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SAHELIAN LIVESTOCK INDUSTRY STATUS
AND
DEVELOPMENT STRATEGY

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Livestock Industry Status

Livestock production is the major occupation and support of approximately 21% of the population of the eight OILSS Member Sahelian Countries. Nearly half of these could be classified as sedentary, while the rest are transhumant or nomadic. The Sahelian rangelands provides forage for about two thirds of the livestock while the higher rainfall areas of the south provide a combination of range, fallow land regrowth and crop residue for the other third.

This livestock industry accounts for approximately 16% of the GNP for the Sahel. Prior to the drought exports of livestock made up to 55% of total exports for some countries, however, these declined to 40% following the drought and have only partially regained previous levels. The main factors which have limited the increase of exports are the rebuilding of reduced livestock herds and the increased domestic demand resulting from increased population and urbanization. Percentage of total meat production exported in previous years has ranged for various Sahelian countries from zero to more than 50%, however, in 1977 the Sahel average was 23% with a high of 43% for Chad and negative or near zero for three other countries (Table I).

While the Sahel is a net exporter of meat as shown in Table I, it is also a net importer of milk and milk products. Importations of milk exceeded the domestic production in 1977 and were valued at 38% of the meat export value. There has been a six fold increase in milk imports since 1968.

TABLE I

PRODUCTION AND DISPOSITION OF MEAT AND MILK IN THE SAHEL 1977
(000 KG)

Country Statistic	Cape Verde	Chad	The Gambia	Mali	Mauri- Tania	Niger	Senegal	Upper Volta	Sahel
Total Meat Production 1,2	1,022	77,291	8,001	101,720	62,702	94,098	73,742	55,502	474,677
Domestic Meat Consumption	1,238	44,537	8,109	82,676	40,092	66,706	73,304	48,546	365,208
Per Capita Meat Consump- tion (3)	-4.1	10.9	15.3	13.8	26.8	13.7	14.0	8.3	12.9
Net Meat Exportation	-216	33,354	-108	19,044	22,610	27,392	438	6,956	109,469
Percent of Meat exported	-21.1	42.8	-13.5	18.7	36.1	29.1	0.6	12.5	23.1
Total Milk Production	7,000	260,700	5,000	154,300	167,300	357,000	119,600	87,000	1,152,600
Domestic Milk Consumption	37,210	270,249	9,052	155,892	237,130	377,742	281,606	151,660	1,520,541
Per Capita Milk consump- tion (3)	124	66	17	26	159	78	54	26	54
Net Milk Imports	30,210	9,593	4,052	31,070	69,850	20,759	161,850	64,080	391,465

1. Beef 55%, Small Ruminant 29%, Camel 5%, Poultry and others 5%.
Includes carcass plus offal.
2. Production figures include camels which were excluded from FAO Data.
3. Given in Kilograms or liters.

In addition to the decreased meat exports and increased milk imports there has been a reduction of domestic per capita consumption from 17.2kg of meat⁽¹⁾ and 54.8 liters of milk in the 1960's to a low of 12.9kg of meat and 53.6 liters of milk in 1977.

Examination of the dynamics of both the human population and livestock population over the past 20 years (Table II) will help explain the factors contributing to this decline. Livestock numbers, expressed in Unites Bovin Tropical (UBT)⁽²⁾, have been cyclic over the period, increasing from 21 million in 1961 to 24 million in 1968 then down to 20 million in the early 1970's before increasing again to an estimated 23 million in 1980. It should be noted that the 1980 stock of livestock has eaten most all reserves and many reports indicate a higher than normal death loss. This may suggest that the livestock population is again at the top of the cycle. The human population, on the other hand, has progressed steadily from 19 million in 1960 to 28 million in 1977. Therefore, the higher ratio of people to livestock has resulted in a reduction of per capita production from approximately 23kg of meat and 54 liters of milk in the 1960's to 17kg of meat and 40 liters of milk in the late 1970's.

Given the lack of a constant trend toward increased livestock numbers, it might be assumed that the experience of the past 20 years has established that the average stocking capacity with present technology and infrastructure for the Sahel is near 22 million with a variation of about 2 million more for rainy years and 2 million less for drought times. Species composition has remained fairly constant with a slight increase in the small

(1) Meat is defined as carcass plus consumable offal.

(2) One UBT = 250kg of live animal weight.

