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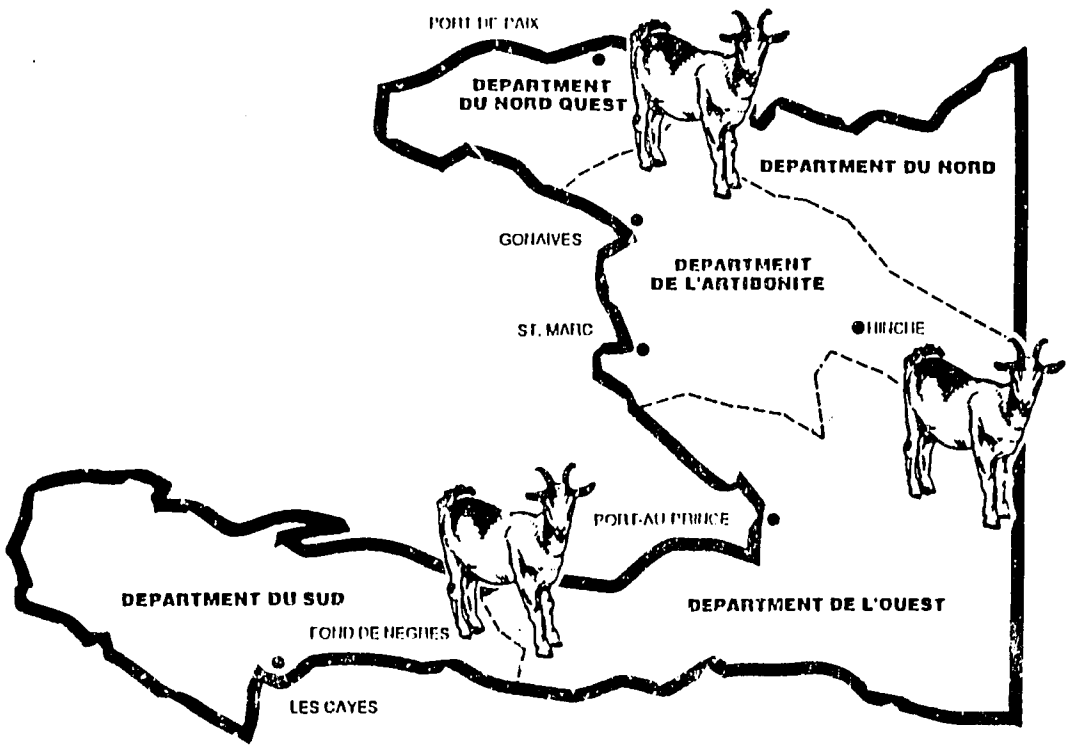
A STUDY ON UTILIZATION OF LOCALLY AVAILABLE FEED INGREDIENTS (AGRICULTURAL CROP RESIDUES, CROP BY-PRODUCTS, FORAGES, FORBS AND SHRUBS) TO IMPROVE PRODUCTIVITY OF GOATS

A FINAL REPORT FOR GRANT NO. DAN-5053-G-SS-4048-00



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ABSTRACT

The objectives of this study were to investigate the possibility of increasing goat production in Haiti by using agricultural crop residues, by-products, forages, shrubs and forbs, determine the nutrition composition of the former mentioned feeds, and make recommendations on how best to use these feeds in goat production programs. Goats have become an important source of protein and income throughout the country due to African Swine Fever. The feeding of these animals becomes very critical during the dry season which usually varies from 6 to 8 months during the year. Crop residues and by-products can provide a significant amount of supplemental feeds during the dry season. However, many of these feeds are now wasted and lost. This may be due to a lack of knowledge or initiative in using them to support livestock feeding programs, especially during the dry season. Particular emphasis is placed on the utilization of crop residues and crop by-products as supplemental sources of nutrients, and more selective use of grasses, shrubs and forbs as primary sources of nutrients for goats. An analysis of the locally available feedstuffs leads to recommendations for effectively utilizing forages during the rainy season, harvesting and storing forages, making hay and silage, incorporating crop residues and crop by-products in goat rations, and improvement in pasturelands as a means fo providing a balanced year-round feeding programs for goats that has both qualitative and quantitative dimensions.

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Project Co-leader

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PUBLICATIONS

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2. McGowan, C. H., Basha, Sheikh, M. and Murugesu, V., 1986. Nutritional Analysis of Certain Grasses, Forbs, Crop Residues and Crop By-Products in Selected Areas of Haiti. Research Bulletin, Florida A&M University. Vol. 28, pp. 31-41.

SPEECHES

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1. SUMMARY OF STUDY RECOMMENDATIONS

1.1 Summary of Study

The objectives of this study were to investigate the possibility of improving goat production in Haiti by using agricultural crop residues, by-products, forages, shrubs and forbs, analyze grasses, crop residues, crop by-products, forbs and shrubs found in selected areas of the country to determine their nutrient composition and make recommendations on the utilization of the above mentioned feeds in goat production programs.

The samples analyzed in this study were collected form the Hinche area (Department Du Sud) and from areas around Port-Au-Prince and vicinities (Departments of De L'Quest, De L'Artibonite and Du Nord Ouest).

Goats are an integral part of Haiti. The hardy goat has become an even more important source of protein and income for Haiti's small farmers since the recent loss of all pork production throughout the country due to African Swine Fever.

Animal health, livestock management, improved breeding practices, and better marketing practices are important factors in livestock development efforts. However, nutrition or the relationship of an individual animal to its feed is of significant importance in developing countries. The feeding of animals become very critical during the dry season which usually varies form 6 to 8

months during the year. During this time most trees (shrubs) lose their leaves, and the production of herbaceous feeds (forages) during the growing season for harvest or reserved grazing is completely neglected in developing countries.

Goats provide an excellent means of utilizing crop residues and by-products to add to total farm production. Crop residues (vines, stems, leaves, straw, etc.) and by-products form central processing plants (rice mills, peanut processing, etc.) can provide a significant amount of supplementai feeds during the dry season. Many of these feeds are now wasted and lost in developing countries. They could contribute to support of livestock programs. The greatest value of these potential feedstuffs is their utilization during the dry season when perennial forage plantings are making little or no growth.

The existing pastureland in Haiti is almost entirely of indigenous grass species. The pastureland has never been the subject of comprehensive scientific investigation to determine its inherent worth for livestock feeding. After an initial flush of new growth at the beginning of the rains, these grasses are apparently subject to rapid lignification buildup of silica which quickly lowers digestibility when grazed by ruminants. The result is a short grazing period of perhaps four to five months on these pastures following by severe reduction in forage availability during the dry season.

The principal by-products on farms in Haiti are from harvested plants like corn, millet, sorghum and various grain legumes; fruits, tubers and their by-products; and assorted brans, meals and cracked grains from household preparation of foodgrains and pulses. Crop

by-products fed in combinations with protein supplements can be made much more valuable as the roughage bases fro on-farm goat rations.

The available agro-industrial by-products can be grouped into two categories: bulk roughages and concentrates. The former consists of rice products like hulls and straw and sugarcane by-products from crops grown in Haiti, such as rice bran, corn bran, and cottonseed meal; and by-products from grains such as wheat bran and middlings, corn bran and soybean oil meal. These by-products can be used in on-farm rations for feeding goats during the long dry season.

The need exists to provide a scientific basis for improving goat production in Haiti through increased utilization of agricultural crop residues and crop by-products as supplemental sources of nutrients, and more selective use of grasses and forbs as primary sources of nutrients for goats that are locally available.

1.2 Summary of Recommendations

Recommendations were developed with emphasis on the principle criteria:

– Goats are an integral part of Haiti, since the recent loss of all pork production through the country due to African Swine Fever. However, the feeding of these animals is critical during the dry season which may vary from 6 to 8 months. Therefore, emphasis should be placed on the utilization of crop residues, crop by-products, shrubs and forbs that are locally available, as

supplemental sources of nutrients for feeding goats during the dry season.

– Grasses, hay and-or silage, crop residues, crop by-products, shrubs, forbs, etc. should be the cornerstone of a year-round feeding program for goats, therefore, method and result demonstrations should be implemented in selected localities for the purpose of teaching and showing goat producers how best to use these feeds on a year-round basis.

