SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAM

DUAL-PURPOSE GOAT TECHNOLOGY PACKAGE FOR SMALLHOLDERS IN KENYA

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FOREWORD

The goal of the Small Ruminant Collaborative Research Support Program (SR-CRSP) in Kenya is to improve the welfare of smallholder agriculturists through the introduction of a dual-purpose goat into farming systems with the objective of improving family nutrition and income. The first phase of research involved description of smallholder farming systems in western Kenya, including identification of the major constraints to successful introduction of dual-purpose goats. These constraints included availability of suitable feed resources, management of health and reproduction, and availability of goats with milk production potential sufficient for raising kids and producing surplus for human consumption.

Subsequent research - both on-station and on-farm - was directed to the resolution of these and other constraints. Strategies and technologies based on this research and on the experience of SR-CRSP scientists working in Kenya have led to the technology packages described in the following pages.

The smallholder farmer in Kenya is the final recipient for these technology packages; however, the intended audience is the extension agent who will work with farmers to introduce dual-purpose goats.

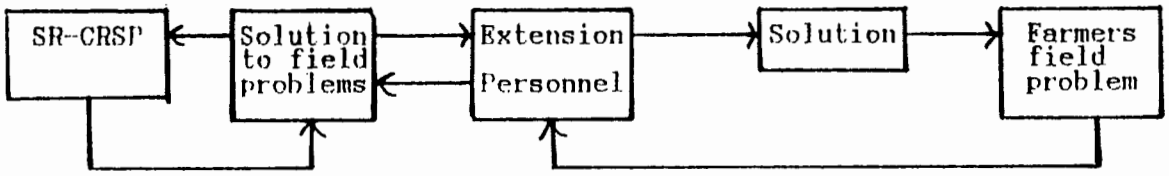
Evaluation of these technology packages continues with large scale placement of dual-purpose goats in western Kenya. The recommended technologies have proven to the technically feasible. However, their socioeconomic acceptability by farmers remains to be tested.

The accompanying write-ups are also an integral part of the continuing evaluation. They provide an objective benchmark for determining the acceptability of the recommendations. Participating farmers are given detailed descriptions of the technology packages following these write-ups and their modifications of the recommendations closely monitored.

INTRODUCTION

The purpose of this manual is to introduce the Dual Purpose Goat technology package to both the extension worker and the smallholder farmer in Western Kenya. The manual is intended to help and teach the farmer better goat management techniques for him to use during and after the current on-farm DPG evaluation program. The manual has been developed by the SR-CRSP scientists and is based on results from on-station research and on-farm experiences in Western Kenya. SR-CRSP which is funded by GoK, USAID and four US Institutions (TAMU, WSU, Missouri, WI) was started eight years ago and its mandate is to develop through research, a dual purpose goat for the high potential small-holders of Kenya. It emphasizes a farming system research approach to ensure that the research is relevant and matches the needs, skills and resources of the smallholder farmers. The research undertaken is multidisciplinary and encompasses breeding, systems analysis, sociology, health, economics, nutrition and management, and feed resources.

Through the farming system approach, the SR-CRSP interdisciplinary team of scientists have been able to develop an on-station DPG production package. The primary goal of the package is to increase farm productivity and enhance farm income of smallholder farm families through supply of appropriate DPG technology package for on-farm management. The package bridges the information gap between the farmer and extension worker on one hand and the researcher on the other through identifying the problems, presenting solutions and making recommendations. This results in a Research - Extension - Farmer linkage as presented schematically below:



Change is an inevitable part of 'development' in agriculture or any other sector of society. The change can occur by merely altering habitual ways of doing things such as time of planting crops or by adopting new ideas and/or technology. Change creates problems and opportunities for both the farmer and those who may attempt to help him (change agents).

This manuscript has therefore been prepared primarily as descriptive background for both the farmer and change agents for effective DPG production. The smallholder farmers have limited resources and limited management skills and most of them lack economic means to try out new ideas and practices that require large cash outlay. They are generally more inclined to adopt those farming practices which they can afford or are readily available. For a technology to be appropriate to them, it must be compatible with their socio-economic and cultural setting otherwise it will have low probability of being adapted regardless of its relative advantage or affordability. This package is being tested and evaluated on smallholders in Western Kenya where SR-CRSP has operation mandate.

The manual includes five sections. The first section (Management and Nutrition) includes information and recommendations on feeding and management of the DPG for the smallholder farmer. The information is to help the smallholder farmer maximise offtake by keeping two, three, four etc. dual purpose goats.

The second section (Development and Utilization of Forages) describes to the farmer how to develop animal feeds from his farm and how to effectively utilize these feeds. The section includes examples of on-station research results that the extension worker may use while explaining the package to the farmers.

Section three (Herd Health Recommendations for DPG in Western Kenya) outlines the commonest health problems in goats in Western Kenya, provides possible alternative methods on how to deal with simple cases on the farm using cheapest methods that match the skills of the farmers. While it is assumed that the farmer can effect some of these recommendations, he is nevertheless strongly advised to contact a veterinary practitioner for the more complicated problems.

The fourth section (Breeding Strategies for Genetic Improvement) describes to the farmer how, given a goat that genotypically matches his environment, he can optimally harvest and enhance flock productivity through proper management techniques.

The fifth and final section is the annex. The section contains Memorandum of Understanding between SR-CRSP and the client farmers, a proposed course outline for collaborating farmers and tentative veterinary drug prices prevailing in Western Kenya.

The performance of this manual will be monitored during the on-farm goat evaluation periods and these experiences gained used for modifying the manual.

SECTION I:

MANAGEMENT AND NUTRITION

1.1 NURSING STRATEGY

Problem: Starvation

Background:

Once a kid is born and it gets on to its feet, its survival probability is more than a half. On the other hand, if the mothering ability of a doe is poor for having a weak doe/kid bond or low milk yield, survival probability is below a half. Mortality of kids on-station and on-farm is highest in the first two months after kidding. Starvation and diseases are the causes of these deaths. Through containment of some of these causes associated with starvation both on-station and on-farm, there have been marked reduction in kid mortality. They are doe/kid bond, blocked teats, low milk yield, milking regime, lack of colostrum and eradication of draughty conditions.

Recommendations:

1. Ensure the doe/kid bond is established soon after kidding. For does that tend to run away from their kid/s before bond establishment, restrain them inorder to remain in close contact with their offspring.

2. Check the teats of the does following kidding. If they are blocked, unblock them through milking.

3. If a kid is unable to suckle, help it by milking some milk directly into its mouth. The sweetness of the milk will psychologically urge the kid to suckle.

4. Make sure the kid has suckled within two hours of birth and thereafter at increasing intervals. The first milk or colostrum is absolutely essential as it contains anti bodies, which are necessary for the survival of the kid for the first part of its age which the kid did not get while in the uterus.

5. If a lactating and nursing doe is not receiving supplementary feed of *Sesbania sesban*, *Leucaena spp*, or any other forage that is rich in protein, then such a doe is not likely to produce milk in excess of its kid requirements. Under this circumstance milk no more than half the udder in the first 30 days and thereafter a quarter per day until the kid attains the weight of 10 kg. On attainment of this weight the kid is weaned and total milk extraction can be realised to the end of the lactation. Incase of twins milk no more than a quarter the udder in the first 30 days and thereafter none to weaning or attainment of 10 kg. For does with triplets no milking until weaning.

6. Kids should be housed in draught and excessive heat-free conditions. Cold draught leads to pneumonia and/or starvation. Starvation arises out of over expenditure of energy in body temperature regulation.

1.2 SWEET POTATO VINES (SPV) AS A MILK REPLACER FOR KIDS

Problem:

In an endeavor to satisfy home needs with milk supply, overmilking of does by farmers is very tempting; and in the process kids are denied their rightful share, which could lead to stunted growth, starvation and eventually death.

Background:

There was no difference in growth performance between the kids that were weaned on SPV and those with total access to their dams' milk as shown in Table 1. A major and significant difference between the treatments was in milk offtake for home use. From the does whose kids were weaned to SPV, each doe was milked 87 kg in 120 days. Through utilization of SPV, which farmers grow as a crop, the accrued side benefit was 87 kg of milk or in monetary terms Ksh. 522/= (1 US dollar = 18 Kshs.). Furthermore, early weaning has the added advantage of enhancing rumen development (*Semenye et al 1986*). SPV is an ideal milk substitute because nearly all the farmers in western Kenya grow sweet potatoes and because of its chemical composition. Sweet potatoes are grown in small plots with an estimated size range of 4 to over 59 sq. meters. From the smaller plots sufficient SPV can be harvested without reducing tuber yield to meet the requirements of a kid (30 g. DM/kg body weight/day). The chemical composition of milk and SPV are comparable in that, the moisture content and digestibility of milk are 85 and 86%, while for SPV are 80 and 72% respectively.

Table 1: Performance of kids and milk offtake

Age-days	0	30	60	90	120	Milk offtake
Total Suckle kg n=8	2.9	4.9	4.6	5.6	7.3	NIL
Weaned on SPV kg n=8	2.4	6.3	6.6	8.4	7.9	87

Recommendation:

1. To obtain optimal growth of kids and of milk offtake for home use, kids must be offered SPV *ad lib* from the age of two weeks until they weigh 10 kg. Continuation of feeding SPV is recommended after the attainment of 10 kg but is not mandatory.

1.3 APPROPRIATE UTILIZATION OF CROP RESIDEUS AS FEEDSTUFFS

Problem: Overcoming short-fall in feedstuffs requirements for maintenance

Background:

A shortage of forage on a year-round basis in small farms of western Kenya, has been reported as a constraint limiting goat production (Sands *et al* 1983; Onim *et al* 1984; Semenye *et al* 1986). This is due to small farm sizes with a mean of 1.9 ha and a range of 0.2-9.6 ha; in addition these farms must support food production for large families. Consequently, livestock are left grazing homesteads' compounds and communal properties whenever available, as their only source of pasture. These pastures are not adequate for meeting both maintenance and production requirements of livestock. Infact by using the conventional stocking rate recommendations for the area, the farms would be classified as overstocked and family livestock in danger of experiencing high mortality through starvation. By proper utilization of crop residues this danger can be avoided. Table 2 is a presentation of chemical composition of crop residues available in western Kenya. The values of the various crop residues as shown in the table are too low to support utilization for production beyond maintenance requirements.

For greater intake and utilization of crop residues a number of methods have been used in different countries for processing the coarse feedstuffs. The methods include chopping, grinding, soaking in water, alkali or urea treatment, sprinkling with molasses or salt and feeding in conjunction with proteinacious forages. In western Kenya the most abundant crop residue, maize stover, has been shown capable of maintaining mature goats following chopping and soaking treatments only (Semenye *et al* 1987).

Table 2: Chemical composition of crop residues available in Western Kenya

Crop residue	Dry matter %	Ash %	Crude Protein %	Dry matter digestibility %
Maize stover *Zea mays*	82	10	5	36
Sorghum stover *Sorghum spp*	86	8	4	42
Beans haulms *Phaseolus vulgaris*	90	7	6	42
Banana peelings *Musa spp*	20	15	8	59
Mango peelings *Mangifera indica*	-	-	7	-

Recommendations:

1. Maize stover which has been processed by soaking and chopping into lengths of no more than 5 cm, is sufficient for meeting the nutritional demands of a mature goat. If a farmer has maize stover only, his goats should not die due to starvation. Better still, if a farmer has access to molasses he should sprinkle it, on stover to enhance palatability and energy intake. Occasional sprinkling of common table salt is also recommended for enhancing palatability and hence intake.