TABLE II

SAHELIAN HUMAN POPULATION AND LIVESTOCK NUMBERS BY COUNTRY
(000 Units) (1)

Species Year Country	Human			Livestock in UBT (3)					20 years Average
	1960	1968	1977	1961-65	1968	1973-76	1977	1980 (3)	
Cape Verde	220	257	301	21	23	22	18	20	21
Chad	2,920	3,531	4,086	4,496	4,570	4,022	4,132	4,230	4,290
Gambia	370	447	530	255	198	264	248	240	240
Mali	4,000	4,840	5,991	4,825	6,014	4,817	4,894	5,300	5,170
Mauritania	1,030	1,249	1,496	3,318	2,921	2,981	3,026	3,540	3,154
Niger	3,160	3,820	4,869	4,448	5,036	3,645	4,149	4,810	4,415
Senegal	3,590	4,235	5,236	1,790	2,789	2,641	2,550	2,680	2,490
Upper Volta	3,960	4,790	5,849	1,638	2,731	2,090	2,157	2,400	2,200
Total Sahel	19,160	23,169	28,358	20,792	24,282	20,482	21,174	23,200	21,980

(1) FAO - 1976 and 1977

(2) UBT = Unites Bovin Tropical
 One Bovin = 0.75 UBT
 One Camel = 1.00 UBT
 One Horse = 1.00 UBT
 One Donkey = 0.50 UBT
 One Small Ruminant = 0.15 UBT

(3) Projected Estimate based on CILSS/Club
 Livestock Strategy Report 1980.

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ruminant percentage. Given this livestock population ceiling, the same production efficiency as 1977, the current human population growth of 2.4% and the present per capita consumption rates the Sahel will become a net importer of meat in addition to milk between 1985 and 1990.

Including milk, the Sahel would be a net importer of livestock products by 1984. Or, to be able to maintain meat exports at the 1977 level, the domestic per capita meat consumption will have to drop to near 10.8kg by 1990.

These are not predictions, but they are real possibilities if little or nothing more is done to improve range and livestock production than has been realized in the past 20 years. Actually there are factors which indicate that domestic per capita demand will increase and that there is potential for significant increases in livestock production. The expected increased per capita demand is tied to the increasing urban population which consumes two to three times the rural population per capita consumption. The potential increased livestock production depends on removal of several constraints to make presently underutilized areas of range forage available and to allow the livestock herd production efficiency to increase.

It is the stated goal of the CILSS/Club du Sahel to meet this challenge of increased production to satisfy the increased domestic demand and maintain present export levels. There are optimists who believe that production can be doubled. This optimism is viewed with skepticism in the 1980 CILSS/Club Livestock Strategy Paper. The CILSS/Club proposes a strategy to obtain a 75% production increase by the year 2000 and they speculate possible additional increases with significant investments. A more realistic goal is considered no more than a 50% to 65% increase. Necessary interventions to achieve the latter will be discussed below.

