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SMALL RUMINANT COLLABORATIVE RESEARCH

SUPPORT PROGRAM

PRODUCTION SYSTEMS PROJECT REPORT
1993 - 1997

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The Small Ruminant Collaborative Research Support Program (SR-CRSP) is a collaborative activity of university and research institutions. It began in 1979 and was jointly funded by the participating universities and institutions and the U.S. Agency for International Development. The Kenya Agricultural Research Institute (KARI) and Ministry of Agriculture, Livestock Development and Marketing were the national collaborators. The participating U.S. institutions were Texas A&M University, Washington State University, University of Missouri, Colorado State University and Winrock International Institute for Agricultural Development. The management entity for the SR-CRSP was the University of California, Davis.

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Kabete, Nairobi October, 1997

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SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAM: PRODUCTION SYSTEMS PROJECT REPORT

INTRODUCTION

Production Systems Project (PSP) started its research activities in western Kenya in 1980 before moving to the lowland humid Coast and eastern Kenya in 1993. Along with the other Small Ruminant Collaborative Research Support Program (SR-CRSP) projects, PSP has enjoyed uninterrupted 15 years of research except for budgetary problems. For the duration of the project the main objective of provision of food (animal protein) food security and alleviation of poverty through sales of the Kenya Dual-purpose Goat (KDPG) remained the same. However, specific objectives changed in reflection of the project's progress and changing international agriculture outlook. It kicked off with farming systems research and was one of the pioneers in this approach with livestock in Kenya and the continent at large. Then came sustainable agriculture which was closely followed by research intended to show people impact. Fortunately for the project having started on the right footing of conducting research to resolve farmers production constraints and with farmers, it survived international agriculture changes and has made a difference to farmers in provision of animal protein and food security. The move of the project from western to eastern Kenya and the Coast was necessitated by changing agricultural research outlook and the need to test KDPG technologies elsewhere. Therefore, the first section of this report will focus on the latter two areas with emphasis on testing KDPG technologies. Also in this section model farms are covered. One of these farms was on station and two were on-farm. Model farms were designed to demonstrate and to provide accurate data on inputs and outputs in an exercise intended to show the impact of developed technologies. Reported in the second section was performance of a small flock of Toggenburg crosses and KDPGs which was maintained by PSP at Katumani for adaptive and comparative research. The third section will cover supportive study of field testing of CCPP vaccine. Animal Health Project (AHL) a sister project of PSP, has developed a thermal stable Contagious Caprine Pleuropneumonia (CCPP) vaccine which it has been testing in the field. PSP contribution towards this study included participatory rural appraisals (PRAs), description of the production systems and monitoring growth of study goats and other management strategies as practiced by concerned pastoralists. A preliminary report on the first regionalization activity of SR-CRSP will take section four. The regional activity was located in southern Tanzania. It was a good example of networking with minimal resources. Also presented in this section are results of participatory rural appraisal conducted in Masaka, Uganda. The fifth section is on national outreach activities, manpower development and publications. The sixth and final section is on project personnel, who were instrumental in generation of results presented in this report.

1. THE KENYA DUAL-PURPOSE GOAT IN DIFFERENT PRODUCTION SYSTEMS

KDPG On-farm

INTRODUCTION

The monitoring research of the KDPG impact study was proposed at the February, 1993 Programme Advisory Committee (PAC) meeting. Whilst the main objective remained the same the specific one was to measure and to test KDPG technologies in different environments of the humid Coast and semi-arid eastern Kenya. Another major difference this time round was the use of "true" KDPGs unlike proxies (F1s Toggenburg X East African Goat) used to develop technologies in western Kenya. As the study was very inclusive (farmers, extension staff, KARI and SR-CRSP scientists) planning, allocation of KDPGs and quarantine requirements delayed commencement of the study until December, 1993 and KDPG does placement on-farm was not completed until August, 1994. The study comprised of 100 smallholder farmers divided into five groups of 20 farmers each and hailing from five villages in three districts. Twenty five of the farmers through a lottery were beneficiaries of two KDPG does each. The remaining 75 farmers acted as a pressure group for overseeing good management of the KDPGs, while awaiting pass on KDPGs.

Background information of study area districts: Important information on districts where the sturdy was conducted is summarized in Tables 1.1 and 1.2. Two of the districts were at the Coast with the study sites less than 300 metres above sea level (asl) and 20 kilometres from Indian Ocean. The sites in Machakos District were at an altitude of 1600 metres asl. Machakos was the most densely populated of the three districts. The two Coast districts were comparable in population density and other factors including life style, culture, religion and language. The Coast districts farmers were predominantly Muslim, while Machakos ones were Christians. It is common knowledge the former were less experienced than the latter in livestock keeping. As shown in Table 1.2 Machakos was least endowed with rainfall. On average in the month of May Matuga-Kwale received rainfall equal to 54% of the total annual rainfall of Katumani-Machakos.

Materials and methods: Statistics: The five villages in four sites were picked in consultation with farmers' representatives, extension officers, KARI and SR-CRSP scientists. Following meetings with farmers, 100 of them were picked randomly for the study. Selected farmers were expected to meet certain conditions and to accept to rear the KDPGs as recommended. Those who were not able were dropped and replaced. Fortunately not many farmers refused to abide with the conditions of the study.

Since a sample size of 10 KDPGs per village yields 5 sampling units and because on-farm animal research is characterized by continuous and discrete variables with high coefficients of variations and large non-treatment variables, meaningful trials with acceptable

levels of statistical precision were out of question. To overcome these constraints monitoring research was employed. Fortunately, monitoring research is equipped to enhance contacts between researchers , farmers and extension officers, introduce technology thought to be appropriate to the target area, monitor farmers' reaction to the technology, adapt and refine technology to suit better farmers' circumstances and objectives, and to assess the impact of the technology.

Table 1.1: Profiles of Study Area Districts

District	Kwale	Kilifi	Machakos
Latitudes	3.30 and 4.45	2.20 and 4.00	0.45 and 1.30
Longitudes	38.31 and 39.31	39.0 and 40.14	36.45 and 37.45
Size sq km	8,322	12,464	5,818
Population Female	236602	379991	497207
Male	228409	364987	462799
Total population	465011	744978	960006
Density per sq km	56	62	165
No. of households	52261	66741	133399

Table 1.2: Mean Monthly Rainfall of Study Sites

Month	Kakanjuni Kilifi	Matuga Kwale	Katumani Machakos	Kaimosi Kakamega
January	24	0	50	82
February	19	3	45	94
March	47	54	89	177
April	104	103	147	317
May	201	385	65	238
June	86	122	11	124
July	61	131	7	187
August	54	56	5	248
September	63	31	9	171
October	77	29	35	173
November	107	133	164	149
December	58	62	84	85
Mean Temp	24	23	23	20

Identification: All kids born on-farm were tagged. The first tag number represented the year of birth, the second village code number and the third and the fourth numbers the kid number.

Flock inventory: It was taken fortnightly. Initially the inventory covered only KDPGs but was later extended to cover other livestock on-farm. Exercise was meant to keep track of farms' stocking rates, sales, purchases and deaths.

Measuring inputs: Bought-in inputs such as drugs and feeds were recorded. Grazing studies were conducted to establish among other things diet botanical composition, grazing orbits and management routines. Financial and logistical constraints could not allow dry matter intake determinations.

Measuring outputs: Birth weights were taken within the week of birth and thereafter along with other KDPGs once a month. Milk extracted for household use was measured daily by volume. Each household was requested to record yields in a duplicate notebook. Once a week the responsible technical assistant collected the first copy for submission to Kabete via Katumani or Mtwapa research centres.

Feed resources: Monitored growth and utilization of introduced fodder. Additionally grazing behaviour studies were carried to determine botanical composition of the diets of KDPGs. Although the five minute method is tedious it was employed because it captured other important events during grazing.

Management: The KDPG is not like an ordinary local goat. It requires more inputs in dry matter intake and prophylactic measures and in turn it can outperform the local goat in meat and milk production. For this reason all farmers in the study were given two 1-day courses on KDPG's husbandry. The courses topics were on management, breeding, feed resources, preventive medicine and the techpacks developed in western Kenya. Courses were offered in collaboration with respective research and extension officers. The extension process continued throughout the study and it was strengthened by farmer to farmer extension. The farmer to farmer extension worked miracles with Kakanjuni farmers. These farmers were initially slow with the KDPG technology until a visit was arranged with Vuga farmers. Following the visit they formed a viable working group and their outlook on KDPGs changed for the better.

On-farm breeding: The study started with over 70% of the does pregnant. This was a good start because on-farm breeding was frustrated by unavailability of bucks (mortality and access), limited breeding partners, missed heats and poor body condition resulting from health and nutritional inadequacy or both. Efforts were made such that bucks placed in respective villages were not related to on-farm does to allow unrestricted mating.

Manure: Manure production was estimated on the basis of 3% dry matter intake, 37 kg doe and 50% dry matter digestibility.

Health: Prophylactic measures taken for KDPGs at the Coast and eastern Kenya were guided by past experience. They included dipping or spraying with acaricide, drenching and vaccination against enterotoxemia. The Health Project was expected to supplement the study with typing of ticks and determination of worm and thrips profiles. With the knowledge of these diseases parameters, a more rational prophylactic regime will be incorporated in the management calendar of KDPGs on-farm. Health matters were attended by three technical assistants, who also collected production systems data for the study. They performed well under difficult circumstances of transport problems and unwillingness by some of the farmers to meet treatment costs. As a consequence of transport problems dead KDPGs were not ferried to veterinary clinics for postmortems. All farmers were initially ready to meet treatment expenses. However, their enthusiasm waned with time dependent on the performance of the KDPGs particularly in milk production; a normal trend for any enterprise where returns are expected.

Pass-on: The first female offsprings were passed to the balance of farmers in waiting and acting as a pressure group. This protocol was adopted from Heifer Project International (HPI). HPI has been in the business of passing on since 1944 when the first shipment of 18 dairy cows sailed to Puerto Rico. In Matuga where HPI got involved before SR-CRSP with dairy cows success story has been registered with a difference. Out of 15 cows at a highly subsidized price to the farmers only five are still alive. The success story of the project was through farmer to farmer extension. Other farmers in the community took up dairy farming without external help. It has worked because concerned farmers have no choice but to give maximum care in protection of their hard earned investment of dairy cows and zero grazing units.

RESULTS

Flock structure: The flock structure of KDPGs on-farm is shown in Table 1.3. The flock structure is not in equilibrium because the flocks started with placement of does on-farm. However, it is encouraging to note the structure is heading towards equilibrium because the percentage of kids and yearlings is 53%. With the current progress, flock equilibrium will be attained in less than two years whereby young stock will continue to dominate and all the other age categories will be represented.

Table 1.3: Flock Structure and Inventory of KDPGs On-farm

Village/Age Sex	0-6m		7-12m		13-24m		25-36m		37-48m		>48		Total Breed
	F	M	F	M	F	M	F	M	F	M	F	M	
Kitanga	6	3	1	1	3	-	-	-	2	-	4	1	21
Kimutwa	2	3	2	-	1	6	-	-	-	-	6	1	21
Vuga	4	5	6	2	-	-	-	-	-	-	7	-	24
Matuga HPI	-	3	1	4	-	-	-	-	1	-	3	-	13
Kakanjuni	3	5	-	1	-	-	-	-	-	-	8	2	19
Total	15	19	10	8	4	6	-	-	3	1	28	4	98
Percentage Total Flocks %	15	20	10	8	4	6	0	-	3	1	29	4	100%

** Date of inventory April, 1996.*

Mortality rates: Mortality rates of kids and does are presented in Table 1.4. Mortality rate of 23% for kids born on-farm is high and not entirely unexpected. Rates of up to 50% have been reported on-station and on-farm pastoral systems 24%. Nonetheless this is no reason for us not to investigate the causes of deaths. The fact that the least mortality rate was 11% and the highest 44% is indicative of existing opportunities to reduce the overall mortality rate to acceptable figures of less than 10%. The overall mortality rate of does of 42% was high and unacceptable. This could have been induced by change of environment due to relocation, inadequate management and health care among other factors. However out of the deaths two each were as a result of deliberate slaughter and poisoning by jealous neighbours. From our experience in western Kenya the survivors of the initial high mortality went on to reduce it to less than 10%. This was probably due to adaptability and experience gained by farmers since acquisition of the does. For Matuga HPI group, management failed in three out of five households. The same farmers had failed with an earlier project of dairy cows. The group members were opposed to allocation of KDPGs to these farmers but due to random selection, they became owners for a short time before failure once again. Random selection with a small sample size could lead to false observations and exaggerated results of discrete variables. Bucks' mortality rate of 63% was extremely high. Bucks' high mortality rate was probably precipitated by varied management as a result of their movement from farm to farm for breeding and uncertainty of ownership, leading to poor husbandry care.

Table 1.4: Mortalities of Does and Kids On-farm

Village	Does			Kids		
	Out of 1)	Dead #	Rate %	Out of 2)	Dead #	Rate %
Kitanga	10	4	40	17	3	18
Kimutwa	11	5	45	25	8	32
Vuga	10	3	30	19	2	11
Matuga HPI	12	8	67	9	4	44
Kakanjuni	10	2	20	9	1	11
Overall	53	22	42	79	18	23

1)Out of does distributed on-farm.
2)Out of kids born on-farm

Drugs used: Table 1.5 is a presentation of drugs used to treat KDPGs. This information was collected to facilitate calculations of gross margins and to formulate budgets and treatment strategies. For general ailments Kimutwa Group stands out in administration of broad spectrum antibiotics. Probably the KDPGs had more ailments or was due to easy access for help. The farthest group member from the technical assistant responsible for treatments was less than five km by foot. For the other groups with the exception of Vuga one could make it by foot. On average on-station KDPGs received seven ml more of anthelmintic than their on-farm counterparts. Farmers generally do not attend to prevention of helminthiasis as recommended due to sub-clinical symptoms and lack of cash. Consequently, KDPGs over time fall sick resulting in antibiotic and multivitamins treatments. For this reason on-farm KDPGs received more antibiotics and multivitamins than their on-station counterparts.

Table 1.5: Mean Drugs Administered to KDPGs On-farm and On-station (ml)

Village	Antibiotics	Anthelmintics	Trypanocides	Vitamins
Kitanga	7.0 SD 3.3	15.0 SD 4.1		10.0 SD 5.0
Kimutwa	20.0 SD 6.9	18.0 SD 2.7		14.0 SD 5.3
Vuga	6.0 SD 5.5	9.0 SD 6.6	5.8 SD 4.9	5.0 SD 0.0
Matuga HPI	5.0 SD 0.0	7.0 SD 2.3		
On-farm overall	9.0 SD 7.3	12.0 SD 6.3	5.8 SD 4.9	12.0 SD 5.6
On-station	7.0 SD 3.0	19.0 SD 4.7		8.0 SD 7.4

Notes: Antibiotics used 10% oxytetracycline, trade name Adamycin Anthelmintics used 1.5% Levamisole HCL, 8% Bi-thional sulfoxide,trade name Wormicid. Trypanocide, trade name Novidium. Multi-vitamins A, D, E, B1, B2, B6, Nicotinamide, Pentothenol and B12, trade name Multi-vitamins injection.