– Training meetings, workshops and short courses should be held for farmers to improve their knowledge of a goat's nutritional requirements and how best to satisfy them.

– Educational materials will need to be developed, particularly on locally available feeds and their use in a year-round feeding program.

1.2.1 SPECIFIC RECOMMENDATIONS

The specific recommendations are based on the fact that a year-round feed supply is the most pervasive constraint to livestock production in developing countries such as Haiti. Feed supply has both qualitative and quantitative dimensions. Therefore, the selective use of grasses, shrubs and forbs as primary sources of nutrients and increased utilization of crop residues and crop by-products as supplemental sources of nutrients should improve feed quality and quantity on a yearly basis.

– A rotational grazing system for effectively utilizing forages should be carried out during the rainy season when they are in

abundance. Rotational grazing systems are effective tools for maintaining the overall nutrient adequacy of pastures and/or forages. In addition to maintaining high quality succulent pastures and forages, a rotational grazing system provides for improved pasture management. Improved pasture management will allow for improvements in quality and quantity forages or pastures grazed by goats during the rainy season.

– Simple methods of harvesting and storing of fresh cut forages, and crop residues, and making hay or silage should be encouraged and demonstrated for general adoption by farmers. These feeds could be used successfully for feeding goats during the long dry season. Also, they can make significant contributions to the quantity and quality of feeds available on a year-round basis.

– Crop residues and crop by-products from harvested plants like corn, millet and sorghum, fruits and tubers and their by-products, and assorted brans should be incorporated into a year-round feeding program. For example, simple processing techniques such as treating crop residues with a solution of wood ash (alkaline solution) greatly improves digestibility and utilization. Subsequent studies could determine the optimum concentration of solution to use in the treatment of the residues. Also, educational programs should be conducted with farmers to teach and show them how best to use their locally available feeds in goat rations.

– Goats have the ability to utilize diverse sources of feedstuffs. Therefore, goat producers who also raise poultry should be taught how to incorporate poultry litter into goat rations. For example, ensiling poultry waste with crop residues and sugarcane

bagassee has been shown to be an acceptable feed for ruminants. However, various crop residues and poultry waste under Haitian conditions should be studied and the ensiling parameters measured to evaluate acceptability of the product.

– Long-term improvement of pasturelands should be geared towards the establishment of improved pastures to complement native pastures, and the identification and propagation of those species – improved and native – that are able to to maintain lush green quality forage over a long growing season.

BACKGROUND AND SITUATION

Goats are an integral part of Haiti. The hardy goat has become an even more important source of protein and income for Haiti's small farmers since the recent loss of all pork production throughout the country to African Swine Fever. The local goats are small with Does attaining 15 to 25 kilograms lightweight at maturity and bucks weighing 23 to 27 kilograms. The doe has poor reproductive traits usually having only one offspring per kidding. She characteristically does not produce enough milk to meet the nutritional requirements of her young and thus mortality rates are high and growth rates very low among kids.

While it is evident that a well-balanced, long term strategy for Haiti must take into account other factors in livestock development such as animal health, livestock management, improved breeding practices, and better marketing of livestock products, the primary relationship which must be dealt with as the highest

priority is that of the individual animal to its feed. This situation is even more critical during the dry season which may vary from 6 to 8 months. During this time most trees (shrubs) lose their leaves, and the production of herbaceous feeds (forages) during the growing season for harvest or reserved grazing is completely neglected in developing countries. The longer the normal dry season for a region, the greater is the need to institute programs to demonstrate the feasibility of supplying feeds, and the best methods for using these feeds on a year-round basis.

It has been estimated that adequate feeds during the dry season could easily double the productivity of existing goats at low cost. Crop residues (vines, stems, leaves, straw, etc.) and by-products from central processing plants (beer distillery waste, rice mills, banana and plantain packing sheds, peanut processing, etc.) can provide significant supplemental feeds during the dry season. Many of these important feeds are now wasted and lost in developing countries.

Goats provide an excellent means of utilizing crop residues and by-products to add to total farm production. For example: (a) sugar cane tops and leaves may be collected and made into palatable silage by the addition of molasses from the sugar mills; (b) green stover of maize, sorghum and millet from which grain has been removed, may be similarly preserved as silage; (c) wheat straw, rice straw, and rice grain polishings may be stored dry and fed as supplements to other stored feed; (d) the meal or cake from extraction of oil from oil seeds (cottonseed, groundnuts, etc.) is high protein feed of excellent nutritive quality for ruminant feeding; (e) the vines and

stems of groundnuts, and all food grain legumes; (f) the plant residues from most vegetable crops are excellent feeds when fed green; and the unsalable bananas and plaintains may be fed successfully; and (g) beer-distillery wastes may be stored dry, and converted into useful ruminant feed by fine chopping and blending with oilseed cake or meal and molasses to produce nutritionally balanced feed. Such crop residues and by-products are often wasted for lack of knowledge or initiative in using them to or support goat production programs. The greatest value of these potential feedstuffs is their utilization during the dry seasons when perennial forage plantings are making little or no growth. The animal manures produced from such feeding practices should be collected and spread on crop lands to fully exploit the income potential of livestock conversion of crop residues and by-products. In general, productivity of goats may become more efficient, so that 1/3 to 1/2 as much feed will be needed under good management, to produce each kilogram of meat. Yearly milk flow may be greatly increased in amount and duration. The common cycle of producing weight gains in the season of rains, followed by losses from deprivation and starvation in the prolonged dry season, can be overcome by utilizing supplemental feeds such as crop residues and by-products to ensure year-round feed supplies. When adequately fed, the control of animal diseases should become more effective and the husbandry of livestock can be well organized to meet needs of the breeding herd, of the young stock, of the lactating animals, and of those being grown for market or local slaughter. With the breeding herd maintained in healthy condition, it will be possible to institute

livestock improvement programs in indigenous herds by selection of superior dams and sires and controlled breeding to propagate the superior stock.

Livestock producers have at least three methods available to them for use separately or in combination to make more feed available to animals on their farms. They are:

1. Improvement of existing pasturelands.
2. Intensification in the use of on-farm crop residues and crop by-products; and
3. Greater use of agro-industrial by-products in the form of processed feeds.

The existing pastureland in Haiti is almost entirely composed of indigenous grass species. The pastureland has never been the subject of a comprehensive scientific investigation to determine its inherent worth for livestock production but the general consensus among livestock specialists in Haiti is that the grasses are of low nutritive value during most of the year. After an initial flush of new growth at the beginning of the rains, these grasses are apparently subject to rapid lignification and buildup of silica which quickly lowers their digestibility when grazed by ruminants. The result is a short grazing period of perhaps four or five months on these pastures followed by severe reductions in forage availability during the dry season.

The principal by-products available on farms in Haiti fall into three general categories: stover, hulls and leaves from harvested plants, like corn, millet, sorghum and various grain legumes; fruits, tubers and their by-products; and assorted brans, meals and cracked

grains from household preparation of food-grains and pulses. By-products in all of these categories are likely to be highly variable with respect to their nutritive values and usefulness as livestock feeds. Crop by-products fed in combination with protein supplements and/op small quantities of molasses or urea, these feeds can be made much more valuable as the roughage bases for on-farm ruminant rations.

Haiti seems to be relatively fortunate in having large quantities of fruit and tuber by-products available on farms for livestock feeding. Bananas, plantains, yams, sweet potatoes, cassava, and citrus and their by-products have all been shown to be acceptable feeds, particularly for swine and cattle, if handled properly.

The available agro-industrial by-products in Haiti can be grouped in two categories: Bulk roughages and concentrates. The former consist of sugarcane by-products, like bagasse and cane tops; citrus rinds; cacao pod wastes; coffee hulls and pulp; and rice products like hulls and straw. The concentrates consist of by-products from crops grown in Haiti, such as rice bran, corn bran, molasses, copra meal and coconut oil meal; and cottonseed meal; and by-products from grains and other agricultural products imported into the country. These latter by-products consist of wheat bran and middlings, the bulk of the corn bran, brewery residues, soybean oil meal, and blood meal.