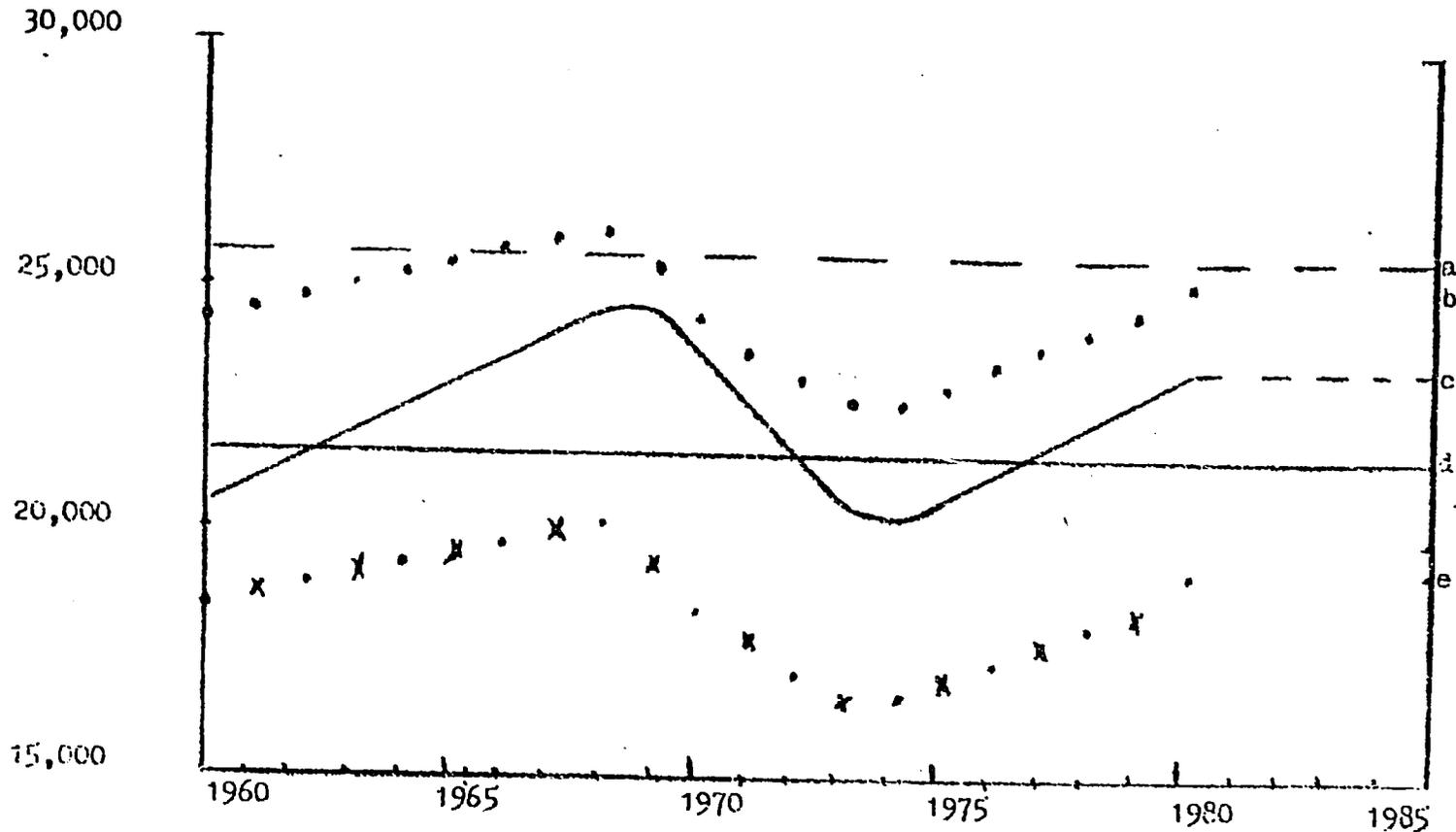
Range Status

The seasonal and annual range capacity is roughly depicted in Figure I as it apparently increased from the early 1960's until the drought in the late 1960's when it fell below average until the late 1970's. The average is projected from 1980 to 1985 since any interventions aimed at increasing the forage supply are likely to take at least five years to have a significant effect and rainfall is unpredictable.

The actual number of livestock is also included in the figure as it was influenced by the forage supply and other factors. During the 10 to 15 years prior to 1968 good climatic conditions; increasing livestock prices and demand; increased animal health care; and an increased numbers of water wells encouraged and facilitated increased livestock numbers and production. Those who judge this increase as irrational livestock and range management due to an unresponsive system fail to recognize that similar livestock buildups tend to occur throughout the developed, as well as the developing world. Likewise livestock losses and temporary range deterioration are not uncommon when livestockmen get caught by droughts with the range stocked to capacity for the rainy years. One should remember the losses suffered in the Southwestern U.S. in the 1950's drought and in Australia in the 70's, not to mention the current U.S. livestock problems. This does not lessen the burden on all livestockmen to find solutions to avoid the excessive buildups, which are ultimately damaging to the natural resources and production.

FIGURE I
(000 UBT)

ESTIMATED SEASONAL AND ANNUAL RANGE CARRYING CAPACITY AND
LIVESTOCK POPULATION IN THE SAHEL
FROM 1960 - 1980 AND PROJECTION TO 1985



- a. Projected Range Carrying Capacity following interventions to the year 2000.
- b. Approximate maximum available forage supply in growing season.
- . - . c. Cyclic level of livestock on range over past 20 years.
- d. Present Safe Range Carrying Capacity before interventions.
- . x . x e. Approximate minimum available forage supply in dry season.

The cause and effect relationship should be studied a bit before assigning the blame for environmental or range degradation on the technical interventions such as animal health service and water wells. These interventions may have facilitated the rate of increase of the herds which were being enlarged anyway, but they were not the cause. The cause was the long period of abundant forage and favorable demand. Improved health only increases the efficiency of production to realize faster growth and/or sales. The increased watering points opened new range to more efficient use due to reduced walking stress between water points. The bad commonly blamed on these interventions should be attributed to the natural survival instinct and hope common to any livestockman who is caught by a drought and tries to hold his herd together in hopes of rain and recovered prices.

The importance of livestock production efficiency for controlling livestock numbers to protect the range is shown in Table III. The same factors which have been blamed for increasing animal numbers and degrading the environment are essential to the potential of a herder family to provide their increasing nutritional and monetary needs with the same or fewer animals. Production level one in Table III gives the present meat and milk production of a "Family Herd" at today's average production efficiency. Following varying degrees of interventions in animal health care, water point developments to improve nutrition and reduce stress, and improved range management, corresponding degrees of increased fertility, reduced death losses and faster growth would be expected. These improved levels of production efficiency, given as production levels 2, 3, 4 and 5, show that that same size family consumption of meat and milk could be obtained from a herd only 67 to 80% as presently required.