Growth rates: As shown in Table 1.6 growth of KDPGs on-farm was quite impressive. The live weights of KDPGs at four and 12 months were equal to those of East African Goats (EAG) at one year and maturity respectively. All KDPG farmers and concerned extension officers were in agreement on growth rates of KDPGs as their most conspicuous positive attribute.

Milk off-takes: The importance of lactation length cannot be over-emphasized in determination of the total milk off-take. As shown in Table 1.7 average lactation length was 80 days. The on-farm daily milk off-take of 690 ml was equal to a bottle of Tree Top, which is the farm gate measure of milk sale. Deducing from the impressive growth of kids shown in Table 1.6 it is apparent milk off-take was below the threshold that could have affected growth. This was deliberate due to lack of a milk replacer such as sweet potato vines and leaves. Arrangements were made to produce cuttings of sweet potato for distribution to farmers. Going by the ratio of 1:0.1025 (kg milk consumed per kg liveweight gained) by the age of one month each kid had consumed 70 lt. This gives a total milk yield estimate of 90 lt for the first lactation month. From above it is evident KDPG does are capable of milk production on-farm and what is needed for the future to increase yields, is to reduce coefficient of variation (45%) and to prolong the lactation length through genetic and environmental manipulations.

Table 1.6: Live Weights of KDPGs On-farm (kg)

Village	Sex	Birth Wt.	4 months	12 months	over 36 months
Kitanga	F	3.0 SD 1.0 (10)	16.0 SD 4.0 (3)	28.5 SD 6.6 (4)	36.0 SD 6.9 (6)
	M	2.8 SD 0.4 (2)	22.0 SD 0.0 (1)	34.0 SD 0.0 (1)	
Kimutwa	F	2.1 SD 0.4 (12)	15.5 SD 0.96 (3)	19.2 SD 5.4 (5)	35.4 SD 4.8 (5)
	M	2.9 SD 0.6 (11)	16.8 SD 2.6 (8)	27.3 SD 4.8 (6)	49.0 SD 0.0 (1)
Vuga	F	2.6 SD 0.2 (9)	7.0 SD 0.0 (1)	-	36.1 SD 4.5 (7)
	M	2.8 SD 0.4 (14)	13.7 SD 7.6 (3)		
Matuga HPI	F	3.5 SD 0.0 (1)		-	37.8 SD 4.6 (4)
	M	3.0 SD 0.0 (1)	21.0 SD 0.0 (1)		
Kakanjuni	F	3.0 SD 0.0 (1)	16.5 SD 0.7 (2)	-	38.0 SD 6.2 (2)
	M	2.9 SD 0.8 (4)	18.0 SD 0.0 (2)		50.0 SD 0.0 (2)
Overall	F	2.6 SD 0.7 (33)	14.8 SD 3.6 (9)	23.7 SD 7.9 (8)	36.6 SD 5.2 (28)
	M	2.8 SD 0.5 (32)	16.9 SD 4.3 (14)	27.8 SD 5.3 (6)	49.7 SD 0.6 (3)
On station	F	2.6 SD 0.6 (30)	12.7 SD 2.1 (20)	29.3 SD 6.0 (10)	43.5 SD 6.8 (20)
	M	2.8 SD 0.5 (27)	14.8 SD 2.7 (15)	31.8 SD 5.6 (6)	55.0 SD 7.0 (3)

( ) In brackets number of goats, SD= Standard Deviation

Grazing behaviour: Table 1.8 is a presentation of observed activities of KDPGs on-farm every five minutes on specific days from 7 am to 7 pm for a possible 144 observations. By looking at the seasonal trends obvious differences are noticeable for Vuga and not for the other sites. During the dry season KDPGs at Vuga spent more time walking and ruminating. This is an indication of the season having scarcity of forage and of lower quality than was available in the wet season. Differences for Kitanga and Kimutwa are not noticeable probably due to seasonal overlap or experimental error in demarcation of the seasons. Nonetheless the trend of more forage species being selected in the wet than in the dry season is true for all the sites. It is also noteworthy the maximum number (41) of forage species selected. For each site the three most foraged species by season were as follows: Vuga dry-*Pennisetum tricholadrian* (Ukoka), Tsalakushe and *Digitaria milanjiana*; wet-Ndago, *Pennisetum purpureum and Pennisetum tricholadrian*; Kitanga dry-*Themeda triandra, Andropogon spp. and Lippia ukambensis*; wet-*Andropogon spp., Themeda triandra and Lippia ukambensis*; Kimutwa dry-*Acacia tortilis, Cenchrus ciliaris* (African foxtail) and *Pennisetum mezianum*; wet-*Bothriochloa insculpta* (pinhole grass), *Cynodon dactylon and Acacia tortilis*. These results were used to

guide selective bush clearance, reseeding and enhancement of different species on-farm and on-station.

Table 1.7: Lactation Length and Yield and Session Milk Off-take of KDPGs On-farm

Village	N	Lactation length (days)	AM (ml)	PM (ml)	Lactation Yields (kg) (1)
Kitanga	6	48 SD 72	500 SD 130	470 SD 185	46 SD 17
Kimutwa	6	90 SD 37	370 SD 170	330 SD 155	63 SD 29
Vuga	10	85 SD 68	560 SD 210	380 SD 125	80 SD 28
Matuga HPI	1	49 SD 0.0	320 SD 100	-------	16 SD 0.0
Kakanjuni	3	111 SD 13	740 SD 170	-------	82 SD 19
Overall	26	79 SD 59	480 SD 210	380 SD 177	68 SD 30
On station	25	110 SD 87	600 SD 230	-------	66 SD 25

SD= Standard Deviation

Manure production: Although local goats produce manure, KDPGs produce more and of slightly higher quality because they are heavier and are provided with higher quality feed. For the year KDPG does were on-farm each produced 202 kg of dry manure as opposed to 137 kg from a local doe. Machakos farmers valued their manure more than their counterparts from the Coast, due to longer history of manure use for crop production in Machakos.

Feed resources: To ensure farmers had high quality fodder to supplement their KDPGs, they were supplied with planting material as shown in Table 1.9. Farmers were keen to plant more materials than was on offer because, they understood their usefulness from the courses and for Machakos farmers, they integrated them in soil conservation. What is shown in the table was distributed to farmers with KDPGs only.

Body condition: Following erratic and poor rainfall during the short rains season of 1996 there was drought in most parts of the Republic. We took the opportunity to assess body condition of all livestock species owned by our KDPG farmers. The exercise was conducted at the peak of a long dry season. It was deliberate in order to assess nutritional status of concerned livestock as reflected by their body conditions. Body condition scoring was used to assess muscle and fat cover of the spinous processes of the lumbar vertebrae, around the tail head and the rib cage. Scoring on a scale of one to five whereby one and five were poorest and best respectively was as follows:

1- Spinous processes were sharp and ribs were easily distinguished. Animal was emaciated and lethargic.
2- Spinous processes and ribs were distinguished
3- Spinous processes were easily felt and ribs were not readily distinguished.

4- Spinous processes and ribs were felt with firm pressure.
5- Bone structure of the animal was no longer noticeable due to fat cover.

Table 1.8: Observed activities of KDPGs on-farm every five minutes.

EVENT	VUGA		KITANGA		KIMUTWA	
	Dry(2)	Wet(6)	Dry(2)	Wet(6)	Dry(2)	Wet(6)
Grazing	49±19	78±17	66±13	68±4	71±14	62±7
Resting standing	10±4	8±6	9±3	22±7	17±4	18±5
Resting lying	3±0	8±9	3±4	6±1	25±13	28±10
Ruminating standing	14±1	5±3	14±10	14±8	4±1	16±2
Ruminating lying	18±1	10±6	20±7	24±4	11±6	11±4
Walking	12±4	6±2	16±5	10±3	9±4	6±1
Drinking	1±0	2±1	2±1	1±0	2±0	1±0
Selected forage species	11	41	24	40	26	35
Duration out (hrs)	8.9	9.8	10.8	12.0	11.6	11.8

( ) In brackets number of goats per season

Table 1.9: Production of Feed Resources On-farm

Village	*Leucaena Leucocephala* (Seedlings)	Napier grass (Cuttings/ Splits)	*Gliricidia spp* (Seedlings)	*Ipomoea batatus* (cuttings)
Kimutwa	1000	1000	-	3000
Kitanga	1000	1000	-	-
Vuga	1000	1000	350	-
Matuga HPI	1000	1000	350	-
Kakanjuni	500	1500	-	-

The results of condition score are shown in Table 1.10. From the results the local East African Goats were best conditioned followed by KDPG and cattle of varied genotype of up to a half exotic breed. At the time of the exercise annual grasses had died and only a limited perennial grasses were available. Planted fodder was also limited and fed to selected animals only. Browse was most available and the animals that made best out of it maintained their body conditions. As a result local goats that were left to free range had the best condition. They were left to free range because there were no crops in the farms. For KDPGs some farmers did not let them free range entirely because they were supplemented with cut and carry, while those set free, reluctance to wonder and browse widely was noticed. Cattle not being good browsers as goats were just holding on. A condition score of below three is undesirable, three to three point five is average and above this score is good to very good.

Table 1.10: Body Condition of Livestock at the Peak of a Dry Season

Parameter	KDPG	Local Goat	Cattle
No. of farms	34	26	13
Standard deviation	0.6	0.5	0.5
Mean farm score	3.35	3.58	3.08

Biological efficiency: Coefficients derived from on-farm monitoring research of KDPGs were used in Table 1.11 to calculate average productivity of a doe per year in different flocks. As the doe productivity index was calculated from doe viability % x kidding % x kid viability % x kid weight at 1 year kg + doe viability % x kidding % x lactation milk off-take kg x 0.1025, is one of the best indicators of biological efficiency. Consequently, the order of villages' flock production efficiency was Kakanjuni, Vuga, Kitanga, Kimutwa and Matuga HPI as of May, 1995.

Table 1.11: Productivity Coefficients and Indices of KDPGs On-farm

Productivity parameters	Kitanga	Kimutwa	Vuga	Matuga HPI	Kakanjuni
Doe Survival (%)	60	55	70	33	90
Kidding (%)	85	85	85	85	90
Kid Survival (%)	82	68	89	56	90
Kid Wt. at 1 yr (kg)	32	23	26	26	25
Lactation Milk off-take (kg)	46	63	80	16	84
Average doe wt. (kg)	36	35	36	37	38
Productivity/doe /year (kg)	16	9	19	5	25
% of the doe live-weight	44	26	52	14	65

The doe productivity index is computed as the product of doe viability % x kidding % x kid viability % x kid weight at 1 year (kg) + doe viability x kidding % x lactation milk off-take kg x 0.1025.

MODEL FARMS:

The two on-farm model farms were in Machakos District. Both were female headed and below average in resources compared with the other 28 farmers in the sample. Their selection was based on minimal resources and willingness to cooperate. Selection criteria had greatest potential to demonstrate impact of introduced interventions. For confidentiality heads of households will be referred by the name of their farm's locality.

Model Farm of Mrs. Kitanga

The head of the household is Mrs Kitanga, who is very active and strong for her age of over 70 years. Her household was made up of her youngest son, his wife and their children, two boys and two girls. Her land according to Kamba inheritance belongs to her youngest son. It is sandwiched by elder sons' pieces. Traditionally the youngest son stays with widowed mother and share resources.

The farm is 80 acres. Big because it is not ancestral land but purchased from a white settler, who also was the employer of most of the owners of the sub-divided farm. So for the three sons of Mrs. Kitanga each has approximately 26 acres or thereabout. Although formal survey has not been carried, demarcation has been done particularly where to build and grow crops. For the time being natural pastures are equally open to the three brothers.

The food preference for the family was maize, beans and cowpeas and to a lesser extent sweet potatoes and cassava. In reflection of their preference these were the crops they planted each season. Animal products are also loved but due to their scarcity and high value, they were rarely consumed. For example, children were given preference for milk and when it remained it was consumed indirectly by the family in tea. Despite her age, the old lady was the final decision maker on household and farm matters. As a hedge against risk she encouraged her son to seek casual employment. During the study the son took various casual jobs including driving, building and general labour work. Another strategy as was true for most neighbours was engagement in crop and animal agriculture; and in each a complete spectrum of crops and livestock to the extend possible were raised.

Labour allocation: As shown in Table 1.12 the toughest chores were undertaken by the daughter in law. She was the one to do a 4-km round trip to fetch household and livestock water and to take cattle to the communal dip. Although she was not a decision maker, she played a vital role in ensuring success of the farm enterprises. Despite the age of the household head she was committed to livestock activities of herding and cutting and carrying fodder. For crop agriculture her role was minimal, while her daughter in law was the prime mover. Hired labour was used in none routine jobs of goat house construction and bush clearing. For the latter jobs PSP paid 90% of the total bill.

Table 1.12: Labour Allocation for Farming Activities

Activity	Person Responsible				
	HHH	Son	DIL	HL	Children <10yr
Herding	4				1
Cut and carry fodder	5				
Milking			5		
General Treatment					
Dipping/Spraying			5		
Drenching		1			
Fetching and watering			5		
Farm works/goat house		1		4	
Planting preparations			5		
Planting	1		4		
Weeding	1		4		
Harvesting			5		
Threshing	1		4		
Fencing					
Bush clearing				5	

Notes: HHH = Head of Household, Son = adult son of the household head, DIL = daughter in-law of the household head, HL = hired labour and children = children under ten, grand children of the household head.
Level of activity involvement 1 least and 5 most.

Animal agriculture interventions: The main intervention was the KDPG and was the first to be introduced. It was followed with interventions to manage the health of the KDPGs and other livestock. Towards good health, good husbandry was promoted through education of the farmer at each visit and more specifically on good housing and prevention of helminthiasis and tick borne diseases. To envelope the interventions was good animal nutrition through development of quality and adequate feed resources.

As was true with other initial farmers in the study, each got two KDPG does. The model farm eventually got a buck for being strategically placed and a vote of confidence from other farmers. The buck was to be shared by the KDPG farmers for service of their does whenever needed. The farmer had her own cattle, local

goats and chicken. These were incorporated in the study because they shared the farm resources.

The KDPGs had a considerable input into the livestock sector of the farm. They contributed additional income to the tune of KShs. 8,850.00 or 30% of the total livestock sector. The household also received extra milk from the KDPG does and passed-on two doelings valued at KShs. 6000.00.

