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Oxenization Versus Tractorization: Options and Constraints for Ethiopian Framing System

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Abstract: Livestock contribute nearly all the draught power for agricultural production at small holder level in Ethiopia. In terms accessibility, affordability, sustainability oxenization is better than tracterization especially for small holder farmers. Ethiopia has 6 million draught oxen equivalent to 500,000 tractors and additional 6 million oxen are required to meet demands because 60% of the farmers own either one or no oxen, A number of factors are responsible for the insufficiency of draught oxen production cascade among them poor reproductive performances of indigenous cattle, competition with dairy and beef fattening, meat export expansions and scarcity of animal feed. Biotechnology appears not to have impact on improving draught animal power. Although animal power needs should not remain static but respond to innovations and new challenges, a short term strategy could be investing in animal feed and health schemes and a long term solution could be an establishment of national animal power development program or as third option integrating motorized technology with draft animal technology is recommended. Otherwise shortage of animal power could severely aggravate crop production. This paper briefly reviews the above situation.

Key words: Cattle % Draught % Animal energy % Agriculture

INTRODUCTION

Ethiopia is a country with a population of about 80 million and an area of 1,000,000 square kilometers [1]. Its economy is very dependent on agriculture (Crop livestock production). Unfortunately, the country's current agricultural production does not meet the food requirement of the population, largely because of high population growth and ecological degradation. Agriculture contributes 52% GDP, 85% of employment opportunities and more than 90% of foreign exchange earnings and most food supply. 90% of the Ethiopian farmers, subsist on rain fed agriculture, crop livestock are integrated. Ethiopia has a large number of livestock of which cattle have more important place (Table 1). Livestock contribute 18.8% of the total GDP, of which 80% is contributed by cattle in Africa [2]. Cattle in Ethiopia make the backbone of the rural household economy. Cattle are the dominant livestock species (Figure 1.), they are highly valued because the benefits they provide. Having access to cattle, either by direct or indirect ownership through borrowing or hiring have several advantages for farmers. The main advantage being, input to crop production (traction and manure), the provision of protein (milk and meat), sociocultural needs (payment loans), security (source of cash, investment) fuel (dung cakes) and companionship.

Ethiopia has a large number of draught animals it possesses 15% of the cattle population half of Africa's equine population with 37%, 58% and 46% of all African donkeys, horses and mules, respectively and 8% of the camel [3]. There of animals have an important place in the Ethiopian agriculture. 90% of the Ethiopian farmers subsist on rained agriculture. Crop-livestock and fuel (manure) are integrated. Ethiopia is a major utilize of animal power in Africa (Table 2). Livestock contribute nearly all the draught power approximately 6 million of oxen (Janhke and Assamnew, 1983) equivalent to 500,000 (80hp tractors) are utilized in the cultivation of 10 million hectares.

Draught animal technology (DAT) in Ethiopia unlike other African countries, which is very recent post colonial era, has been an integral component of farming system for several millennia 3000 years of history [5].

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Table 1: Livestock population and number of breeds in Ethiopia and Africa

	Population in 000*			Number of breeds#		
Species	Ethiopia	Africa	As % of Africa	Ethiopia	Africa	As % of Africa
Cattle	30,000	192,000	15	17	200	9
Camel	1,000	14,000	7	5	36	14
Donkey	4,000	11,000	36	2	15	13
Horse	1,500	3,000	50	2	34	5

Compiled from * FAO 2004[1]; # Mason, 1971[4]

