and Shambat; whereby data were collected from dairy farms in the two areas. The secondary data was obtained from official documents and reports of the Ministry of Agriculture and Animals Resource and Fisheries and from relevant resource.

Shambat was selected to represent the location of the project because it has many favorable advantages (fertile land, availability of input of agricultural production, existence of marketing facilities and having a big number of animals and animal production activities).

The product has two components: forage productions and milk production; as with respect to the forage production component, the proposed fodder crops were included in both the summer and winter rotations in such a sequence that permits legumes crops to alternate with cereal crops to maintain soil fertility. Therefore, a balanced forage mixture required for dairy production including Abu 70 (Sorghum–Valgare) maize (Zea–maize), Lubia (Vigna Spp.) and Barseem were selected.

As for the dairy production component, 50 cross pregnant dairy herd heifers were to be bought in order to build up 80 cross dairy cows (with 62% exogenous blood heifers). This flock will take 8 years to become stably established. The capital investment will take one year, and the operation of the dairy farm will commence in the same year. The total investment cost would amount to Ls 27011 million and the total operation cost would be about Ls 1045603 million.

6.2. The main findings:

The main findings were that from 10 year of the project life cycle (after stabilization of the cattle breed) the dairy farm will produce about 297 tons of milk, about 42 heads of males for culling and about 1620 cubic meters of farm yard manure. The forage production (fodder) will cover the herd requirement and the surplus will go to the market.

The financial analysis was conducted using a discount factor of 15% to estimate the discounted the cash flow. The NPV was found to be positive, the Benefit/Cost ratio was found to be 1.6, the project will be able to pay pack its capital and variable costs in two years including the

establishment year, the internal rate of returns (IRR) was found to be 47% (with tax) and 49% (without tax).

A sensitivity analysis was carried out by increasing the cost of the project by 10%. The results indicated a positive NPV with tax without tax, the Benefit/Cost ratio was 1.5, and the IRR was 43% with tax, and 45% without tax.

Another sensitivity analysis was carried out by reducing the total benefits by 10%. The results of the analysis indicated also a positive NPV value with tax and without tax. The Benefit/Cost ratio was 1.4 and the IRR was 39% with tax and 41% without tax.

6.3. Conclusions:

The conclusion showed that the project was feasible in the normal and the sensitivity analysis cases.

6.4. Recommendations:

The following recommendations are suggested for improvement of the situation of milk production in the proposed Dairy Farm at Shambat, Khartoum State:-

1. To reduce the cost of roughages through increasing the production of the green fodder in the farms.
2. To use artificial insemination technique in the farm and to encourage the establishment of artificial insemination centers to produce improved types of cattle breed for milk production and increase the profitability of dairy farming.
3. To train dairy farmers to improve their managerial skills and knowledge, and use of high production breeds to avoid competition from abroad regarding milk production.
4. To encourage the private financing sources, especially of the Agriculture Bank and the Animal Wealth Bank to invest in milk and by

products production and increase small producers access to sufficient credit.

5. To provide extension services on feed processing quality and quantity through research and extension agencies.

6. To encourage improved research in dairy production in Sudan.

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Appendix

Appendix 1 : Fresh milk productions from various species of animal in Sudan 1990/91 – 2004 (000 tonnes)

Year	Cows Milk	Goat Milk	Sheeps Milk	Camel Milk	Total
1991	1682	572	148	0	2402
1992	3139	693	174	-	4060
1993	3356	841	206	-	4403
1994	3813	1020	365	-	5198
1995	4162	1022	440	-	5841
1996	4370	1024	391	-	5785
1997	4560	1026	415	-	6001
1998	4766	1028	436	-	6230
1999	4955	1197	461	-	6650
2000	5133	1245	462	30	6879
2001	5297	1295	463	40	7095
2002	5445	1347	464	42	7298
2003	5494	1384	464	45	7387
2004	5384	1500	475	46	7405

Source: Ministry of Animal Wealth and Resources, Khartoum 2005.

Appendix 2: Milk production in Khartoum State form various species of animal for (1990/2005) (Tones)

Year	Milk Production Cattle	Milk Production Sheep	Milk Production Goats	Total Production	Available for Human consumption
1990	107627	9192	31063	147882	41734
1991	110528	9485	31901	151914	42861
1992	209150	8251	26995	243738	70314
1993	215424	8461	27670	250880	72382
1994	221880	8676	28362	258232	74511
1995	228544	8896	29071	265802	76702
1996	235400	9122	29071	273593	78958
1997	242461	9354	29798	281613	81281
1998	249735	9591	30543	289869	83672
1999	257228	9835	31306	289869	86134
2000	264944	10088	32089	307121	88668
2001	328950	11475	38250	382500	141525
2002	357406	16625	41559	415588	153768
2003	357416	16624	41560	415600	153772
2004	363974	16929	42322	423225	150593
2005	3806711	17706	44264	442641	163777

Source: Socio-economic and marketing study, September 2002, and by the author.