Contrary to previous belief that the traditional Sahelian herder will

TABLE III

POTENTIAL MEAT AND MILK PRODUCTION FROM A FAMILY HERD OF 50 HEAD OF CATTLE OR EQUIVALENT HERD OF SMALL RUMINANTS OR CAMELS (36 UBT)

Production Level	Production Rate of Production	Annual Meat Produced		Annual Milk Produced		Per Capita (1) Production		% of Herd Needed For Constant Production Level	
		Kg	% Change	Liters	% Change	Meat	Milk	Meat	Milk
1	Present (2) 60% Fertility 35% Calf Mortality Standard Growth	800	0.0%	2000	0.0%	53kg	133 Liters	100%	100%
2	Partial Interventions (3) 65% Fertility 25% Mortality Standard Growth	950	18%	2400	20%	63kg	160 Liters	84%	83%
3	Partial Interventions (4) 65% Fertility 25% Mortality 10% Increase Growth	1050	30%	2400	20%	70kg	160 Liters	76%	83%
4	Full Interventions (3) 70% Fertility 20% Mortality Standard Growth	1000	26%	2850	43%	67kg	190 Liters	80%	70%
5	Full Interventions (4) 70% Fertility 20% Mortality 20% Increase Growth	1200	50%	2850	43%	80kg	190 Liters	67%	70%

- (1) For Family of 15 persons.
- (2) Value of present production at 1977 prices is \$1600 for the family or \$107 per capita.
- (3) Primarily animal health interventions.
- (4) Animal health plus nutritional interventions.

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continue irrational herd increases above his needs, it is now more commonly accepted that herd numbers are governed very rationally. Herd numbers are controlled by family needs, labor constraints, forage and water supply, market demand, and rational reserve for bad years. If we accept that the herder is rational, then we are obliged to demonstrate to him that the services we offer will in fact allow him to increase his family security and his annual income at the same time. In this situation the traditional incentive to increase the size of the family herd and the aggregate pressure on the range will be reduced.

Another lesson learned following the drought, was the need to limit water production at each point to accommodate a number of livestock compatible with the forage capacity of the area or route. Equally important is the need to study the social structure to help regulate the new water and grazing area opened. A cadre of personnel should be established in the areas to make a continuing study of the human needs, as well as monitoring the range and livestock conditions while extending information on animal and range management. These actions will help avoid future losses, while further increasing efficiency.

Following the drought of 1968-73 livestock numbers returned to the more reasonable stocking rate which existed in the early 60's. A graphic presentation of the stocking rate or grazing pressure on the forage supply as it varies within years and between years is also shown in Figure I. Livestock numbers cannot be adjusted rapidly enough to fit this variable forage supply due to slow herd regrowth as well as market absorption limitations in times of drought. Therefore a margin of safety must always be maintained. That is, livestock numbers should never significantly exceed that which could be maintained, even if poorly, during the worst years and seasons with the present

technology and infrastructure. A general rule is to stock at 60% of average capacity in order to have at least a 20% forage reserve for drought years.

Forage growth well exceeded animal numbers during most months for the rainy years prior to 1968. This excess forage and higher prices encouraged increased herd numbers until the herd was dependent on that maximum forage production. Then with the onset of the drought there was only enough forage during the peak months of the year, making it necessary to market, move further south or chance high weight and death losses during the rest of the year. The improved health controls did allow some of these cattle to move into previously unusable southern range. By 1973 livestock numbers in the Sahel had leveled off at about 20,000,000 UBT which appears to be within about 10% of the maximum numbers that can be properly managed on the present accessible range and seasonal cropland. Table IV gives the number of UBT by country for 1977, the average for the past 20 years and estimated carrying capacity for the present and future potential as calculated by IEMVT⁽¹⁾.

The IEMVT estimated potential stocking rate of 20 million UBT by the year 2000 is an increase of 25% over the present capacity. This increase is dependent on extensive projects to develop water points, reduce range fires, introduce and enforce range management and improve animal health. These interventions are essential to obtaining optimum utilization of underutilized areas in the north as well as to opening new lands to grazing in the southern regions of higher disease risk. The capacity might be farther increased to a maximum of 30 million by extensive reseeding of fallow lands.

(1) IEMVT = Institut d'Elevage et Médecine Vétérinaire des Pays Tropicaux.