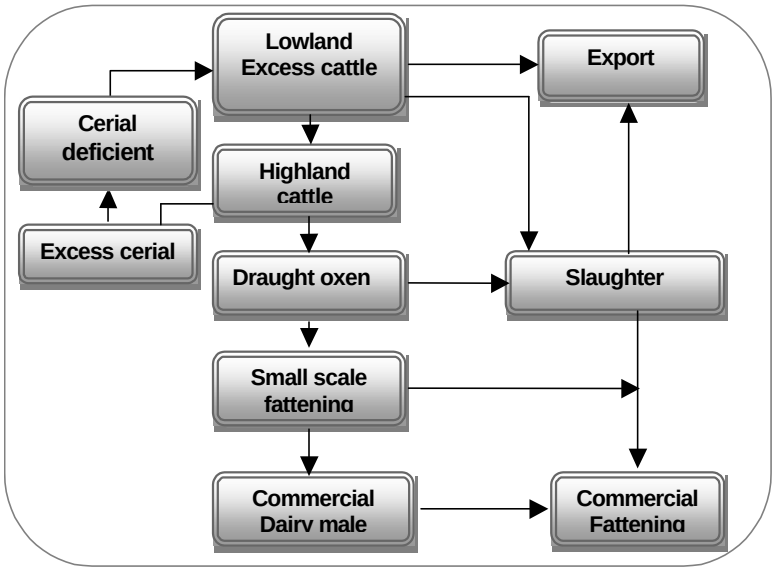

Fig. 1: Representation of cattle rotation and interaction of farming systems in Ethiopia

Table 2: Draught cattle population of seven major African countries

Country	Draught cattle (000)
Ethiopia	6,000
Kenya	700
Tanzania	600
Zimbabwe	500
Botswana	400
Madagascar	300
Nigeria	200

Source: [12]

Despite increased mechanization, 3 billion people living in thirty developing countries still depend on animal traction power for agricultural production and the transport of goods and people [6].

Cattle contribute nearly all the draught power for agricultural production at smallholder level in Ethiopia. Ethiopia has around 6 million draught oxen, which is equivalent to 500,000 tractors; an additional 6 million oxen are required to meet demands. At present 60% of the farmers own either one or no oxen [7].

However, market distortion seems presently to operate in favor of tractor power This scenario calls for more attention on the part of the Ethiopian government to exploit this sector and make it economically viable through support services to the cattle farmers and save meager foreign exchange spent on import of tractor, oil, milk, meat and related products.

The role of this paper is to highlight the potential role of the Ethiopian cattle for traction power and socioeconomic development. To develop a better understanding by outlining, the constraints hampering economic viability and measures aimed at revamping productivity in the sector, to help formulate strategies for breeding and production policies.

Characterization of Livestock Farming Systems: In our contemporary, there are three cattle production systems in Ethiopia: a draught oriented system in the highlands, milk oriented system in the lowlands (subsistence) and a minor commercial dairy system in periurban areas. However, farming systems are not static. They change overtime and between locations owing to changes in resource availability and demand patterns.

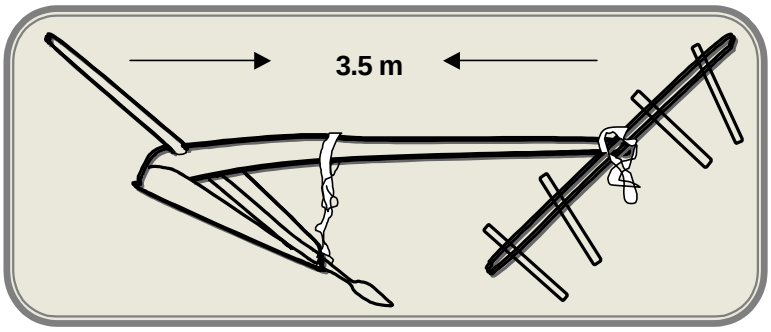

Fig. 2: Schematic diagram of traditional Ethiopian plow (*Maresha*)

Pastoral Production System: Ethiopia is a country, which is frequently affected by drought and erratic nature of the rainfall hence a national carrying capacity cannot be predicted precisely that is, there is no equilibrium between pasture and fixed number of livestock.. Ethiopian highlands have 70% of cattle population while the lowlands have 30%. Traditionally the highlands and lowlands are linked economically in the form of trade. The highlands supply the cereal requirement of the pastoralists. In return the pastoralist supply livestock to the sedentary farmers, which they use them as plough oxen, see Figure 1.

