

# **ANIMAL PRODUCTION ACTIVITIES in the DRYLANDS of EMBU and THARAKA-NITHI**

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## **Summary**

This review was prepared in order to assist in the planning of activities of the Livestock Project in the dryland areas down-slope from Embu. The farmers generally perceive that the major problems facing the livestock industry are to do with animal health. There is, however, recognition amongst the institutional representatives in the area, of the strong interactions that exist between nutrition and animal health and production. Research into the provision and utilization of high quality fodder is therefore of high priority in the area, even though the need is poorly appreciated by farmers. Although tree fodders are to be studied by DAREP under an agroforestry heading, the animal production activities of the group are currently concerned mainly with animal health issues. There are two other potential collaborators for animal work, these being the Goat and Sheep Project at Marimanti, and the University of Nairobi at their property at Machang'a. It is argued that in addition to the continuation of the evaluation work that has recently started with indigenous species, the Livestock Project should become involved in collaborative research to evaluate a range of exotic tree species, to measure animal utilization and production from these species, and to measure the production potential of local animals when kept under high standards of management, health and nutrition. There are a number of other activities, including studies on the supplementary feeding of draught animals, that could logically be addressed by the project, but it would be impossible to make a start on such topics unless a 3 year extension to the project were to be approved beyond the current termination date of mid 1996.

## **Introduction**

From its inception, the ODA-funded project entitled "Development and On-farm Evaluation of Agroforestry Livestock Feeding Systems" (LFSP) became an integral part of the wider National Agroforestry Research Project (NAFRP), a joint initiative between the Kenya Agricultural Research Institute (KARI), the Kenya Forestry Research Institute (KEFRI) and the International Centre for Research in Agroforestry (ICRAF). At the start of LFSP, emphasis was placed on work in the coffee based land use systems of the higher potential regions of the mandate area of the Embu Regional Research Centre (RRC) of KARI. This was because there was an existing body of research results from NAFRP, other activities of the centre and from private farms, regarding the adaptation of a range of tree species to the region and their growth rates in specific production systems (e.g. O'Neill, 1993). LFSP became a logical extension of these activities, with the aim of progressing beyond the basic agronomic work to study aspects of animal utilization of the most promising tree fodders.

While the higher potential areas support a high population density, they encompass only about 20% of the mandate area of the KARI Embu RRC. The remaining areas of lower agricultural potential, commonly classified as arid and semi arid lands (ASAL), are situated at lower altitudes, further down the slopes of Mt. Kenya. These areas have received attention from ODA-funded activities since 1982, starting with the Embu, Meru and Isiolo Arid and Semi Arid Lands (EMI ASAL) programme and followed by the Dryland Applied Research Project (DARP). In 1993, DARP, which had been largely concerned with crop production and water harvesting techniques, was recast and expanded by the inclusion, or reinstatement, of animal production, agroforestry, and participatory and socio-economic activities, to form the Dryland Applied Research and Extension Project (DAREP). Despite these continuing activities and the data that had emerged from the work, the area was still poorly understood from the point of view of animal production in general and the potential of agroforestry for livestock production in particular.

In February 1994, at the planning meeting of the East Africa Highlands agroforestry research network (AFRENA) coordinated by ICRAF, it was decided that Embu would become the lead (flagship) site for work on the use of tree foliage for animal production. This decision, together with the need to more fully address the requirements of the RRC mandate area, made it necessary to extend the activities of NAFRP, and with it, those of LFSP, into the ASAL. In view of the lack of detailed knowledge of the area however, it was considered appropriate to proceed with caution. The results of a number of farmer surveys, which had recently been conducted, or which were planned by both DAREP and ICRAF, were expected to provide guidelines which would be of use in the development of a programme of activities of relevance to farmers in the region. The time has now come for detailed planning of future research activities and the present paper has been prepared to assist in this process.