The need exists to provide a scientific basis for improving goat production in Haiti through increased utilization of agricultural crop residues and crop by-products as supplemental sources of

nutrients, and more selective use of grasses and forbs as primary sources of nutrients for animals that are locally available.

PROJECT OBJECTIVE

The overall purpose of the study was to investigate the possibility of improving goat production by using agricultural crop residues, by-products, forages, shrubs and forbs available as sources of nutrients for goats.

RESEARCH OBJECTIVE

To accomplish this purpose the following specific objective was identified:

-- Conduct a nutritional analysis of grasses, crop residues, crop by-products, forbs and shrubs (Table 1) in selected areas in Haiti (Figure 1). The Central Plateau (Hinche Agricultural District) and Port-Au-Prince and Vicinities (Plaine du Nord, Plaine des Gonaives, Vallee de l'Artibonite, Plaine du Cul-de-Sac and Les Cayes) were the targeted areas.

METHODOLOGY

The nutritional analysis of feeds includes determinations of selected chemical constituents of grasses, crop residues, crop by-products, shrubs and forbs that are used, or are available for use as goat feed, and industrial wastes that are available to local farmers.

Table 1. List of Grasses, Crop Residues and Crop By-Products Collected from Selected Areas in Haiti for Analysis

COMMON NAME	SCIENTIFIC NAME
A. GRASSES	
a. Angletongrass	Andropogn nodosus
b. Buffelgrass	Cenchrus ciliaris
c. Bermudagrass	Cynodon dactylon
d. Pangolagrass	Digitaria decumbens
e. Molassesgrass	Melinis minutiflora
f. Guineagrass	Panicum maximum
g. Laurissa grass	Pennisetum orientale
h. Napiergrass/Elephantgrass	Pennisetum purpureum
i. Sorghum	Sorghum vulgare
j. Madame Michel	Themeda quadrivalvis
k. Guatemalagrass	Tripsacum laxum
FORAGE LEGUMES	
l. Leucaena	Leucaena leucocephala
m. Siratro	Macroptilium atropurpurem
n. Glycine	Neonotoria wightii
o. Teramnus	Teramnus labialis
2. ROUGHAGES (LEAVES)	
GRASSES	
a. Elephantgrass	Pennisetum purpureum
b. Sugarcane tops	Saccharum officinarium
c. Maize	Zea mays
LEGUME PLANT LEAVES	
d. Dividivi	Caesalpinia coriaria
e. Pigeon pea	Cajanus cajan
f. Cassia leaf	Cassia occidentalis
g. Campeche (Logwood) campecchianum	Haematoxylom
h. Bayahonde	Prosopis juliflora
TREE AND OTHER PLANT LEAVES	
a. Neem Tree (Margosa Tree)	Azadirachta indica
b. Panama Gum leaves	Castilla elastica
c. Trompette	Cecropia peltata

d. Flamboyant	Delonix regia
e. Yam	Dioscorea alata
f. Cotton leaves	Guazuma ulmifolia
h. Sweet potato	Ipomoea batatas
i. Mango	Mangifera indica
j. Cassava	Manihot esculenta
k. Benzolive	Moringa oleifera
l. Plantain/Banana	Musa spp.
m. Avocado	Persea americana
n. Hog plum	Spondias lutea
o. Spanish plum	Spondias Purpurea

3. DRY FORAGES AND ROUGHAGES

a. Andropogon	Andropogon spp.

4. SILAGES

5. ENERGY FEEDS

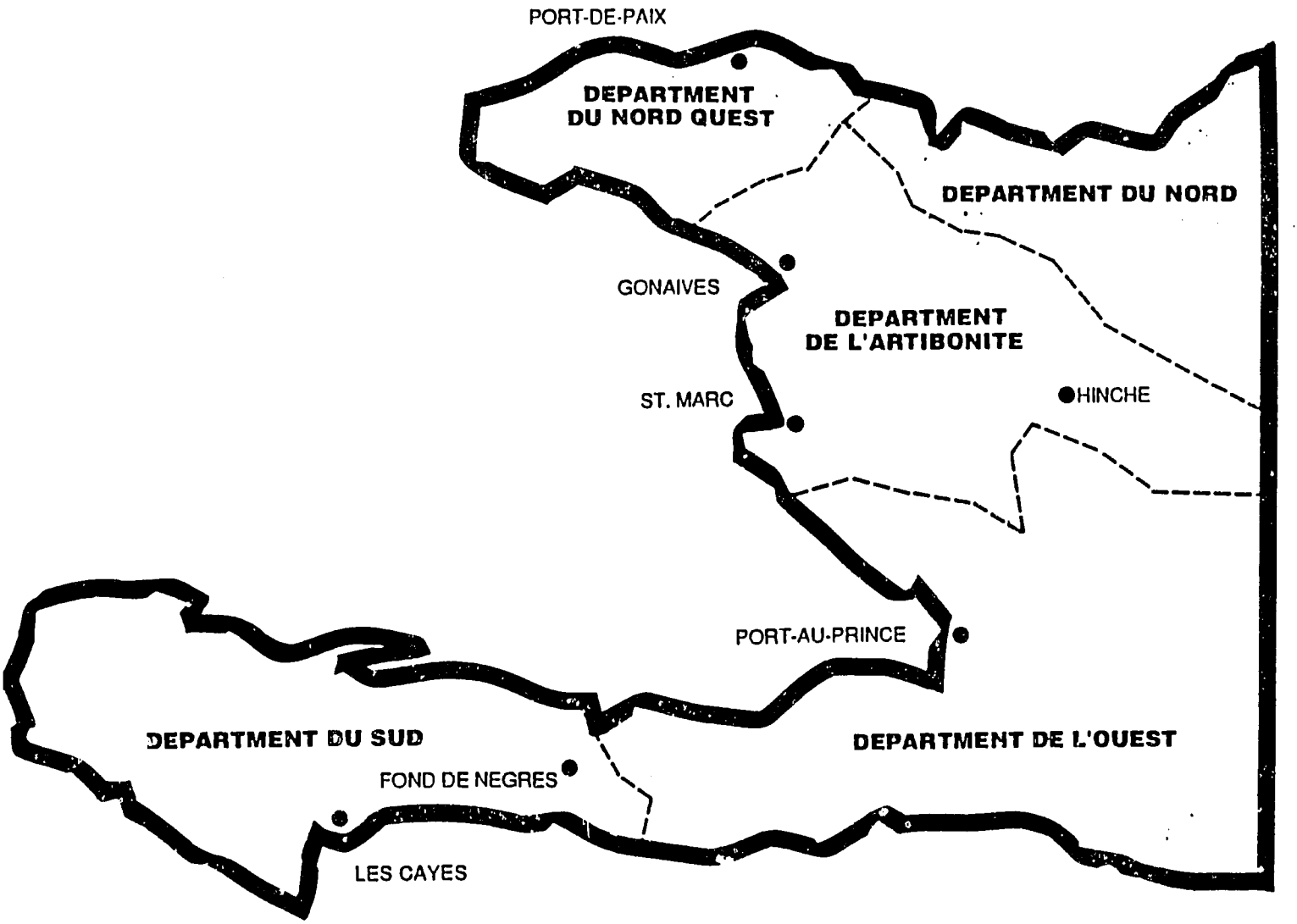
a. Rice bran, rice polish, rice flour	Oryza sativa
b. Molasses	Saccharum officinarum
c. Sorghum bran residues	Sorghum vulgare
d. Wheat bran	Triticum vulgare
e. Corn bran, corn germ, cracked corn	Zea mays
f. Lemon pulp	Citrus spp.

6. PROTEIN SUPPLEMENTS

a. Green sundried pigeon peas, matured dried pigeon peas	Cajanus cajan
b. Soybean meal	Glycine max
c. Cottonseed meal	Gossypium barbadense

FIGURE 1 - MAP OF HAITI

Showing Sample Collection Areas



SAMPLE COLLECTION PROCEDURES AND SCHEDULES

Collection Procedures

Representativeness is the most important aspect of sample collection. Hence every attempt was made to include the most representative material from the gross area. Also, samples were collected from at least 3 representative areas of the Central Plateau and packed separately. It was necessary to collect the plant parts that were most likely be available for livestock feeding.