In all pastoral systems the consumption of milk or blood seems to be steadily dropping and there are few, if any which rely almost totally on milk or milk products. In some the reliance is still fairly high. The Borana of the southern rangelands of Ethiopia for example, with some seasonal variations, still consume up to 59% of their diet as milk or milk products with the balance of the diet being increasingly made up of grain. For the Afar, milk probably constitutes less than 60% of total energy requirements and grain again is increasingly the main food substitute [8] This increase of grain and decrease of milk consumption is in fact more and more the pattern in pastoral Africa. Nevertheless the African pastoralist is still firmly oriented towards a milk production mode as far as circumstances will allow and has not yet dramatically changed this in favour of selling meat or growing crops. Pastoral areas in Ethiopia, which cover about 0.6 million square km, are generally known as the range lands. These areas support about 9.8 million people (12% of total population of the country) of which 56 % are pastorals, 32% are agro-pastoral and the remaining 22% are urban dwellers [9] Pastoralism relies on livestock diversity to exploit and make use of the diverse rangeland resources and typical pastoral herds and flocks include grazing cattle, donkeys and sheep and browsing camels and goats. Pastoralism also relies on the diverse livestock products including milk, hides, meat, blood and draft power.

Role of Cattle in the Lowlands: Pastoral communities mainly inhabit the lowlands. Ethiopian pastoral area is estimated to occupy 60% of the total land area home to 12% of the total population. 30% of cattle, 52% of sheep, 45% of goat and 100% of camel are found in the pastoral area[9]. Livestock in pastoral area are main source of milk up to 60% of the diet is milk, meat, blood and other byproducts. The climate in the lowlands is arid and, owing to the unreliable rainfall, the ecosystem in these dry ranges never achieves equilibrium between grazing and fixed number of settled livestock. Crop failure is also common due to insufficient rain. Thus, traditional pastoralism constitutes the only efficient means exploitation until the introduction of heavy investment or irrigation and moisture harvesting technologies.

Advantage of Pastoral Production:

- Extensive use of resources= less stress on environment
- Livestock good investment
- Livestock survive better than crops
- Low population density decreases disease
- Mobility a way to manage conflict

However, pastoral herds are poor producers, disease is rampant and reproduction is slow

Mixed Crop Livestock Farming: Ethiopia has 14 million hectare of land cultivated annually. 10 million hectare is cultivated using oxen power. Mostly they grow cereal and keep small number of animals cattle, sheep, goat, donkey and equine. The average holding per farmer is less than one hectare and it is shrinking year to year as population grows. For this reason most farmers around 60% do not own or have only one ox. Cows are not plowed because under scarce nutrition in addition to a work they will completely stop reproducing and hence no subsistence milk production. These farmers they occupy the central highlands. Mainly they relay on rain fed agriculture and

draught is recurrent. Thus the have to depend animals for plowing from the pastoralists. Many researchers blame the indigenous livestock as non productive. However, in the highlands the Primary use of cattle is for draft power. Milk, meat and other products are secondary.

Commercial Farms in Ethiopia: A major component of the government's agricultural policy since the l974 revolution has been the development of large-scale state farms. After the l975 land reform, the *Derg* converted a majority of the estimated 75,000 hectares of large, commercial farms owned by individuals and cooperatives into state farms. Since then, the government has expanded the size of state farms. In l987/88 there were about 2l6, 000 hectares of state farmland, accounting for 3.3 percent of the total cultivated area [10]. Livestock particularly commercial dairy farms were also confiscated during that era and put under ownership of the government control. And currently a private monopole company by the name ELFORA controls all large dairy farms. The number of dairy cattle is estimated to be 100,000. But this industry does not contribute to the draft animal production for the following reasons: the bulls are heavy requiring more food of higher quality, they are susceptible to injury disease and heat and they do not have endurance for work because they easily get tired. ILRI (International Livestock Research Institute), conducted research plowing with single crossbred cows. The technology did was not accepted by farmers as crossbred cow feed requirement is high, the plow itself is hard and if worked they do not reproduce fatigue and. There is no beef farm or beef breed in Ethiopia however culled animals from lowland and draft oxen at the end of their plow life they are sent to a fattening farms where they are fed for about three months and are then slaughtered to give a fat beef a favorite culture of Ethiopians the eating raw meat.