With effect from April 1996, it has been suggested by ODA that DAREP should be absorbed into the second phase of the National Agricultural Research Project (NARP-II), with a very reduced budget. KARI has clearly stated that adaptive research activities should continue in the ASAL areas, but unless alternative sources of funds are identified, the proposed changes will have a significant effect on the field work planned for the coming years. These could include the loss of the Technical Cooperation Officer (TCO) and a reduction in both the number of DAREP field sites and field activities. The present state of uncertainty has complicated the planning process, but there has been no alternative but to assume a continuation, at a reduced level, of the ASAL activities of KARI, with support from either NARP-II or from a rerieved and independant DAREP.

### **Characteristics of the Area**

The ASAL areas in the mandate region generally receive rainfall in the region of 600 to 900 mm annually, although annual totals often hide the potentially devastating effects of poor seasonal distribution. The rainfall tends towards a bimodal pattern with peaks in the periods from April to June and from November to January. The second season,

known as the short rains in the higher potential area, is more reliable than the first and only in relatively infrequent good seasons can two crops be obtained in a calendar year. The soils are frequently sandy, often relatively shallow and stony, with poor natural fertility. The better, more fertile soils are vertisols, with their inherent cultivation difficulties. Apart from a few major access roads, communications in the area are difficult and the inputs needed for technically advanced agriculture (seed, fertilizers, veterinary supplies, etc.) are both expensive and logistically hard to come by.

Almost all farmers in the area keep goats, either of local breeds or of crosses, as they can be readily sold in times of shortage of cash. The Galla breed is of local importance for cross breeding, particularly in those parts of the region which have had influence from the Goat and Sheep Project (GASP) located at Marimanti, even though it appears to be more susceptible to diseases than the local types. A number of farmers keep sheep, but their importance varies from area to area. Zebu cattle are present on most farms, although there is some evidence to suggest that their importance is declining, particularly in pockets with higher agricultural potential in Gachoka, Siakigo, Chuka and Tharaka Central, as a result of increased cross breeding to promote dairy production. As well as being important for direct food production and as the principal source of cash in times of need, ruminant animals are valued by farmers in some areas, for their role as producers of manure for use in crop production. It is likely that this attitude will become more pervasive as agriculture is intensified in the future. Particularly where vertisols are found, animal traction is common for both cultivation and transport. Poultry is important in all areas, while rabbits can be of local importance in some areas. Bee hives are tended throughout the region, but appear to be of greatest importance in the lower parts near the Tana River (Kangara and Sutherland, 1994; DAREP, 1994; 1995b, c). It is clear that both large and small animals make considerable contributions to the farming systems presently employed in the ASAL areas.

The drier parts of Lower Embu, perhaps more than in Tharaka-Nithi, are experiencing a process of change due to rapidly increasing human population, both from natural reproduction of the traditional residents and also by immigration of people from the over-crowded highlands. The new arrivals often bring with them crop species, varieties and production technologies that are inappropriate for the dry lands. In newly settled areas such as Mbeti South, there are many farms in the range of 20 to 30 ha, while in older areas such as Chuka and parts of Tharaka-Nithi, land holdings are more frequently in the range of 2 to 15 ha (Kangara and Sutherland, 1994).

Although there is little information available on the productivity of the naturally occurring range in the area, the indigenous species that are traditionally used as fodder have been recorded by Blomley and Mbogo (1992). Older residents note that while some years ago there were appreciable areas which could be used for common grazing and browsing of livestock, these are coming under increasing pressure as land is demarcated and used for crop production. It would appear that as time progresses and areas available for communal grazing shrink even further, there will need to be increasing reliance on home-grown fodder for the farm animals in the system. It is not known if indigenous fodder species will be able to support the expected future levels of intensification of livestock production.

In the more densely populated parts of the region, there is already a trend towards greater intensification of livestock management. This appears to be associated with a shift away from emphasis on goats, Zebu cattle and bee-keeping, in favour of poultry and cross-bred cattle (DAREP, 1994; 1995b, c). Little is known about farmer preferences between goats and cows for dairy production, although there is a suggestion that an appreciable proportion of the population obtain their milk from goats (Kang'ara and Sutherland, 1995). In view of long established traditions and the ease of conversion of goats into cash, it seems unlikely that small ruminants will entirely disappear from the system, even if their numbers are reduced as a result of smaller farm sizes. Goats are known to provide additional flexibility to the farming system and during a drought in North East Brazil, small farms with cattle, sheep and goats performed better than similar farms with only cattle and sheep (Gutierrez Aleman and de Boer, 1988). Current trends in the high potential areas around Embu suggest that there is growing interest in the crossing of local goats with Alpine bucks to improve their potential for milk production. It could be that with time, farmers in the ASAL areas may follow the example of their neighbours. With careful cross breeding and intensive management, there is the possibility of increased production of either meat or milk from smaller flocks.