Drenching with anthelmintic as a measure to control helminthiasis was introduced and its importance stressed in relation to thriftiness of the KDPGs. PSP bought sufficient amount for the first two drenchings thereafter the farmer was supposed to buy. As a whole the strategy of intervention had the Project initiate and the farmer was to continue as recommended. Although the farmer had goats, she had not drenched nor treated them before for any ailment. So for the very first time she had to drench and treat local goats. None attention for local goats was possible because they can withstand a heavy challenge of worms, while for severe challenge or ailment the farmer would either sell or slaughter before impending death. This was forced disposal for salvage value.

After the initial drenching by the Project, the farmer purchased anthelmintics only once. For eight months the goats went without drenching with conventional anthelmintic. During that period the farmer claims to have treated them with a local anthelmintic called "Kivunu". Although the efficacy of Kivunu is not known, it was assumed had the farmer continued drenching deaths reported probably would not have occurred. Due to sub-clinical symptoms of helminthiasis farmers normally do not drench in good time.

Spraying and dipping in control of tick borne diseases for goats was introduced as outlined above. Dipping of cattle had been going on casually, depending on availability of money and visible ticks on them. Cattle were trekked weekly to a community dip about two kilometres from the homestead. This was the task of the daughter in-law who did it between 7 and 9 am. The farmer took dipping or control of ticks seriously. Each dipping did cost KShs 5.00 and KShs. 3.00 per head of cattle and goat respectively. On insistent by the Project to spray or dip goats regularly, she started spraying with the acaricide provided. Since her preference was to spray, she routinely sprayed weekly and only dipped whenever she was out of money to buy acaricide. The community dip had a shortcoming of poor management. The strength of acaricide more than often was under strength. This lead to continued carrying of ticks by livestock a day after dipping. When the strength was very ineffective the farmer was forced to spray her cattle as well. The farmer did not spray throughout because it was more expensive than dipping. Dip management is a problem throughout Kenya.

Feed resources intervention included selective bush clearing and production of fodder namely, Chloris guyana (Rhodes grass), Pennisetum purpureum (bana grass), Panicum maximum (Panicum) and

Leucaena leucocephala (leucaena). Selective bush clearing was meant to increase grass growth while retaining preferred browse species especially for goats. Selective clearing covered one hectare. This was followed by reseeding of denuded patches with Rhodes grass. Also a stand of 20 sq. metres of Rhodes was established to argument fodder biomass and seed production. Two hundred and fifty leucaena seedlings, 600 and 300 root splits of Bana and Panicum respectively were planted. The combined feed resources intervention produced an estimated 3.7 tons extra dry matter for supplementation.

The goat house we found with the farmer was small to accommodate all the goats and to facilitate smooth collection of manure. Another was designed and erected to house more goats and lessen the task of daily manure collection.

Part of the income generated from animal agriculture was used to build a three roomed house for Mrs Kitanga's son. This was a very significant contribution to the household. According to the farmer the building project was possible because livestock enterprise was the only one capable of raising such money. For major projects they rely on animal agriculture and crop agriculture on staple crop sufficiency when the weather permits. In monetary terms inputs and outputs of the farm are summarized in Table 1.13.

The trend of livestock assets of Mrs. Kitanga are shown in Table 1.14. For this farm during the one year monitoring research there was a decrease of livestock assets by KShs 10100.00 or 10% of the initial value. Deaths and sales accounted for 13% and 39% of the initial value.

Crop agriculture interventions: Crop interventions included fertilizer application, higher yielding seed varieties, realignment of soil conservation terraces and timely operations.

In this report animal agriculture intervention extend from March 1996 to February 1997 and crop agriculture covered two seasons, short rains of 1995 and long rains of 1996. According to the farmer the short rains yields were better than average. She credited fertilizer and other crop interventions for the good yields. For the long rains season it was a crop failure for most farmers. Incase of our farmer she only failed to harvest one variety of beans. She once again credited her relative success to introduced interventions. Due to wide spread crop failure in this and subsequent season , Kenya Government had to import maize and beans for relief food. Machakos District where the model farms were situated was one of the beneficiary districts for relief food. Crop failure resulted from inadequate moisture because of erratic and below average rainfall. Crop agriculture performance is summarized in Tables 1.15 and 1.16.

Table 1.13: Animal Agriculture Intervention: Outputs and Inputs

Outputs	**Kshs.**
KDPGs, F1s & local goats sales	8850.00
Cattle	29000.00
Milk 3.5 months @ 4kg/day	8400.00
Manure, 7 tonnes @ 460.00	3220.00
Sub-total	**49470.00**
Inputs	**Kshs.**
Anthelmintics	130.00
Dipping & spraying	2292.00
Other drugs	200.00
Rhodes grass	600.00
Splits and seedlings	300.00
Selective bush clearing	1000.00
Sub-total	**4522.00**

Note no investment cost on KDPG does because the farmer passed-on two doelings valued at KShs. 6000.00 in kind payment for does allocated initially.

Table: 1.14 : Livestock Trends Kitanga Model Farm

Livestock Type	Initial Stock	Births	Deaths	Gift In	Gift Out	Bought In *	Sold	Predation	End of Study
Cattle									
Cows	1								1
Calves (F)									
Calves (M)	1	1							2
weaners (F)									
Weaners (M)									
Bulls/Oxen	3					1	2		2
KDPG Goats									
Does	4		1						
Kids (F)		3							4
Kids (M)	1	1	1						
weaners (F)	1				2				
Weaners (M)									
Bucks	2		1				1		1
Local Goats/F1									
Does	2								
Kids (F)									1
Kids (M)		2							
weaners (F)									1
weaners (M)	5						5		1
Bucks									
LOCAL GOATS									
Does	4		2				1		1
Kids (F)									
Kids (M)									1
Weaners (F)									
Weaners (M)							5		1
Bucks			2						
Poultry									
Hens	4		1				1		2
Chicks		14	6					1	
Growers									
Cocks	3								2
Value Kshs	96580	7140	12230		6000	5000	37850	30	86480

** After one year*

The difference between inputs and outputs of 3.6 and 1.9 times for the short and long rains respectively was noteworthy. But this does not mean the farmer generated more income by the number of times, because all harvests were not even adequate for home consumption. This further illustrates the fact that, crop agriculture in semi-arid areas hardly meets food sufficiency. It is speculated because of no real cash generation by the sector in the following season, when the Project did not intervene, she was reluctant to buy fertilizer. According to her any purchase meant sale of one goat, something she was not prepared to do. If she did, animal agriculture would have promoted crop agriculture and in turn food sufficiency. On this aspect and others there is still need for farmer education. In the mind of Mrs. Kitanga, it was probably a question of promoting one sector at the expense of the other. On the other hand for the son and the daughter in law, they were all for purchase of fertilizer. They would benefit most with less purchase of grains to feed their four children.

Table 1.15: Crop Agriculture Intervention, Short Rains: Outputs and Inputs

Crop planted and inputs	Seed		Area Ha	Yield Kg	Value Kshs
	Kg	Cost			
Maize - KCB	2	130	0.14	(a)	(a)
Maize 511	2	130	0.17	(a)	(a)
Maize local	8	160	1.10	190	3800
Beans-Rosecoco	2	200	0.02	12	960
Beans - Katumani Bean1	2	200	0.02	6	480
Mwezi Moja Bean	2	200	0.02	13	1040
Cowpeas	1	20	0.04	16	240
Inputs		2500			
Beans Pinto	4	3860	0.50	93	13960

(a) Harvesting of maize varieties was not partitioned, all together to give a total yield of 190 kg.

Table 1.16: Crop Agriculture Intervention, Long Rains: Outputs and Inputs

Crop Planted	Seed		Area Ha	Yield Kg	Value Kshs
	Kg	Cost			
Maize - Kangundo	16	240	1.01	80	1600
Maize - Katumani	2	130	0.08	10	200
Beans - Rosecoco	9	900	0.12	16	1280
Beans - Katumani Bean1	3	300	0.03		nil
Beans - Mwezi Moja	11	1100	0.33	46	3680
Beans - Katumbuka	16	1600	0.22	43	3440
Total value KShs.		4270			10200

Model Farm of Mrs Kimutwa

The second farm was also headed by a widow. She was in her forties and employed as a waiter at the local shopping centre, which is less than two kilometres from her farm. Her household was made up of her mother in-law, three sons and four daughters. Four of her seven children were still in school. Food preference and a hedge against risk was the same as for the earlier family. In the first model farm the son sought employment while here it was the head of the household. This is true in most households in Machakos District. In the District at least one member of the household has some form of outside farm employment. It has been necessitated by unfavourable weather resulting in crop failures; hence the need for cash for food security.

The farm measuring 6 ha lies at 1600 m above sea level has loamy sand to sandy loam soil. It is ancestral land hence its smaller size compared with the other model farm. In the long run the farm will be sub-divided into three parcels of two hectares for each son.

Labour allocation: As in the previous farm Table 1.17 is a presentation of labour allocation for the farm of Mrs Kimutwa. Unlike in the previous farm this one has varied labour allocation. This was a reflection of the family age structure and size. In this family all members were above ten years, an age considered capable of performing nearly all farm activities. Consequently, no single member was over loaded with work.

The trend of livestock assets of Mrs. Kimutwa are shown in Table 1.18. For this farm during the one year monitoring research there was a decrease of livestock assets by KShs 6350.00 or 7% of the initial value. Deaths and sales accounted for 3% and 6% of the initial value.

Animal agriculture interventions: Interventions were similar to those of Kitanga Model Farm except for one instead of two does initial placement. The doe for this model farm came from a fellow farmer who was initially allocated with two does from the Project. Mrs Kimutwa was a beneficiary of a pass-on doe. The pass-on scheme which was executed by the farmers demanded release of the first two female offsprings for pass-on. This was in lieu of out right purchase of the same.

The KDPGs contributed 33% of the total animal agriculture income. This was a major contribution and was made possible through production of KDPG crosses with local goats. The resulting crossbreeds were fast growing and in great demand. The most outstanding intervention on this farm was fodder production and particularly selective bush clearing. Because of the latter the farm was conspicuous during the peak of the dry season in having adequate standing hay and complete ground cover in soil conservation. Consequently, she was able to rent her pastures for two months at a price of KShs. 5300.00. It also fetched KShs. 500.00 through sales of resulting firewood. Results are summarized in Table 1.19.

Table 1.17: Labour Allocation for Farming Activities

Activity	Person Responsible				
	HHH	MIL	SONS	DGS	HL
Herding			4		1
Cut and carry fodder			5		
Milking		2	3		
General Treatment					5
Dipping/Spraying	4		1		
Drenching					5
Fetching and watering			5		
Farm works/goat house			4		1
Planting preparations			3		2
Planting		4	1		
Weeding	1	2	1	1	1
Harvesting		1	3	1	
Threshing		4		1	
Fencing			1		4
Bush clearing					5

Notes: HHH = Head of Household, SONS = one or all three sons who were over 10 years old, DGS = one or all three daughters who were over ten years old, MIL = mother in-law of the household head and HL = hired labour.
Level of activity involvement 1 least and 5 most.

Table 1.18: Livestock Trends Kimutwa Model Farm

Livestock Type	Initial Stock	Births	Deaths	Gift In	Gift Out	Bought In	Sold	Predation	End of Study
Cattle									
Cows	2								2
Calves (F)									1
Calves (M)		1							
weaners (F)	1								
Weaners (M)									2
Bulls/Oxen	2								
KDPG Goats									
Does	1								1
Kids (F)									
Kids (M)		1							1
weaners (F)									
Weaners (M)	1						1		
Bucks	1								1
Local Goats/F1									
Does									1
Kids (F)		4							2
Kids (M)		1							1
weaners (F)									
weaners (M)									
Bucks									
LOCAL GOATS							1		
Does	2								1
Kids (F)									
Kids (M)									
Weaners (F)	1								
Weaners (M)			1						
Bucks							1		
Poultry									
Hens	2					2	2		2
Chicks		7							
Growers									7
Cocks	3					2			5
Value Kshs	92040	8070	2400			840	5300		85690

Table 1.19: Animal Agriculture Interventions: Outputs and Inputs

Outputs	**Kshs.**
KDPGs and local goats sales	5300.00
Cattle	-
Milk	2520.00
Manure, 5.3 tonnes @ 460	2438.00
Firewood from cleared bush	500.00
Grazing rental	5300.00
Sub-total	**16058.00**
Inputs	**Kshs.**
Anthelmintics	150.00
Dipping and spraying	730.00
Other drugs	346.00
Rhodes grass	600.00
Splits and seedlings	300.00
Hired herding labour	2000.00
Selective bush clearing	1500.00
Sub-total	**5626.00**

Crop agriculture interventions: The interventions were the same as for Kitanga Model Farm. The outputs and inputs are summarized in Tables 1.20 and 1.21. Once again it is evident for Machakos the short rains are more favourable for crop production. Having had a good short rains season the farmer went all out for the long rains, unfortunately she lost money and labour because the crops failed.

Table 1.20: Crop Agriculture Intervention, Short Rains: Outputs and Inputs

Crop Planted	Seed		Area Ha	Yield Kg	Value Kshs
	Kg	Cost			
Maize - local	F	200	0.11	315	6300
Maize - Katumani	4	260	1.21	360	7200
Beans - Rosecoco	F	100	0.07	110	11000
Beans - Katumani Bean1	1	80	0.001	30	3000
Cowpeas	1	20	0.02	5	100
Total value KShs		660			27600

Table 1.21: Crop Agriculture Interventions, Long Rains: Outputs and Inputs

Crop Planted	Seed		Area Ha	Yield Kg	Value Kshs
	Kg	Cost			
Maize - local	13		0.38		CG
Maize - Katumani	10		0.22		CG
Beans - Rosecoco	3		0.09		CF
Beans - Katumani Bean1	7		0.19	3	240
Beans - Mwezi Moja	6		0.19	3	240
Cowpeas	1		0.05		CF
Pigeon pea			0.27		CG
Sorghum	1		0.18		CF
Total value KShs		2210			480

CG= Consumed green, CF= Crop Failure

On-station Model Farm

Introduction: The inter-relationships between components of livestock production (feed, health, breed etc) and the competition for resources with crops necessitates that the demands of any new technology be thoroughly understood, and conflicts that it might cause in the existing system sorted out before dissemination. This is best done at two levels on-station and on-farm. The on-station simulates farmers capital resources and on-farm ensures timely implementation of interventions. Model farms also serve to demonstrate their potential for income generation and to give indications for possible credit to facilitate adoption of technologies.

Previous surveys in the lower Machakos District revealed that the average land holding was 7.5 ha on which mixed farming was practiced (crop growing and livestock rearing). Of the land holding, 2.5 ha was under crop production mainly maize and beans, also minor pulses were grown in mixtures, the rest (5 ha) was used for livestock production. The main constraints to livestock production being feed shortage, water, diseases and limited genetic potential of indigenous animals.