For fresh products, the initial sample was approximately 4 to 5 kg, which when dried yielded between 40% to 60% of the initial weight. In the field, samples were collected in bags with proper aeration such as synthetic fiber, jute or cloth bags. Following drying (sun drying), for 2 to 3 days, the samples were crushed into powder either manually or mechanically and them transferred into sealed plastic bags.

The above sampling procedure yielded about 3 or 4 samples for each crop residue, representing major areas of the plateau. Care was exercised at every step not to get the samples wet (rain or other source of moisture).

Crop Residues

Crop residues were collected at various maturities during both rainy and dry seasons following harvesting and processing for seeds and tubers. Immediately after the collection of the residues, they were dried in the sum for 3 to 4 days or until the material felt dry and crushed easily. Following drying, the sample was crushed either

manually or mechanically into a powdery form to facilitate efficient packing, and transferred into ziplock bags for labeling and shipping to Florida A&M University for analysis.

Grasses

Leaf and stem samples of grasses were collected at various maturities from 3 to 4 representative areas and packed separately. Again, at least 3 to 4 kg of fresh material was collected and transported to Hinche to be dried. The grasses were dried for at least 2 to 3 days, crushed, packed in ziplock plastic bags, and labeled for shipping to Florida A&M University for analysis.

Crop and Industrial By-products and Wastes

These materials were collected at different times during the year, with respect to their availability. Approximately 2 to 3 kg of the above materials were collected, from the point of origin or site of distribution. Since storage conditions and duration have an effect on the quality of these products, attempts were made to collect the least affected products. The samples were collected directly in the plastic bags designated for shipping. However, precautions were taken to ensure their dryness. If they were found to contain excessive moisture, they were sun dried for at least 12 to 24 hours to prevent fungal contamination.

ANALYTICAL METHODS

The air dried samples were ground through a 1 mm screen. Duplicate 1 g samples were dried in an oven at 105 degrees C to determine dry matter. Fresh samples were used to determine neutral detergent fiber (Van Soest and Wine, 1967). acid detergent fiber (Van Soest, 1963), ash (Van Soest, 1968) and Kjeldahl nitrogen (ADAC, 1985). Ether extract and crude fiber (ADAC, 1985) were also determined. Total carbohydrates were determined by extraction (Basha et al., 1976) and then analyzed for free sugars (Lemm and Willis, 1954). Mineral concentration was determined by atomic absorption spectrophotometry using appropriate standards.

Dry Matter and Organic Matter

Porcelain crucibles were dried at 105 degrees C and then cooled in a dessicator and then weighed. One gram of sample was placed in the crucibles and then dried at 105 degrees C overnight. The samples were cooled in a dessicator and weighed. The samples were ashed at 600 degrees C for 3 hours before weighing (ADAC, 1985). Percent dry matter was calculated using the formula:

$$\frac{\text{wt. of oven dried sample}}{\text{wt. of sample}} \times 100 \text{ and the}$$

$$\text{percent organic matter} = \frac{\text{wt. of ashed sample}}{\text{wt. of oven dried sample}} \times 100$$

Crude Fiber

One gram of air dried sample was digested with the digestion mixture in a large centrifugal tube by placing it in boiling water for 20 minutes. The sample was then cooled and filtered through scintered glass crucible (fritted disc.), then the residue was washed with hot water, hot 95% ethanol, benzene, hot 95% ethanol and finally ether (ADAC, 1980). The sample was then placed in an oven at 110 degrees C overnight. The sample was cooled by placing it in a dessicator for approximately 2 hours and then weighed. The weighed samples were then ashed at 500 degrees C overnight. The sample was cooled in a dessicator and then weighed.

Percent (dry matter basis) crude fiber was determined using the formula:

$$\frac{\text{Dry wt. of crucible + sample - ashed wt. of crucible + sample}}{\text{weight of oven dried sample}} \times 100$$

Total Nitrogen and Crude Protein

About 30-40 mg of sample were digested in the Kjeldahl flask by adding 1 gm of digestion mixture and 1.5 ml of concentrated H_2SO_4 to each flask. Three to four drops of H_2O_2 were added to the sample before total digestion. Digestion was complete when sample was clear and pale green. The flasks were then cooled and 20 ml of distilled water was added.

The digested sample was distilled by placing 5 ml of 4% boric acid in a 50 ml erlenmeyer flask and by adding 4-5 drops of indicator solution, beneath steam shunt. Ten ml of NAOH - $Na_2S_2O_3$

solution was added to the digestion flask and ammonia was collected for 3 minutes.

The distillate was titrated with 0.01 N HC1. Percent nitrogen was determined using the formula:

$$\frac{\text{ml. of 0.01 N HCl used}}{\text{mg. of sample used}} \times 15.09 \text{ (faster)}$$

Percent crude protein was determined by multiplying the percent nitrogen by a factor of 6.25.

Total Carbohydrates

Thirty mg of sample was placed in a centrifuge tube. To this 4 ml of 0.04 N H_2SO_4 was added and boiled for 1 hour. The sample was cooled and centrifuged at 12,000 rpm for 15 minutes. The resulting pellet was reextracted with 3 ml of 0.04 N H_2SO_4 then centrifuged for 15 minutes at 12,000 rpm. The above two supernatants were mixed and made up to a known volume (Basha et al., 1976). An aliquot of the supernatant was analyzed for free sugar content following the Anthrone-H_2SO_4 method of Yemm and Willis (1954).

Minerals

Two grams of sample were ashed in a glazed porcelain dish at 550 degrees C for 4 hours. The sample was cooled and 10 ml of 3 N HCl was added and boiled for 10 minutes. The material was transferred into a 200 ml volumetric flask by filtering through a No. 3 filter paper (ADAC, 1980). An aliquot of the sample was loaded

into an atomic absorption spectrophotometer and the amount of various metals were determined using the following standards:

Calcium:	Lanthanum Oxide
Iron:	Iron stock solution (pure iron wire)
Copper:	Copper stock solution (pure Cu metal)
Manganese:	Manganese stock solution (MNO_2)
Magnesium:	Mangnesium stock solution (pure Mg metal)
Zinc:	Zinc stock solution (pure Zn metal)

Ether Extract

Ether extract beakers were dried in an oven for one hour at 85 degrees C, and placed in a desiccator to cool for about one hour. Beakers were weighed after cooling on a Metler balance. One gram of air dried sample was placed into an asbestos thimble, and the weight was recorded. Samples were prepared and analyzed in duplicates. Thimbles were then placed on ether extraction apparatus. Thirty (30) ml of anhydrous ether was placed in an extraction beaker, and then attached to an extraction apparatus. Beakers were then heated until ether started to boil. Samples were extracted for 4 to 5 hours. Samples were removed from the apparatus and replaced with an ether collection apparatus. Ether was allowed to evaporate from sample. Ether was carefully boiled until beaker was just about dry. Beakers were placed in a desiccator until cool (one hour). Beaker was then weighed accurately.

Percent ether extract was determined using the formula:

wt. of beaker and residue - wt. of beaker = wt. of ether extract

wt. of ether extract/wt. of sample x 100 = percent ether extract (dry basis)

Acid Detergent Fiber

One gram of air dried sample that was ground to pass through a 1 mm screen was placed in a Berzelius beaker. One hundred (100) ml of acid detergent solution and 2.0 ml of decalin was added to the sample in the Berzelius beaker. Beakers were placed on a hot refluxing apparatus and boiled for 5 to 10 minutes. Heat was reduced as boiling began to avoid foaming. Boiling was adjusted to an even level and refluxed for 60 minutes. Previously tared crucible was placed on filtering apparatus. Beaker was swirled to suspend solids and fill crucible. Vacuum was admitted after crucible had been filled. Sample was rinsed into crucible with a minimum of hot water (90 - 100 degrees C). Vacuum was removed, mat broken up, and crucible was filled with hot water. Liquid was filtered and washing procedure was repeated. Washing was repeated with acetone until it removed no more color, breaking up all lumps so that the solvent comes into contact with all particles of fiber. Sample was then washed with hexane. Hexane was added while crucible still contained some acetone. The acid-detergent fiber was sucked free of hexane and dried at 100 - 105 degrees C overnight, cooled at room temperature and weighed.