### **Limitations to Animal Production**

In a situation of constant flux, survey results and conclusions can be rapidly overtaken by events. It is therefore necessary to regularly update information on farming systems, enterprises, etc. Three separate surveys were conducted between late 1993 and mid 1994, in on-going attempts to describe the current farming systems and to determine the limitations to production. Two of these were diagnostic surveys carried out by DAREP, while the other was a baseline survey conducted by ICRAF, the ASAL component of which was done with the collaboration of DAREP.

In the ICRAF survey, a total of 1340 farmers were interviewed in 25 clusters located across the agroecological zones in the KARI mandate area. Unfortunately, the contract of the ICRAF staff member was not renewed when it came to an end in August 1994. The data from the survey have largely been computerized, but have not yet been subjected to either full analysis or interpretation. Continuing attempts to identify a socio-economist to complete the work have not yet led to the availability of data. The two DAREP surveys were conducted in the ASAL areas of Tharaka-Nithi and Lower Embu respectively. Preliminary summary reports on the Tharaka-Nithi and Embu surveys were given respectively in DAREP (1994 and 1995a). Full reports were later published in DAREP (1995b and c). The following comments draw heavily upon all of these documents, together with the DAREP preliminary reconnaissance survey conducted in 1993 (Kangara and Sutherland, 1994) and the technical report covering the period August 1993 to March 1994 (DAREP, 1994). Important information is also derived from the conclusions of two regional planning workshops held in Embu in November 1994 (Kang'ara and Sutherland, 1995) and February 1995 (Anon, 1995).

In the reconnaissance survey, the major limitations to livestock production as perceived by farmers were identified as follows (DAREP, 1994):

Diseases, with emphasis on tick-borne diseases and parasites

Water shortage

Poor nutrition in dry periods

Low genetic potential of local animals

The diagnostic survey in Tharaka-Nithi, reported in the same source, gave the following results:

Shortage of draught animals

Livestock mortality due to diseases, parasites and drought

Low animal productivity (including both ruminants and bees)

Low market values

While nutrition was specifically mentioned as a problem by relatively few farmers, there did not appear to be general farmer awareness of the close interactions between nutrition and either animal health or productivity. These relationships are well documented and it has been shown, for example, that sheep infected with trypanosomiasis grew as well as uninfected controls when kept on a high protein diet. They recovered faster after treatment than contemporaries fed a diet low in protein (Katunguka-Rwakishaya, 1994). In the drier areas, browse is capable of providing fodder of high feeding quality, particularly when animals are given the freedom to select their own diets (Lamprey *et al.*, 1980). This is particularly obvious at low stocking rates (Tessema and Emojong, 1984). With the observed trends in land tenure in the area, the luxuries of low stocking rates and opportunity for feed selection are bound to become less common in the future. Although farmers do not perceive lack of feed as a general problem at this time, the appearance, particularly of cattle in the area, suggests that for much of the year, many are being fed at levels that do not permit the expression of their genetic potential, even though this may be limited.