2. Other crop residues such as , sorghum and beans haulms are also recommended as is the case for maize stover above.

3. Peelings of mangoes and bananas should not be wasted, but fed to goats whenever available. They however, should be regarded as playing the role of meeting the days' appetite. Peelings are usually not available in sufficient quantities to meet requirements.

1.4 FEEDING A DPG DOE FOR PRODUCTION OF MILK AND KIDS

Problem:

Farmers are ignorant of the partitioning of feed energy in goats and other livestock.

Background:

The first and the foremost requirement for any livestock type is to utilize available feed energy to keep itself alive. This is the state of maintaining itself in which there is neither a net gain nor loss of nutrients. Feed energy necessary to achieve this equilibrium is the maintenance requirements. Maintenance requirement is dependent on body size and activity of an individual animal. A cow because of its bigger size requires more energy for maintenance than a doe. With regards to activity a doe that is tethered has less demand for maintenance energy than one that is free ranging. Of the feeding energy that is left after maintenance needs have been met goes to production. Production pathways are lactional, pregnancy and growth. The efficiency of conversion of feed energy into lactation is 60% and into liveweight is 42%, while for pregnancy falls in between (MAFF 1975; Konandreas and Anderson 1982). On the other hand when energy derived from feed intake is insufficient to meet a doe's total energy requirements, then the energy balance is achieved by the mobilization of reserves. This happens in situations of low quality and quantity of forage on offer to a doe. Under such circumstances a doe will mobilize its body reserves to meet lactation, pregnancy and maintenance requirements. This is highly undesirable due to body weight loss and because the energy so released is lower than the energy that originally went into its synthesis. A simple rule to farmers therefore is to feed their does above maintenance requirements at all times.

Recommendations:

- Does must be fed above their maintenance requirements inorder to ensure high milk yields, and conception and kidding rates and at the same time avoid body reserves mobilization.

2. In addition to a full day's grazing, ensure doe receives supplementary feed that is high in crude protein content and digestibility at over 12% and 55% respectively. This should be a third or more of its total ration of 1 to 1.5 kg dry matter per day. Candidates for supplementary feeding are:-

Sesbania sesban	- fresh or hay (Maximum 30% of basal diet)
Leucaena leucocephala	- fresh or hay (Maximum 30% of basal diet)
Zea mays	- maize thinnings and leaves
Tylossema spp	- fresh leaves
Ipomoea batatas	- sweet potato vines
Digitaria scalarum	- Couch grass fresh

3. When the appetite of a doe is not met following a day's grazing, above supplements could be fed as sole diets with exception of leucaena and sesbania. In addition to grazing, another source of meeting a doe's appetite is from cut and carry of napier grass (*Pennisetum purpureum*). Farmers who anticipate shortage of grazing pastures are advised to grow napier grass.

4. If cash is available bought-in concentrates can be used as supplementary feed for enhancement of production. Concentrates meant for cows are equally good for does.

5. For proper maintenance of rumen digestive properties, supplements should be fed at least twice in a day. If a doe is being milked the ideal frequency is twice a day at morning and afternoon milking. This stimulates milk let down.

6. To avoid competition for energy between pregnancy and lactation, dry-off does in their last two months of gestation.

1.5 TETHERING

Problem:

Restriction of grazing area and selection, movement and courtship/mating contact

Background:

In western Kenya due to small land sizes, double cropping and lack of fences to contain goats, tethering is the preferred method of confining goats. Advantages of tethering goats are close control, avoidance of crop damage particularly of neighbours plots and facilitates in site feeding of crop residues and cut and carry. For these advantages to be realized careful planning and management are necessary otherwise, tethering results in harmful restriction of grazing selection, area, contact with other goats for mating, exposure to helminths and accidents.

Restriction of grazing area and selectivity has been studied. It has been found that a tethering rope with a radius of four metres and changing pegging station at least twice daily are best (Semenye *et al* 1986). Other factors studied in this experiment (Semenye *et al* 1986) will became evident under recommendations.

Recommendations:

1. Tether goats with a rope of approximately four metres in length or two and a half body lengths (man). Note, long ropes cause entanglement, while short ones restrict grazing area severely.

2. Change the tethering station at least twice in a day. Change of site presents fresh pastures that have not been contaminated with the day's faeces and urine.

3. Base tethering pattern upon the movement of the sun, herbage availability and large stock tethering sequence. In a tethering sequence always have your goats tethered on sites ahead of cattle. This is a strategy for reduction of internal worms infestation.

4. If your DPG doe is in estrus ensure the DPG buck's and the doe's tethering areas overlap to facilitate contact and, hence, courtship and mating. Under other circumstances don't allow any overlap of tethering areas, as this more than often, leads to entanglement of the ropes and unnecessary stress of the goats in trying to free themselves.

5. Don't tether where the rope can get entangled with other objects or near cliffs, which could lead to accidents such as goats hanging themselves.

1.6 MATING SCHEDULE FOR DUAL PURPOSE GOATS

Problem:

Knowing the age, appropriate nutritional status and the breeding frequency for increased conception and kidding rates.

Background:

The age at first kidding and the frequency of breeding thereafter, are of great importance in the determination of an individual doe's lifetime kid crop. The nutritional status of a doe is also an important factor in the determination of the kid crop size in that, if a doe is in a poor nutritional status because of a low plane of nutrition, its ovulation rate and hence conception rate drops proportionally. On the other hand, if the plane of nutrition drops following conception to kidding and thereafter, then high rates of abortions and mortality should be expected post-partum.

Doelings may start to cycle at the age of two months (Robinet 1973) hence, they could first kid at the age of seven months. It is not appropriate to breed at the sight of the first heat. The correct practice is to breed, when the doeling has attained a liveweight that poses no danger of being permanently stunted. A stunted doe has a low prolificacy and produces kids with low birth weights and viability. There is general agreement for breeding doelings on attainment of 60-67% of their expected adult liveweight.

The terminologies 'flushing' and 'steaming-up' are very common in animal husbandry. Farmers and researchers insist on "flushing" and 'steaming -up"inorder to maintain does in good nutritional status and hence good body condition, because the correlation between good body condition with conception and kidding rates are high and positive. At Maseno the does are in good body condition in the 'dry' season, when the pastures dry matter content is high. This therefore, is the appropriate time for breeding because of the natural effect of 'flushing'. They then proceed to drop their kids in the next 'dry' season, which provides the 'steaming-up' effect. This strategy is recommended, when in the dry season there is adequate feed.

Under a good plane of nutrition, where concentrate feeding is practised accelerated kidding is recommended. In an accelerated kidding programme, the kidding intervals are eight months, in which does have to be bred in less than three months following kidding. For situations where reliance for feedstuffs is on pastures, crop residues and marginal supplementation with quality fodder, kidding once a year is more appropriate.

Recommendations:

1. Breed DPG doelings for the first time, when weighing over 20 kg and in good body condition. Good body conditions and liveweights of 20 kg are attainable in western Kenya when the doelings are at least one year of age.

2. 'Flush' your doelings and does three weeks before mating. Use high quality fodder such as *Sesbania sesban, Tylossema spp, Leucaena leucocephala*, maize thinnings, green maize leaves and sweet potato vines, etc.

3. Buy, hire or go for a DPG buck with high libido and in good condition. Preference should be given to bucks known to sire twins.

4. Ensure your doe is bred in its second day of heat (estrus) inorder to overlap with ovulation, which occurs approximately 18-36 hours after the onset of the heat period.

5. Ensure tethering does not impede courtship or mating.

1.7 FEEDSTUFFS PRESENTATION

Problem: Wastage that can be avoided

Background:

Mothers resent, when children eat sweets before a meal. Puddings such as ice cream and fruit salad are served after a meal. It is accepted if they are taken before they have a negative impact on the appetite and intake of the main meal. This is true also with the eating psychology of goats. Goats being very selective feeders, when presented with a cut and carry fodder of mixed species, they will have a go first at the most palatable species (sweets or pudding). After eating the most palatable species they naturally feel less inclined to eat the remaining ones. Eventually whether it is eaten or not is dependent on the degree of hunger, soilage and contamination. In an endeavor to reduce the amount of orts from cut and carry an experiment was conducted at Maseno (Semenye *et al* 1986), which ranked common forages according to their palatability. For results see Tables 3a, 3b and 3c.

Table 3a: Preference Ranking of Grass Species

Species	Rank	Intake g.	CP%	DMD%
Couch grass	1	1223[a)]	17	65
Napier (13)	2	1080[a)]	9	63
Giant panicum	3	890[b)]	9	54
Brachiaria spp	4	741[b)]	11	51
Rhodes grass	5	703[b)]	8	50
Bana grass	6	672[b)]	13	57

ab) Means not having the same superscript in common differ at $P \leq 0.05$

DMD = In vitro dry matter digestibility

Table 3b: Preference Ranking of Proteinous Species

Species	Rank	Intake g.	CP%	DMD%
Sweet potato vines	1	1689[a)]	17	68
Leucaena	2	1353[b)]	21	65
Tylossema spp	3	1199[b)]	14	55
Pigeon pea	4	751[c)]	21	69
Sesbania spp	5	684[c)]	21	68
Gliricidia	6	187[d)]	18	55

abcd) Means not having the same superscript in common differ at $P \leq 0.05$

DMD = In vitro dry matter digestibility

Table 3c: Preference Ranking of Grass and Proteinous species

Species	Rank	Intake g.	CP%	DMD%
Sweet potato vines	1	1757	17	68
Leucaena L.	2	1079	21	65
Couch grass	3	754	17	55
Tylossema spp	4	711	14	69
Napier (13)	5	570	9	68
Giant panicum	6	480	9	55

DMD = In vitro dry matter digestibility

Goats by nature are browsers. They often stand on their rear legs to enable them reach shrubs and small trees. So when goats are given cut and carry fodder from a hanging position, it emulates their preferred stance of foraging. Tieing and hanging cut and carry fodder has other benefits to the welfare of the goat. It reduces the amount of orts through reduced contamination and soilage of the feedstuff on offer. Cut and carry feedstuffs not presented in a hanging position, but placed on the ground, usually gets urinated, defacated, salivated, soiled and tramped. As goats are fussy in their feeding habit (Devendra and McLeroy 1982) such feedstuff would be taken with alot of reluctance resulting in a large amount of orts. For your information, what is orts to goats is cherished by cattle.

Feeding of crop residues to livestock following physical treatment (chopping, grinding and soaking in water) enhances intake and digestibility (Semenye *et al* 1986. Nour 1987), while chemical treatment (urea, NaOH, NH3) enhances digestibility (Said 1981). For increased palatability and hence intake treatment with salt or molasses is effective. So for satisfactory utilization of crop residues one or more of the above treatments can be engaged. For smallholders in Kenya except for NaOH and NH3 treatments, the other treatments are within their reach.

Recommendations:

1. Feed the most and the least palatable forages last and first, respectively.

2. Tie and hang your cut and carry forage inorder to reduce the amount of orts. This practice is also credited with reduced worm infestation.