TABLE IV

PRESENT STOCKING RATES AND ESTIMATED CAPACITY BEFORE
AND AFTER PROPOSED INTERVENTIONS BY SAHELIAN COUNTRIES
(000 UBT)

Country Statistic	Cape Verde	Chad	The Gambia	Mali	Mauritania	Niger	Senegal	Upper Volta	Total Sahel
1977 Livestock Numbers in UBT (1)	19	4,133	248	4,750	3,026	4,354	2,551	2,157	21,237
20 years Average (2)	21	4,290	240	5,170	3,154	4,415	2,490	2,200	21,980
Estimated of UBT Capacity Before Interventions	18	4,623	185	5,240	2,990	4,844	2,232	1,492	21,626
Estimate of Future UBT Capacity After Interventions (Year 2000) (3)	20	8,158	185	6,244	3,209	5,489	2,232	1,492	27,032

(1) United Bovin Tropical calculated by ICAVT from FAO Statistics 1977

(2) Average of FAO Statistics 1960-1977 plus projection to 1980

(3) Main Interventions aimed at expansion: water point development, fire control and animal disease control. (intent is to conserve 20% of forage for emergency reserve).

Note: In cases where estimated capacity is lower than actual population the analyst feels the overpopulation will cause longterm range deterioration and should not be maintained.

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For purposes of this paper a slightly more conservative increase of 20% to a stocking rate of 25.6 million by the year 2000 will be used. This is considered more nearly within the physical and financial possibilities.

Social and Ecological Considerations

While many articles have been written about the negative effects of a variety of technical interventions, others point out the lack of evidence to establish a cause and effect relationship. Swift⁽¹⁾ suggest that a lack of assistance to the pastoralist may be more detrimental to both the social structure and the ecology than the threat of technical interventions. This could result from the increased exit of pastoralists to become sedentary farmers on marginal land, both changing the social balance and putting a greater farming stress on the environment. A shortage of pastoralists might lead to establishment of large ranches needing less labor. The intent of interventions would be to improve the efficiency of herding to avoid forced departure into farming or urbanization.

Efforts to improve grazing distribution through proper water point development and associated range management will also contribute to the protection of the ecology. While assuring a more efficient use of the range resources the excess grass covers will be reduced, thereby decreasing the threat of range fires. (The uniformly shorter grass reduces frequency and intensity of range fires which tend to destroy trees, other plants and animals).

It is essential to the success of every intervention that a continuing dialogue be established with the target population to learn their needs, desires and capacity, while gaining their confidence and explaining

(1) Jeremy Swift, 1977.

or demonstrating the potential interventions. The sociological as well as the ecological implications of each intervention should be studied in advance as well as simultaneously with the implementation.

Livestock Production Potential and Disposition

While the interventions of water point development, range management and animal health improvements are essential to expanding range utilization and carrying capacity, they will also improve efficiency of animal offtake. That is, the increased supply of water and nearby forage will improve the nutritional state and reduce stress, and the improved animal health will reduce direct death loss, as well as production losses due to non-fatal diseases and parasites.

It is estimated that these interventions could increase efficiency of offtake 25% by the year 2000. This combined with a 30% increased herd size and increased offtake as herd growth becomes stable results in a total increase of 68% over the 1977 production level of meat. Production of milk will only increase 50% as herd stabilization will not increase milk offtake as it will meat offtake.

The 25% increased production efficiency is based on estimates that the cited interventions will increase fertility from 60% to 70%; reduce calf death losses from 35% to 20%; and increase growth rate by 20% in half the herds by the year 2000.

Table V presents the projected animal numbers, production and consumption from 1968 to 2000. Based on these estimates, which depend on very large donor inputs, excellent host country cooperation and a bit of good luck, the domestic meat consumption can be satisfied through the year 2000, while

TABLE V.

PROJECTED LIVESTOCK NUMBERS, HUMAN POPULATION, AND
PRODUCTION AND CONSUMPTION OF MEAT AND MILK 1968-2000

Parameter Year	Livestock Numbers (000 UBT)	Meat + Offal Production (000 kg)	Milk Production (000 liters)	Human Population (000)	Total Domestic Consumption		Per Capita Domestic (1) Consumption	
					Meat + Offal (000 kg)	Milk (000 liters)	Meat (kg)	Milk (liters)
1968 (1)	24,300	516,700	1,206,300	23,200	399,500	1,270,000	17.2	54.8
1977 (1)	21,200	474,700	1,129,000	28,400	365,200	1,520,500	12.9	53.6
1978 (2)	21,800	489,000	1,162,900	29,100	378,300	1,557,000	13.0	53.6
1979 (2)	22,500	503,600	1,197,800	29,800	390,400	1,594,400	13.1	53.6
1980 (2)	23,200	577,000	1,270,700	30,500	402,600	1,632,600	13.2	53.6
1981	23,200	577,000	1,270,700	31,200	415,000	1,671,800	13.3	53.3
1982	23,200	577,000	1,270,700	32,000	428,800	1,712,000	13.4	53.6
1983	23,200	577,000	1,270,700	32,700	441,500	1,753,000	13.5	53.6
1984	23,200	577,000	1,270,700	33,500	455,600	1,795,100	13.6	53.6
1985	23,200	613,000	1,350,000	34,300	469,900	1,838,200	13.7	53.6
1990	23,600	660,400	1,454,400	38,700	561,200	2,069,600	14.5	53.6
1995	24,600	726,500	1,600,000	43,500	669,900	2,330,200	15.4	53.6
2000	25,600	796,000	1,752,800	49,000	803,600	2,623,500	16.4	53.6

(1) Source FAO and CILSS/Club du Sahel Strategy Paper 1980.