Draught Animal Technology (DAT) in Ethiopia: Draught animal technology (DAT) in Ethiopia unlike other African countries, which is very recent, has been an integral component of the farming system for several millennia. Occasionally horses donkeys and camels are used for plowing however in cmparison to oxen the contribution to traction is less than 1%. Equine and camels are mainly used as pack animals for pulling carts. Despite the country's enormous animal population very little has been done to improve draught animal technology [11].

The scratch plow stands at center of agricultural system because of simplicity and efficacy in human labor it is used for minimum tillage a method of plowing in which disturbance of the soil does not affect the deeper layers. The benefits are conservation of organic matter, leading to a better soil structure and less soil erosion, better soil biodiversity and the use of less energy. The disadvantages include the easier germination of grass seeds. The Ethiopian version has eight basic parts [13] all available locally the beam (*Mofer),* the plowshare (*Maresha*) the sheath (*Wogal*) the stilt (*erf*) two wooden ears (*diggir*) inserted in to a plowshare's sheath a yolk (Kenber) and a leather strap (Mangecha0 which adjust plow depth. Non of these basic parts has changed over course of plow record history. Blacksmiths fashion twentieth century plow shares from leaf spring steal of automobile car cases rather than locally smelted iron the wood used for the beam has also changed from favorite Olea *Africana* (weyra) to more widely available eucalyptus. the plow is (12-20 kg) it is adjustable to specific needs a field or task for farmers to carry from field to field farmers adjust the angle of the pull to the desired plowing depth by varying the shear and ear length, adjusting the angle between share and beam or exerting down word pressure on the handle during plowing the angle of the pull may vary also 15-25 degree. The *maresha* design allows itb to break the soil surface at fairly shallow angle an efficient substantially different from heavy steal mold board plows of European origin. The clods of soil pushed to the side on first pass can be broken up by repeated passes depending on soil prior to field use and crop to be sown. Recent attempts to introduce heavier steel mould board plows have ignored the essential element of probability which allowed farmers to cultivate highly fragmented land holding at different altitude and long distance apart.

The revolutionary qualities of the ox plow system reside partly in its adaptability but more fundamentally in its clear saving to labor over hand tillage.

Advantages of Draught Animal Technology:

- Draught animals specifically cattle in addition to power provision they are also source of milk, meat, hide and dung for fuel and fertilizer, blood, bone and numerous other products
- DAT is environmental friendly
- They can be produced, fed and managed using local resources where as alternative use of engines require fossil fuel which is expensive and needs foreign exchange (Table 3.)
- Require no foreign currency (Table 4)
- Draught cattle are better source of agricultural power, in water logged fields, sloppy hills and rugged terrains
- Can be used for variety of tasks such as plowing cultivation, harvesting, threshing and transportation

- Land tenure regulations and inheritance patterns combined with population growth will tend to keep farm size relatively small compared with the area normally considered economically viable for tractors
- Can maintain a labor-intensive agriculture without exacerbating problems of unemployment and encourages less skewed income distribution, avoids illegal transaction of land and new forms of exploitation.
- Animal traction is in many parts of the world is an affordable, appropriate and sustainable technology

Past Attempts of DAP improvement: Ethiopian farmers have been using the *Maresha*, an ox-drawn plough for thousands of years. Most of the components of the plough are wooden except two pieces: the plough share and a tying unit. It is cheap and simple, It was considered inefficient compared several researchers and organizations have made repeated attempts to replace the Maresha with the moldboard plough. The animal drawn moldboard plough was for the first time introduced to Ethiopia by Italians in 1939, [13] However, farmers rejected the plough for its heavy weight, high draft power requirement and complicated adjustment and attachment systems.

On-station research results has showed that using crossbred dairy cows for both milk production and draught work is a feasible technology as long as the increased energy requirement is met. However, the technology was not accepted because crossbred cows could not reproduce high veterinary cost and feed requirement. And single cow traction is considered an ethical in the hard soils of Ethiopia.