3. Treat your crop residues physically and chemically to enhance palatability, intake and utilization. Treatments suitable to smallholders are:-

   3.1 Chopping into lengths of approximately 5 cm

   3.2 Soaking in clean water

   3.3 Sprinkling with molasses or common salt

1.8 MILK AND MILK HYGIENE

Problem: Inadequate knowledge on milking and milk hygiene

Background:

Breed and nutrition have been given the attention they deserve in the struggle for increased milk yields. However, other variables namely pre-milking preparations and milking procedure, which play vital roles in regulating milk yield have not been given the attention they deserve. These variables, which for convenience will collectively be termed managerial, have expressed their importance in our on-farm research. Examples of how managerial factors have caused variations in milk yields:

a) Does have refused to let milk down when their regular milkers are away.

b) Irregularity in milking frequency and interval, in homes that milk on demand, has lowered yields and in some cases caused mastitis.

c) Following transfer of a doe that was yielding 0.5 kg per day to another home, because of a domestic quarrel, it started yielding 1.2 kg per day. In the latter home the doe received managerial attention that was conducive with maximum milk production.

d) During milking demonstrations does have failed to give their average yields.

The managerial factors must be observed by providing a conducive environment for milking, which is characterized with uniformity, gentleness, quietness and skill.

Although milk is a noble nourishment if not pasteurized it could be a source of infection. Goat milk must be pasteurized as a standard procedure, so as to ensure the milk is safe for consumption and/or preservation. Unpasteurized milk from diseased goats can transmit brucellosis (Nicoletti 1987). On the other hand, in India goat milk is prescribed by doctors in cases of jaundice, peptic ulcers and dyspepsia (NDRI 1978). Goat milk is also more digestible than cow milk and is richer in antibiotics. In western Kenya collaborating farmers claim, when making tea a lesser amount of milk is required incase of goat than cow milk. This is an indication of higher levels of butter fat and certain minerals in

goats' milk. Despite these advantages over cow milk, there is some unfounded prejudice against goat milk evaluation. This statement is supported by the findings of Boor *et al* (1982) in western Kenya, whose random blind tests on the consumer preference between goat and cow milk yielded no significant difference in preference for either fresh or soured milk.

Recommendations:

1. Provide a conducive environment for milk let-down
2. Prepare your doe for milking by presenting it with a supplementary feed (see 2.4) and wash its udder if it is dirty.
3. Restrain your doe by using the most convenient method. See illustrations, Figures 1 and 2.
4. Employ the correct milking procedure as illustrated (Figure 3). Milk by pulling the teats (Figure 4) only, when the teats are two small for engagement of the appropriate procedure (Figure 3). As you milk, nudge or push gently the udder to mimick a kid sucking. This trick causes more milk let-down.
5. Discard the first squirt from each teat.
6. If milk is lumpy with blood spots discard it all and seek veterinary advice. This is a symptom of mastitis.
7. Stripping should be done at all milkings to ensure the final drop of milk is out. If not done it becomes a source of infection and premature drying up.
8. Milk at regular intervals and by the same milker as much as possible.
9. Record milk yields daily.
10. Stop milking when a doe is three months in-kid
11. Ensure your hands are clean and dry before milking
12. Milk into a container that is clean
13. Pasteurize your milk by bringing it to a point of boiling and holding it there for approximately one minute.

Figure 1 Restraining with a shortened tethering rope

Figure 2 Restraining by stanchioning the hind leg

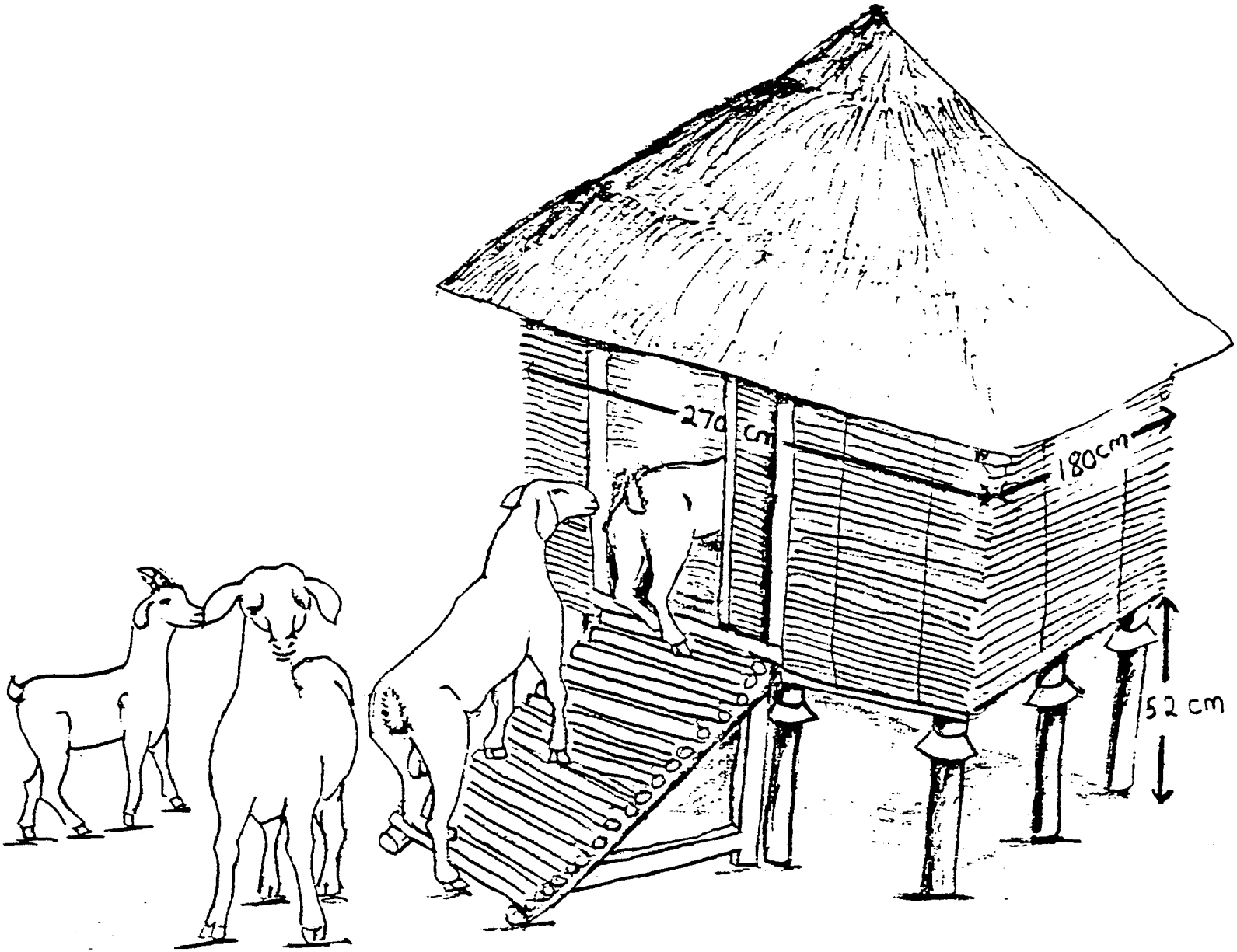

270 cm
180cm
52 cm

Fig. 3a Trapping milk in the teat

Fig. 3b Onset of squeezing process

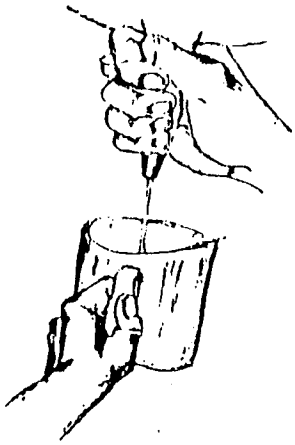


Fig. 3c Squeezing milk out

Fig. 4 Procedure for small teats only

1.9 HOUSING

Problem: Lack of appropriate housing for goats

Background:

Goats are more susceptible than cattle to draughts, rain, dampness and sudden weather changes. For this reason goats must be provided with a housing facility. The facility could be an adapted building or a farm structure. Nonetheless, whether a planned or an adapted house it must be one that is ventilated and draught free. It must also be lockable and strategically placed to prevent thefts and above all predator-proof.

In western Kenya few farmers have need of a special goat house because they convert their kitchens into goat houses for the night. This arrangement is adequate for a small flock of up to six goats. When the same kitchen is used to house more or other livestock, space in the kitchen becomes a major limitation, which invariably leads to crowding and associated side effects of injuries, trampling of the young and pneumonia infection of goats due to inadequate ventilation.

Recommendations:

1. If planning to build a goat house follow the recommended goat house plan. To reduce construction costs, use locally available materials as much as possible. For instance if in an area where the thatch grass is available use it, otherwise corrugated iron sheets are the next best choice. According to the plan the floor is raised and slatted to allow slippage of urine and faeces. This plan is for six medium sized goats.

   It is also partitionable to accommodate storage facility for hay or other farm produce, in other words it is a versatile goat house.

2. Whatever the house, ensure it is ventilated adequately, draught free, the floor is swept and kept dry daily, predator and theft proof.

3. There is no crowding

1.10 GRADUAL WEANING

Problem:

Kids get shocked by sudden weaning, which may lead to high mortality rates or reduced growth rates.

Background:

Goat kids must be weaned to conform with the development of their digestive systems, and to go into a ration that is cheaper than milk. Weaning time must be planned to effect introduction of the new ration, well in advance of the weaning date. In the introductory period the kids must be monitored inorder to ascertain, whether intake and utilization of the ration will be adequate to meet their energy requirements for maintenance plus growth. When not well timed it causes mortality and checks growth either temporarily or permanently. Mortality arises out of starvation because the weaned kids intake of the new ration is either zero or very low, while growth is checked by an intake that just meets maintenance requirements. So if kids are to be weaned to the pastures as is the case with the majority, then expose them to forage (cut and carry) early. Early exposure promotes rumen development hence, intake and utilization is adequate to prevent starvation or reduced growth rates. Research results (Semenye *et al* 1986) indicate that, early exposure to forage followed by gradual weaning, when kids are denied their full share of milk, is practicable and ideal. Gradual denial of milk or nursing forces kids to forage more with time, while sudden cessation has negative impact on foraging. Also for consideration along with gradual weaning is liveweight. Four times birth weight or 10 kg liveweight at weaning is suitable for western Kenya conditions (Brown and Nderito 1983).

Recommendations

1. When weaning a goat kid to pastures or fodder, start denying the kid its full share of milk ten days before the planned day of weaning. This is easily done by over-milking. At the same time the kid must be exposed to its new ration. It is a good practice to introduce the future ration of the kid as early as possible.
2. Prevent contact of the dam and its kid following weaning.
3. Ensure that intake of the new ration (whether forage or a milk replacer) is adequate for maintenance and growth energy requirements.
4. Wean when a kid is approximately four times its birth weight or 10 kg.

1.11 KNOW YOUR GOAT

Problem:

Farmers don't know basic facts concerning the physiology of their goats.

Background:

Following contacts with farmers either on farms or at workshops, it is evident farmers' knowledge on basic physiological events of their goats is lacking. Farmers for instance, cannot tell with certainty what is the gestation period of a goat. It is important for farmers to know these facts which give decisive guidance in making management decisions.