Labour allocation: The daily labour requirements for management of the livestock on-station model farm is shown in Table 1.22. Over a half of the total time was taken up by herding. Substantial, but what was the opportunity cost. Herding time can be reduced through paddocking of the 4-ha under natural pastures. Effective, and lasting fencing can be achieved by use of live fence. Fetching of water took a little time because on-station the distance to the source was 100 metres. On-farm the distance is much longer with those within a kilometre regarded as short. Time spent on health care (i.e dipping, drenching and treatment) was about one hour in a week. The important point to note is that the daily labour requirement was approximately 1-manday which can easily be met from the family labour pool as illustrated by the on-farm models.

Table 1.22: Labour Allocation

Activity	Hr/day
Milking (2 cows, 2 goats)	:51
Cleaning shed and transporting manure	1:22
Feeding (Harvesting, transporting, chopping and feeding)	1:50
Herding (cattle plus smallstock)	5:09
Watering (fetching and hauling water ≈ 100m away)	:30
Total	**9:42**

Animal intervention: Research results at the National Dry Land Farming Research Centre, Katumani have shown that the feed resource base on small holder farms can be greatly improved through;

- Introduction of planted forages on 1 ha of the 5 ha remaining.
- Selective bush clearing of the rest (4 ha) to increase grass growth but also retain preferred browse for goats, followed by reseeding the denuded patches.
- Proper collection and storage of crop residues from the cropped land.

Subsequently, the farmer would then gain from the above efforts on further realignment of farm enterprises:

- Introduction of cross-bred cows with high milk production potential.
- Adjustment of livestock numbers to the available feed resources.
- Maintenance of systematic disease prevention and control schedule.
- Provision of an appropriate shed and other facilities for better feeding, watering and manure collection.

Based on the feed resources developed the recommended livestock for the model farm were:-

- 2 cross-bred dairy cows
- 1 replacement heifer
- 2 oxen (indigenous zebu)
- 5 sheep and their followers
- 5 goats and their followers

This was the mixture of livestock which met the farmer's needs for draft power, milk production (for sale and home consumption) and smallstock for meat and periodic sale to meet cash needs such as school fees.

It was within this improved system that the KDPG technology was introduced and its impact monitored for a period of one year. Two KDPG does and 1 buck were introduced as an added improved technology into the model farm. Data were collected on milk production from cattle and goats, calf, lamb, and kid growth, livestock offtakes, disease occurrence and mortality, input data records of labour needs for various activities and cost prices for all items.

Results: Feed resources improvement based on forage interventions produced feed resources as shown in Table 1.23. The 19.2 tonnes of dry matter generated was sufficient throughout the year for a stocking rate of 7 TLUs of 250 kg each. As a result when the stocking rate was exceeded the excess were sold following strategic selection.

Investment and Inputs Costs: As stated earlier there were initial investment and input costs to the model farm in order to improve outputs. These are presented in Table 1.24. It will be noted that the cost of cross-bred dairy cows and the KDPGs are not included since they are supposed to be acquired through improved breeding (A.I. or bull for cows and through pass-on scheme for KDPGs). The major item of expenditure was the livestock shed whose cost escalated due to use of iron sheets for roofing. The farmer can improvise and use grass for thatching, however the choice of iron

sheets was so as to facilitate water harvesting for both domestic and livestock use.

Table 1.23: Estimated Total Forage Resources

Type of resource	Yield t. DM ha	Total t. DM
4 ha improved rangeland	2.3	9.2
0.5 ha planted fodder	6.0	3.0
0.5 leucaena	4.0	2.0
2.5 ha crop residues	2.0	5.0
Total		19.2

t= tonnes, 1000 kg dry matter

Table 1.24: Cost of Inputs

	Activity	Labour mandays	Cost (KSh)
1.	Bushclearing (4.0 ha)	48	2,697
2.	Establishment of Forage 0.5 ha fodder grass 0.5 ha shrub legume (planting plus 2 weedings)	75.6	4,248
3.	Collection of crop residues from 2.5 ha	25	1,405
4.	Drugs (Acaricides, Antibiotics, Anthelmintics etc) for all animals		6,760
5.	Mineral supplements		1,500
6.	Livestock shed		10,000
7.	Miscellaneous (milking utensils, wheelbarrow, drum for water, etc)		4,000
	TOTAL		**30,610**

Milk Production

The average lactation yield (315 days) from two cows was 1,638 kg per cow without the calf at foot. This production was realized under semi-zero grazing where natural pasture grazing was supplemented with napier grass during the wet season and maize stover mixed with conserved leucaena leaf meal during the dry season. Out of the total yield 450 litres was fed to each calf over a 4-month period, leaving 1,188 kg of milk per cow for sale or home consumption. At the current local price of milk of KSh. 25/= per litre, the value of milk offtake from two cows amounted to KShs. 59,400/= over a period of less than a year. The contribution of the two goats to milk production was not much since one of the goats dried much earlier, which was not normal. The other goat produced on average 570 ml per day for 50 days giving a total production of 28.5 litres. This production level excludes milk that was suckled by the kids. The second goat produced 4.6 litres only, in 27 days. Thus the total amount of goat milk produced in one and a half months was 33.1 litres valued at Kshs. 827.50. A small amount but in rural Kenya it is substantial for it is more than a half of recommended labour wage.

The lactation curves for the dairy cows had a marked rise in milk production at week 32 in response to feeding of treated stover supplemented with leucaena leaf meal. The curve for goats followed the normal trend of starting at the peak followed by a steady drop until drying.

Live animal off-takes: Culling was done as shown in Table 1.25 to maintain carrying stocking rate equal to available feed resources. The animal offtake consisted of 5 sheep with a total of 144 kg and a value of KShs. 5,040/= (at 35/= per kg) and 4 goats with a total of 131 kg valued at KShs. 6,550/= (at 50/= per kg).

Table 1.25: Live Animal Off-takes

	Sex	Date Culled	Age at culling	Culling Weight
Sheep	M	31-10-96	2 years	41.0
	F	27-11-96	4.5 years	25.0
	F	27-11-96	2 years	30.0
	M	27-11-96	7 months	22.0
	M	07-02-96	5½ months	26.0
Goats	M	31-10-96	3 years	51.0
	F	27-11-96	4 years	30.0
	F	27-11-96	3 years	30.0
	M	07-02-97	7 months	25.0

Manure: An estimated 20 tons of manure (composite) was collected in the year from the herd. The monetary value of the manure was KShs. 9,200.00 at the current selling price of KShs. 460 per ton.

Thus the total output of KShs. 80,967/= (milk - KShs. 60,227; sales of live animals - KShs. 11,540 and manure KShs. 9,200) from the system greatly outstrips the initial costs of KShs. 30,610 and

makes the investment quite attractive. The introduction of the KDPG into the system did not alter the demands at all neither did it cause any conflicts in the system, instead it made positive contribution to the income even after just one year. It is anticipated that over time this contribution would greatly increase as the indigenous breeds are improved through cross-breeding and faster growth rates are experienced.

Discussions

The model farm concept of quantifying inputs and outputs worked in demonstrating how technical interventions individually and collectively generate farm income. Contribution of some of the interventions were quite obvious while others had a long term effect. KDPGs contributed directly up to 33% of the total animal agriculture income within an year. This is a continuous contribution provided the goats are there. Manure from KDPGs and other livestock had immediate and residue impact as nutrients continued to be released in soils. In fact the money value pegged on manure was underestimated because of its nutrients cycling benefits to the environment as a whole and resultant higher crop yields. Also the monetary value of cow and goat milk was even more significant because, what value do you peg human nourishment and good health.

The intervention of drenching was not taken by the farmers as recommended for the reason of sub-clinical symptoms of helminthiasis. For tick borne diseases farmers were more concerned as they monitored ticks on their livestock. Dipping and spraying frequencies were dependent on tick load. For helminthiasis it is suggested a simple diagnostic procedure of determining egg count in faeces, would go along way towards making farmers more responsive. On proper housing the farmers responded positively. Except for nails and where applicable iron sheets other building materials were readily available within the farms. Housing was a move of discontinuing livestock from sharing accommodation with people. Where goats are not housed they are kept in kitchens or other rooms for the night. When housed with the people cleanliness of where the goats sleep is taken care of, but when housed separately sweeping and collection of manure should be done daily. For this reason the design must be friendly for these daily tasks.

Growing of fodder and selective bush clearance was a tremendous success in feed resources production, utilization and income generation. But above all in reclaiming denuded areas through reseeding, selective bush control and realignment of soil control terrace benches at a minimal cost of less than KShs. 2500.00 per farm.

The on-station out-performed on-farm model farms in milk production. This was due to genetics and better environment for the former. With increased use of AI and accompanying zero grazing units, there is no reason why on-farm farms should not surpass the on-station performance.

Judging by the performance of the model farms, it is quite evident animal agriculture has an edge over crop agriculture in the livelihood of semi-arid farmers. Animal agriculture provides food security through easily convertible assets. It is further stated in this environment successful crop agriculture is dependent on animal agriculture. The latter generates cash to purchase necessary inputs for the farm eg. fertilizer and pesticides.

KDPG Management Calendars:

A production management calendar is an important tool for producers. It is particularly useful to new producers in giving guidelines on what operations to undertake or to expect. Nonetheless, it should not be taken as the final authority because adjustments are necessary to accommodate variations in weather, livestock services and localized situations within a production system.

The management calendars presented in Tables 1.26, 1.27 and 1.28 were developed in consideration of the production system, agro-system, weather pattern, vegetation and factors observed during the monitoring study affecting dry matter intake, survival rate and thriftiness of KDPGs. The western Kenya calendar, where annual rainfall was twice as much as the study sites was included for comparative purpose. All calendars avoid as much as possible kidding in the peak of wet seasons (see Table 1.2). According to the study dry matter intake of does were lowest in wet seasons due to high water content of the forage. Also they were associated with high kid mortality linked with scouring and pneumonia. Consequently, kidding was programmed to take place when forage dry matter was at its highest to promote milk production hence nursing ability of the doe. A well nourished kid has the best chance to thrive. On the other hand least dry matter intake needs of the does were programmed to coincide with availability of crop residues.

Table 1.26: Yearly Operation Calendar for Dual-Purpose Goats: Humid Coast

OPERATIONAL	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Kidding												
Marking/Castration /Disbudding												
Creep Feeding												
Weaning												
Lactation												
Dry Period												
Flushing												
Breeding												
Gestation												
Drenching												
Hoof Trimming												
Dipping/Spraying												

Note, two breeding seasons

Table 1.27: Yearly Operation Calendar for Dual-Purpose Goats: Eastern Kenya

OPERATIONAL	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Kidding												
Marking/Castration /Disbudding												
Creep Feeding												
Weaning												
Lactation												
Dry Period												
Flushing												
Breeding												
Gestation												
Drenching												
Hoof Trimming												
Dipping/Spraying												

Note, one breeding season

Table 1.28: Yearly Operation Calendar for Dual-Purpose Goats: Western Kenya

OPERATIONAL	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Kidding												
Marking/Castration /Disbudding												
Creep Feeding												
Weaning												
Lactation												
Dry Period												
Recuperation												
Flushing												
Breeding												
Gestation												
Drenching												
Hoof Trimming												
Dipping/Spraying												

Note, one breeding season

PSP in Relation to KDPG Outputs and Impacts

Although the following outputs and impacts were not specified at the beginning of the study, they are hereby listed in conformity with current project trends.

1. Farmers and extension officers were trained on all aspects of KDPG production (see Section 4).
2. Instruments were developed by PSP to execute on-farm monitoring research. It entailed instruments to capture identity of individual goats, body weight, milk yield, sales, grazing behaviour, management strategies and treatments.
3. Used instruments to monitor KDPGs and where applicable other livestock in 100 farms.
4. Technologies developed in western Kenya were introduced or adapted for the new sites. They included incubation of kids in boxes to cut mortality resulting from mismothering, stress and cross infection, inadequate nursing and creep feeding among others.
5. Establishment of two on-station and four on-farm model farms. Results of a half of the model farms are in this report.
6. Establishment of a Toggenburg grade and KDPG flock at the National Dryland Farming Centre, Katumani and a demonstration flock at Mtwapa Regional Research Centre.
7. Initiation and support of dairy goat production from a foundation of 10 does (Toggenburg X East African Goat) provided by PSP to a women group in Ngong, Kajiado.
8. Distribution of over 13,700 fodder planting materials to all the study sites. From these fodder establishments farmers will source planting materials for themselves, neighbours and for sale. This is a continuous process provided establishments are taken care and popularity and appropriateness of the same continues.
9. Provided leadership in formulation and development of the National Small Ruminant Research Programme. The Programme is expected to have far reaching benefits to livestock industry in Kenya. Already the Programme is active in extensive testing of shelf ready technologies.
10. The same leadership and adoption of some of the PSP technologies have been extended to member countries of the Association of Strengthening Agricultural Research in East and Central Africa (ASARECA).
11. Popularized and promoted KDPGs and at large dairy goats and small ruminants in Kenya. Consequently, KDPGs are in high demand for their impressive growth and milk production. Their production gross margins were positive and on-farm income generation was impressive as illustrated by the model farms. Credit not only due to PSP but to all SR-CRSP projects.

2. KDPGs AND TOGGENBURG GRADES ON-STATION

INTRODUCTION

PSP has been maintaining a small flock of goats at Katumani. In 1993 it moved out of Maseno with 38 F1s and received from the Breeding Project 10 KDPGs. The goats have multiplied steadily over the years to a restricted flock of about 100 head while excess have been transferred to farms for on-farm research. The flock inventory from 1994 to 1996 is shown in Table 2.1. The flock has been very useful in feeding trials, grazing behaviour and management studies and for demonstration in the station model farm and to visiting farmers and extension officers. It has also generated data to compare the performance of Toggenburg grades versus KDPGs on-station and on-farm.

RESULTS

The birth weights of the Toggenburg grades (TG) were higher than for KDPGs as expected, because some of the TGs were three quarters Toggenburg. However for both breeds birth weights were much higher than for East African Goats (EAG) that average 2.0 kg. Growth from birth to weaning was from 103 g to 118 g per day. At one year all classes weighed over 25 kg, which is the weight of a fully grown EAG. It is for this reason among others the KDPGs are admired by farmers. At 24 months TGs and KDPGs were only 3 kg below the desired simulated weight of 38 kg. The mean body weights of the on-station goats are presented in Table 2.2.

Milk off-take and lactation lengths are shown in Table 2.3. Milk off-take was exclusive of what was taken by kids. It was procedural to milk once a day and to leave stripping to kids. This procedure ensured kids got more milk than off-take for man. By converting growth to milk equivalent plus milk off-take for a lactation of 100 days, estimated total milk per day ranged from 1.4 to 1.6 kg. Production of this amount of milk entirely from forage is noteworthy. If concentrates were added to boost dry matter intake higher yields could have resulted. While at Maseno some of the TGs with concentrates supplementation and after weaning averaged a total off-take of 3 kg per day. Lactation lengths for both KDPGs and TGs were short with an average ranging from 40 to 175 days. The longest lactation period should be viewed cautiously because it was registered by a single doe.