Oxen were considered to work only for about 60 days a year and the rest of the time they are not used for productive agricultural purposes, [14; 15]. The annual working cycle of an ox is characterized by short periods of high intensive labor and long periods of idleness, with about 15% of the feed intake actually used for work and the remainder being just dedicated to maintenance [15] And it was considered farmers should try to diversify the use of the animals. Thus the high investments concerning training time and feed could bring better returns. Draught animals have been used for soil excavation and landscape shaping and single ox traction[16]. However draught animals are not athletes, this strategy failed due to insufficient study on the physiology of local oxen, feed utilization and the salvage value of the animal as meat. The failure of International Center for Africa (ILCA) was due to biased research and non participation of farmers. Since then there has been very little research on DAT in Ethiopia

Present Trends of Dat in Ethiopia: Programs for milk and meat are gaining momentum, there is no corresponding programme in magnitude for improving the system of draught animal technology (DAT). In Ethiopia fertilizer improved seed, water, tractor, pesticides are subsidized or credit is available. DAP is nether neither subsidized nor supported by other infrastructural help such as credit insurance and cooperatives except vaccination of cattle. Dap is not looked as part of an integrated agricultural production system. The benefits are not appreciated. Modernization attempts have always tried to show only the benefits of fertilizer, water, pesticide, tractor, improved seed etc. Ethiopian smallholder farmers almost invariably

Table 3: Foreign Exchange Comparison

	Tractor power (80 hp tractor	Animal power (10 pairs of oxen)
Capital cost	500,540	50,000
Land preparation cost Birr/ha		
Fixed cost	2000	500
Implement cost	1000	60
Running cost	600	60
Operation cost	2000	120
Total cost	506140	506,20

Table 4: Foreign Exchange Comparison

	Tractor power (80 hp tractor)		Animal power (10 pairs of oxen)	
	For ex (Birr)	For ex % total	For ex (Birr)	For ex % total
Capital cost	500,540	78	0	0
Land preparation cost				
Fixed cost	1000	53	0	0
Implement cost	500		0	0
Running cost	600	33	0	0
Operation cost	0	0	0	0
Total cost	502,640	38	0	0

Table 5: Import and export of cattle products

					Annual growth rate %	
	1980	1990	2000	2015	1980-1990	1990-2000
Population(000)	31,065	45,198	62,908	89,765	3.8	3.4
Cattle (000)	28,500	29,450	35,480	-	1.1	1.9
Beef production(000 mt)	203.6	230.0	298.0		0.9	2.6
Beef consumption trend	200.8	230.0	298.1	-	1.0	2.6
Cattle export	13,647	5,600	326			
Cattle imports (Number)	200					
Milk Production (000mt)	797.9	969.6	1,197.5		1.5	2.1
Milk consumption (000mt)	585.3	725.4	905.0		1.7	2.2
Milk export	241	7	4			
Milk imports	29,709	14,986	8,290			

Source: [1]

plough with traditional *maresha*, employing a similar technology to that used several centuries ago due to insufficient involvement of professionals in research and development in identifying constraints and improvement of DAT.

Draught power availability is inadequate for timely and proper cultivation. About 29% of Ethiopian farmers have no oxen, 34 % have one, 29% have two and 8% have two or more [17] Hence more than 60% of the farmers have to rent or borrow one or two animals for cultivation. Increased food production requires additional energy input. Based on the above figure about 6 million extra oxen are required to satisfy the present demand. But this can not be easily met because of threat factors. The following are serious factors threatening DAP in favor of tracterization:

Cattle Export: At present live animals, meat and meat products,. A study made by livestock and meat authority [19] indicates that the country loses about 325,800 heads of cattle through informal cross-border trade of livestock and livestock products.

Exported cattle are exclusively sourced from pastoral areas and the pastoral areas can supply annually two million heads of cattle, by deducting the domestic demand and female animals there is a potential for export of 404 thousand heads [1].