Recommendations:

1. Examine your goats weekly or as often as necessary for removal of ticks and for noticing of ailments or physiological changes if any.

2. Heat or estrous period is 12-36 hours. So breed your does in the second half of the period to coincide with ovulation.

3. Estrus cycle is approximately 21 days. Does returning into heat following service are open. Such does must be bred again.

4. Gestation period of a goat is approximately 150 days or five months. If a doe does not kid approximately 150 days following breeding, then it may have had silent heats or aborted. This is an indication of a reproductive problem.

5. Signs of heat or estrus - bleating, uneasiness, tail shaking, frequent urination, swollen vulva, mucus discharge from the vagina and mounting of other goats.

6. Signs of kidding - The udder will have enlarged and full with milk. Doe is restless, appears hollow on either side of the tail, discharging a starchy substance, in pain and showing signs of affection.

7. Provided milk yields are acceptable and the doe is in good condition, the longer the lactation period the better; nonetheless stop milking when the doe completes third month of gestation.

8. Your can estimate the age of your goat by the number of incisor teeth as follows:

8.1 Temporary incisors (milk teeth) - less than a year

8.2 First pair of incisors - approximately one year

8.3 Second pair of incisors - approximately two years

8.4 Third pair of incisors - approximately three years

8.5 Fourth pair of incisors - three and a half years

8.6 Worn incisors - an old goat over seven years.

1.12 REFERENCES

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SECTION II:

DEVELOPMENT AND UTILIZATION OF FORAGES

2.1 FEED PRODUCTION FROM MAIZE-BASED CROPPING SYSTEMS

This can take several forms:

i. Pure - Maize crop
ii. Maize - Beans
iii. Maize - Pigeon peas
iv. Maize - Sorghum
v. Maize - Finger millet
vi. Maize - Alley cropping

1. Approximately 6 months in a year farmers in Western Kenya experience feed shortage and this can be overcome through generation of feeds from the farmer's maize - based cropping systems indicated above.

   These cropping systems occupy approximately 90% of the farmer's land (particularly in Hamisi) and take about 50% of his resources. The farmer can generate from the maize crop only about 10 tons of dry matter (DM) of feed per hectare (ha) per year from the cropping systems and this can potentially feed four mature goats for about a year.

   However, this feed may be able to meet the animals maintenance requirements only and not adequate for production. Its bulkiness also creates a need for storage facilities.

   Alley cropping with legume forages can generate high quality feeds to overcome the problem of low quality.

2. Summary of Research Results:

Crops	Grain and Forage yields (t/ha)			
	Maize		Intercrop Component	
	Grain	Stover/ forage	Grain	Stover/ forage
Pure maize	4.2	10.2	--	--
Maize/Beans	6.3	9.2	0.6	0.3
Maize/Pigeon-peas	4.3	8.4	--	4.1
Maize/Fingermillet	5.8	8.3	0.6	1.3
Maize-Alley cropping	3.4	9.2	--	4.0

NOTE:

The intercrops increased maize grain yield by 19% but reduced maize stover yields by 14%. However, the grain and forage yields from the intercrop component were all extra/additional advantages above the pure maize crop.

References:

Onim et al. 1984 a and b

Mathuva et al. 1986

ILCA Annual Reports, Humid zone programme

3. Recommendations

i. Early land preparation - where necessary, ploughing and harrowing.

ii. Manure/Fertilizer application.

a. Spread manures uniformly before ploughing.

b. Apply two handfuls of well - decomposed manures in each planting hole; mix well before placing seeds (use the same method for fertilizers as recommended).

iii. Plant, preferably, two seeds per hill of high yielding recommended varieties at the onset of rains eg. maize hybrid H614 for long-rains H5012 and H511 for lower Maseno and Siaya (Experimental maize varieties from Maseno Research can also be used).

a. Spacing for maize in an intercrop - 90 cm x 30 cm.

b. For pigeon-pea or sesbania intercrops plant one row of the intercrop components at 90 cm x 30 cm between the maize rows. Wider spacing for intercrops may be used when preferred.

c. For Beans and Fingermillet plant two rows between the rows of maize crop.

iv Early weeding - once or twice as necessary

a. Thin weak seedlings (removing one plant per hill) at first weeding. (upto 500 kg DM of feed per ha can be generated from this).

b. Where more than one seedling per hill was left at first thinning further thin to one plant per hill (more than 500 Kg DM of feed per ha can be realized).

c. Weeds from the field should be gathered and fed to the livestock (This can also give about 500 kg DM of feed per ha).

v. *Leaf-stripping*

From early milk stage, start removing one leaf per plant per week starting with the lowest leaves (this can generate about 500 kg DM of feed per ha).

vi. *Topping:*

At the maize hardening stage remove the top of the stalk above the cobs (ears). (About 2 t DM of feed per ha can be realized).

vii. *Remaining stover:*

Gather the remaining stover for storage. This will be of the lowest quality compared to the other forage realized from maize crop (about 6.5 to DM of this per ha will be realized).

viii. *Intercrop components:*

(a) *Beans:*

After harvesting the pods and threshing, gather the haulms and split grains for later feeding to livestock (approximately 300 Kg DM of feed per ha can be obtained)

(b) *Pigeon pea:*

After harvesting the maize crop, pigeon pea may be cut-back (ratooned) and fed as a protein supplement as needed (about 4 t DM of feed per ha can be realized). If grain is needed then the crop may be allowed to grow to maturity and after harvesting the pods the crop be cut-back and fed as necessary. Threshed pods may also be fed. (about 6 t DM of forage per ha can be realized).

(c) *Finger millet:*

These will mature and be ready for harvesting before maize crop. After threshing the dry heads the remaining chaff makes good feed for livestock. The remaining stover should be cut, dried and baled for later feeding (about 1.3 t DM of feed per ha can be realized).

(d) *Alley cropping:*

Several legume forages can be alley cropped with maize eg. sesbania, leucaena, calliandra.

Spacing:

Plant two pair rows of the legume forage four metres apart. Rows of maize crop are then planted within the four metres.

2.2 FEED PRODUCTION FROM CASSAVA-BASED CROPPING SYSTEMS

This may be in the form of:

i. Pure Cassava

ii. Cassava/Maize/Sorghum Cropping

iii. Cassava/Sorghum cropping

1. Cassava (*Manihot esculenta*) does well in dry areas and also in areas with low soil fertility. Its leaves contain high levels of crude protein (upto 30% has been recorded) which is also known to be of high quality. The tuber yields are also high (upto 10 t of DM of tuber have been realized in Western Kenya).

   The problem of feed shortage, both in quantity and quality in Western Kenya which occurs for approximately six months in a year can partly be overcome through the generation of feeds from the cassava-based cropping systems.

   The high quality cassava leaves can be pruned and used as protein supplement for the low quality diets.

2. *Summary of Research Results*

Crops		Tuber and Forage DM Yields (t/ha)			
		Cassava		Intercrop component	
		Tuber	Forage	Grain	Forage
Pure Cassava		10.0*	1.0	-	-
Cassava/Maize no-pruning		11.0*	1.2	1.0	3.8
Cassava/Maize -cassava pruned					
	1/4**	2.8***	2.1	1.4	3.8
	1/2	2.3	4.3	1.4	3.8
	3/4	1.7	3.2	1.4	3.8
	1	0.9	2.8	1.4	3.8

* Yields for tubers harvested after a period of between three and five years.

**1/4-1 Proportion of total number of leaves pruned from ground level per stem per plant. No."1" in the table indicates pruning of all the leaves from a stem.

***2.8-09 Yields for tubers harvested after only one year.

NOTE:

From the summary of research results in the above table, it is recommended that the pruning of half (1/2) of the total number of cassava leaves per stem per plant after every two months be adopted.

References

Mathuva et al. 1985

IITA'S Tropical Root Crop Publications

CIAT'S Annual Reports and Cassava Abstracts

3. Recommendations

i. Intercroppings should be used in cassava-based cropping systems rather than pure cassava stands.

ii. Early land preparation - ploughing and harrowing where necessary.

iii. *Maize:*

(a) Manure/Fertilizer application

- Spread manures uniformly before ploughing.
- Apply two handfuls of well-decomposed manure in each planting hole; mix well before placing seeds (use the same method for fertilizer as recommended).

(b) Planting is as described elsewhere.

iv. *Cassava:*

(a) The sweet varieties should be planted and not the bitter types.

(b) Different planting methods can be used and these include flat planting, mound planting or ridging.

- *Spacing*: 100 cm x 100 cm - each row of cassava being between two maize rows

(c) *Planting material:*

The cassava cuttings used should be disease and pest free

(d) Second weeding (for maize and first for cassava) should be done when the cassava is already established.

(e) *Cassava leaf prunning:*

Should start after the maize crop has been harvested (the cassava will be about 3 months old). Half the total number of cassava leaves per stem in a plant should be pruned from the ground level at two months interval until the cassava roots are ready for harvesting. At the time of root harvesting the rest of the leaves left on the plant can then be harvested (about 4 t DM of feed per ha per year can be realized).

<u>NOTE</u>: The leaves should be wilted or dried before feeding.

2.3 FODDER CROPS AND TREE NURSERIES

1. The availability of feeds in Western Kenya fluctuates both in quantity and quality over the year in response to the fluctuating pattern of rainfall. The tree legumes can provide high quality feeds for supplementation especially during the months when feeds are not adequate.

2. **Summary of Research Results**

Forage DM Yield (t/ha), %CP and %DM Invitro Digestibility

Cropping Systems	Leucaena	Sesbania	Pigeon-pea
Intensive feed gardening	17.0	13.0	4.0
Hedge rows	17.0	13.0	4.0
Alley - cropping	-	6.0	-
Intercropping	11.0	5.0	4.1
Mean CP	25.0	26.0	25.0
Mean %DM invitro digestibility	57.7	74.3	62.1

NOTE:

There is a potential for fuelwood depending in the management system used.

References:

Mathuva et al. 1986, Sidahmed et al. 1984,

Kenya Woodfuel Development Project, Kakamega, booklets No. 1-4.

3. **Recommendations**

i. Start nursery preparation and planting two months before rains start. There are many advantages of using a nursery over direct planting.

ii. *Site Selection:*

(a) Select a good site near water source.

(b) The soils at the site should be well-drained and fertile.

(c) The soils should be loosened and raised.

iii. Fence the site away from livestock.

iv. *Preparation of seeds for planting*

(a) Some seeds such as those of leucaena should be scarified before planting. Clipping off the seed coat on the side away from the embryo is recommended.

(b) Some legumes such as leucaena exhibit rhizobium strain specificity. The seeds should be inoculated with suitable rhizobium for effective nodulation.

v. *Actual planting:*

Make furrows. The depth of these depends on seed size, the larger the seed, the deeper the farrow and vice versa.

vi. *Nursery management:*

(a) Water the nursery every morning and evening if there are no rains, reducing this frequency as seedlings become older.

(b) Seedlings should be in the nursery for approximately one month before being transplanted into tubes.

(c) With some fodder crops, once you have established trees, a lot of seedlings emerge under the trees at the onset of rains and these can be directly transplanted into tubes or into the field without establishing a nursery eg. with leucaena and sesbania.