The mean kidding intervals of the on-station does are shown in Table 2.4. The intervals were more a reflection of management strategy and not biological efficiency of concerned breeds. Breeding was controlled to match available feed resources. Were feed resources adequate throughout the year management strategy would have been modified for kidding every eight months. In semi-arid Katumani feed quality and quantity are of concern for six or more months in a year.

On the trend of weaning percentage over the years as shown in Table 2.5, there was an inverse correlation of weaning percent with the number of kids born. There is still room to improve on the weaning percent. A percentage of 90 or more is acceptable. Introduction of individual nursing boxes equivalent to incubators helped in reducing pre-weaning mortality hence increased weaning rates. More incubator boxes have to be constructed to cater for more kids. Mortalities from weaning to yearling were reasonable except for 1994, when many KDPGs were lost.

To give a picture of ailments encountered at Katumani Table 2.6 is a presentation of treatments administered. Most of these administrations were to treat symptoms. Most encountered treatment was for dullness and weakness. Symptoms were a result of one or many factors which necessitated treatment with either a broad spectrum antibiotic, multi-vitamins or both.

CONCLUSION

It was a good opportunity to compare Toggenburg grades with KDPGs in the same environment. From the results it is obvious the two breeds are comparable. Consequently, it is suggested where appropriate bucks and mechanism for upgrading are available there is no need for breed synthesis. Breed synthesis takes years and is expensive, expenses incurred would be best utilized in up grading schemes. Through upgrading farmers realize their goals soonest and at minimal cost. Success stories are many such as the small scale dairy farming in Kenya which is based on grades of exotic dairy breeds. Another success story is the Integrated Smallstock Livestock Project based in Nyeri, which is involved in upgrading EAG to a maximum of 75% Germany Alpine.

Table 2.1: **Flock Inventory**

Breed	Year	Age Group (Months)												Total
		0 -6M		7-12M		13-24M		25-36M		37-48M		>48M		
		F	M	F	M	F	M	F	M	F	M	F	M	
Togg. Grades	1994	7	6	8	7	6	7	4	1	3	-	8	3	59
	1995	3	2	6	2	10	8	2	10	2	1	8	1	55
	1996	6	7	3	7	8	4	10	8	2	7	9	1	72
KDPG	1994	2	1	2	3	1	3	1	-	3	-	4	-	20
	1995	1	1	3	6	4	3	3	1	-	-	5	-	27
	1996	6	10	3	3	5	5	5	2	2	4	4	-	49

Table 2.2: **Mean Liveweights**

Breed	Sex	Birth Weight	Wt4	Wt12	Wt24	Wt36
Toggen. Grades	F	2.7 SD 0.4 (52)	12.6 SD 2.2 (37)	25.3 SD 4.7 (30)	34.7 SD 4.8 (15)	36.2 SD 5.5 (5)
	M	2.9 SD 0.4 (44)	14.2 SD 3.6 (26)	27.5 SD 6.0 (22)	47.3 SD 7.0 (13)	57.1 SD 5.8 (8)
KDPG	F	2.4 SD 0.4 (23)	12.4 SD 3.4 (14)	27.2 SD 4.4 (12)	34.8 SD 6.7 (9)	45.0 SD . (1)
	M	2.7 SD 0.4 (31)	13.2 SD 2.8 (24)	26.4 SD 2.9 (13)	44.0 SD 8.7 (3)	-

( ) In brackets number of goats

Table 2.3: **Milk Production and Lactation Length (days)**

Breed	Lactation 1		Lactation 2		Lactation 3		Lactation 4	
	Days	Milk	Days	Milk	Days	Milk	Days	Milk
Togg. Grades	89 SD 54 (32)	492 SD 227 (32)	117 SD 81 (15)	435 SD 165 (15)	40 SD 27 (6)	487 SD 115 (6)	-	-
KDPG	104 SD 86 (18)	414 SD 198 (18)	85 SD 52 (8)	406 SD 144 (8)	175 SD . (1)	565 SD . (1)	7 SD . (1)	493 SD . (1)

SD= Standard deviation, ( ) In brackets number of does
Milk excludes what was taken by goat kids.

Table 2.4: Mean Kidding Interval (days)

Breed	Kidding Interval 1	Kidding Interval 2
Togg. Grades	283 SD 67 (18)	270 SD 50 (9)
KDPG	271 SD 51 (9)	257 SD 72 (4)

( ) In brackets number of does

Table 2.5: Weaning and Yearling Rates

Breed	Year	# of kids born	# of kids weaned	Weaning %	Weaning to Yearling %
KDPG	1993	3	3	100	100
	1994	11	8	72	78
	1995	13	11	85	91
	1996	27	22	81	*
	1997	10	*	*	*
Togg. Crosses	1993	11	10	90	100
	1994	25	24	96	88
	1995	16	13	81	85
	1996	25	21	84	*
	1997	28	*	*	*

** No statistics by the time of this report*

Table 2.6. **Number of Treatments at Katumani**

Year	Limping	Running nose/ Coughing	Dull and weak	Bloat	Diarrhoea	Abscess	Mastitis	Eye problems	Orf	General Treatment
1994	-	-	4	-	-	1	1	1	9	2
1995	7	14	20	3	5	-	1	4	-	1
1996	-	-	3	-	2	1	-	-	-	-
1997	-	-	-	-	1	-	-	-	-	-

3. CONTAGIOUS CAPRINE PLEUROPNEUMONIA SUPPLEMENTARY STUDY: MONITORING RESEARCH AND PASTORAL MANAGEMENT STRATEGIES

INTRODUCTION

The Animal Health Project (AHP) of SR-CRSP was successful in producing a thermal stable contagious caprine pleuropneumonia (CCPP) vaccine. Before the vaccine is released for commercial production it has to undergo extensive field testing. In order to adequately describe the production systems where the vaccine was tested, PSP undertook the task of describing respective production systems and to monitor changes and potential management alternatives. Participatory rural appraisal (PRA) was used to supplement monitoring research in describing production systems and to identify production constraints, interventions and opportunities. Therefore the objects of PSP in the study were:

(a) To characterize production systems where CCPP vaccine was tested;
(b) To identify constraints and to elucidate implications of technical and policy alternatives;
(c) To monitor production trends following intervention with the vaccine.

MATERIALS AND METHODS

(1) The first step in the study was to gather secondary information. For each CCPP study area it was undertaken to cover information on human and livestock population and natural resources.
(2) Participatory rural appraisals were conducted. PRA was chosen because it is rapid and accurate in gathering data in group discussions and observations. Under PRA unlike Top-Down approach, concerned communities were directly involved in assessing and ranking their livestock production constraints and arriving at a consensus of most appropriate actions to be taken by themselves or the researcher.

The following technical information was gathered on management and husbandry of small ruminants with emphasis on goats.

1. Reasons for raising goats
2. Seasons were demarcated
3. Watering frequency, source and water quality
4. Feed quality and quantity
5. Body condition: poor, fair and good
6. Grazing orbit. Define short, medium and long
7. Salting frequency: Source type and quality
8. Breeding and kidding patterns
9. Special care of kids if yes, what and when?
10. Castration if yes, when?
11. Feet trimming if yes, when?
12. Sales when and why? Culling and selection criteria

13. Vaccinations, which and when?
14. Drenching, which and when?
15. Predators, which and when?
16. Ranked goat diseases in order of importance
17. Ranked constraints limiting goat productivity

3. All goats administered with CCPP vaccine or placebo were weighed and mouthed for determination of their dental eruption and indirectly their chronological ages. Weighing and assessment of body conditions was strategic to capture seasonal, managerial and intervention effects.

BACKGROUND INFORMATION OF STUDY SITES

Ngong Division, Kajiado District: In Kajiado District, there were two sites and both were in Ngong Division. Ngong Division is administered from Ngong town which is 30 km from Nairobi. Ngong Division is the third largest division in Kajiado District with an area of 3692 sq. km or 17% of the District. Ngong has the highest population of 125,699 and with an estimated growth rate of 5.54% per annum. The Division also has the highest population density of 34 persons per sq. km.

The Division has bimodal rainfall. The short rains fall between October and December while the long rains fall between March and May. Annual rainfall is strongly influenced by altitude. Highest rainfall of 1,000 mm falls around Ngong Hills and decreases with elevation to around 600 mm. The economy of the Division is derived from animal and crop agriculture and tourism. Livestock reared are cattle, goats and sheep, with a stocking rate of 2.6 ha per livestock unit. The major food crops grown are maize and beans. The division has potential for horticulture and drought resistant crops such as millet, sorghum, green grams, cowpeas and pigeon peas.

Mogotio Division, Koibatek District: In the newly created district of Koibatek there were two study sites both in Mogotio Division. Mogotio which is also the name of divisional headquarters is 200 km north-west of Nairobi. Mogotio is the largest division of the three in Koibatek District. It covers an area of 1254 sq. km or 52% of the District. It has a population of 40719 and population density of 32 persons per sq. km. The Division receives bimodal rainfall with a 5-year mean of 730 mm. The main livelihood of the people is animal agriculture. Crop agriculture is restricted to small plots of maize, sorghum, millet and vegetables along river banks, while cash crops are cotton and sisal.

RESULTS

Role of goats: When pastoralists from four different communities and in two districts that are 200 km apart were asked to rank livestock in order of importance, goats were ranked second to cattle. Considerable debate ensued before ranking, for some thought it was too close to call. Goats coming second to cattle in the concerned areas is not surprising because the areas are

semi-arid to arid and characterized by seasonal under growth and permanent bushes. Such weather and vegetation is more suitable for goat production. Goats were kept for various reasons among them source of food (meat and milk), for sale to raise cash, dowry payment, skins, for ceremonial slaughter, barter for cattle and medicinal effect of their meat, derived soup and milk. According to the pastoralists medicinal effect of goat products is derived from its diet, which is composed of many herbs.

Production trends: Goat population trends from 1930 to date was solicited from the pastoralists. From 1930 because in all the PRAs there were no older people who could recall earlier than this year. In general goat population was on the increase despite drops during droughts. This further confirms the pastoral production cycle of booming and bursting. Recurrent droughts are usually followed by good years for livestock production during which their numbers increase tremendously. The strategy of pastoralists is to hedge against droughts by numbers logic. The more livestock you have before a drought, the higher probability of survivors there after.

Production calendars: Table 3.1 is a presentation of the seasonal goat production calendar for Koibatek. It is evident the calendar is based on the weather pattern. When ambient temperatures are highest the goats are watered every two days to conserve energy and water metabolism. Feed availability as expected was there after the rains. However feed quality was highest three months after the onset of rains. This is a good indicator of the pastoralists excellent perception and husbandry knowledge. It is known lush grass is low in nutrients and high in water content. For them to capitalize on quality forage availability, they breed their goats to be in the third trimester and to eventually kid in this season. The nursing period also captures the feed season. The best prices for goats are offered in December. Demand for goats is highest in this festival month. Kenyan families that can afford are expected to slaughter a goat to either celebrate Christmas or New Year. Prices are lowest soon after in January when parents are forced to sell to pay fees for the new school year. Again prices are low in April in readiness for second term fees. For the third term there is no indication probably because the least amount is paid and parents have had time to adjust. Labour for herding is most available during school holidays. For interventions requiring labour or meetings and workshops this is the best time to conduct them. Predation coincides with dry months when goats have to venture further from settlements in search of scarce forage. For Kajiado the story is the same as for Koibatek calendar except for the following. The two rainy seasons are quite distinct hence two breeding seasons. Have good prices for seven months unlike their counterparts for only one month in a year. Kajiado pastoralists are lucky in being close to Nairobi the biggest market for goats. Although Kajiado pastoralists have to sell to meet cash needs such as fees, their market prices are more determined by whether there is foot and mouth quarantine and prevailing production conditions in areas with less

pronounced bimodal rainfall for example Koibatek. Notice prices are good in Kajiado May to August when supply is lowest from Koibatek and other districts, when production conditions are ideal, hence no need to dispose as a hedge against drought. The production calendar for Kajiado is summarized in Table 3.2.

Seasonal Calendar of Diseases of Economic Importance: Occurrence of goat diseases as told by the pastoralists is shown in Table 3.3. The Table should be interpreted with caution because diseases were assigned by their symptoms and local names of which PRA leaders were not fully conversant. For some columns, there are no time periods because diseases varied in importance from one site to another.

Ranking of Goat Diseases in Order of Economic Important: Table 3.4 is a presentation of goat diseases ranked in order of economic importance. It is obvious the ranking of the diseases between sites did not overlap, even for Suswa and Lodariak that are within the same division. On scoring the diseases on a scale of five, the first five diseases in order were:

(1) scours
(2) CCPP
(3) tickborne diseases,
(4) enterotoxemia
(5) abortions.

Although remedies of these diseases are known there is need, first for laboratory diagnosis and secondly of establishing potential economic gain of appropriate interventions.

Ranking of constraints that limit goat productivity: As shown in Table 3.5, the three PRAs came up with 13 production constraints. Kapyemit-Mogotio had 13 constraints following by Lodariak-Ngong with nine and the least Suswa-Ngong with six. As for the diseases on scoring the production constraints on a scale of one to five, with first ranked constraint scoring five and fifth ranked one, the resultant ranking for the three communities was as follows:

(1) Water shortage
(2) Drought
(3) Feed shortage
(4) Predation
(5) Limited land

Causes of constraints, producers' current coping strategies and possible opportunities: Due to lack of time at the three PRAs, the participants were only asked causes, coping strategies and possible opportunities for five production constraints and two diseases. Their responses are summarized in Table 3.6. Please note for opportunities researchers and extension officers present helped in deliberations and identification.