However these figures seem to be unrealizable. As Ethiopia's human population is growing by 3.4%, by the year 2015 there will be 89 million people (Table 5). To meet local animal protein needs arising from population, urbanization and economic growth, livestock productivity has to increase by more than 5% a year compared to 2% today which is already lower than the rate of population growth.

Although cattle export provides a means of reducing poverty levels by increasing reserve of hard currency. Commercial producers would be the first to benefit but the stimulus of export prices would gradually be felt in the traditional sector, which would be the main source of animal exports. It is an incentive to improved livestock feeding, management and health. Cattle which were exported via contraband, would be exported formally and the country will get a fare share in the export trade Farmers are able to convert their livestock capital into investment capital, enable to store their wealth in Monetary form and this avoids risk of lose during drought and disease outbreak. The number of cattle will decrease, as a result overgrazing will be reduced and fertility of land Improved. Employment will increase as a result of market and veterinary expansion, the benefit gained from cattle export is not without negative consequences. Although possibilities for expanding the arena of pastoral commercialization often appear attractive to development planners, there may also be substantial costs, especially those associated with greater social differentiation. While some producers clearly profit from sales, others, perhaps the majority, may find themselves further ratcheted into poverty or forced out of livestock rearing altogether.

The shift from subsistence dairying to commercial meat operations fundamentally affects the pastoral community. A successful beef -or mutton- producing operation requires a high survival of male stock; both heifer and bull calves must receive adequate supplies of milk. For a pastoral community, raising bull calves on milk is a luxury to be enjoyed only after human hunger is satisfied and during the frequent periods of low milk production male stock beyond herd reproductive requirements may be allowed to starve. That is, in the hierarchy of milk consumers, pastoral children in a

Table 6: Reproductive performance of indigenous cattle in Ethiopia

	Traditional management	Improved management
Calf mortality (%)	29	2
Birth weights (kg)	20	40
Age at first calving (months)	50	36
Calving rate (%)	46	80
Calving interval (months)	25	12

subsistence dairy operation take precedence over animals: Shifting from subsistence dairying to commercial meat production tends to reduce the size of the pastoral population. Commercialization can lead to displacement of labor from poorer, subsistence-oriented pastoral households. This loss of a work force of course further reduces the productivity capacity of poorer households

Production constraints: Almost all cattle in Ethiopia are indigenous and produced in the traditional sector. The inherent characteristics of these animals is for survival rather than productivity, their small size, diseases and inadequate nutrition mean grow slowly and often come to market at 5-10 years of age. Export markets are interested in younger, larger animals of higher grade

Apparently agricultural pricing structures are operating against the smallholder. Increasing export dose not alleviate poverty unless accompanied by increasing in purchasing power of the farmer. Cash flow problems of resource-poor farmers generally limit the rate of adoption of new technologies unless there is an immediate return (Example milk production). And it is only by improving the overall disposable income and quality of life in rural areas that population growth can be expected to fall naturally. Hence taxation should be minimal and protection of this is enfant industry is required.

Infertility: Fertility in cattle is affected by management, nutrition and genetic factors. Reproductive parameters are good index of production. Some selected reproductive parameters for cattle around Debre-Zeit under farmers condition in and improved management feed supplementation, vaccination and dewarming are indicated in Table 5.

From the above table the present reproductive performance is poor in traditional system. But with proper management there is a potential we can improve the reproductive performance by 100% simply doubling the calving rate one is able to double the calving crop plus milk production.

The contribution of the bull to infertility is mainly through dissemination of poor quality semen. Bulls are castrated for plowing purpose for this reason hundreds of thousands of best bulls are castrated annually after being selected for draught, this makes to deteriorate the genetic pool and reduces the probability of having offspring's from superior animals. Leaving behind inferior animals to serve the cows

Malnutrition: Difference in nutrition probably accounts for most variations in reproductive performance between and within the heard. The effects of underfeeding are greatest on prepubertal animals and lactating cows. Table 6. Shows some additional impact of nutrition on reproduction cattle maintained on high and law protein [20] The high and low rations contained 150% and 41 % of estimated requirement respectively.