Percent acid-detergent fiber was determined using the formula:

$$\text{ADF percentage on partial dry or as fed basis} = \frac{(\text{wt. of crucible and fiber} - \text{wt. of crucible})}{\text{wt. of sample}} \times 100$$

$$\text{Adjusted to dry basis} = \frac{\text{acid detergent fiber \% on as fed sample}}{\text{dry matter \% of as fed sample}} \times 100$$

Neutral Detergent Fiber

One gram of air dried sample was ground to pass through a 1 mm screen and placed in a Berzelius beaker. One hundred (100) ml of neutral detergent solution, and 2.0 ml of decalin was added to the sample in the beaker. The beaker was then placed on a hot refluxing apparatus with condensers in place. One-half gram of sodium sulfite was added to the beaker. Beaker was heated to boiling. Heat was reduced as boiling began to avoid foaming. Boiling was then reduced to an even level and refluxed for 60 minutes. Reflux was timed from onset of boiling. Previously dried and tared crucibles were placed on filtering apparatus. Beaker was swirled to suspend solids and crucibles were filled. Low vacuum was used at first, and was increased only as more force was needed. Sampole was rinsed into crucible with a minimum of hot water (80 degrees C). Vacuum was removed, mat broken up and crucible was filled with hot water. Liquid was filtered and washing procedure was repeated. Washing procedure was done twice with acetone and sucked dry. Crucibles were dried at 105 degrees C overnight and weighed.

Percent cell was determined using the formula:
Cell walls % on as fed or partial dry basis =

$$\frac{\text{wt. of crucible and cell walls - wt. of crucible}}{\text{wt. of sample}} \times 100$$

Adjusted to dry basis:

(a) cell walls % on as fed sample

dry matter % of as fed sample

Results and Discussion

Most of the feed samples that were analyzed from areas in the Departments of De L'Quest, Du Sud, De L'Artibonite and Du Nord Ouest are generally adequate in crude protein, averaging at least 10 percent except cassava peels, bone (ashed), sweet potato, breadfruit, banana peel, guatemala siratro, maize (leaves), and mesquite pods. Ten percent crude protein on a dry basis is considered adequate to meet the maintenance needs of adult animals.

Ash contents appear to be generally high in the feedstuffs analyzed except for the traditional feeds such as maize, sorghum, cassava roots, potato tube, mesquite pods, saman pods, and breadfruit. Total ash even at the lower end will be adequate to meet the nutritional needs of most classes of goats. However, individual minerals may be inadequate due to imbalances or excesses of others. Of particular concern is the Ca:P ratio which for most species is around 2:1. The data on minerals indicate that only a few of these feeds satisfy this requirement. Also of concern is goat feed II refuse, guinea leucaenea and Agridcantane. In the ruminant, there is antagonistic interaction between Mg and K absorption and so excessive levels of one mineral will affect absorption of the other.

Total digestible nutrients (TDN) for all feeds appear very good averaging well around 70% and above. However, this is to be excepted since most the feeds are high in nitrogen free extract, (the most soluble carbohydrates). Also it would appear that the high ash content may have also contributed to the high values observed for

the high TDN values. All the feeds are rather low in fiber (NDF, ADF), suggesting that these samples were from young succulent plants.

HINCHE AREA

The feeds from this area are generally high in protein except for the grain by-products such as rice bran, wheated rice bran, corn bran, and wheat bran. The dividivi fruit, corn husks and madame michel are also relatively low in crude protein.

The ash content overall is moderate to high, but particularly high in the rice bran feeds. The high ash content is probably due to high levels of silicates known to be present in rice hulls. Silicates have a detrimental effect on digestibility and this may partly explain the lower TDN values observed for rice bran feeds.

Nitrogen-free extract is very low in the sugar cane tops, hence additional energy supplementation will be required. Ether extract (fat) is relatively adequate in the feeds for most ruminant diets. However, 5% is usually regarded as the maximum amount of fat that can be included in ruminant diets, without depressing the digestibility of other nutrients. Some of the feedstuffs exceed this maximum value and so mixing with other ingredients low in fat will be required.

Crude fiber is generally higher in the grasses and crop residues than in the legumes and tree leaves. This is to be expected since grasses are generally more stemmy and have more structural carbohydrates than legumes. The legumes and tree leaves on the

other hand are good sources of calcium and will complement the grasses very well in a feeding regime.

With regards to the influence of stage of growth and nutritive quality, the data indicate that in general, early growth is usually higher in soluble carbohydrates (NFE) than mature forages especially in the grasses. However, other factors like total dry matter yield per hectare, and stability of the grass/legume stands may warrant harvesting at the mid-season stage.

RECOMMENDATIONS

I. Rotational Grazing

The following proposed rotational grazing scheme is based on an evaluation of the current available forages and the desire to minimize the disruption to the people and at the same time meet their needs in terms of improved management and development of the range and livestock resources.

Under the proposed program, the grazing system will, to the extent feasible, be based on a four block rotation, on a year-round basis. The boundaries of each block can be defined by a fire-break and where feasible shrubs can be planted to form a natural living fence.

It is recommended that the rotation system be based on a one month rotational interval beginning about June 25 of each year through October 15 to ensure that each pasture is grazed for one month during the rainy season. Following October 15, a three-month rotational interval could be followed during the next rainy season.

Under the proposed system, each village grazing area would be subdivided into 5 grazing areas with each area having 4 grazing blocks. Although it is recommended that the system be based on a year long grazing, some blocks may be set aside for seasonal grazing in order to make the best use of the forage and water supplies. Figure 2 to Figure 6 shows a five-year grazing treatment schedule and sequence time, use and forage treatment. Under this system the following is the regular schedule to be followed by all permitted during the time periods:

Graze all livestock on these pastures from beginning of rainy season (normally starting about June 25 annually), just as soon as suitable forage and water are available there. Continue to graze here as long as suitable forage and water are available for livestock. Prevent trampling other than on narrow main access trails by proper herding and adjusting stocking to balance amount of suitable forage available.

Expand grazing of livestock into these pastures only after August 20th (after peak of flowering of desirable grasses), unless otherwise instructed by the block manager. Plan to continue to graze these pastures as long as suitable forage and water for the livestock are available there. Prevent excess trampling near water points and limit trampling to main access trails by proper herding and adjusting stocking to balances amount of suitable forage available.

Expand grazing of livestock into these "Dry Season" pastures after forage and water for livestock has been utilized to a desired amount in the pastures grazed (above) and after September 25 (begin seed ripe time). Plan to continue to graze these pastures until the beginning of the rainy season (about June 25) the following year. Likewise prevent excess trampling and limit trampling to narrow main access trails by proper herding and adjusting stocking to balance forage produced. Assign water attendant to pasture's needs to assist herders in getting livestock watered and in and out of water point area (1/2 km reserve) to avoid excess trampling and to advise herds of location of other water points when livestock reach stocking planned at a water point.