(a) Calculated projections based on following assumption (1978-2000):

(a) Assuming 20% herd increase by 2000 plus 25% increased efficiency.

(b) Offtake = UBT Marketed or consumed divided by total UBT in herd.

(c) Assuming 14.8% offtake in 1980, 15.7% in 1985, 16.6% in 1990, 17.5% in 1995 and 18.5% in 2000.

(d) Assuming 2 to 3% herd growth rate or 12% increased production by the year 2000.

(e) Recommended stocking rate 21,500,000 in 1980, 22,600,000 in 1985, 23,600,000 in 1990, 24,600,000 in 1995 and 25,600,000 in the year 2000. Human Population Growth Rate 2.4%

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surplus meat for exports will tend to decline to near zero by the end of the century. The increased milk production will only partially fill the the increased demand of the growing population, while the deficit will tend to increase each year.

The production balance of meat and milk is given in Table VI along with the net foreign exchange value of the two products. Export of meat and foreign exchange value is expected to reach its highest in 1980 or shortly thereafter as excessive stocking of the range forces a slowing of herd growth. Following the high in the early 1980's both meat export and foreign exchange value will tend to decline until they are below zero by the year 2000 due to the faster growing domestic demand.

Club du Sahel First Generation Livestock Projects

Fifty five percent of the proposed projects have commitments, are being studied or have expressions of interest from donors. The livestock sector is receiving 10 to 15% of total donor aid, which is slightly below its relative importance as it provides 16% of GNP.

USAID Livestock Projects

Much useful information has been gained from the various AID livestock projects which range from near completion to those not yet fully implemented. These projects have addressed animal health vaccine production; commercial feedlots; forage production; marketing; range fire control; training in range and livestock management and extension; farm level animal feeding; animal disease and parasite research; development of animal diagnostic lab; animal traction studies; mixed livestock - farming studies; small ruminants and cattle breed disease resistance research; socio-economic studies of herders

TABLE VI

PROJECTED MEAT EXPORT, MILK IMPORT AND
NET FOREIGN EXCHANGE VALUE

Year	Production Balance for Export or Import or Reduced Consumption		Net (1) Foreign Exchange Value (US \$000)
	Meat and Offal (000 kg)	Milk and Milk Products (000 liters)	
1968	117,200	- 63,700	175,800
1977	109,500	-391,500	108,200
1978	110,700	-394,100	110,100
1979	113,200	-396,600	113,700
1980	174,400	-361,900	217,500
1981	162,000	-401,100	191,000
1982	148,200	-441,300	162,100
1983	135,500	-482,300	134,800
1984	121,400	-524,400	105,100
1985	143,100	-488,200	146,000
1990	99,200	-615,200	54,100
1995	56,600	-730,200	- 33,600
2000	- 7,600	-870,700	-160,200

(1) 1977 Value Meat and Offal US \$1.6/kg (CILSS/IE:VT 1980)
1977 Value Milk US \$0.17/liter (CILSS/IE:VT 1980)

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in project areas; and ecological evaluations of previous interventions and/or pressure from human and livestock populations. The livestock sector is receiving 11% of total USAID funds or 20% of funds directly related to production (\$10,000,000 proposed for 1981).

Delayed project implementation and progress has been a common problem due to a variety of reasons including: host country desire to control projects and make them more action orientated than study orientated; delays in AID/Washington approval and contract assignment; difficulty in locating experienced French speaking technical advisors willing to accept project site and conditions; shortage of technical and administrative counterparts; shortage of project and/or host country funds for transportation and maintenance; and often a lack of good communication among project manager, contractor, technical advisors, host government organization, and the project target population.

These experiences plus various evaluation studies suggest that all projects should contain a strong socio-economic and resource monitoring evaluation component which can utilize counterparts who would also double as extension agents to introduce potential interventions. The interventions should be conservatively chosen but of enough magnitude to interest the host government sufficiently to gain support. Training of the counterparts in-country, on the job, as well as short term and long term U.S. or third country training is considered essential to project success and continued development. Recurrent costs should be closely considered and provided for in the project funding.