Table 3.1: Seasonal Goat Production Calendar: Kapyemit, Mugorin-Mugotio, Koibatek District

ACTIVITY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Rainfall												
Temp. (high)												
Temp. (low)												
Water availability												
Watering frequency	2	2	2	1	1	1	1	1	1	1	1	1
Feed availability												
Feed quality												
Good body condition												
Grazing orbit Short												
Long												
Salt availability												
Breeding Mating												
Pregnancy												
Kidding												
Highest prices												
Lowest prices												
Labour availability												
Predation												

Notes: 1. Daily watering
2. Every other day
Shaded denotes activity or situation prevalence

Table 3.2: Seasonal Goat Production Calendar: Suswa-Ngong, Kajiado District

ACTIVITY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Rainfall												
Temp. (high)												
Temp. (low)												
Water availability												
Watering frequency	2	2	2	1	1	1	1	2	2	2	1	1
Feed availability												
Feed quality												
Good body condition												
Grazing orbit Short												
Long												
Salt availability												
Breeding Mating												
Pregnancy												
Kidding												
Highest prices												
Lowest prices												
Labour availability												
Predation												

Note: 1. Daily watering
2. Every other day
Shaded denotes activity or situation prevalence

Table 3.3: Seasonal Calendar of Goat Diseases of Economic Importance by Study Site

Disease	Occurrence		
	Kapyemit-Mogotio	Suswa-Ngong	Lodariak-Ngong
Scours	April-May, July-August	April, October	September - October
Enterotoxemia	May - June	May-June	April, December
CCPP	Any time particularly May-July	Anytime	Anytime
Ecto-parasites (fleas)	-	August-September	August-September
Abortions	-	-	April-August, January-February
Tickborne diseases			
Orf	April-May, July	-	September-December
Fungal/Mange	January-May	-	July
Footrot	April-May, July	April-May	April-May
Helminthiasis	May	April-May, December	April, December
Foot and mouth	-	Anytime	-
Sheep/Goat pox	Anytime	-	-
Eye-infection	June	May	June
Abscesses	Anytime	Anytime	Anytime

Table 3.4: Ranking in Order of Economic Importance Diseases of Small Ruminants in Mogotio and Ngong Divisions

Disease	Occurrence		
	Kapyemit-Mogotio	Suswa-Ngong	Lodariak-Ngong
Colibaccillosis (scours)	4	1	2
Enterotoxemia	7	2	4
CCPP	1	3	5
Ecto-parasites (fleas)	-	5	8
Abortions	-	-	1
Tickborne diseases	5	4	3
Arthritis	-	-	6
Orf	8	-	7
Fungal/Mange	3	-	10
Footrot	6	-	-
Helminthiasis	11	-	9
Foot and mouth	-	6	-
Sheep/Goat pox	2	-	-
Eye-infection	9	-	-
Abscesses	10	-	-

Table 3.5: Ranked Constraints that Limit Goat Productivity in Mogotio and Ngong Divisions

Constraint/Problem	Occurrence		
	Kapyemit-Mogotio	Suswa-Ngong	Lodariak-Ngong
Feed shortage	4	2	4
Water shortage	1	1	2
Drought	2	-	1
Predation	8	5	3
Limited land	5	3	-
Inbreeding	12	-	-
Shortage of ext/vet. services	6	6	6
High cost of drugs	9	-	8
Poor market	10	4	5
Lack of better breeds	11	-	9
Labour scarcity	13	-	7
Food shortage-human	3	-	-

Table 3.6: Some Problems, Causes, Producers' Current Coping Strategies and Possible Opportunities

PROBLEM	CAUSES	COPPING STRATEGIES	OPPORTUNITIES
1. WATER SHORTAGE	1. Low rainfall 2. Lack of dams 3. Lack of springs 4. Poor maintenance of water system 5. Settlement 6. Springs not protected	1. Excavation 2. Migration 3. Reduction of watering frequency 4. Bring in water for kids/lambs 5. Construction of dams 6. Piped water 7. Harvesting of rain water	1. Bore holes 2. Cost sharing piped water and dam construction 3. Roof catchment 4. Reforestation 5. Training locals on water management
2. DROUGHT	1. Lack of rainfall	1. Migration	1. Plant drought
3. FEED SHORTAGE	1. Low rainfall 2. Stony terrain	1. Shifting 2. Supplementation through lopping/pods 3. Conservation standing hay 4. Forced culling	1. Reseeding 2. Conservation 3. Purchase 4. Assessment of stocking rates versus animal and land productivity 5. Enforcement of traditional grazing pattern (wet and dry grazing areas)

4.PREDATION	1. Scarcity of forage 2. Scarcity of water 3. Less care during wet seasons	1. Killing predators 2. Poisoning 3. Confinement at night bomas	1. Seek help from Kenya Wildlife Services 2. Exercise stringent herding care throughout 3. Partition wildlife sanctuaries to earn from tourism and gaming
5. LIMITED LAND	1. Population growth 2. Land adju-dication and sub-division	1. Salvage destocking 2. Migration	1. Increase productivity per animal 2. Destocking of both livestock and wildlife 3. Increase land pro ductivity - water distribution, growing of staple crops and fodder 4. Nutrients recycling - shifting of bomas
6. SCOURS	1. Poor Sanitation 2. Contact 3. Seasonal breeding	1. Treatment-broadspectrum antibiotics 2. Herbs 3. Isolation	1. Awareness - education 2. Ensure intake of colostrum within two hours after birth 3. Oral antibiotics

7. CCPP	1. Wind dispersal 2. Introduced 3. Not all farmers treat/vaccinate 4. Expensive drugs 5. Ignorance	1. Treatment-broad spectrum antibiotics 2. Isolation 3. Vaccination 4. Transfer to other areas	1. Routine vaccination 2. Treatment 3. Enforce isolation, reject hosting goats in transit and purchase in when it is absolutely necessary 4. Observe imposed quarantines 5. Notifiable disease 6. Above 3-5, awareness-education

This is a continuation of Table 3.6.

Body weights: As presented in Table 3.7 body weights of the different classes of goats were as expected for East African Goat breed. The goats were supposed to be weighed strategically to capture seasonal or intervention effects. This however, was not possible due to expiry of the Project. As shown in Table 3.8 the flock structures were not in equilibrium for maximum productivity. The kidding rate as reflected by 178 does (6 and 8 incisors) versus 113 kids was poor. Also the number of kids graduating to 2 incisors of 113 against 64 was poor. Either there was high mortality or were sold. The sale speculation is most probable because there were fewer males. Culling pressure was low because 6% of the total flock with broken mouths is not desirable.

Table 3.7: Mean Body Weight by Area, Sex and Age

Area	Sex	Age by Dentation (number of incisors)					
		MT	2	4	6	8	Broken
Suswa	F	19.7 SD 3.0 (22)	24.9 SD 3.3 (13)	27.6 SD 2.2 (8)	28.7 SD 2.3 (17)	32.1 SD 3.0 (45)	29.6 SD 2.8 (17)
	M	22.0 SD 2.5 (38)	29.7 SD 3.9 (5)	41.0 SD (1)	41.3 SD 2.1 (3)	33.5 SD 8.7 (3)	46.0 SD . (1)
	C	-	28.3 SD 1.3 (3)	34.1 SD 3.6 (5)	39.0 SD 12.7 (2)	48.9 SD 3.4 (8)	-
Kapyemit	F	16.2 SD 3.3 (19)	23.0 SD 3.7 (15)	23.7 SD 2.7 (17)	27.8 SD 3.7 (33)	27.9 SD 4.3 (51)	27.6 SD 4.2 (6)
	M	19.5 SD 4.1 (21)	25.9 SD 3.7 (15)	30.9 SD 4.0 (6)	33.4 SD 6.2 (7)	39.2 SD 4.6 (5)	-
	C	-	23.0 SD . (1)	31.0 SD 1.4 (2)	39.3 SD 2.2 (4)	44.3 SD 7.9 (4)	41.0 SD . (1)
Lodariak	F	22.9 SD 3.2 (12)	28.3 SD 3.6 (16)	28.5 SD 3.5 (14)	31.8 SD 4.3 (19)	34.3 SD 5.6 (13)	-
	M	27.0 SD . (1)	-	39.0 SD . (1)	52.0 SD 4.2 (2)		-
	C	-	-	-	-	-	-
Overall	F	19.2 SD 4.0 (53)	25.5 SD 4.1 (44)	26.2 SD 3.6 (39)	29.1 SD 3.9 (69)	31.3 SD 4.3 (109)	28.9 SD 3.5 (28)
	M	21.2 SD 3.4 (60)	26.9 SD 4.0 (20)	33.2 SD 5.4 (8)	38.5 SD 8.7 (12)	37.1 SD 6.5 (8)	46.0 SD . (1)
	C	-	27.4 SD 3.1 (4)	33.2 SD 3.3 (7)	39.2 SD 5.9 (6)	47.3 SD 5.5 (12)	41.0 SD . (1)

MT = milk teeth, F = female, M = male and C = castrate,
( ) In brackets number of goats

Table: 3.8 Flock structures by Dentation

Area	Age by Dentation (Number of incisors)																		Total
	MT			2			4			6			8			Broken			
	F	M	C	F	M	C	F	M	C	F	M	C	F	M	C	F	M	C	
Kapyemit	19	21	-	15	15	1	17	6	2	33	7	4	51	5	4	6	-	-	207
Suswa	22	38	-	13	5	3	8	1	5	17	3	2	45	3	8	17	1	-	191
Lodariak	12	1	-	16	-	-	14	1	-	19	2	-	13	-	-	-	-	-	78
Overall	53	60	-	44	20	4	39	8	7	69	12	6	109	8	12	23	1	1	476
%Total flock	11	13	-	9	4	0.8	8	1.6	1.5	14	3	1.5	23	1.6	3	5	0.2	0.2	100%
% by age	24			14			11			18			27			6			100%

MT= Milk Teeth, F= Female, M= Male and C= Castrate

4. REGIONALIZATION OF KDPG TECHNOLOGIES

INTRODUCTION

Since 1992 PSP has been active in regionalizing KDPG technologies in East Africa. The approach has been through networking as resource persons and active participation following invitation by the Government of Tanzania. The initiative in southern Tanzania was in Newala District and Masaka District in Uganda, but due to the decision of no further funding of the KDPG Programme, PSP activity will remain at the level of a (PRA) conducted in May 1997.

The Newala Goat Project in Tanzania was attractive because of availability of suitable technologies developed in Kenya. For this reason and invitation from the Government, PSP took the opportunity to regionalize SR-CRSP activities in southern Tanzania. The specific objectives of the Project were:

- To characterize Newala goat breed under optimal management
- To produce dual-purpose goats from crosses of Toggenburg and Newala (upgrading up to 3/4 Toggenburg)
- To sell Newala goats and their crosses to farmers and NGOs
- To develop appropriate management techniques for goat production
- To evaluate promising forage species and to multiply the same for distribution to farmers and NGOs.
- To conduct feeding trials on promising forage species
- To evaluate the socio-economic impact of the introduced technologies

Achievements of the Project so far: Grants totalling $ 17,500.00 from SR-CRSP through PSP enabled the Project to take-off with purchase of goats and reactivation of production and research activities at Mnima Ranch. Consequently, the flock at the Ranch was as in Table 4.1 by September 1996.

Table 4.1: Goat Flock at Mnima Ranch

Age	<4 months	4-18 months	>18 months	Total
Males	26	6	25	57
Females	36	11	78	125
Total	62	17	103	182

To meet the objectives of the Project the breeding plan was based on pure breeding, crossbreeding and selection. A half of the foundation Newala does were bred pure with heavy culling (selection pressure). The other half were used in rotational

crossbreeding to produce dual-purpose goats. Also a flock of pure Toggenburgs was established for supply of bucks.

2. Characterization of the Newala goat breed under optimal management was started.

3. The Project was collaborating with FINIDA, Rural Integrated Project Support and the extension service in an ambitious programme of goat distribution in nine districts of southern Tanzania. Farmers in the programme were selected following a goat husbandry course and construction of a goat house. Once these two conditions were met concerned farmers were allocated with two does. Payments for the two does were to be in kind through giving back of the first two female offsprings.

The programme was looking upon the Project to supply proven Newala and Toggenburg bucks and first filial does (Toggenburg X Newala). Other services expected were: development of appropriate management calendars and husbandry strategies, feeding and health packages and training of front line staff.

4. A feeding trial was conducted to find out the effect of feeding dry cassava ad-libitum. Results indicated significant differences in thiocyanate concentration between the group with dry cassava peels (mean 80.6 uml/litre) and that fed with green herbs and shrubs (mean 2.2 uml/litre). A single death was recorded of the goat that had the highest concentration of thiocyanate of 630 uml/litre in its urine.

Above findings have given a clear message to the extension staff on feeding of dried cassava peels. Drying of cassava peels does not completely eradicate toxicity and ad-libitum feeding of the same should be discouraged. In southern Tanzania the main staple crop is cassava hence the abundance of cassava peels.

It was recommended for the future to introduce less toxic varieties of cassava and to conduct experiments on treatments aimed on reduction or eradication of toxicity.

5. Surveys conducted highlighted:
   - (i) Protein-energy malnutrition with the people
   - (ii) High child mortality
   - (iii) Water shortage
   - (iv) Low income (cashew the only cash crop, has processing and marketing problems). As a result the only livestock intervention the people could afford was either poultry or goats.
   - (v) Helminthiasis and trypanosomiasis were major health problems of goats
   - (vi) Lack of dual-purpose goats
   - (vii) Inadequate quality and quantity of livestock feed throughout the year

RESULTS OF PARTICIPATORY RURAL APPRAISAL: MASAKA DISTRICT, UGANDA

Background information: Masaka District is one of over thirty nine districts in Uganda. Currently it is in the process of being sub-divided into Sembabule and Masaka (w.e.f. July 1, 1997). The headquarters of the district are located in Masaka town which is 137 km. south west of Kampala and within the Lake Crescent belt of Lake Victoria. It is said to be the fourth or fifth largest town in Uganda. During Uganda's civil wars the town suffered a lot of destruction and in peace and reconstruction it is not spared the agony of aids/HIV. Despite these problems Masaka residents, farmers and other stake holders have embarked in an ambitious reconstruction programme of animal and crop agriculture, infrastructure and commerce and trade.

The District occupies an area of 6986 sq. km. This is approximately 3% of the total area of Uganda. It is divided in to six counties, thirty parishes and eighty circles (agricultural extension administrative units). Each circle is supposed to have a front line extension staff for advising farmers and as a link between farmers and subject specialists. Area under cultivation is approximately 122,120 hectares and annual rainfall is between 600 and 1000 mm per year. Human population is 834,631 with a density of 119 persons per sq. km. Total number of farm-families in the District is 139,105 (1993).

Crops: The main crops are banana, coffee, beans, maize and cassava. Banana as the staple crop is grown widely. The District is a good reflection of Uganda as described by Winston Churchill (1908). "Uganda is from end to end one beautiful garden, where the staple food of the people grows almost without labour. Does it not sound like paradise on earth. It is the pearl of Africa."

Livestock population in Masaka District is shown in Table 4.2. By population size cattle are the most important followed by goats. Roughly each farm-family has 0.7, 0.2, 1.5 and 0.3 of a goat, sheep, cattle and a pig respectively. It is noteworthy Masaka has more pigs than sheep. In many other districts in the region it is the reverse.

There are three production systems namely, extensive, semi-intensive and intensive. Extensive production of ranching is practiced in half of the District. In this production system livestock are free ranged. In semi-intensive livestock are tethered. While in intensive they are confined necessitating "cut and carry" management.

Table 4.2: Livestock Population In Masaka District (1993).