(d) Some fodder crops may be raised from cuttings eg. gliricidia. These cuttings can be planted directly into the tubes or in the field.

vii. *Transplanting seedlings:*

While establishing your seedlings into the field, spacing will depend on the cropping system used.

(a) *Spacings:*

Hedgerows and feed-banks:

90 cm between rows and 30 - 50 cm between plants within the row.

Intercropping: 90 cm x 30 cm

Alley-cropping:

Plant two pair rows of the legume forage 4 m apart. The maize or any other crop is then planted within the 4 m space between the fodder crop rows.

(b) *Preparation of transplanting holes:*

Dig a hole, thoroughly mix two tablespoons of double or triple superphosphate fertilizer with the soil then transplant your seedlings in the morning or evening, firming the soil well around the seedling.

If organic manure are used add it into planting hole taking handfuls of well decomposed manure and mix it well with the soil before transplanting the seedlings.

viii. *Weeding:* Keep fodder crop seedlings weed-free.

ix. *Fodder harvesting:*

(a) The time before seedlings/trees may be harvested for livestock feeding varies with both the tree species and type of management.

(b) The time to start harvesting depends on the type of management eg. after two months from planting for sesbania in an intensive management system or upto four months in alley-cropping systems.

(c) *Height of cutting for intensive management:*

Cut at 60 cm above the ground whenever the regrowth is more than 30 cm above the cut canopy. This gives about six cuttings in a year. However, where the fodder trees may have been planted for other uses eg. wood for construction, other methods of harvesting such as prunning of branches may be preferred.

x. Feed the fodder generated directly to the livestock, and/or conserve the excess as hay.

xi. The roots and stems should be removed whenever 50% of the crops in the field die - off due to aging.

2.4 PASTURES/FALLOW LAND

1. Pastures and fallow land still constitute between 50% and 80% of the feed-resources in small farms. The quality and quantity of forages in these, however, fluctuates very drastically. For example, percentage crude protein (% CP) in grasses may vary from 21% to below 7%. These drastic fluctuations are mainly caused by rainfall, soil fertility, grazing management and plant phenology. There is a need for proper management. However, it should be noted that goats are capable of selecting high quality feeds so that the drastic fluctuations in quality are not reflected in goat diets sampled by mimicking grazing goats. See % CP in table below.

2. Summary of Research Results

   DM Yield (t/ha), % CP and In Vitro Dry Matter Digestibilities (IVDMD) of Natural Forages in Western Kenya as Mimicked by Grazing Goats are shown in the Table below.

	The Major Seasons in a Year	
DM Yield (t/ha)	0.80	1.26
% CP	16.44	11.83
%DM invitro digestibility	53.11	60.33

ii In four different experiments performed at different sites, N-fertilizer application gave a mean increase in DM yield of about 193%.

iii Some legume tree crops enhance the growth of grasses growing under them, eg. *Acacia albida*.

References

Onim et. al. 1984

Mathuva et. al. 1987

Onim et. al. 1986

Lungu in Africa Series: Agroforestry in African Farming Systems, 1985.

3. Recommendations

   i. Remove all the weedy species that would suppress the growth of grasses, browse species and fodder legume trees.

ii. Apply organic or inorganic fertilizers to your pastures to increase quality and DM yields.

iii. Do not over graze your pastures, hence do not graze the pastures to a sward height below 4 cm.

iv. Cut any excess growth when 50% of the forages in a sward reach flowering stage and store these as hay for later feeding of livestock. Cut only when there is adequate sun for drying. This management strategy will improve the growth of the pastures as well as maintaining them at high quality for a longer time. The total yield (the forages directly grazed plus the conserved) will be high.

v. When you tether your livestock make sure you change the tethering sites frequently to avoid trampling the pastures to bare ground. The rotation might also reduce the build-up of intestinal parasites at a single site.

vi. When cattle are grazed on a pasture they usually drop dung on it. The pastures around the dung pats would grow tall but the animal will reject them resulting into pockets of grass surrounded by overgrazed areas. To ensure uniform utilization of the pastures spread the dung over the pastures.

vii Avoid grazing animals in waterlogged pastures to avoid trampling and suffocation of the grass. In the dry season graze the pastures less frequently to avoid soil erosion.

viii. During the rainy seasons, broadcast legume seeds on the pastures and plant scattered tree fodder legumes within or around the pastures.

ix. If a farmer does not have enough animals to utilize his pastures and fallow land, he can lease it out for neighbours to graze or he can cut the grass and sell for cash. For example, the market price of mixed grasses is about Ksh. 2000.00 per ton of DM in Western Kenya. (1 gunny bag full of fresh grass costs Ksh. 10.00 in the local markets).

2.5 FEED CONSERVATION AS HAY AND SILAGE

1. Since there is a fluctuation of feed production in a year due to seasonality of rainfall and other environmental factors, there is a need to conserve feeds during periods of excess for utilization when feeds are not adequate. This ensures uniform distribution of the feeds throughout the year. Simple methods of hay and silage-making have been developed to address this problem. Conservation ensures that the feeds are harvested when dry matter yields and quality are optimal.

2. Summary of Research Results

   i. Hay-making

   a. A farmer can cut 0.125 ha (1250 sq m) of forage within 4 to 5 hours. The amount of feed cut per hour will depend on the species harvested and its fresh forage yield per hectare. However, it can generally be upto 0.4 tons of dry matter per day. The harvesting can be done between two and six times in a year.

   b. The time between cutting the forage to the time it is ready for storing is about 2 days for grasses and less for the legumes.

   c. Quality of stored hay remains the same for a period of several months in Western Kenya.

   d. The table below shows the rates of drying of some forages cut on a sunny day (average temp. 32 deg.C.) in Maseno and the crude protein (% CP) content of the fresh forages and their hays after six months of storage.

	Moisture Content (%)		% CP	
Forages	Fresh	After 10h	Fresh	Hay
Sesbania	70	4	13.8	13.4
Pigeon pea	68	3	14.4	16.0
Rana grass	77	11	10.3	9.4
Leucaena	66	3	26.6	19.3
Sudan grass	66	21	28.2	36.7
Mixed grasses	78	8	26.9	36.0

ii Silage making

a. There are several forage crops that are not suitable for hay making and should therefore be conserved as silage. There are many types of crops that can be ensiled and these include maize stalks, napier grasses, sugarcane tops, sorghum stalks and other grasses.

b. When using a machete (panga) one person can chop upto 150 kg of fresh material within 4 hours.

c. When the chopped materials are packed in gunny bags and stored in air-tight trench or pit silos, good silage can be achieved and this can stay in good condition for several months in the silo.

d. Percentage dry matter crude protein and in vitro dry matter digestibility of some forages before ensiling and after six months ensiling are shown in the Table below

Compared to the fresh material there was a %DM increase of 42.3%, and increase of 5.37% in %CP and a decrease of 12.0% in %IVDMD after six months of ensiling.

	% DM Invitro					
	% DM		% CP		Digestibility	
Forages	Before ensiling	After 6 mth	Before ensiling	After 6 mth	Before ensiling	After 6 mth
Maize	22.58	20.83	6.08	9.28	51.05	47.31
Bana grass	15.90	16.94	12.59	10.38	68.97	56.28
Sugarcane tops	23.67	33.97	5.52	3.88	52.24	45.51

NOTE:

When molasses or jaggery sugar is used as an additional source of water soluble carbohydrates then the fermentation quality is greatly improved.

References

FAO Publication, 1986

Onim et. al., 1985

Otieno et. al., 1986

3. Recommendations

i. Hay-making

There are several methods of storing hay and these include standing hay, hay stacking and baled hay.

a. *Cutting and drying*

Cut the forage when it is at its best quality eg. for the grasses cut when 50% of the grasses in a sward are in flower. This compromises between quantity and quality.

- For the grasses leave them to dry in the field.
- For most of the legumes gather and carry away the cut material while still wet to avoid shattering of leaves.
- Cutting should be done on a sunny day during the dry (not rainy) spell.
- Spread the forage thinly when drying and turn them over (tedding) in the evening.
- Moisture content in the forage should be below 20% before the hay can be gathered for storage. This would usually take place within 2 days of drying.

b. *Gathering and storing*

In the case of grasses gather the dry grass and transport to the storage site. For the legumes, once the leaves have dropped they can be gathered and stored appropriately eg. in gunny bags.
Two storage methods can be used.

Hay-stacking method

- Stack the hay on a raised platform to keep away termites
- Compact the layers as you pack into a pyramid or conical shape. Once the stack is ready cover it to keep off rain.

Thatch the top of the tack with a thin layer of grass

Hay baling method

- A simplified hay-baling box can be used.
- Lay cut twines inside the box lengthwise and cross-wise
- Gather the dried hay and compress tightly into the box
- Pull the twines hard and tighten. Pull the bail out and store in appropriate place.

- Feed the hay in small quantities as a supplement during the time of feed shortages.

ii Silage-making

a. Dig a trench measuring about 5 m long x 3 m wide x 1.5 m deep.

b. Harvest the forages at appropriate physiological stages eg. Maize - 125 days from planting in Western Kenya. Bana grass - when about 1.5 m tall.

c. Chop the harvested materials separately with a machete (panga) or a hand-powered chaff cutter if available to lengths of about 1.5 cm.

d. Tightly pack the chopped materials into gunny bags packing each crop species into a separate bag. A tightly packed bag will weigh about 35 kg green weight.
The bags should be synthetic ones.

e. With crops requiring addition of a source of water soluble carbohydrates eg. young bana grass less than 1 m tall, add 1.5 kg of molasses, diluted with an equal amount of water, into each bag.

f. Tie the bags tightly with a twine and pack all of them horizontally into the already dug trench (or pit)..

g. Cover the bags with a polythene sheeting then with the earth that was removed at the time of digging the pit, then compact the soils by jumping on it.

h. Remove each bag as required by opening one side of the silo. Put back the sheeting and the earth and cover properly each time you remove a bag.

NOTE:

There is another method of silage-making suitable for small scale farmers and this involves ensiling straight in the trench without using any gunny bag. This has high spoilage when the pit is open due to air rushing in.

2.6 FEED STORAGE

1. There is lack of adequate storage facilities or structures in small scale farms in Western Kenya. The shortage is more acute for hays. Various methods of storage have been tried, for example, stacking hay outdoors, stacking hay bales outdoors, hanging hay bales on eaves of roofs and the use of multipurpose stores. All of these have some disadvantages eg. in terms of costs of construction, high spoilage due to rainfall and termites, and the bales when hang on the eaves may pull down roofs.

   This is where ensiling by pit method may have an advantage in that it saves on the available above ground space.

2. Summary of Research Results

   Of all the above tested methods of storage, silage pits, hay stack, multipurpose stores, and stacked baled hay are the most cost effective and suitable for small scale farmers.

References

FAO publication, 1986

FR and NM experiences in Maseno

Bunda College of Agriculture, Lilongwe, Malawi

3. Recommendations

   i Silage pit (Gunny bag method)

   a. Dig a pit of about 5 m long, 3 m wide and 1.5 m deep at a sloping site and away from an area subject to waterlogging.

   b. Gunny bags and polythene sheeting are needed for storing the forages and the details of the procedure are as mentioned elsewhere in these recommendations.

   c. Once the pit is dug it can be re-used several times. The same is true for the gunny-bags.