At the DAREP planning workshop held in November 1994, the participating extension workers, ministry officials and representatives of NGO's and the University of Nairobi were divided into three separate working groups. These groups considered animal health; animal nutrition; and socioeconomic aspects of livestock production. Their conclusions would appear to reflect the consensus views of the local and regional agricultural authorities. On the basis of importance, technical and economic feasibility, social acceptability and the prospects of obtaining usable results in the short term (2-3 years), the groups concluded that the highest priorities for future DAREP research should be as shown below for aspects of health and nutrition (Kang'ara and Sutherland, 1995):

- Health:
1. Strategic control of worms
  2. Control of mange in goats
  3. Epidemiology and control of helminths

- Nutrition:
1. Formulation of home made concentrate rations
  2. Pasture improvement, including range rehabilitation  
( Fodder banks (trees)
  - equal 3 ( Establishment of the production potential of local breeds  
( Improvement of habitat for bees

At the second DAREP planning workshop (February 1995), designed as a follow-up to further define the recommendations of the 1994 meeting and to elaborate on potential areas for further research into animal production, three working groups were again formed, this time to discuss research into multi-purpose trees (MPT); draught animal power (DAP); and animal nutrition, including both ruminants and poultry. Researchable options within these fields were listed in the following orders of priority (Anon, 1995):

- MPT:
1. Current management, nutritive value and farmer preferences for both indigenous and exotic tree fodders.
  2. Production of MPT's in farm compounds and linear niches.
  3. Optimal management of existing vegetation.

- DAP:
1. Study of access and current usage.
  2. Improved efficiency.

- Nutrition:
1. Poor growth and high mortality of young stock.
  2. Dry season feeding strategies.
  3. Strategic supplementary feeding

The second workshop placed increased emphasis on the possibility of obtaining useful results within a time-frame of about three years. This was an important aspect that had not been fully considered by the participants at the first meeting. MPT's were separated from general animal nutrition, and DAP, which had appeared under socio-economic aspects during the first meeting, was treated as a separate theme. The working groups were charged with the preparation of outline research protocols, although not all of the priority themes were developed in this way. The meeting generally achieved the stated aims of refining and re-defining the rather broad, sweeping conclusions of the first workshop. It also helped to clarify the scope for collaborative field work between DAREP and LFSP.

It was clear that without a large expansion of existing staffing levels, the DAREP project could not tackle all of the many topics on these lists of priorities. As a result of in-house meetings which followed on from the second planning workshop, a series of research protocols was developed to define the programme that the DAREP team felt able to tackle in the short term (Kidundo, 1995). Since animal health is considered by farmers to be a major issue and since the project had already begun work on the

efficacy of local remedies for both internal and external parasite control (DAREP, 1994; 1995a), a continuation of these activities formed the bulk of the programme. Protocols were therefore prepared to study the epidemiology of worms in goats; local methods of mange control; and the screening for efficacy of commonly used herbal dewormers.

Under the broad heading of agroforestry, two protocols were prepared that were designed to include collaboration with, and to directly address matters of concern to the activities of LFSP. The first was to study the growing of fodder trees in linear, or scattered arrangements, for strategic feeding to ruminant livestock. The specified planting niches were in home compounds, within croplands and along boundaries and contours. The second protocol dealt with the on-farm participatory screening of MPT's and shrubs. While not aimed specifically at fodder, this aspect was included in a list of potentially important tree products, together with fruit, timber, poles and fuel. The second planning workshop had prepared an outline protocol to survey farmer knowledge about, and the current usage of, indigenous tree fodder species (Anon, 1995) but since LFSP had already planned an activity along these lines, it was not included in the list of DAREP protocols prepared by Kidundo (1995).

In view of the research decisions taken by DAREP for immediate action, it is believed that LFSP could usefully complement these activities by carrying out experiments to study the potential of woody species for both conventional pasture improvement and intensive fodder banks. As farms become smaller due to increasing population pressure, it is likely that animal nutrition will assume greater prominence. This will become even more important if there is a widespread move towards cross breeding to improve the genetic potential of the animals. It will take several years of research to either adapt technologies imported from other areas or to generate them locally, in order to establish appropriate fodder recommendations for the area. DAREP alone cannot provide all the answers that will be needed in the future. A joint, coordinated programme between DAREP and LFSP will stand a better chance of having appropriate information available when the need for it is felt by the farmers.