Appendix 3: Estimated milk consumption in Khartoum State (1990/2005)

Year	Population (000)	Average annual per capita consumption (kg)	Total consumption (ton)	Available for consumption	Deficit (tone)
1990	2507	101-1	253708	41734	211974
1991	2637	101-2	267128	42861	224267
1992	2775	101-3	281385	70314	211071
1993	3129	101-4	317594	72382	245212
1994	3326	101-5	337922	74511	263411
1995	3535	101-6	359560	76703	282857
1996	3757	101-7	382463	78958	303505
1997	3993	101-8	406887	81281	325606
1998	4244	101-9	432888	83672	349216
1999	4511	101-9	460573	86134	374439
2000	4795	102-0	490049	88668	401381
2001	4936	102-1	503966	141525	362441
2002	5139	102-2	525206	153768	371438
2003	5352	102-3	547510	153772	393738
2004	5553	102-4	568627	156593	412034
2005	5754	102.5	589785	163777	426008

Source: Socio-economic and marketing study, September, 2002, and by the author.

Appendix 4: Annual Imports of milk powder in Sudan (1990-2004)

Year	Quantity (MT)
1990	5180
1991	1219
1992	4868
1993	4905
1994	3971
1995	1002
1996	2613
1997	4592
1998	5245
1999	4921
2000	5039
2001	8327
2002	10328
2003	23213
2004	24694

Source: Sudan Customs Police and Department of Statistics.

Appendix 5: Annual Imports of liquid milk in Sudan (1990-2004)

Year	Quantity (MT)
1996	0.480
1997	13.427
1998	21.228
1999	0.314
2000	23.720
2001	2.436
2002	56.009
2003	56.041
2004	102.280

Source: Sudan Customs Police and the Department of Statistics.

Appendix 6 : The total cost of Agriculture production for the first 10 year. (According to the potation) :-

Year	Forage crop	Total area Faddans	Cost per (F) (SD)/F	Total cost (SD)
1	Abu 70	10	28000	280000
	Barseem	5	34750	173750
	Lubia	10	18780	187800
	Mize	10	26500	265000
		35		906550
2	Abu 70	10	28000	280000
	Barseem	10	34750	347500
	Lubia	5	18780	93900
	Mize	5	26500	132500
		35		853900
3	Abu 70	5	28000	140000
	Barseem	15	34750	521250
	Lubia	5	18780	93900
	Mize	5	26500	132500
		35		887650
4	Abu 70	5	28000	140000
	Barseem	10	34750	347500
	Lubia	5	18780	93900
	Mize	5	26500	132500
		25		713900
5	Abu 70	10	28000	280000
	Barseem	10	34750	347500
	Lubia	5	18780	93900
	Mize	5	26500	132500
		30		853900
6	Abu 70	10	28000	280000
	Barseem	10	34750	347500
	Lubia	5	18780	93900
	Mize	5	26500	132500
		30		853900
7	Abu 70	5	28000	140000
	Barseem	15	34750	173750
	Lubia	5	18780	93900
	Mize	5	26500	132500
		30		887650
8	Abu 70	10	28000	28000
	Barseem	5	34750	173750
	Lubia	5	18780	93900
	Mize	5	26500	132500
		25		680150

Year	Forage crop	Total area Faddans	Cost per (F) (SD)/F	Total cost (SD)
9	Abu 70	5	28000	140000
	Barseem	10	34750	347500
	Lubia	5	18780	93900
	Mize	5	26500	132500
		25		713900
10	Abu 70	10	28000	28000
	Barseem	10	34750	34750
	Lubia	5	18780	93900
	Mize	5	26500	132500
		30		853900
11	Abu 70	10	28000	28000
	Barseem	10	34750	34750
	Lubia	5	18780	93900
	Mize	5	26500	132500
		30		853900
12	Abu 70	5	28000	140000
	Barseem	15	34750	251250
	Lubia	5	18780	93900
	Mize	5	26500	132500
		30		887650
13	Abu 70	10	28000	28000
	Barseem	5	34750	173750
	Lubia	5	18780	93900
	Mize	5	26500	132500
		25		680150
14	Abu 70	5	28000	140000
	Barseem	10	34750	347500
	Lubia	5	18780	93900
	Mize	5	26500	132500
		25		713900
15	Abu 70	10	28000	28000
	Barseem	10	34750	34750
	Lubia	5	18780	93900
	Mize	5	26500	132500
		30		853900
16	Abu 70	10	28000	28000
	Barseem	10	34750	34750
	Lubia	5	18780	93900
	Mize	5	26500	132500
		30		853900
17	Abu 70	5	28000	140000
	Barseem	15	34750	251250
	Lubia	5	18780	93900
	Mize	5	26500	132500
		30		887650