County	Goats	Sheep	Cattle	Pigs
Bukoto East	7749	1759	15225	6349
Bukoto West	24157	2063	32321	5973
Bukomansimbi	10800	1674	9719	13507
Kalungu	13606	17508	17206	7751
Mawogola	29247	13506	67666	3748
Lwemiyaga	14671	1247	63263	475
Total	100230	27757	205400	37623

Source: SMS/Animal Production Report 1996.

Breeds of goats: There are three indigenous breeds of goats in Masaka. They are East African Goat (EAG), Mubende and Kigezi. Saanens, Toggenburgs and Boers have been introduced in the District, the first two for milk and the last for meat production. Within the District various crosses of these exotic breeds were encountered.

Feed resources: Consists mainly of Pennisetum spp, Bracharia brizantha, Hyparrhenia spp, Panicum maximum and a variety of leguminous species. For a few farmers to supplement natural grazing, they are growing Chloris gayana, Stylosanthes spp, Desmodium spp, Siratro spp and multi-purpose trees (MPTs). Integration of animal and crop agriculture was evident in utilization of dual purpose and crop residues. Main concern was feed shortages and nutrient deficiencies in dry seasons.

Results of PRA: Conducted in Busense Village. Was attended by Uganda National Farmers Association special interest group (SIG). This goat SIG with fifteen members was formed in 1996. Busense Village is 15 km South of Masaka.

1. Farm size 2 to 5 acres
2. Goat flock size 1 to 5 head per farm
3. Goats are raised for meat, manure and security against emergencies eg. school and medical fees. Recently, they have learned of milk goats with great interest. This interest prompted formation of SIG for acquisition of milk goats. As a result they bought a Saanen Toggenburg cross from Joy Children Centre. The members are sharing the buck and are in desperate need for more quality bucks and does. In the past few years goats have acquired a new role of the animal to be sold to raise money to pay graduated income tax. The tax is approximately equal to the value of a 2-year old goat which is UShs. 20,000.00.

4. Preference ranking of livestock species by women: 1. cattle 2. chicken 3. goat 4. sheep. Men differed on whether it was the chicken before goats or vice vasa. Women ranked chicken second because of eggs output. They hinted goats would take the second position on production of milk. Currently they own meat goats.

5. Weather pattern: Two dry seasons January/February and July to September.
Coldest month July
Hottest months December and January
Rainfall throughout the year but heaviest in April and May.

6. Division of labour (goats): Women- mostly involved in feeding and cleaning where goats sleep. For many farmers their goats sleep in kitchens. Men- treatment of goats and other animals plus selling, making tethering ropes and cutting and carrying fodder.

7. Health management: Veterinary drugs are considered to be too expensive for many farmers. Therefore they were bought or help was sought when diseases were obvious and advanced. When money was not available it was time to use local herbs. Diseases treated include helminthiasis (black and red seeds from an unidentified tree) pneumonia (boiled extracts of *Lantana camara* and guava leaves) and mange (washing affected areas with omo) among others. Misuse of drugs, under dosage and adulteration is creeping in. It is catalyzed by liberalization of the pharmaceutical trade coupled with poor enforcement of standards.

8. Feed resources inventory: *Pennisetum purpureum, Pennisetum clandestinum, Bracharia spp., Hyparrhenia spp., Panicum maximum*, indigenous legumes and shrubs, *Lantana camara, Artocarpus heterophyllus*, recently introduced MPTs, maize stover, cassava, bean haulms, banana leaves and peels and sweet potato leaves and vines. The inventory list is much longer than above. This list came from the PRA exercise and observations during our stay in Busense. Concentrates are available but farmers are weary of quality, due to the problem cited above of enforcement of standards.

9. Results of pairwise ranked goat production constraints
   1. Appropriate goat house
   2. High cost of drugs
   3. Worms
   4. Feed shortage
   5. Pneumonia
   6. Orf
   7. Mange

10. Problem analysis

Constraint: Lack of appropriate goat house. An appropriate house is a low cost one that can also serve for total confinement (zero grazing) and facilitates collection of faeces for manure.

Coping strategies:
a) Goats are housed in kitchens
b) Some farmers have partitioned their kitchens
c) Some farmers have built goat houses

Opportunities:
a) Credit for construction
b) Introduce appropriate house designs requiring minimum bought-in materials.
c) Because of buck odour isolate, sell or debud bucklings early

Constraint: High cost of drugs. Farmers are aware of drugs and are available. Buy when it is a must or opportunistically following a good sale. Opportunistic buying and treatment is common with anthelmintics.

Coping strategies:
a) Use of local herbs
b) Sell crops to purchase drugs
c) Forced sale or slaughter

Opportunities:
a) Veterinary service on credit
b) Bulk purchase by the group or association
c) Introduction of community based delivery of veterinary and other livestock services
d) Research on local herbs

Constraint: Worms (Helminthiasis) Mean monthly temperature and rainfall of Masaka are optimal for helminthiasis.Although farmers are aware of the bad effects of helminthiasis, they do not drench their goats routinely. This is probably due to sub-clinical symptoms and high cost of anthelmintics or both.

Coping strategies:
a) Occasional drenching

Opportunities:
a) Routine strategic drenching
b) Zero grazing
c) Wilting of fodder
d) Strategic tethering
e) Efficacy testing of anthelmintics in the market and enforcement of standards

Constraint: Feed shortage. In agricultural high potential areas with rainfall of 1000 mm or thereabout, feed shortage is a result of diminishing land for pastures in preference for staple and high value crops.

Coping strategies:
a) Utilization of crop residues
b) Capitalizing of relatives, neighbours and public land
c) Opportunistic buying of feedstuffs

Opportunities:
a) Planting fodder
b) Conservation (hay or silage)
c) Improved use of crop residues
d) Improved use of agro-industrial byproducts
e) Integration of animal and crop agriculture
f) Improved pastures

Constraint: Pneumonia. Infectious or noninfectious causes resulting in coughing (kukorora).

Coping strategies:
a) Use local herbs
b) Good care and hygiene
c) Treatment with broad spectrum antibiotics

Opportunities:
a) Appropriate housing
b) Diagnosis
c) Optimal feeding and drenching
d) Good husbandry education/awareness

Constraint: Orf. Is a contagious disease of sheep and goats. The virus is very hardy and can live for extended periods away from the host. It is also contagious to man.

Coping strategies: a) Use local herbs

Opportunities:
a) Spraying of sores
b) Treatment with antibiotics to prevent secondary infection.
c) Vaccination

Constraint: Mange. The two most common mites infecting goats are the scab mite (Sarcoptes) and the follicle mite (Demodex).

Coping strategies: a) Use omo to wash affected areas.

Opportunities:
a) Dip goats
b) Use insecticides
c) Use Ivermectin

CONCLUSION

Regionalization of KDPG technologies in southern Tanzania was extremely cost effective. At 17,500.00 US dollars over four years a fully fledged research cum development project was launched. The Project is currently looked upon by the Government, NGOs and farmers for provision of selected Newala and dual-purpose goats. It is the only goat research in southern Tanzania. As a result it has promoted a lot of awareness in animal agriculture in a predominantly cassava and cashew agro-system. As the Government met its obligations satisfactorily, it is our hope this Project will continue to thrive without outside assistance. For the Uganda initiative it did not go beyond PRA results. However, it is hoped the farmers' union and respective extension officers who were involved in the exercise will implement some of the opportunities cited in the PRA report.

Who knows where the shoe is pinching most? It is the wearer and for farming production constraints it is the farmer. The on-farm monitoring research and PRAs conducted in this study illustrated the importance of involving farmers. The top-down approach of what experts felt were constraints is no more tenable in sustainable agriculture without subsidies. The solution is a happy balance between top-down and bottom-up approaches. The happy balance is obtained when farmers along with experts (researchers and extensionists) are involved in diagnosis, planning and implementation.

5. OUTREACH ACTIVITIES

INTRODUCTION

Although a research project, it was not possible not to meet other needs of the environment in which PSP worked. They included dissemination of results, institution building, production linkages, agricultural shows, publications and training among others. It is the observation of many, these factors have greatest potential in the long run to create significant impact.

ACTIVITIES

Institution building: Before SR-CRSP moved to Maseno, the station then called Veterinary Farm had only one function of producing experimental calves for foot and mouth research. Due to the presence of SR-CRSP the farm was transformed into a station with modest facilities for research. Building on Maseno experience two new research sites have started research with KDPGs. They are Katumani National Dryland Farming Research Centre (NDFRC), and Mtwapa Regional Research Centre.

Networking: Personnel for production systems have worked over the years very closely with local and international professional societies and networks in promoting livestock production. They include:-

- The International Goat Association (presented keynote papers, chaired round table sessions and presented oral and poster papers).
- Animal Production Society of Kenya (Presented papers at their annual conferences and assisted in staging two field days at Sangalo and Maseno).
- African Feed Resources Network (AFRNET) (ILCA) (collaborated in organizing two regional workshops and in conducting *Sesbania sesban* research).
- Small Ruminant Research Network (ILCA) (presented papers at biennial workshops. Member of the steering committee.

Production Linkages: At the following institutions, we have helped them start multiplication centres for F1s and eventually KDPGs.

- Bukura Institute of Agriculture
- Diocese of Maseno West
- Lumigo Women Group
- GK Prison Kibos

Dissemination of results: The research approach adopted by the PSP, initially disseminates results through on-farm trials. One hundred and fifty farmers in western Kenya have benefitted through this channel; and in turn a bigger number of neighbouring farmers have benefitted through farmer to farmer extension. In eastern Kenya and the humid lowland Coast 100 farmers were in the study.

In collaboration with the Ministry of Livestock Development we have exhibited KDPGs and KDPG techpacks at local agricultural shows since 1985. It is estimated 50,000 people have given audience to us. These shows held in Kisumu, Kakamega and Siaya were annual. In addition, many field days have been conducted jointly with the Ministry and two field days in collaboration with the Animal Production Society of Kenya.

Between 1985 and 1992, at Maseno and Katumani we received over 550 distinguished visitors.

Produced in collaboration with Kenya Broadcasting Corporation and Good News Production two video films on KDPG production and accompanying technology packages.

Publications:	Extension manuals	2
	Chapters in books	7
	Theses PhD	4
	Theses MSc	10
	Proceeding papers	65
	Refereed papers	10

Training: Accepted many invitations as resource persons (small ruminant production) at national and international workshops and courses of KARI, Ministry of Agriculture, Livestock Development and Marketing, ILCA, CIMMYT, Winrock, IDRC, ICRAF, World Bank and the World Vision.

Kenyan and American students have been supported either fully or partially for following degrees:

MSc.	-	10
PhD	-	4

Short courses for collaborating scientists with support from ILCA.

Forage agronomy	-	1
Smallstock production	-	1

Internship of undergraduate students

Egerton University	-	4
University of Eastern Africa Baraton	-	2
Cornell University	-	2
Tufts University	-	1

In the last two years primary and secondary schools have been coming to Maseno and Katumani to learn goat production and related aspects at the rate of one school per month.

6. PERSONNEL FOR PRODUCTION SYSTEMS PROJECT

The Project has been lucky for having had qualified and dedicated personnel. Over the years, they unselfishly gave their time including some weekends to ensure success. They at all times focussed their thoughts, outlook and activities on the welfare of their farmers. These attributes enhanced their on-farm research results by coming up with production constraints, solutions and opportunities.

Credit for PSP work between 1993 and 1997 go to all listed below, extension officers, SR-CRSP sister Projects and above all collaborating farmers.

Dr. Will Getz	Principal Investigator
Dr. Jim Yazman	Principal Investigator
Dr. Henk Knipscheer	Principal Investigator
Dr. Patterson Semenye	Resident Scientist
Dr. Moses Onim	Resident Scientist
Dr. Augusta Abate	Assistant Director KARI
Dr. Peter Wandera	Small Ruminant Research Coordinator KARI
Dr. Mbae Bauni	Head Livestock Research Katumani
Mr. Donald Njarui	Research Officer Katumani
Mr. Malu Nzioka	Research Officer Katumani
Mrs. Merioth Wanyama	Research Officer Katumani
Mr. J. Musyoki	Technical Office Katumani
Mr. Naboth Olonde	Technical Assistant Katumani
Dr. Rahab Muinga	Head Livestock Research Mtwapa
Mr. Ali Ramadhan	Research Officer Mtwapa
Mr. Justin Mukonoh	Technical Assistant DLPO/Kwale
Mr. Julius Tembo	Technical Assistant DLPO/Kilifi
Dr. Wellington Kiriswo	Veterinary Officer Koibatek District
Mr. David Mpiri	Assistant Commissioner Livestock Research Tanzania.
Dr. M. Salum	Head Livestock Research Naliendele Tanzania
Mr. A. Mtambuki	Research Officer Naliendele.
Mr. C. Omutelema	Field Assistant, Katumani
Ms. N. Ngugi	SR-CRSP, Secretary, Kabete
Mr. P. Onyango	Office Assistant, Kabete