NOTE Direct ensiling into open pits without using gunny bags can also be done and oil drums filled with water used for compacting the ensiled material. Like other direct ensiling methods, this method can result into surface spoilage of the silage due to exposure to air at feed out time.

ii Loose hay stack

a. Stack the hay on a raised ground to avoid ground surface water from reaching it.

b. To avoid termites use a raised platform or a pile of stones.

c. The platform stands should be vermin and termite proof eg. paint the stands with old engine oil or wood preservative.

d. Incase of piled stones sprinkle old engine oil on and between the stones or use wood ash to keep termites away.

e. Use cheap and readily available building materials to reduce the cost of construction.

f. Once the hay is stack and compacted into a pyramid or a conical shape, thatch the top to keep off rain water. The thatch should be on a framework of twigs that can be lifted and placed back when the hay is being removed.

iii Multipurpose store

a. Where there are other stores such as grain cribs, these can be used for storing hay when the grains have been threshed and stored elsewhere.

b. Where there is a need to construct new stores, then very simple and appropriate building materials should be used eg. weaved stores - two types of these are available, the fixed types and the wooven large basket types.

c. Raise the stores off the ground and they should be termite and vermin proofed.

d. Thatch the roof with suitable but cheap and locally available materials such as grass or papyrus reeds.

e. The stores can be used for hay storage for part of the year and for grain during other parts of the year.

iv Stacking baled hay

a. Baled hay can also be stored on raised platforms and covered with a removable thatched roof.

b. Stack the bales to a height not more than 2.25 m to allow the roof to be placed well on top.

c. The platform should be 2.75 m x 2.55 m. This will accommodate about 15 bales in a single layer, each bale being 85 cm x 55 cm x 45 cm. Pile the bales up into five layers giving a height of 2.25 m. Overall the stack will accommodate upto 75 bales of 20 kg each giving a total of 1.5 tons of DM of feed.

d. The pitch of the roof should be steep enough to allow rain water to drip off. The angle of the pitch should not be less than 45 degrees.

e. Use light materials for roof construction eg. dry sorghum stalks, twigs of shrubs or trees eg. *Lantana camara*, or other light materials such as *Phragmites mauritianus* ("Odundu", Luo).

f. Thatch the roof with light grass.

2.7 IMPROVING SOIL CONSERVATION AND FERTILITY

1. Degradation due to soil erosion caused by water run-off is quite common in Western Kenya. Soil surveys in the area indicate deficiencies in several macro- and micro-nutrients.

   Small scale farmers often lack the cash for purchasing commercial fertilizers. In order to increase food and feed yields on these small farms the problems of soil conservation and improved fertility should be urgently addressed.

2. Summary of Research Results

   i. Application of fertilizers easily gives yield increases of 200% in Western Kenya.

   ii. In a green manure study in Maseno where green leaves and young stems of legumes (Leucaena, sesbania and pigeon pea) were incorporated into the soil as green manure and compared with maize stover incorporation and fallow land, various amounts of DM and Nitrogen were added into the soil as a result,as shown in the table below.

Treatments	Feed DM yield (Kg/ha)	N-yield (Kg/ha)	Test crop responses: Maize grain yield (Kg/ha)	Test crop responses: Bean grain yield (Kg/ha)
Maize	7793	120	5156	596
Pigeon Pea	4806	161	6378	389
Leucaena	16659	643	6578	478
Sesbania	13603	448	6667	433
Fallow	-----	---	3911	307

NOTE:

The green manures were incorporated six times in the course of one year.

   iii. Grain yield increases in maize, for instance, was 71% higher when fallow plots are compared to those where sesbania was incorporated, giving a yield difference of 2.8 t/ha between the two treatments.

References

Orim et al., 1986

East African Crops, Ackland, 1976

Ssali et.al.

3. Recommendations

i Soil conservation

a. Establish soil erosion strips and terraces across the field. The number of these bands will depend on the slope of the field, the steeper the slope the more bands will be required. These bands can take many forms eg. grass strips, tree strips and trenches.

b. The bands should be stabilized with recommended fodder grasses and legumes such as napier grass and leucaena.

c. The fodder crops on the bands should not be allowed to spread into the crop field. They should be cut frequently for feeding livestock.

ii. Soil fertility improvement

This can be through several methods; - application of livestock manures, using manures from composed heaps, use of legume crops (through nodulation, leaf litter and green manures) and application of inorganic fertilizers.

a. *Livestock manures*

Livestock manures, from the homestead can be spread directly into the field on a daily basis and then incorporated into the soil when the land is being cultivated. However, this is not the most effective method and large quantities of manure will be needed to realize any marked yield responses.

b. *Livestock manure heaps*

As you clean the livestock houses (or boma) heap together the manures at a particular site, preferably under a shade within the homestead. Do this continuously until planting time when the decomposed manures should then be removed and spread uniformly on the field before ploughing.

Alternatively, it can be applied directly into single holes at the time of planting of crops and mixed thoroughly with the soils before placing the seeds.

c. *Compost heaps*

Cleanings from the homestead and crop fields can be heaped together at a site in the homestead. This heap should be turned frequently to enhance decomposition. The well decomposed manure may then be applied in a similar manner as described in (b).

d. *Legume crops*

1. *Leaf litter* - plant the recommended fodder legume trees, perhaps for other uses eg. fuelwood. Leaf litter falling from the trees will improve the soil fertility over time.

2. *Green manures* - plant your fodder legumes using high density spacing (90 cm x 30 cm) eg. sesbania, leucaena and pigeon pea) in a piece of land that you do not intend to use for food crops that season. Once the crop is established taller than 60 cm above ground, cut back at 60 cm above the ground dropping the cut material on the soil. Repeat this every time the crop regrows above 60 cm (6 cuttings per year is possible).

   After one year dig out the legumes and plough the field (potential for fuelwood from the stumps is quite good).

   This method can return to the soil upto 600 Kg of N/ha/year.

e. *Inorganic fertilizers*

Use these as recommended. In Western Kenya there is an acute phosphorous and Nitrogen deficiency in the soil. Therefore, the use of compound fertilizers high in these nutrients (eg. DAP 20 N:46 P: 0 K) is strongly recommended.

2.8 GRASS FODDER CROPS

1. Due to the fluctuations in feed production in Western Kenya, there is a need for high yielding fodder crops that can also remain productive and green for over the dry periods. However, these high yields and the persistency of productivity depends on the frequency of cutting (harvesting) and fertilizer application .

   Fodder crops here refers to those feeds that are grown and cut for feeding and not often directly grazed in the field. They include Napier grass (*Pennisetum purpureum*) derivatives (eg. Bana, Pakistan hybrid, and Clone 13), Guatemala grass, Sudan grass, and local and giant Panicums.

2. **Summary of Research Results**

   The quality data on these fodder grasses generated at Maseno Research Station indicate that they have very high dry matter yields (5 cuttings in a year), good protein contents and digestibilities as shown in the table below.

Cultivars	Fodder DM yields t/ha/yr	Mean %CP	%DM invitro Digestibility	Palatability ranking
Bana*	39.0	13.1	61.0	6**
Clone 13*	33.0	9.7	59.0	2**
Pakistan hybrid*	27.0	12.8	60.0	---
Sudan grass	22.0	12.0	64.0	---
Giant panicum	19.0	11.0	56.0	3**
Local panicum	17.0	11.3	59.0	---
Guatemala grass	20.0	11.2	58.0	---

* Napier grass derivatives
** This ranking was based on palatability by goats where 6 grasses were used in a cafeteria feeding system

References

Mathuva et. al., 1986

Wouters, A.P., 1986

Tropical Feeds, (FAO), 1975

Chudleigh P.D., 1974

3. Recommendations

There are many different ways in which these fodder grasses can be planted and these include, feed gardens, alley cropping, hedgerows, soil conservation and soil erosion bands and in the fields.

i. *Land preparation*

The field does not need to be finely cultivated when vegetative materials like cuttings or splits are used. Fine tilth is however, necessary when seeds are used.

ii. *Field establishment*

Cuttings and splits should be established at the beginning of rains when the soils are sufficiently wet.

There are two alternative methods of field establishment:- direct field planting and raising the seedlings in a nursery (eg. raising of napier grass derivative cuttings in a nursery).

a. *Direct planting*

Here the planting materials will either be cuttings or splits. These should be taken from mature plants.

Splits: Each split should at least contain one stem to enable the farmer to establish a large field with manageable quantities of planting material since these are bulky. eg. for Guatemala and Panicums.

Cuttings: These should have at least three nodes. They should be pest free from, especially Mealy bugs and scales.

Spacing: *Napier derivatives and Guatemala*: 50 cm x 100cm. *Sudan grass and Panicums*: 45 cm between rows and the seeds to be drilled within the rows. Incase splits are used as in the case of Panicums, then use a spacing of 45 cm between rows and 30 cm within rows.

b. *Nursery establishment* (Napier derivatives)

This method has several advantages.

You can start planting a month or two ahead of the rains and thus the feeds can be available in the farm within a very short time.

You can generate seedlings from single nodes, hence a few planting canes (stems) can produce 5 to 10 times more plants than the direct field planting method where cuttings are used.

You can avoid termites which is a common problem with cuttings. However, this method is more labour intensive and requires availability of water.

The important steps to follow:

1. Fill small polythene bags which are perforated at the bottom with good nursery soild mixture and firm it well. 100 polythene bags costs Ksh. 7.00. at the moment.
2. Water the tubes thoroughly, then plant the single cut node right-side up.
3. Keep watering until the cuttings germinate. Usually within one week the buds will start to grow. Water once a day preferably until the onset of rains.

iii Fertilizer application

a. Apply one handful of well-decomposed livestock or compost heap manure and mix thoroughly before planting the splits, cuttings or nursery seedlings.

b. Incase of Inorganic fertilizers use compound fertilizers such as NPK or DAP. Apply one teaspoonful per hill. The fertilizer should be thoroughly mixed with the soil before planting.

iv Weeding

A single weeding would be adequate.

v Harvesting

Incases where splits and cuttings are used the first harvesting can be done after 3 months from planting. However, where nursery seedlings are used then the first harvesting should be 3 weeks from planting, depending on other factors like size of seedling at transplanting to the field, soil fertility and rainfall.

Do not allow your fodder grasses to develop into hard stems. eg. for the Napier grasses cut when 1 m high.

vi Top dressing

Top dress with organic or inorganic fertilizers at the onset of every rains to stimulate growth during rains.

vii Utilization

Fodder grasses are important feeds in cut-and-carry systems (zero-grazing) because of their high productivity and good quality. Incase of surpluses, these can be conserved by ensiling (Napiers and Guatemala) and silage or hay for Sudan grass or Panicums.

NOTE:

We recommend that each farmer cultivates 0.125 ha (1250 sq m eg. 35 m x 36 m) of fodder grasses every year. This may be planted in various farms: feed gardens, alley cropping, hedgerows, soil conservation and soil erosion bands and in the fields. This will provide 3.2 tons of dry matter of fodder per year.

2.9 SWEET POTATO AS A FOOD AND FEED CROP

1. Acute fluctuations in both human food and livestock feeds occur in Western Kenya in a year. Since sweet potato tubers can remain in the field for some time before harvesting, it is one of the insurance crops that small holder farmers depend upon during periods of food shortage. That they also have a large tuber yield potential is an important asset in small scale farms in Western Kenya where human population is very high.