Recommended Interventions

I. Sahelian Rangeland Areas

A. Redistribution of range land utilization through water management.

1. Finance surface water catchment basins or traditional wells in underutilized grazing areas for specific control by most proximate herder or family identified by a sociological study team in the project zone. Wells or basins should be planned to supply only enough water to support a given number of animal units for the space and rational time sequence recommended by the range management team.
2. As alternative "limited water supply points" are developed, the existing "unlimited water supply points" (such as boreholes and pumping stations) should be fitted with supply limiting devices (hand drawn system; hand pumps, or limited orifice size) in accord with agreements reached by sociological and range management team with well users and government regulations.

B. Reinforce Existing Animal Health Service.

1. Refrigerator and fuel budget for health stations and coolers for distribution.
2. Supplies of vaccine, medicine and basic materials for health care of animals, including small ruminants.
3. Based on specific local transport needs, motor bikes, animal drawn carts or other forms of transportation might be provided with appropriate fuel and maintenance budget.

4. Short term training in animal health care and equipment maintenance.
 5. Provide simple village level animal care kit and rustic livestock corrals.
 6. Support regional research to improve small ruminant health care.
- C. Search for economical source of supplemental minerals and salt.
(Present prices are prohibitive, i.e. not cost effective).
- D. Support Regional Satellite Range Monitoring Project
- E. Range Fire Management - Support research to study controlled burning on range nutrition, forage production, wood fuel supply and soil condition. There are both advantages and disadvantages of burning, but very little firm information or agreement on its use. However, there appears to be a preponderance of information to indicate the ineffectiveness and lack of cost efficiency of firebreaks. Reduction of range fires through extension education should be promoted, while studying periodic managed burning.

II. Mixed Farming Area

- A. Reinforce existing animal health service to apply prophylactic care package to animals introduced into the area.
1. Furnish same support to health service as listed under Rangeland Area.
 2. Develop appropriate prophylactic care package for these areas.
 3. Support research and improvement of trypanotolerant breeds of cattle and small ruminants.

- B. Support pilot and research projects to increase soil building forage crops on fallow land and increase efficient utilization of all crop residue and native forage by ruminants for production of milk, meat and work. This can be done on integrated rural development projects and in association with food crop production research.
- C. Livestock Feeding - Because the Sahel is a grain deficit region and cost of energy and protein supplements as well as cultivated forage are relatively high, livestock feeding can not be expected to contribute significantly to increasing meat production. (The cost of increased weight in feedlots of the Sahel have averaged two to three times the value of the weight gained). While interventions in industrial feeding are frequently not justified, there are some conditions under which feeding on the farm or near a source of cheap feed can be profitable. There may be special cases where animal health services, credit or transportation support may be justified to facilitate use of these resources, but mixed farming area livestock feeding should generally be left to its normal growth in line with feed supply and livestock demand. This increase in livestock husbandry in the higher rainfall farming areas will contribute to stratification, but only a small percentage of the northern area young animals will be needed to utilize the resources. It is expected that most of the resources will be used by the permanent-disease resistant herds of the south; hence explicit stratification projects should not be attempted.

1. Seasonal Farm Fattening or Holding - Excess crop residue, fallow land forage and possibly industrial by-product feeds, not needed to feed work oxen and the permanent village herd, can be profitably fed to market age livestock for a few months of the dry season to defer marketing until the seasonal price increases.
2. Industrial Feedlots - Only suggested in cases where a feedlot can be located adjacent to a dependable, steady supply of a cheap energy and/or protein by-product feed source such as a sugar mill or oil mill in a farming area which also has a good source of forage. Depending on the cost and supply of feedstuff, there may be only seasonal feeding advantage.

D. Milk Production - Feeding of by-product feeds to supplement the nutritional needs of the traditional dual-purpose herds near urban markets is recommended, but establishment of commercial dairying is not considered feasible in most areas. Sahelian milk production is not competitive with world markets, nor is it likely to be so; hence milk production projects should generally not be considered.

III. Livestock Marketing - Marketing studies in West Africa have suggested that the traditional marketing system is efficient and responsive to the needs of the livestock industry. Domestic marketing is expected to increase and may need to be facilitated in some cases.

- A. Develop water points on traditional marketing trails.
- B. Establish native range forage reserves at strategic points on the trails to be used in the dry seasons.
- C. Distribution and storage of food grain and other commodities in livestock production areas.

IV. Participant Training - Both technical and administrative training should be an integral part of every project to prepare host country personnel to continue the projects and extend the improved technology throughout their countries.