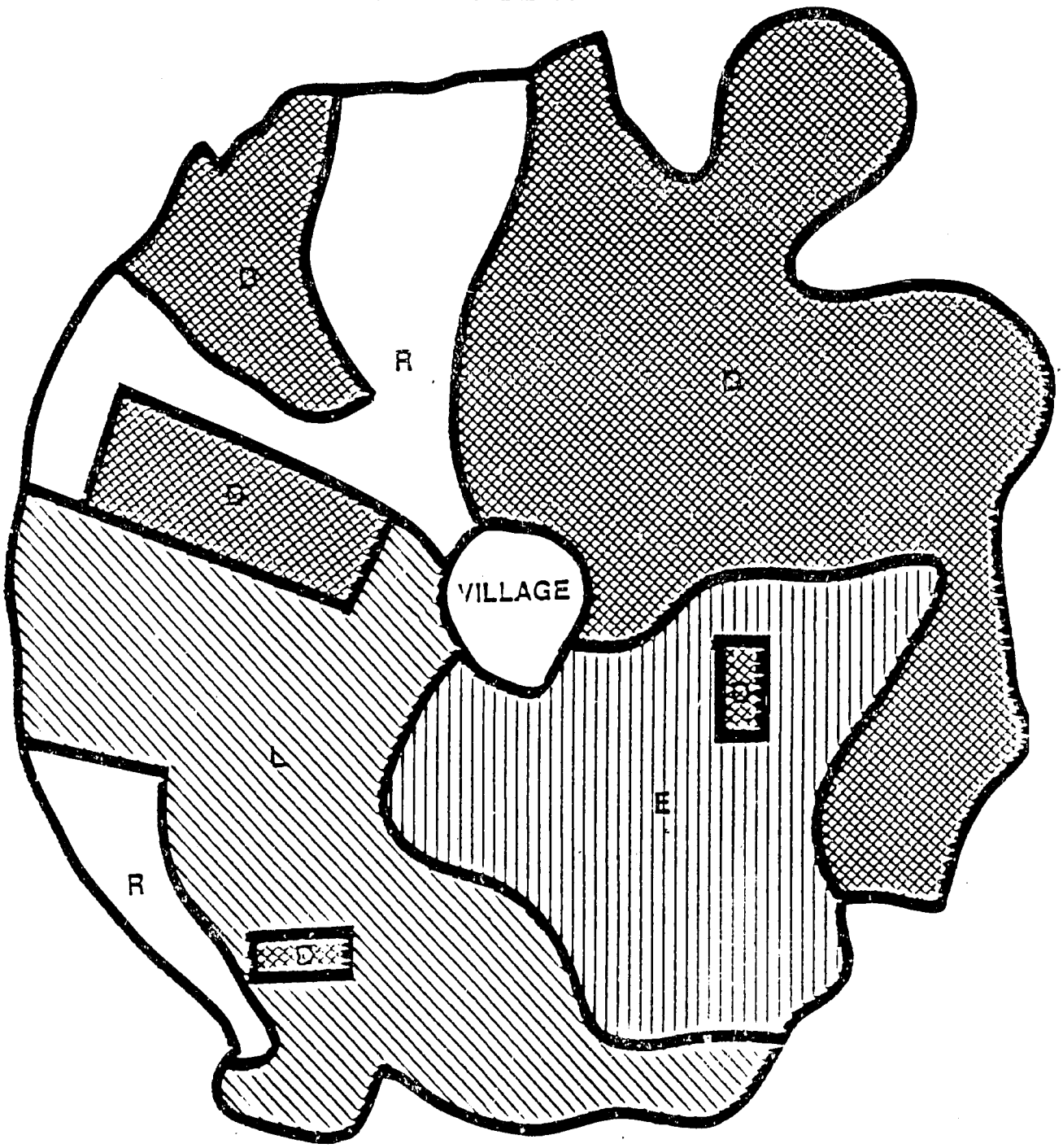
Area to be set aside for reforestation and regeneration trials.

The animals grazing in each block should be divided into several flocks rather than one large flock of goats. (To facilitate this approach, watering points should be strategically placed within each grazing block to the extent feasible.)

The milking herd can be handled in basically the same way as the main herd at present time. They will be kept in the villages at night and graze nearby during the day. The milking animals will be near the village only while they are producing milk for human consumption. As soon as production drops, they will be moved out to graze with the main herd. It is estimated that 20% of the goats will be near the village and milking at any one time. The remainder will all be with the main herd out on the grazing land. Therefore, an area adjacent to the village should be set aside based on the needs of each village for the animals to be milked. The milk animal area should also be subdivided into a four pasture rotation system to ensure adequate forage and to minimize overgrazing. The main herd including bucks, castrated males, and non-milking does should be kept out on the grazing land. During the rainy season the goats will stay out on the grazing lands at all times and not return to the village at night. They can be kept on thorn corrals out in the bush. In the dry season, the goats can also be kept out in the bush but should also graze some of the croplands to utilize the crop residues and also fertilize the croplands.