APPENDIX

Appendix 1 Map of Kenya showing districts and international boundaries

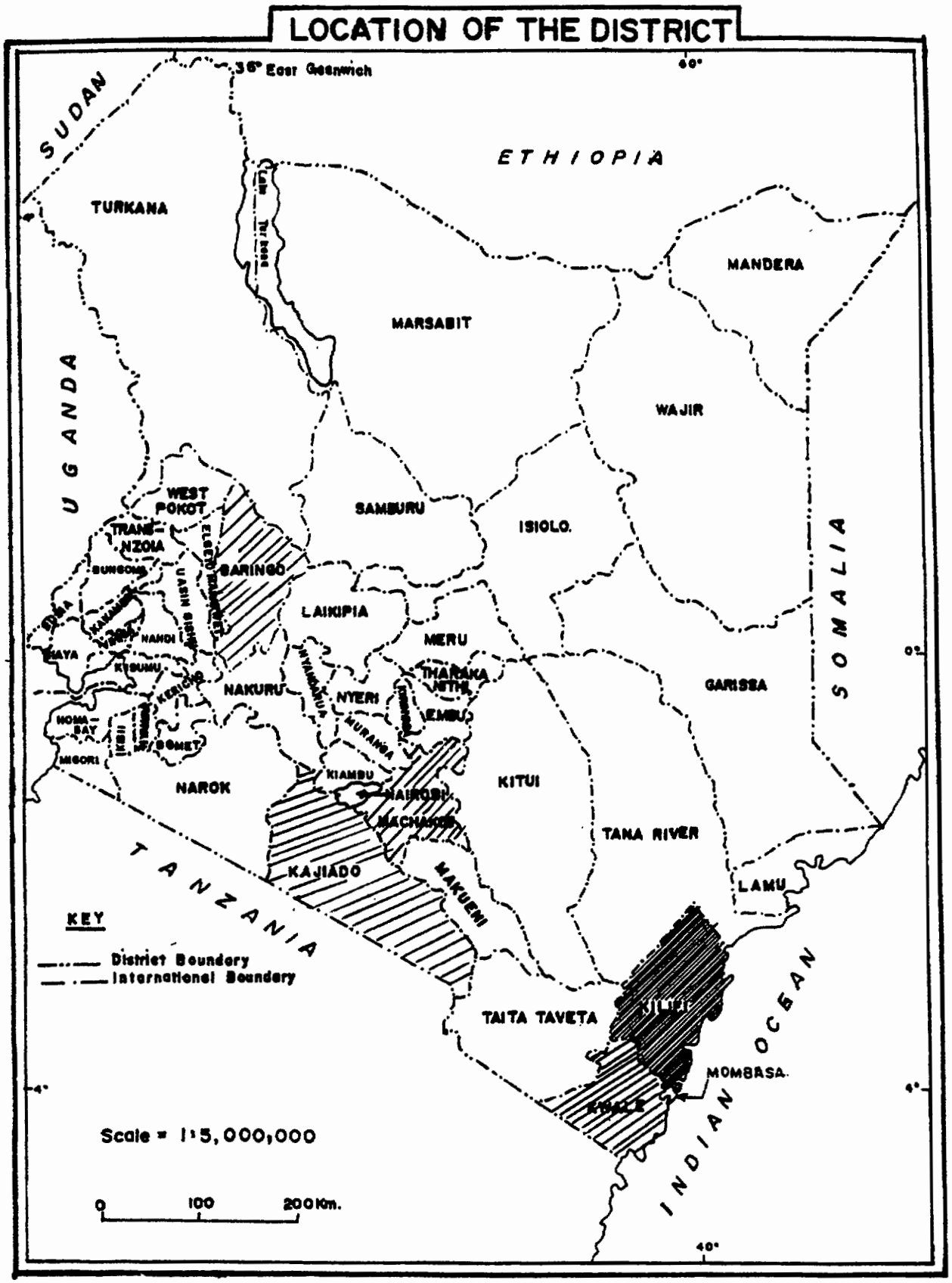
Sketches of Model Farms

Appendix 2 Kitanga Model Farm

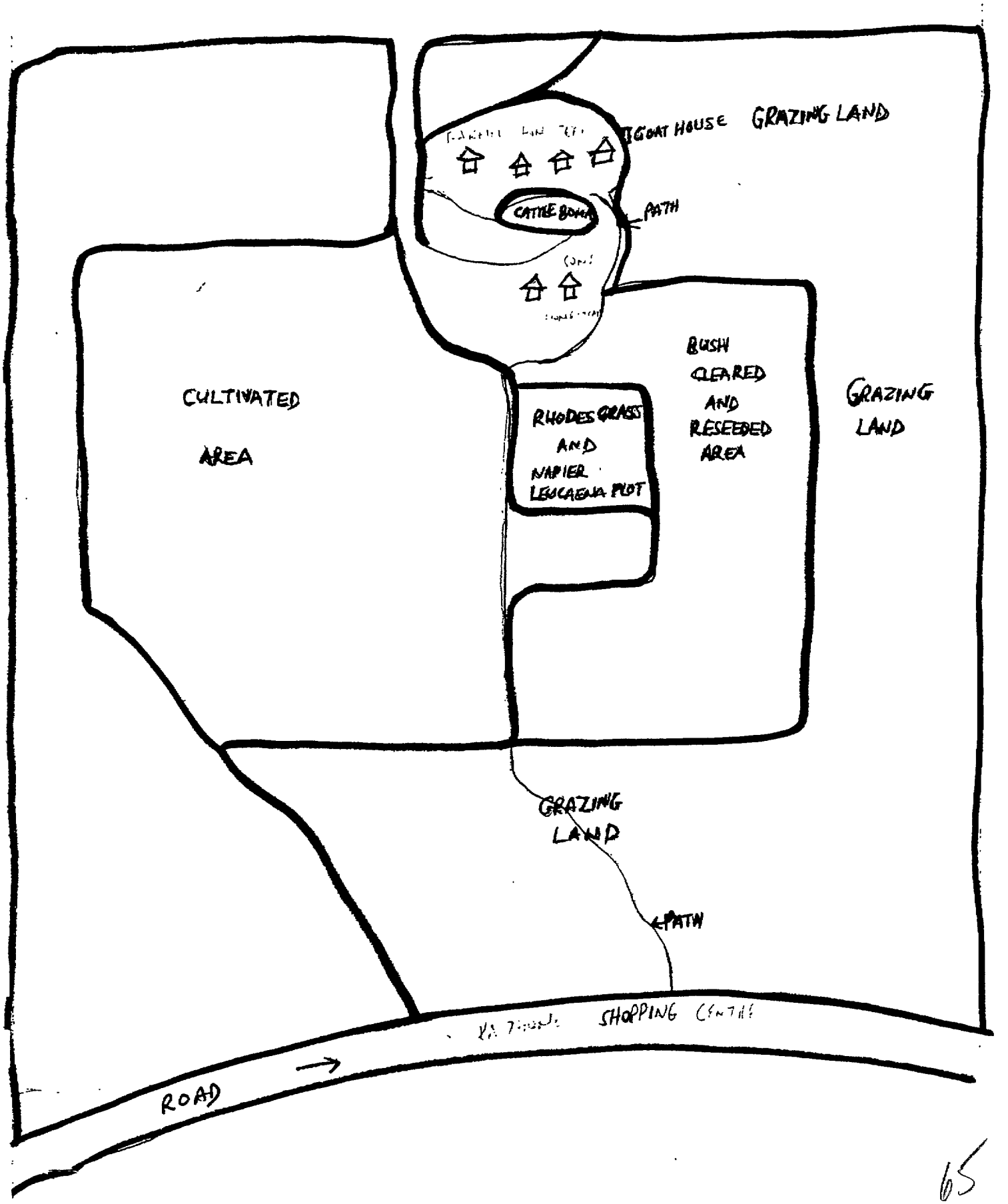
Appendix 3 Kimutwa Model Farm

Appendix 4 On-Station Model Farm

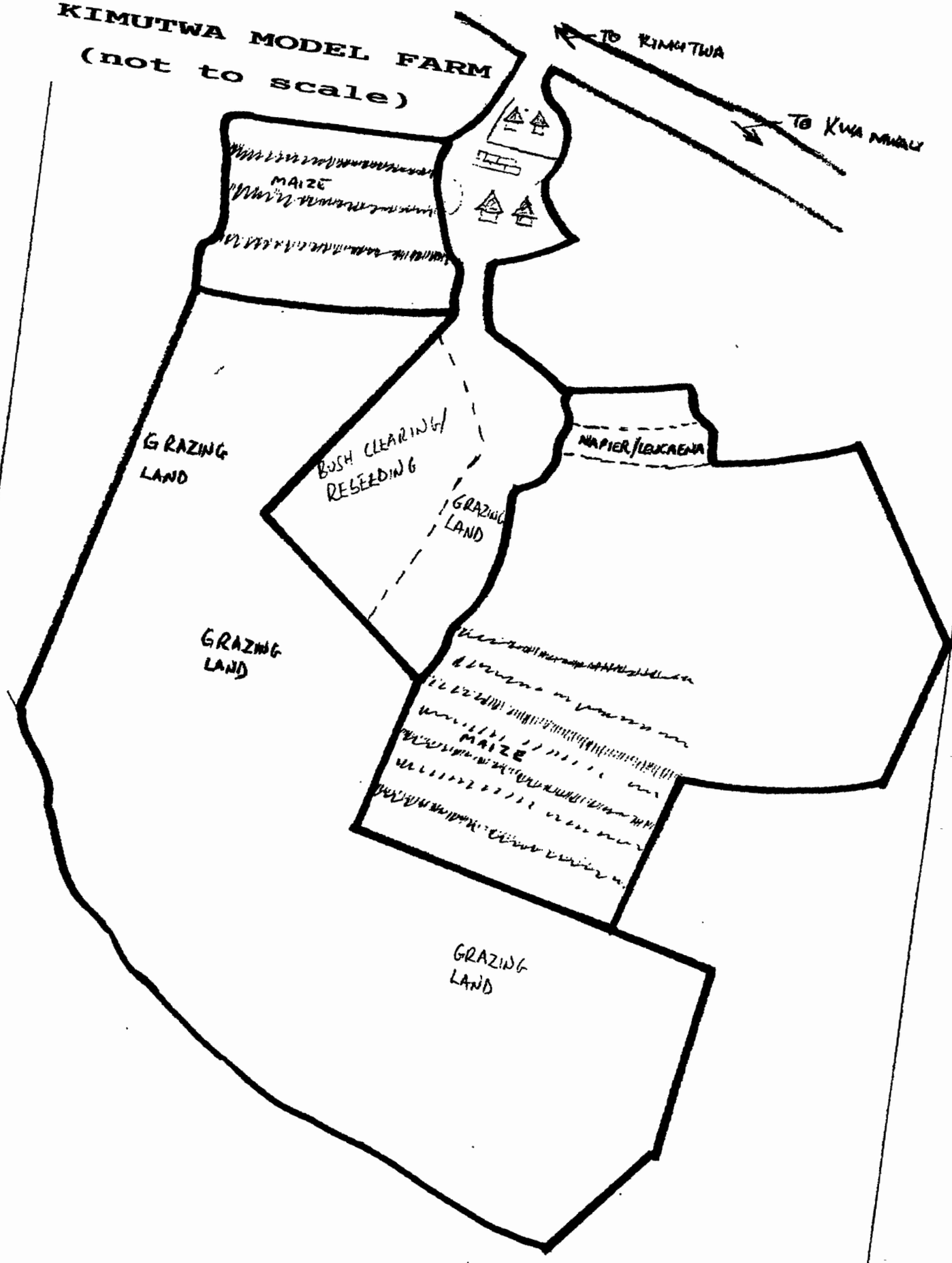
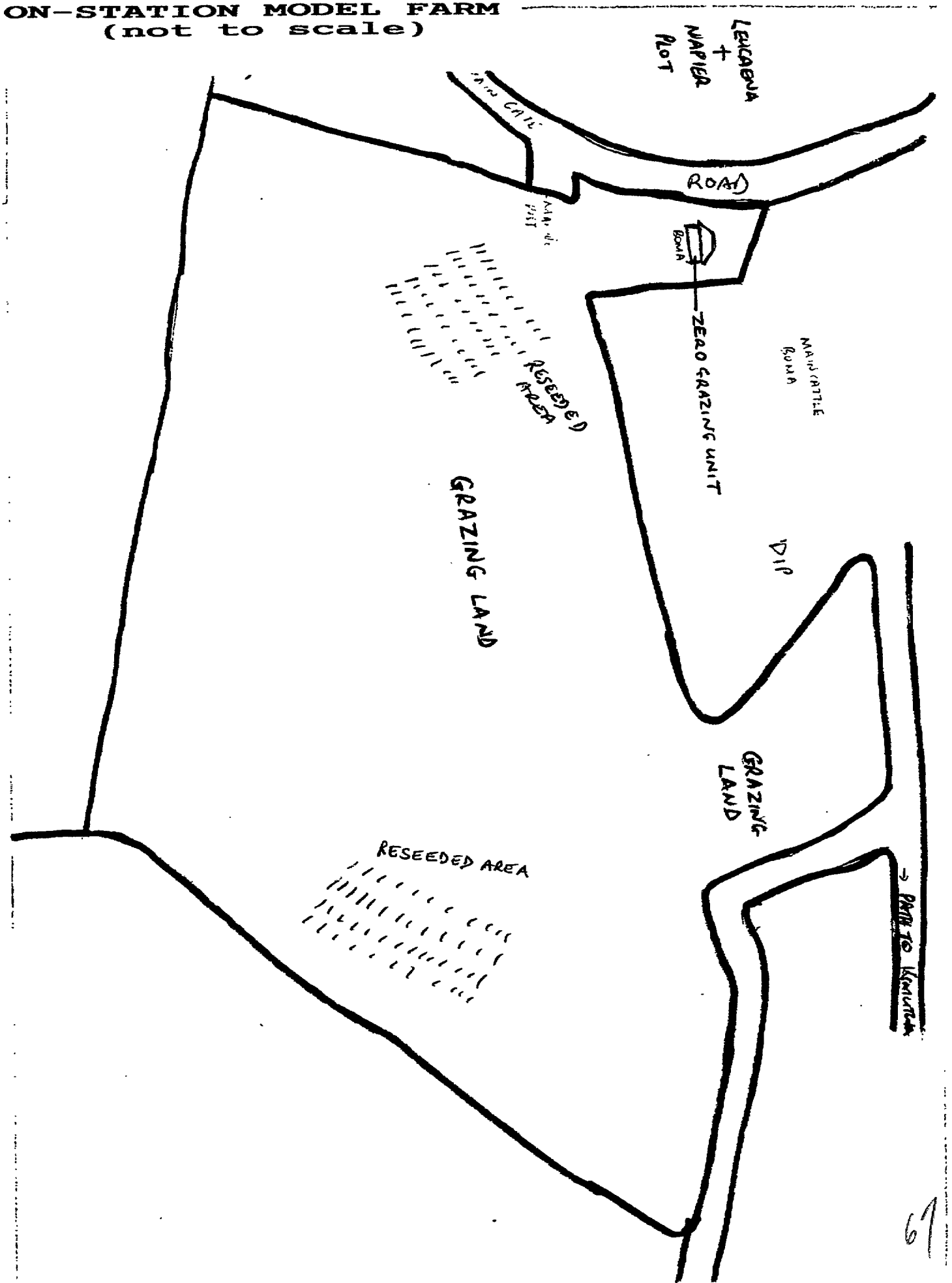
MAP OF KENYA


LOCATION OF THE DISTRICT
36° East Greenwich
40°
SUDAN
ETHIOPIA
UGANDA
TANZANIA
SOMALIA
INDIAN OCEAN
TURKANA
MARSABIT
MANDERA
WAJIR
WEST POKOT
SAMBURU
ISIOLO
TRANS-NZOIA
BUNGOMA
ELGEYO MARAKWET
BARINGO
UASIN GISHU
LAIKIPIA
BUSIA
KAKAMEGA
NANDI
MERU
SIAYA
KISUMU
KERICHO
NAKURU
NYANDARUA
NYERI
THARAKA NITHI
GARISSA
HOMA-BAY
KISII
BOMET
EMBU
MURANGA
MISORI
NAROK
KIAMBU
NAIROBI
KITUI
MACHAKOS
TANA RIVER
KAJIADO
MAKUENI
LAMU
KEY
District Boundary
International Boundary
TAITA TAVETA
KILIFI
MOMBASA
KWALE
Scale = 1:5,000,000
0
100
200Km.
40°

KITANGA MODEL FARM
(not to scale)



KIMUTWA MODEL FARM
(not to scale)



ON-STATION MODEL FARM
(not to scale)