18	Abu 70	10	28000	28000
	Barseem	5	34750	173750
	Lubia	5	18780	93900
	Mize	5	26500	132500
		25		680150
19	Abu 70	5	28000	140000
	Barseem	10	34750	347500
	Lubia	5	18780	93900
	Mize	5	26500	132500
		25		713900
20	Abu 70	10	28000	28000
	Barseem	10	34750	34750
	Lubia	5	18780	93900
	Mize	5	26500	132500
		30		853900
21	Abu 70	10	28000	28000
	Barseem	10	34750	34750
	Lubia	5	18780	93900
	Mize	5	26500	132500
		30		853900
22	Abu 70	5	28000	140000
	Barseem	15	34750	251250
	Lubia	5	18780	93900
	Mize	5	26500	132500
		30		887650
23	Abu 70	10	28000	28000
	Barseem	5	34750	173750
	Lubia	5	18780	93900
	Mize	5	26500	132500
		25		680150
24	Abu 70	5	28000	140000
	Barseem	10	34750	347500
	Lubia	5	18780	93900
	Mize	5	26500	132500
		25		713900
25	Abu 70	10	28000	28000
	Barseem	10	34750	34750
	Lubia	5	18780	93900
	Mize	5	26500	132500
		30		853900

Source: compiled by the Auther.

Appendix 7 : Estimate of forage production due to agriculture duration.

Year	Forage corps	Cultivated units	Total area per (F)	Number of cut	Average yield per (ton/F)		Total production (ton)	
					Green	Dry	Green	Dry
1	Lubia	2,4	10	1	6	2	60	20
	Abu 70	1,3	10	1	7	2.1	70	21
	Maize	2,4	10	1	6	2	60	20
	Barseem	1	5	1	18	9	90	45
			35				280	106
2	Lubia	4	5	1	6	2	30	10
	Abu 70	2,4	10	1	7	2.1	70	21
	Maize	3	5	1	6	2	30	10
	Barseem	1	10	15	18	9	2700	1350
			30				2830	1391
3	Lubia	2	5	1	6	2	30	10
	Abu 70	3	5	1	7	2.1	35	10.5
	Maize	2	5	1	6	2	30	10
	Barseem	1,3,4	15	15	18	9	4050	2025
			30				4145	20605
4	Lubia	2	5	1	6	2	30	10
	Abu 70	1	5	1	7	2.1	35	10.5
	Maize	2	5	1	6	2	30	10
	Barseem	3,4	15	15	18	9	2700	1350
			30				2795	1380.5
5	Lubia	1	5	1	6	2	30	10
	Abu 70	2,4	10	1	7	2.1	70	21
	Maize	1	5	1	6	2	30	10
	Barseem	2,3	10	15	18	9	2700	1350
			30				2830	1391
6	Lubia	4	5	1	6	2	30	10
	Abu 70	1,3	10	1	7	2.1	70	21
	Maize	4	5	1	6	2	30	10
	Barseem	1,2	10	15	18	9	2700	1350
			30				2830	1391

Year	Forage corps	Cultivated units	Total area per (F)	Number of cut	Average yield per (ton/F)		Total production (ton)	
					Green	Dry	Green	Dry
7	Lubia	3	5	1	6	2	30	10
	Abu 70	4	5	1	7	2.1	35	10.5
	Maize	3	5	1	6	2	30	10
	Barseem	1,2,4	15	15	18	9	**	2025
			30				2795	1380.5
8	Lubia	4	5	1	6	2	30	10
	Abu 70	1,3	10	1	7	2.1	70	21
	Maize	4	5	1	6	2	30	10
	Barseem	2	5	15	18	9	1350	675
			25				1480	716
9	Lubia	2	5	1	6	2	30	10
	Abu 70	1	5	1	7	2.1	35	10.5
	Maize	2	5	1	6	2	30	10
	Barseem	3,4	15	15	18	9	2700	1350
			30				2795	1380.5
10	Lubia	1	5	1	6	2	30	10
	Abu 70	2,4	10	1	7	2.1	70	21
	Maize	1	5	1	6	2	30	10
	Barseem	2,3	10	15	18	9	2700	1350
			30				2830	1391

Source: compiled by the Auther.