### **Available Technologies**

While introduced fodder trees may be planted in selected niches in the ASAL areas, it is likely that animal production, at least in the medium term, will continue to rely heavily on existing fodder resources. Traditional farmer management of the natural vegetation is largely restricted to the herding of browsing animals and the occasional lopping of trees and shrubs during the dry season, but the productivity and persistence of the better local woody species has not been studied under either normal range, or more intensive cutting regimes. It is important to determine these parameters and to compare the local species with exotics, in terms of their responses to management. A prerequisite for this work could well be research into propagation techniques to ensure a steady supply of indigenous seedlings. Suitable management practices for the better local species must be determined in order to optimize sustainable fodder productivity in the region.

Exotic fodder trees such as *Gliricidia sepium* and *Leucaena* spp are recognized for their productivity and persistence under intensive management practices. Farmers may, however, be reluctant to plant and care for seedlings which are intended only for animal feeding. From this point of view, multi-purpose species and management practices which give other tree products in addition to fodder (eg. poles, fuel wood, fruits), could be more attractive than an intensive technology such as hedgerows that are established purely for fodder production. These are factors that should be taken into account in the planning proposals.

It is well recognized that agroforestry interventions and range improvement through attempts at reseedling with either local, or introduced species, have been generally disappointing in the ASAL region. Failures have often been associated with inadequate control of the roaming livestock that originally caused the degradation of the range. While it cannot be claimed that this is a thing of the past, increased pressure on land will ensure the confinement of livestock and lead to reduced damage to pasture and fodder plants during the establishment phase, at least when this coincides with the cropping season. Termites are also often seen to destroy newly planted seedlings in the ASAL areas. While these pests can be controlled by the application of commercially available chemicals, they are increasingly out of reach of most farmers in the region due to escalating costs. DAREP plans to study the efficacy of currently used, local control methods in an attempt to identify economic means to combat the pests.

A further cause of establishment difficulty has been the lack of attention to good soil husbandry, including appropriate soil and water conservation techniques. Experience in GASP at Marimanti showed that where ridges were used, range rehabilitation was greatly facilitated (Blair Rains, 1986). Soil and water conservation in crop production is a matter that is presently being addressed by the DAREP project (DAREP, 1994) and a proposal has recently been submitted by members of NAFRP at Embu for possible funding by SIDA, to study the effects of agroforestry interventions on soil and water movement at both the farm and the catchment level. Results from these studies should provide guidelines for establishment techniques which could be of use in future pasture improvement activities.

Despite very real problems of establishment, there are suggestions that introduced tree species suitable for the region are beginning to emerge. At Machang'a, *Gliricidia sepium* is showing high levels of fodder production. At Marimanti, recently established *Acacia angustissima* is growing extremely fast and looks like being a high producer of fodder. It appears to be well accepted by goats and it could well appeal to farmers, since it has a long period of inflorescence and the flowers are attractive to bees (personal observations). *Leucaena* spp. are less affected by the leucaena psyllid (*Heteropsylla cubana*) in the ASAL areas than in the moister highlands and are still of interest, although they are sometimes severely attacked by termites. These species, which are also doing well in areas of Zimbabwe with similar amounts of annual rainfall (Dzowela, 1994; Dzowela *et al.*, 1994), merit further evaluation under management conditions appropriate for fodder production.

The planting niches for testing these species need to be chosen with care, in order to minimize the danger of fatal damage by uncontrolled livestock during the critical



establishment period. For this reason, it is believed that initial work should concentrate on the intensive production of fodder from hedges around the homestead, as suggested by DAREP, or from banks located in enclosed and secure areas near to the farm buildings. It is believed that the production and utilization of either indigenous or exotic tree fodder from the block plantings (fodder banks) should be the primary target of LFSP.

### **Possible Collaborators for LFSP Fodder Research**

Within the ASAL area, there are many potential partners for collaborative research, including government, non-government and church groups. The following are considered to be those with the necessary infrastructure to facilitate activities that will need to involve the use of animals:

- DAREP is currently active in both on-station and on-farm work at about 16 sites in Embu, Tharaka-Nithi and Isiolo Districts, although in view of the pending financial crisis, these could be reduced by at least 50% with effect from April 1996. Of these, in the present year, there are livestock activities at one station site (Kamwaa in Embu District) and 12 farm sites in both Embu and Tharaka-Nithi (DAREP, 1994; J. Kang'ara, personal communication). Collaborative efforts are already planned and they will be logistically simple as it shares the KARI base with LFSP. DAREP only has one livestock officer and one forester, however, both of whom will be fully occupied with the recently defined work plan (Kidundo, 1995). It is felt that any further collaborative activities could over-load the DAREP schedule, particularly in the light of the forthcoming budgetary constraints.
- GASP is located at Marimanti, some two hours drive from Embu during the dry season. When the roads are wet, they can be almost impassable for extended periods of time. There are some 400 breeding female Galla goats at the station and plans are in hand to increase the numbers up to 600 breeders. There are quite good facilities for handling and working with animals. Located on the edge of the goat project, there is a KARI agroforestry site and the officer in charge is keen to collaborate in any way possible. The major problem would appear to lie in the difficulties involved in close monitoring of experimental work by Embu-based staff during the wet season. This aspect may limit the nature of the work that can be done there, unless local staff are well versed in the complexities of livestock research.
- The University of Nairobi has a property of about 400 ha located at Machang'a, some 45 minutes drive from Embu on a sealed road. It is very close to the KARI/DAREP sub-station, where results are available on the productivity of some introduced fodder trees. The university is in the process of establishing herds of both cattle and goats and have expressed interest in the planting of recommended fodder trees to complement the areas of natural vegetation. There would appear to be excellent prospects for fruitful collaboration in both agronomic and livestock research. Although no formal proposal has yet been formulated, informal contacts have been made and appear to be very promising.

- Utilization by livestock of the best lines from the above evaluation. This work would seek to measure voluntary intake and establish the parts of the tree that are readily consumed by the animals. It should also measure animal production in terms of weight gains of young, growing animals. This could be carried out at Machang'a, or Marimanti. In view of the variety of animals in the region, it should be conducted with both cattle and goats. It may be sufficient to use Zebu cattle, since results with recognized dairy breeds should be available from elsewhere, at least for the exotic tree species. If possible, it would be beneficial to use both local and Galla goats in the evaluation, to measure any differences between the breeds.
- The University has expressed interest in the evaluation of the production potential of local breeds of livestock when free of parasites and kept under good standards of management, health and nutrition. It is likely that tree fodders would have a role to play in the feeding of animals in such an investigation. If this is the case, it would be of interest for the project to participate in the study as an active partner.

There are a number of other activities that could logically be addressed by LFSP. These would include the role of tree fodders in the formulation of home made concentrates for a range of different animal species. This could possibly be done in collaboration with NARP-II, who also have interest in this subject. The order of priority of the major animal species to be supplemented in this way is still a matter of debate (Kang'ara and Sutherland, 1995; Anon, 1995), but it may possibly be as follows: recently weaned small ruminants; poultry (during the cropping season when they are confined); recently weaned calves; and lactating dairy cattle.

A second potentially productive field of work is related to the first. It would be concerned with the feeding of oxen and possibly also donkeys, for use in animal traction. In common with many other areas, the ASAL region suffers from the fact that animals are in their poorest condition at the end of the dry season, and it is precisely at this time that they are most in demand for land preparation. Tree fodder has a clear potential role to play in the dry season provision of the high protein feed which is required to increase liveweight prior to the period of peak field activity, although it could be that energy may be of greater importance when it comes to the output of work. The Centre for Tropical Veterinary Medicine (CTVM) at the University of Edinburgh has recently expressed interest in collaboration in this activity, probably through a PhD student (either Kenyan or foreign), who would conduct the field work in the Embu area and undertake course and laboratory work in Edinburgh.

It is expected that ODA will assign an Associate Professional Officer (APO) to the project with effect from October 1995 and her provisional terms of reference note that she will be working in the ASAL area on almost a full-time basis for a period of about 12 months. Even so, with constraints of time and support staff, together with the current budgetary levels, it is most unlikely that all of these topics will be tackled unless LFSP is extended for a 3 year period beyond July 1996. If, as seems likely at this time, satisfactory progress has been made in research in the higher potential areas, the topics noted above would become matters of high priority in the future work plan of LFSP for the period 1996-99.

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