V. Monitoring and Evaluation

- A. Good data collection for monitoring and analysis before, during and following any intervention is essential to planning, management and evaluation of that intervention as it effects the target group's economy, social life and ecology.
- B. An interdisciplinary team including production specialist, socio-economist and ecologist should be involved from the planning stage and implementation to the final evaluation.
- C. Information Needed for Design, Management and Evaluation.
1. Vegetation map of area including standing forage estimates by location, season and year (minimum of two years data).
 2. Animal distribution map by species, ages, sex, season and year (2 years data).
 3. Animal production parameters including weights, reproductive rate and death losses should be estimated.
 4. Stock water distribution map with capacity by location and season.
 5. Human population distribution, ethnic and social relationships, principle activity and water-range control by location.
 6. Animal disease status.
 7. Animal health, government extension service and other support service available to the project area.
 8. Present government policy on water control and/or range control.

9. Status of use of forage by-products in mixed farming areas.
10. Availability and price of concentrate by-products in mixed farming areas.
11. Present use of fallow land and potential for legume forage production in rotation system.
12. Constraints which may limit development such as supplies of materials, social acceptance, water development on treks between grazing areas and market, and the market demand for livestock.
13. Availability of host country technicians and candidates for training as technicians necessary to implement project.
14. Livestock development activities of other donors as well as host country.

General Summary of Livestock Development Strategy

The 1980 number of livestock in the Sahel is estimated to be slightly in excess of the safe carrying capacity for protection of the range resources and for maintaining a forage reserve of approximately twenty percent for livestock survival in drought years. That forage reserve was obviously completely consumed in many areas in 1980 before the new rains commenced. Hence livestock were reported to be in poorer condition and to have suffered higher death losses than normal.

Reduction of herd size, or at least, maintenance at zero growth should be encouraged by introducing government policy to charge for all animal health services, while requiring a strict health care program which will tend to increase production of the smaller herds remaining. All price and export controls should be removed to allow fair market price and maximum marketing.

Estimates of potential increase of Sahelian range carrying capacity range from 15 to 30%, while 20% is considered an obtainable goal by the year 2000. This increase will require substantial donor support of projects for the development of stock water, range management, range fire management and animal disease control. If these range improvements are started now, the range capacity might be sufficient for today's livestock charge by 1985.

The traditional livestock production system is relatively effective for the Sahelian conditions, therefore it should be supported by improving the use of available resources rather than replacing the system. In addition to expanding the grazing capacity through the range developments and opening of disease infested areas, these same interventions are expected to improve offtake efficiency as much as 25% by the year 2000. The increased offtake will be from a combination of higher reproduction, lower calf mortality and faster growth rate resulting from increased forage and water supply, reduced stress and improved health.

Other interventions which are recommended include research of large animal and small ruminant disease and parasite problems which limit production efficiency and prohibit use of some southern ranges, research to optimize production of trypanomiasis tolerant breeds of cattle and small ruminants; and research on soil building legumes for rotation, forage production, forage storage and forage utilization on the mixed farming-livestock operations.

While these interventions in the higher rainfall areas will tend to increase livestock husbandry in the south, the concept of stratification is not expected to increase significantly over present trends. Most of the livestock grown and fed in these mixed farming areas will continue to be

work oxen and permanent herds of disease tolerant breeds. A small percentage of young stock from the north will be needed for the increased feeding capacity in these areas, but most animals will continue to be grown out on the traditional northern ranges.

These substantial production increases will not be enough to maintain the present level of domestic per capita meat and milk consumption and net exports if population growth continues at the present rate. By the year 2000 domestic meat consumption will equal the optimistic projected production, while milk production will, at best, only satisfy the rural consumption. The host governments should be prepared for this probabilities. Substantial levels of meat exports are expected to continue due to higher coastal prices hence domestic Sahelian per capita consumption will continue to decline.

The traditional marketing system has been found to be efficient and is expected to continue to meet the needs of increased marketing to the national urban centers and to the export markets. Recommended interventions to facilitate marketing are: 1.) development of supplemental watering points on traditional market trails, 2.) establishment of native range reserve areas on these trails to be used only in the dry season to encourage and facilitate marketing at that time and 3.) distribution and storage of food grain and other commodities in livestock production areas.

Due to the extensive nature of Sahelian milk production, the high cost of a milk collection system and the lack of a sufficient economical source of high energy feedstuff for a commercial dairy industry, these countries should plan to increase milk imports to satisfy the growing urban demand. The projected increased milk production is expected to continue to supply the rural demand.

Some portion of the agricultural by-product feeds will be used for the growing-fattening operations where transportation cost is not prohibitive and for milk, poultry and possibly swine production near the urban centers. However, trade and price controls should be discouraged since local livestock efficiency will not always compete economically with world market prices which may tend to return a greater benefit to the same mixed farming population.

Technical training in all the livestock and range management disciplines as well as administrative training is essential to development project implementation and to the long term administration of continued development.

Continual monitoring, evaluation and redesign of these recommended interventions will be necessary to most effectively and efficiently utilize and protect the natural resources and the limited financial resources.