   The fluctuations in feed quantity and quality that also occur in Western Kenya in a year can also be effectively overcome by sweet potato vines which have a high quality (high palatability, digestibility and % CP). These high quality characteristics and the high water content of the fresh vines make them an effective milk replacer for young livestock (goat kids, lambs and calves). When fed on sweet potato vines the young livestock can be weaned early thereby releasing sizable quantities of milk for human consumption.

2. Summary of Research Results

   i The major feed quality parameters and the fresh tuber yields of three sweet potato types (tuber types, vine types and dual purpose types) in Western Kenya are summarised in the table below:-

Cultivar types	Fresh tuber yield t/ha/yr	DM yield t/ha/yr	Vine characteristics % DM invitro Digestibility	%CP	% Moisture Content
Tuber types	18.4	7.6	66.0	15.8	75.0
Dual Purpose types	6.7	9.7	70.0	16.1	78.0
Vine types	3.8	14.1	74.0	16.0	80.0

   ii From experimental plots in Maseno, upto 21 tons of fresh tuber yield/ha/yr, 21% CP in vines, 14 tons of DM yield of vines/ha/yr, and a digestibility of vines of 77% have been realized in the best cultivars in these parameters.

   Sweet potato vines can therefore provide adequate Nitrogen in livestock diets in the same way as would forage legumes.

References

Onim et. al, 1986

Karachi, 1986

IITA Annual Reports

4. Recommendations

i *Land preparation*

Sweet potato requires deep cultivation for good tuber development. This may also be achieved by ridging or mounding which also helps good tuber development in areas with water logging and shallow soils problems.

However, there are no major yield differences between flat planting and mounding where water logging and shallow soils are not a problem and where ploughing is deep. When ploughing ensure couch grass is totally removed from the fields.

ii *Planting*

a. *Time of planting*

Plant at the onset of short or long rains. Where there is labour constraint, plant after you have planted the food crops. The planting of sweet potato can be done in a separate field from other food crops or in between the food crops such as maize after the main crop has been weeded.

b. *Varieties*

Select suitable varieties for your particular needs eg. tuber, vine or dual-purpose types (These types can be obtained from Moseno or Kakamega Research Stations). The planting materials should be disease free particularly from viral diseases.

c. *Spacing*

A spacing of 40 cm between rows and 30 cm between plants within a row is recommended. Cut the planting vines at least 30 cm long of which 20 cm from the cut end should be burried in the soil during planting.

iii *Weeding*

Sweet potatoes should be kept weed free all the time. The vines should be earthed-up at the time of weeding to encourage tuber development.

iv *Vine and tuber harvesting*

After 4 months from planting the early maturing cultivars will have formed tubers and the first tuber harvesting can be done. A selective piecemeal harvesting of vines should also begin from this time. Upto 40% of the vines can be removed from the canopy without significantly reducing tuber yields.

However, much less vines should be harvested during the dry seasons if tuber yields are not to be affected.

If these steps are followed, upto 10 tons of DM of vines/ha/yr with 18 tons of fresh tuber/ha/yr from suitable cultivars can easily be realized..

g. *Feeding of vines*

For the young livestock (Goat kids, lambs, calves)

It is advisable to feed fresh vines from the field without wilting since the young livestock require the high moisture content of the vines.

For adult livestock

The vines should be wilted for about one day before feeding. This is important because the high moisture content of the vines fills up the gut thereby reducing the dry matter intake and could subsequently lower the livestock productivity.

NOTE:

We recommend that each farmer cultivates 0.125 ha (1250 sq m eg. 35 m x 36 m) ha of sweet potatoes every year. This provides 2.5 tons of tubers and 1.3 tons of dry matter of vines.

SECTION III

HERD HEALTH RECOMMENDATIONS FOR DUAL-PURPOSE GOATS IN WESTERN KENYA

3.1 GENERAL

These recommendations are meant to cover some problems specific to the study area and are not meant to be inclusive or to duplicate three other worthwhile handbooks on goat health.

1. Goat Health Handbook. A Field Guide for Producers with Limited Veterinary Services. T.R. Thedford. Winrock International Information Services Publication, Morrilton, Arkansas 72110 U.S.A.

2. Dairy Goat Management: External and Internal Parasites. A.B. Watkins. International Dairy Goat Research Center, Praire View A&M University, Praire View, Texas U.S.A.

3. Diseases of Dairy Goats. N.L. Gates. Western Regional Extension Publication, Washington State University, Pullman, WA 99164 U.S.A.

Also, these recommendations are made with consideration to rules and regulations in Kenya regarding procurement and administration of drugs. Veterinary services in the study area are delivered by the government through district veterinary officers and their animal health assistants. Government regulated fees are charged for services and drugs. It should be noted that many farmers live several kilometers from the veterinary officers without telephones or ready access to transportation.

3.2 RECOMMENDATION FOR GOATS ON FARMS

These procedures are selected to provide as small an economic input as possible, yet keep the high-production, dual-purpose goats in good health.

3.2.1 Ticks

Most goats in Western Kenya will have a few ticks.

Solutions:

1. The farmer should examine all goats 2 times per week.
2. All ticks should be removed be hand except those in sensitive areas such as between the toes and on the eyelids. Ticks in these areas should be left on the goat and pierced with a large sharp pin or thorn. The pierced ticks will die and drop off the goat without causing irritation and infection.
3. If hand removal of ticks is not done and ticks build up to 30-40 per goat, the farmer should take the goat to a local dip or spray.

Rationale:

1. Dips and sprays are expensive.
2. Complete control of ticks by regular dipping causes goats to lose immunity to tick-born diseases. If the tick control is relaxed, large numbers of infections occur.
3. Tick counts on goats in the study area low enough for hand control.

3.2.2. Hair loss and itching which is manifested by excessive scratching

Causes: The most common causes are lice, mites and fleas.
Lice and mites cause dry, crusty skin.
Fleas cause the goats to scratch which irritates the skin. Fleas can be seen by the farmer when the affected skin is examined.

Solution:

1. In the case of fleas, the goats should be sprayed by the farmer with a commercial flea spray. Since dogs are the usual source of fleas, the dogs should be sprayed.
2. Other cases should be taken to the local dip.
3. If the skin condition remains after 2 dippings, the veterinary assistant should be contacted.

3.2.3 Cuts and injuries

Solution:

1. Minor cuts - the farmers should clean the cut with soap and water and allow the cut to heal.
2. Cuts requiring sutures - the farmer should contact the veterinary assistant.
3. Lameness - In cases where the goat will not stand or put weight on the foot for 2 days, the farmer should contact the veterinary assistant.

3.2.4 Internal parasites (worms)

Solution:

1. The farmer should drench every 6 weeks.
2. The drug and amount are those recommended by the government for the area.

Rationale:

1. All goats in the study area have internal parasites.
2. The number of eggs hatching to infectious larva are highest after a rain. Therefore, in some areas the drenching schedule can be based on the rain or rainy periods. In the study area, rainfall is too frequent to serve as a basis for treatment.
3. No reliable and economical indicators of when to treat are available to farmers.
4. Untreated dual-purpose goats have decreased milk production and weight-loss. When other disease occur in conjuction with parasites, death can occur.

3.2.5 Breathing hard, coughing and poor appetite

Causes: These signs of pneumonia are most often caused by *Pausteurella* and other bacterial pneumonias and by CCPP.

Solution:

1. The farmer should try to prevent bacterial pneumonias in both kids and does by providing clean, dry housing and by keeping the goats out of the rain.

2. Goats should be vaccinated for CCPP.
3. If these preventions do not work and goats develop signs of pneumonia, a veterinary assistant should be contacted for treatment.

3.2.6 Blisters around mouth and on teats, poor appetite, depression

Cause: Orf virus causes this disease which can affect kids as well as does.

Solution:

1. There is no treatment or readily available vaccine. The goats will get over the disease in a few days.
2. Farmers should wear gloves when handling animals with blisters on the mouth and teats.

3.2.7 Kids sick and having signs including poor appetites, diarrhoea, coughing or breathing hard during the first 3 weeks of life

Cause: Failure to obtain colostrum in high enough quantities or early enough after birth.

Solution:

1. The farmer should make sure kids suckle as much as possible and as soon as possible after birth. Weak kids should be assisted.
2. If kids show any of the signs described, a veterinary assistant should be contacted for treatment.

Rationale:

1. Most infections of any type in young kids occur because of inadequate transfer of antibodies from the colostrum.
2. The most important determinants for adequate transfer are the amount of colostrum the kid gets and the time after birth when the kid gets colostrum.
3. Absorption by the kid starts to decrease by 6 hours after birth and very little absorption occurs after 24 hours.

3.2.8 Swollen udder, clotted milk

Cause: Bacteria cause inflammation of the udder (mastitis) which results in a swollen udder that causes pain when touched and clotted milk.

Solution:

1. The farmer should always wash the udder with soap and water before milking.
2. If mastitis occurs, the goat should be treated by infusing antibiotic preparations into the udder by the farmer or veterinary assistant.

3.2.9 Lame goats which have hooves with bad odour

Cause: Foot rot caused by bacterial infection.

Solution:

1. Farmers should prevent foot rot by keeping feet trimmed and housing goats in a dry place.
2. If foot rot occurs, the farmer should have the goats walk through a copper sulfate solution until cured.

3.2.10. Abortion

Cause: There are several causes but the most common and serious is *Brucella melitensis*.

Solution:

1. When an abortion occurs, the farmer should contact the veterinary officer.
2. Aborted fetuses and membranes should not be handled without rubber gloves.

3.2.11 Other diseases not described in these recommendations

Cause: There is a long list of infectious and non-infectious diseases that occur in goats in the study area that include heartwater and typanosomiasis. A list of these diseases is in the Goat Health Handbook.

Solution:

1. The farmer should isolate newly purchase goats from others for at least 1 month to prevent introduction of diseases.
2. The farmer should contact the veterinary officer with serious problems that do not fit in the described diseases.

Rationale:

1. The value of individual animals, the distance of the farmer from veterinary services and the distance of veterinary services from major diagnostic centers, prevent the application of many diagnostic procedures and treatments.
2. Our recommendations cover most of the problems documented by SR-CRSP monitoring programs in Western Kenya.
3. Management strategies continue to be the best and cheapest way to prevent disease.

3.3 Recommendations for SR-CRSP goats

Brucella mellitensis occurs in goats in several areas of Kenya. This is the major type of brucellosis in goats and it is transmissible to humans through milk and contaminated tissues, especially aborted fetuses and placental membranes. Therefore defined procedures must be implemented to prevent infection of SR-CRSP goats. Since SR-CRSP goats are being bred and maintained in large groups and since SR-CRSP does not want to introduce certain diseases into their herds or onto farms, the following procedures are done.

3.3.1 Contagious caprine pleuropneumonia

This disease occurs in epizootics and can be devastating to goats on small or large farms and especially to multiplication centers. There mortality is high and goats that survive have pneumonic lesions that cause decreased productivity.

1. Therefore, for goats that are purchased or transferred from other stations the following is done:

   a. Goats are bled and checked for brucellosis before being brought to an SR-CRSP station.

b. When the goats arrive at the station they are vaccinated for CCPP.

c. Goats are quarantined for 6 weeks in facilities that are physically separated from other goats and observed. Goats that become sick are not mixed with other goats unless treated and cured.

d. At the end of 6 weeks the goats are retested for brucellosis

e. After 2 negative tests, goats are vaccinated with REV 1 brucellosis vaccine.