The efficiency of animals in converting feed to food is another factor to consider. In Ethiopia livestock can not be fed grain because of food shortages, at the same time the scarcity of land prohibits the cultivation of forage crops and the erratic nature of rain fed agriculture. To this effect the main source of food is roughage and crop residues. Any strategy of improving animal feed should focus primarily on utilization of crop residue.

Disease: Diseases and parasites not only cause heavy loses due to morbidity and mortality, but also can affect the reproductive system causing infertility and production wastage through subclinical infections. Also indirectly affect the feed conversion efficiency. In Ethiopia regular vaccination against Rinderpest and CBPP were conducted annually. However, strategic dewarming and disinfestations programme, insuring individual animal treatments and proper AI services should also be the aim of the veterinary services in the future. The ratio of animals to veterinarians is extremely very high (Table 8) man power development is crucial. Hence the Federal Government of Ethiopia has increased the veterinary schools from one to nine and enrolement rates from 50 to 700 annually which is a positive development

The current ratio of animals to veterinarians is calculated and the result is shown on Table 8.

Table 7: Age and weight at puberty of Nigerian heifers maintained on two levels of nutrition[#]

	High Protein	Low protein
Age at puberty(days)	570	704
Weight at puberty(kg)	207	161
Weight at conception((kg)	204	248
Age at conception(days)	624	930*

[#][20]; Difference between treatments significant at $p<0.05$

Table 8: Ratio of animals to veterinerian

Animal species	Number of animal/veterinarian
Cattle	40,000
Equine	7,000
Camel	2,000
Small ruminants	30,000

(n=1000 active veterinarians)

In Ethiopia regular vaccination of cattle against Rinderpest and CCPP were campaigned in the past. Rinderpest is eradicated. However, despite widespread prevalence of parasitic disease strategic deworming, disinfestations programmes, insuring individual animal treatment and proper AI services should be in place. According to Mukassa, (1989) [20] deworming and disinfestations can improve age at puberty and body weight (Table 8.)

Treatment	n	Number attaining puberty	Mean age in days	Mean weight in Kg
control	50	45	557a	253a
Acaricide	56	47	553a	253a
Antheminthics	50	50	551a	262b
Anthelnintics+acaricide	56	55	552b	274b

Source: [20]; Means without common subscripts are different ($p<0.05$)

Competition with Dairy: The milk yield of local cattle breeds can be increased by crossing them with improved dairy breeds. A number of improved heifers and bulls were distributed since 1972 namely Brown Swiss, Jersey, Ayrishire, Holestien, Red Poll and Simental Ethiopian ministry of agriculture However, selection and importation of above breeds were based on individual preferences. Cross bred bulls are not good for plowing they eat a lot have low digestibility, less heat tolerance, have high oxygen consumption, slower, worked less hours and more susceptible to disease and leg injuries.

DAP has not been linked with dairy system. Dairy breeds suitable for milk were selected but not for draught power hence the local animal resource was neglected.

The centralization and subsidized government urban and peri-urban dairy has reduced the income of small holder farmer through competition of prices. Seemingly agricultural pricing structures are operating against the small holder. Increasing food supplies does not alleviate poverty unless accompanied by increasing in purchasing power of farmers. Cash flow of problems of resource-poor farmers generally limits the rate of adoption of new technologies unless there is an immediate return milk production. It is only by improving the overall disposable income and quality of life in rural areas that population growth can be expected to fall naturally [21].

The dairy industry competes directly for feed resource with DAP. Large quantities of feed mainly industrial byproducts go to the dairy because it is considered more profitable.

Competition with Meat Industry: At present meat cattle expansion is competing directly with draught cattle production system, as a result of more and more export and slaughter of nomadic heard. And there is rapid rotation of draught cattle in the sedentary herd. Feed that was originally fed to draught cattle is also diverted for fattening to investors. This has resulted in difficulty in obtaining young replacement for old animals and poor commercial value at slaughter of old animals. This problem might be alevated through management of service life of draught oxen that could be adapted by farmers under different strategies (Table 9.)