SAMPLE - VILLAGE GRAZING SYSTEM

YEAR 1 SEQUENCE



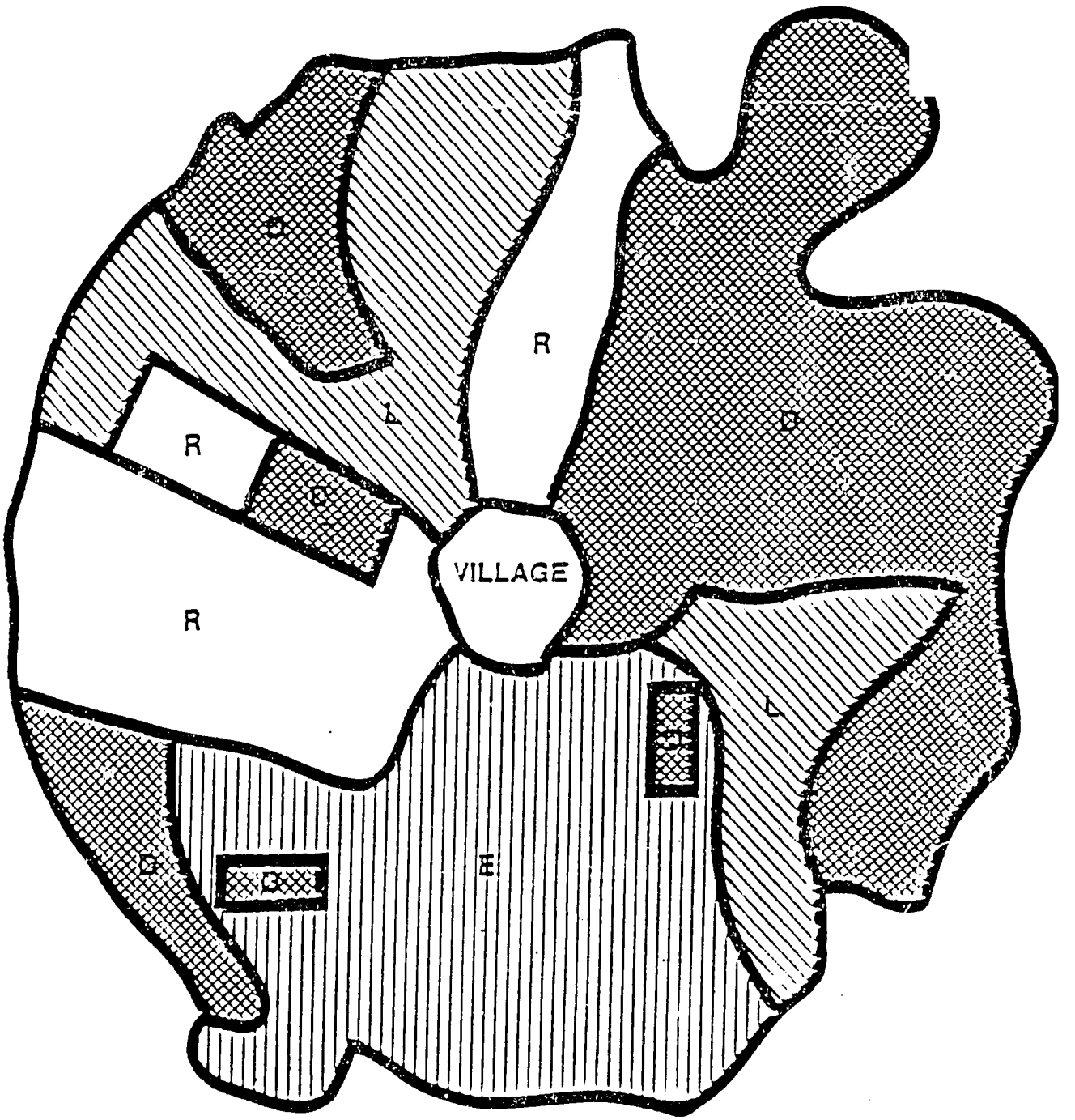
L - PASTURES DEFERRED TO AUGUST 20

D - PASTURES DEFERRED TO SEPTMEBER 25

R - PASTURE TO REST YEAR LONG

SAMPLE - VILLAGE GRAZING SYSTEM

YEAR 2 SEQUENCE



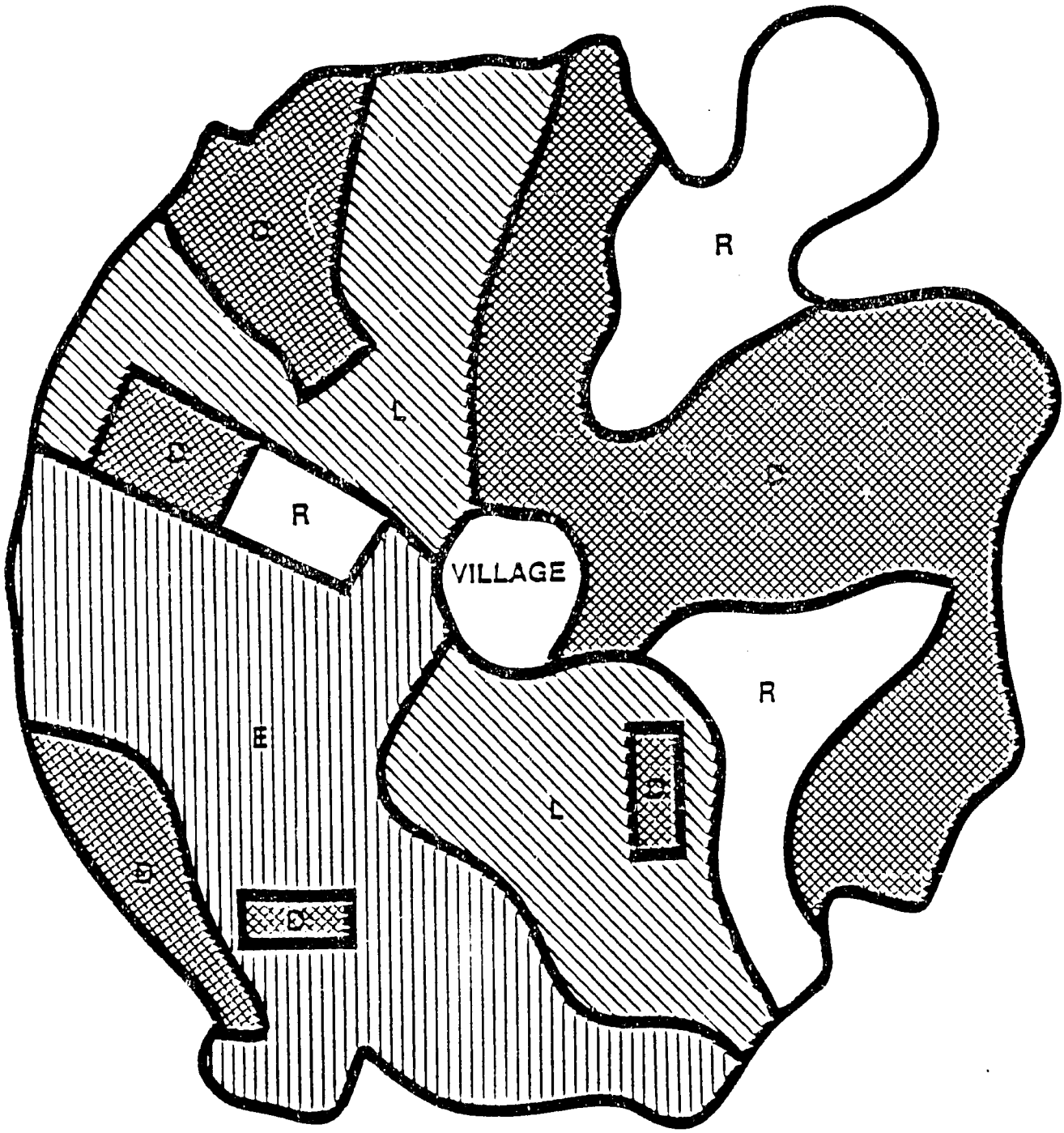
L - PASTURES DEFERRED TO AUGUST 20

D - PASTURES DEFERRED TO SEPTMEBER 25

R - PASTURE TO REST YEAR LONG

SAMPLE - VILLAGE GRAZING SYSTEM

YEAR 3 SEQUENCE

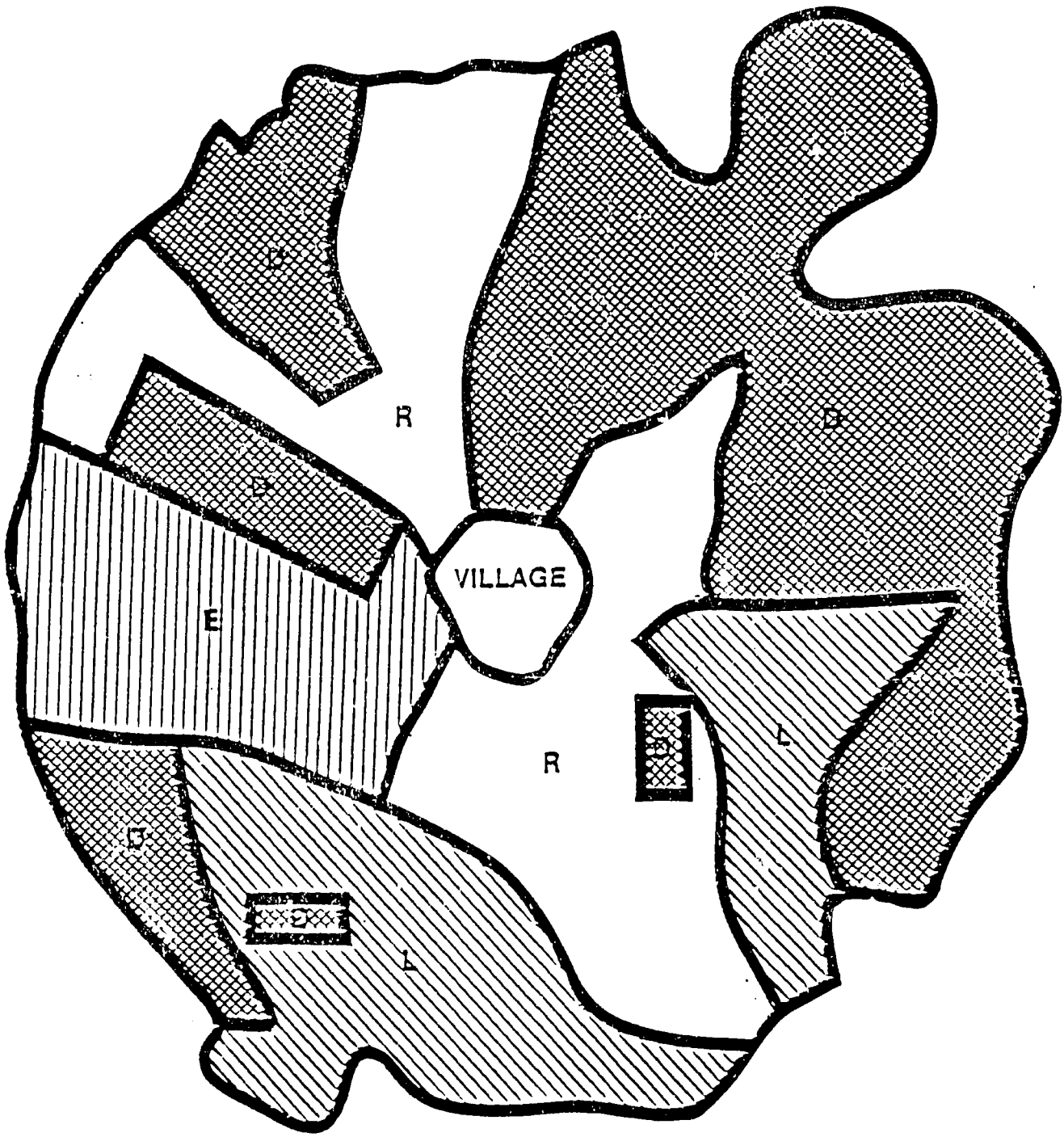


L - PASTURES DEFERRED TO AUGUST 20

D - PASTURES DEFERRED TO SEPTMEBER 25

R - PASTURE TO REST YEAR LONG

SAMPLE - VILLAGE GRAZING SYSTEM
YEAR 4 SEQUENCE



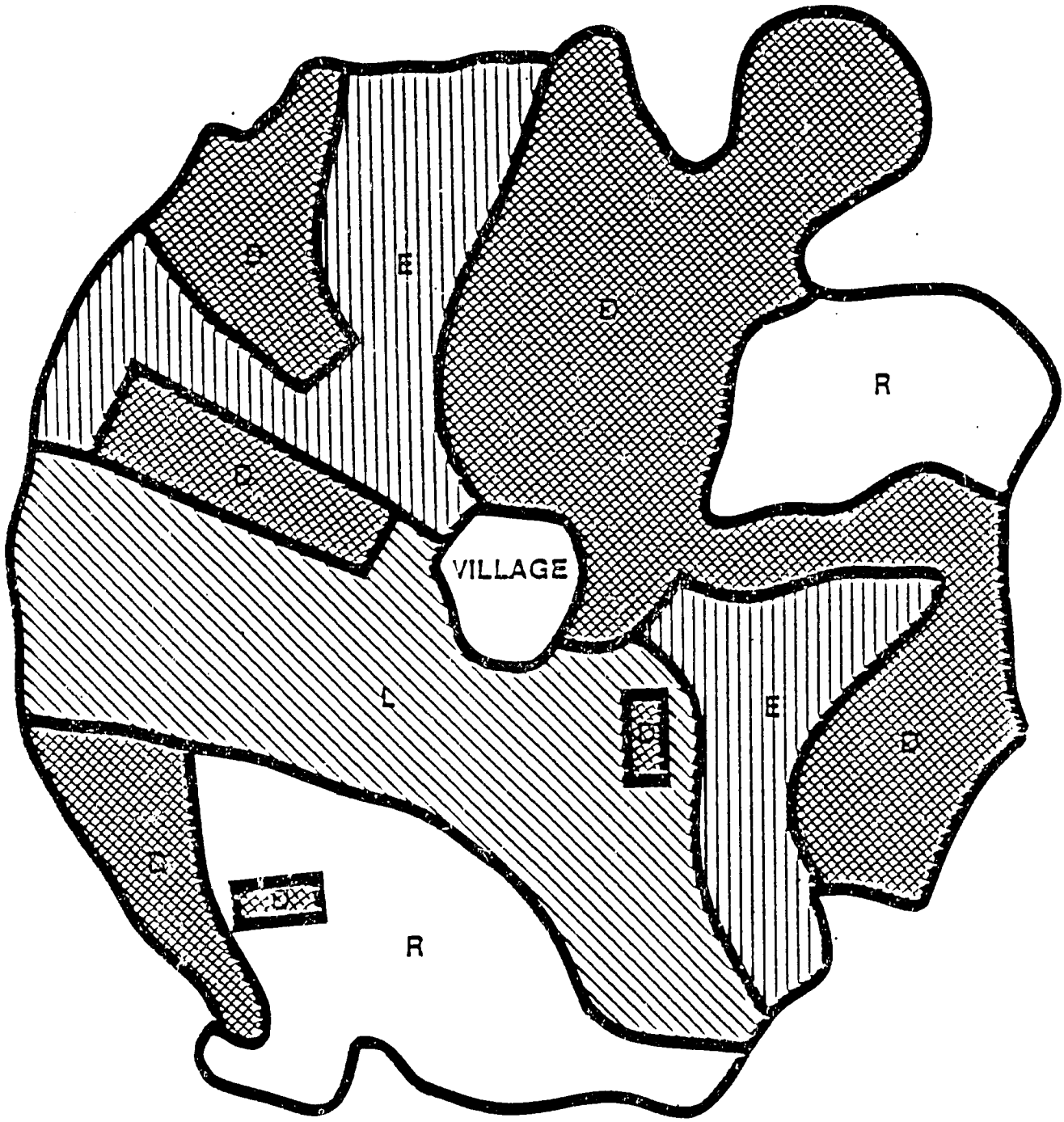
L - PASTURES DEFERRED TO AUGUST 20

D - PASTURES DEFERRED TO SEPTMEBER 25

R - PASTURE TO REST YEAR LONG

SAMPLE - VILLAGE GRAZING SYSTEM

YEAR 5 SEQUENCE



L - PASTURES DEFERRED TO AUGUST 20

D - PASTURES DEFERRED TO SEPTMEBER 25

R - PASTURE TO REST YEAR LONG

II. Crop Production

The land to be cultivated in each block should be specifically designated, including areas around the village as will such other places that have been traditionally tilled. However, if the rotational grazing system is to be accepted, the needs of both goat producers and cultivators must be adequately considered.

It is believed that adequate accommodation can be made regarding the needs of both. This statement is based on (1) families in each village who own goats as well as cultivate the field and thus are familiar with the potential for conditions and complementarity between the two systems; and (2) perhaps most important, the assumption that both groups are appropriately involved in the design of any rotational grazing/cultivating system which is established within each village. It is highly possible that the villages have a set of crop rotation pattern which they have been following for years. Thus it should be possible in close coordination with the villages to specifically identify the crop rotation plan inside the area for 2 to 4 years. This would permit a close coordination between the grazing and cultivation rotation patterns thus facilitating the complementary aspects of the relationship.

The traditional system of slash/burn agriculture should be discouraged where appropriate while at the same time the use of crop rotations systems including legumes and the application of natural fertilizer should be encouraged.

Controlled burning should be incorporated into the grazing plan to allow burning one every three to four years of those areas requiring such treatment.

III. Feeding Program