2. Kids born to vaccinated does are vaccinated with CCPP and REV 1 vaccines at 4 - 5 months of age.

3. Station goats are drenched every 6 weeks for internal parasites with the drench currently recommended for the area.

SECTION IV

BREEDING STRATEGIES FOR GENETIC IMPROVEMENT

Genetic enhancement by the smallholder farmer can be effected with no new inputs other than some simple records, and in some cases, with no changes or only modest changes in management. There are five major breeding strategies, which if executed appropriately will increase productivity on the farm.

4.1 MATING STRATEGY

Potential genetic progress is reduced by extended kidding intervals, forced culling due to low fertility and sterility. Recommended strategies are:

i) Yearlings bred first at 12 months of age

ii) Breed does within 18 hours after heat is detected. This ensures conception rate of greater than 70%.

iii) Rebreed does 60 to 90 days after kidding. It is possible to breed does 60 days postpartum; however, early breeding requires supplementation of kids and/or does. The optimum time is 90 days (3 months) postpartum without supplementation.

iv) Recommended mating practices: a) Breed the flock to the best buck, but avoid mating related animals (e.g. buck to daughter, buck to half sister). b) Castrate all unwanted males.

4.2 DOE CULLING STRATEGY

Genetic progress will be most rapid when only accurately evaluated genetically elite bucks are used. Every yearling female is raised as a herd replacement and few, if any, does should be culled involuntarily. Good doe-culling decisions require on-going month-by-month evaluation and doe comparisons. It is recommended culling decisions be based on both the animal's present and anticipated future production. The timing of removal also should be planned to minimize extended low-productivity periods.

4.3 HARVESTING THE GENETIC POTENTIAL

Genetically superior does must be fed and managed to achieve their genetic potentials. Failure to give herd members the opportunity to express their genetic capabilities will reduce the flock's productivity potential. Feeding levels that greatly surpass the animal's genetic capabilities are usually inefficient and economically wasteful.

4.4 IDENTIFICATION

Positive, permanent and accurate animal identification is essential to good records and genetic progress. It brings money, time, and convenience in day-to-day flock management. A written birth record containing sire, dam, birth date, and permanent animal identification for each kid takes little effort. The risk of mistaken identity will be smallest if done when each new kid is born.

4.5 RECORDS

The risk of management error can be reduced with good records to monitor and evaluate results, to establish realistic goals, and to provide the specific information for scheduling and executing management action. Kidding dates, milk production, health exams, heat dates, breeding dates etc. are critical for deciding when and which ones to watch for heat, to check pregnancy, to cull, to dry, to prepare for kidding, as well as how much to feed. Good records will help the farmer exert tighter control over management inputs. Production records are as fundamental to effective management as they are to genetic appraisal. Some important information include:

i) Month by month accounting of individual doe production: accumulated lactation totals for comparing does and for evaluating management factors affecting production results.

ii) Permanent identification records showing sire, dam, birth date for use in management and genetic evaluations.

iii) Important dates for doe management such as kidding, dry, breeding, due, and birth.

ANNEXE I

MEMORANDUM OF UNDERSTANDING

SR-CRSP vs. DPG FARMERS

1. Partners

First and foremost farmers must collaborate with SR-CRSP and Ministry of Livestock Development staff in all matters pertaining to DPG husbandry, management and health.

2. Handouts to the farmers (drugs, planting material, etc)

The new clusters established in 1988 are intended to be part of a farmer-managed trial of the DPGs. It was agreed, therefore, that the handout of free supplies, equipment, and drugs that were given to farmers in the previous phase of research will be eliminated. The only exception to this is that Feed Resources will supply seedlings to farmers to help them establish a forage nursery.

Drugs

The major role of the FR and NM field assistants is to advise the farmers concerning the recommendations in the "techpak" for managing the DPGs. Drugs will not be supplied free to the farmers nor will the SR-CRSP staff treat the animals for illnesses. The NM field assistants will carry a supply of non-prescription drugs (e.g. for drenching the animals as per recommendation) but these drugs must be purchased at a fair local price by the farmers. Prescription drugs (such as injections, anti-biotics) must be prescribed by veterinary officers.

Though the SR-CRSP encourages the use of the available veterinary services, farmers may use local herbal medicines to treat their DPGs if they wish. The field assistants should be informed of this treatment, however, and they should keep a record of the disease symptoms, the type of herbal medicines used, and the outcome of the treatment.

3. DPG ownership

Does place on-farm in the clusters are jointly owned by the farmer and SR-CRSP. To obtain full ownership of the does, farmers must be willing to co-operate with project staff and take care of the DPGs according to the recommendations contained in the "techpaks". This includes attendance at group meetings, willingness to allow SR-CRSP personnel to visit the farm and take measurements and do periodic interviews, and adherence to the health, nutrition management, and feed resource recommendations of the SR-CRSP. If farmers follow these procedures they will obtain full ownership of the does after two successful kiddings or in September 1990, whichever comes first.

If farmers are unwilling to follow the techpak recommendations, the DPGs will be withdrawn by the project and the farmer will not be paid any compensation for the upkeep of the goats.

A DPG buck placed on farm becomes the farmer's property after 10 successful services (conceptions) or in September 1990, whichever comes first.

The first batch of DPGS will arrive in the Clusters in September. Each farmer will receive one pregnant doe and one female weaner. A third doe will be provided to each farmer by the end of 1988.

4. Mating service

Owners of the DPG bucks will be expected to make them available for breeding DPG does owned by other farmers in the cluster. Buck owners should be compensated for mating services according to existing local practices. DPG bucks may be used to service local does as well.

5. Utilization and disposal

Of the initial generation of kids born on farm, the SR-CRSp will buy back all female kids when they are weaned at the approximate age of four months. Farmers will be paid a compensation of KSh. 200.00 per female kid.

All male kids and any female kids born after the first crop become the property of the farmer one year after the initial arrival of the DPG does (e.g. if the does arrive September 1988, male kids and females of the second and subsequent generations become the property of the farmer in September 1989). After this date the farmer may dispose of the kids as he/she wishes, but should report the disposal to the SR-CRSP.

All milk offtake from the DPG does may be utilized according to the farmer's wishes.

ANNEX 2

COURSE OUTLINE FOR COLLABORATING SR-CRSP FARMERS

1. Introduction
   - 1.1 SR-CRSP staff
   - 1.2 Farmers

2. Introductory Remarks on:
   - 2.1 Maseno station
   - 2.2 SR-CRSP (Morocco, Brazil, Indonesia and Peru)
   - 2.3 Farming systems research
     - 2.3.1 Descriptive
     - 2.3.2 Diagnostic
     - 2.3.3 Researcher managed and executed
     - 2.3.4 Testing farmer managed and executed
     - 2.3.5 Extension

3. Nutrition and Management Tech Paks
   - 3.1 Nursing strategy (problem starvation)
     - 3.1.1 Doe/kid bond
     - 3.1.2 Milk let down
     - 3.1.3 Assist kids inorder to suckle
     - 3.1.4 Colostrum
     - 3.1.5 Milking offtake schedule
     - 3.1.6 Stress avoidance (draught, cold or heat)
   - 3.2 Milk and milk hygiene
     - 3.2.1 Conducive environment (uniformity, gentleness, quietness and skill)
     - 3.2.2 Prepare your doe (supplementary feed)
     - 3.2.3 Correct milking procedure (discard first squirt)
     - 3.2.4 Check for mastitis (lumpy with blood clots)
     - 3.2.5 Stripping is essential
     - 3.2.6 Dry off when your doe is three months in-kid
     - 3.2.7 Pasteurize milk by boiling
   - 3.3 Sweet potato vies as a milk replacer for kids

3.4 Partitioning of feed energy

3.4.1 Maintenance

3.4.2 Production (growth, lactation and pregnancy)

3.4.3 Supplementary feeding

3.5 Crop residue

3.5.1 For maintenance alone (maize, sorghum, beans haulms)

3.5.2 Treatment necessary

3.5.3 Peelings of mangoes, bananas, etc. (appetite)

3.6 Weaning

3.6.1 Gradual weaning

3.6.2 Monitor intake of a new ration

3.6.3 Wean when 10 kg or more

3.7 Breeding strategy

3.7.1 Breed doelings when 20 kg or more, and in good body condition

3.7.2 Flushing at least three weeks before mating

3.7.3 Use bucks with high libido and sires twins or triplets

3.7.4 Breed/mate second day of heat

3.7.5 Ensure tethering does not impede courtship or mating

3.8 Pregnancy diagnosis

3.8.1 Estrous cycle 17-21 days

3.8.2 Gestation period 150 days

3.8.3 Pregsonic

3.8.4 Change of shape and size

3.9 Feedstuffs presentation

3.9.1 Hang your cut and carry feedstuff

3.9.2 Give least palatable feed first

3.9.3 Treat to enhance palatability and intake

3.10 Tethering

3.10.1 Length of rope 4 metres

3.10.2 Change tethering station at least twice in a day

3.10.3 Tethering pattern (other livestock, sun and herbage)

3.10.4 Avoid overlap of tethering areas

3.10.5 Avoid entanglement and accidents due to tethering

3.11 Goat house

3.11.1 Ventilated, draught free, dry floor, predator and theft proof

3.11.2 Not crowded

3.11.3 Plan available for a multi-purpose house

4. **Preventive Medicine**

4.1 Identification of a sick goat

4.2 Ecto-parasites control (ticks, fleas, lice, etc)

4.3 Endo-parasites control

4.4 Injuries/lameness

4.5 Poisoning

4.6 Unprofessional practice

5. **Feed Resources**

5.1 Production

5.1.1 Planting material

5.1.2 Planting preparations

5.1.3 Nurseries

5.1.4 When and how to harvest?

5.1.5 Dual purpose crops

5.2 Preservation

5.2.1 Hay

5.2.2 Silage

6. **Testing Phase - Monitoring Methodology**

6.1 Tagging

6.2 Weighing

6.3 Sampling of forage, faeces and blood

6.4 Feedstuff and water intake

6.5 Recording of milk yields and treatments

6.6 Group meetings

6.7 Visitors

6.8 Memorandum of understanding

ANNEX 3

SR-CRSP VETERINARY DRUGS PRICES

		KShs.
1.	**Antihelmintics**	
	Nilzan, Rintal, Wormicid etc. One dose	2.00
2.	**Antibiotics**	
	Oxytetracycline soluble powder, per treatment	2.00
	Clamoxyl tablets, per tablet	5.00
	Sulfa tablets, per tablet	3.00
	*Injectables, Oxytetracyclines, pen and strep etc; when authorized, per cc.	2.00
3.	**Topical applications**	
	Oxytetracycline spray	Free
	Eye ointment, per application	1.00
	Antiseptics, per application	1.00
4.	**Intramammary treatment**	
	Orbenin L.A., per tube	3.00
5.	**Other injectables**	
	Catosol, multi-vitamin, etc., per cc.	1.50
6.	Professional fees (Vet. Officer) plus drugs in accordance with GoK administered veterinary clinics country-wide, per treatment	20.00