Biotechnology its Impact on Availability of DAP: Embryo transfer has been heralded as a means of increasing cattle profitability by inducing multiple births but this technology can result in high degree of stress in both the cow and attendant (Table 9.)

Table 9: Breeding herd strategies for replacement of draught oxen

	Strategies		
Draught oxen n=100	1	2	3
Mean age of training (Years)	2	3	5
Mean length of services(Years)	3	4	6
Mean number of oxen needed for replacement	40	30	20
Corresponding Breeding Herd	100	80	60
Number of weaned calves	100	80	60
Replacement breeding cows	500	400	300
Mean size of extensive herd	500	400	300

Source: [21]

Table 10: Inducing twining by embryo transfer

Parameter	Single birth	Twin Birth
Dystokia (%)	3	12
Retained Placenta (%)	9	38
Still birth (%)	6	9
Birth weight(kg)	44	33

Source: [22]

The potential of embryo transfer for developing countries needs further investigation. But one fact is that it is the safest way importing animal germplasm. As the result it can be helpful in genetic amelioration programmes.

Strategies for Production and Growth: Technology transfer can be used to improve breeding and and productivity of local cattle. This should be done by first improving indigenous cattle. However, if exotic breeds suit production and marketing conditions and are genetically as good as or better than domestic stock then as pointed by Smith, 1988 a policy of continuous importation can be recommended.

Based on these ideas commercial herd could be used, as nucleus herds while base herds could be those in traditional sector. This means well, adapted improved heifers and bulls could be obtained from the commercial sector for subsequent improvement of Village herds as discussed This may be a better step and perhaps a less costly way of improving production other than direct use of imported cattle for improvement of village herds.

The feed problem in the traditional sector can be resolved by teaching the farmers how to use crop residues and how to make good fodder.

The majority of the rural populations are smallholders. If viability of dairy development and meat production are to be enhanced and they are to have a real impact on socio-economic development, it is important that small farmers be involved. However, it should be pointed out that the role of commercial dairying and beef production should not be overlooked because of its strategic importance. It is doubtful if the smallholder alone can support the growing urban population if the commercial sector is allowed to collapse. Therefore, it would be wise to suggest that any change should be gradual, leaving both sectors to co-exist.

A large commercial undertaking may do well, but its inability to earn the foreign exchange required for inputs, shortage of spare parts and shortage of human resources to man commercial operations hinders maximization of production, although these problems can be solved by streamlining foreign exchange allocations to farmers. Unless the rural population develops economically and can feed itself, the lack of purchasing power of those who need milk will prohibit the scale of the commercial undertaking as the market will remain limited to higher income group who can afford products such as milk, butter cheese and other dairy products. Expansion to large-scale undertaking is limited to the availability of land, which may eventually become scarce. Intensification as increasing population pressure will result in progressively smaller agricultural holdings and grazing will be taken over by either crop or other development activities, the introduction of more intensive production system is imperative.

The only remedy here is to improve reproductive efficiency. If the present age at first calving of 3-5 years and inter-calving interval of 24 months is improved to 2 years at first calving and 12- 13 months calving interval, the number of cows in milk would double as well as the number of calves produced per year. And inheritance

patterns combined with population growth will tend to keep farm size relatively small compared with the area normally considered economically viable for tractors can maintain labor intensive agriculture without exacerbating problems of unemployment and encourages less skewed income distribution. Avoids illegal transaction of land and new forms of exploitation

CONCLUSION

Linking, DAT with dairy and beef systems by ensuring coordination of policy measures mutually reinforces each other. Subsidized breeding programs, animal health initiatives animal power projects and additional taxation on tractors. A national work ox programme should be established, for sustainable breeding purchasing-resale on regional stations. Decentralization of any government dairy, meat or poultry industries. Encourage production at smallholder farmer level, to increase the income of rural community. And encouraging professional in Research and development identifying current constraints of DAT. Presently with all the deficiency of draught oxen it is impossible to cover all the traction power needed and this requires integration of draught power and motorized power together.

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