It is recommended that grazing animals will subsist on native grasslands during the period of rains an active plant growth. However, there should be sufficient harvested feeds stored to meet feed requirements for the long dry season. Adequate feeds during the dry season could easily double the productivity of existing livestock herds, and at low cost. Adequate feed supplies are basic to successful livestock enterprises. When feeds are inadequate, lactation stops, with severe effects on kids; There is prolonged cessation in breeding; the animals cease growth; and continued feed deprivation causes severe loss in animal weight. However, there should be sufficient harvested feeds stored to meet feed requirements for the long dry season. Thus, it is proposed that feeds be harvested to permit maintenance of a larger herd with sufficient nutritive feeds to prevent serious animal weight losses and to permit the breeding herd to kid normally and to maintain milk production until the following period of rains.

Under demonstrational activities, the following can be pursued: (a) Native grass could be cut and made into hay toward the end of the rains, while the forage is still green. The hay could be collected in stacks or bales for protection and to facilitate feeding at a later date. The grass will be cut by hand or by oxen with a cutting bar attachment. If the forage is dry when stacked, the hay may be stored in relatively large stacks compacted with round tops to shed water in the event of occasional late rains. Hand tools such as sickles for cutting, and pitch forks for handling dry hay are low in cost. (b) In areas where crops are grown, the opportunity exists to

harvest crop by-products and residues, and native weedy growth along field borders and roads, for storage as goat feeds. For example rice straws, the non-fruiting tillers of millet, sorghum or maize may be cut as soon as head formation has occurred on the fertile stalks, and collected as dry fodder, or made into silage. Figures 7 to 11 show instructions for erecting a staff SAV-R silo for making silage. The SAV-R plastic silo if properly used can provide silage of premium quality and palatability with minimum spoilage loss. Also, the vines of groundnut harvest or harvests of other food grain legumes may be saved for goat feed. Crop farmers may negotiate with herders to provide such feed, or the crop farmers may use such feed to carry the family subsistence herd through the dry season, with greatly improved milk production and growth of meat animals. The volume and kinds of crop residues and by-products will vary greatly from village to village, by encouragement should be given to collect and store all such feeds for use in the dry season.

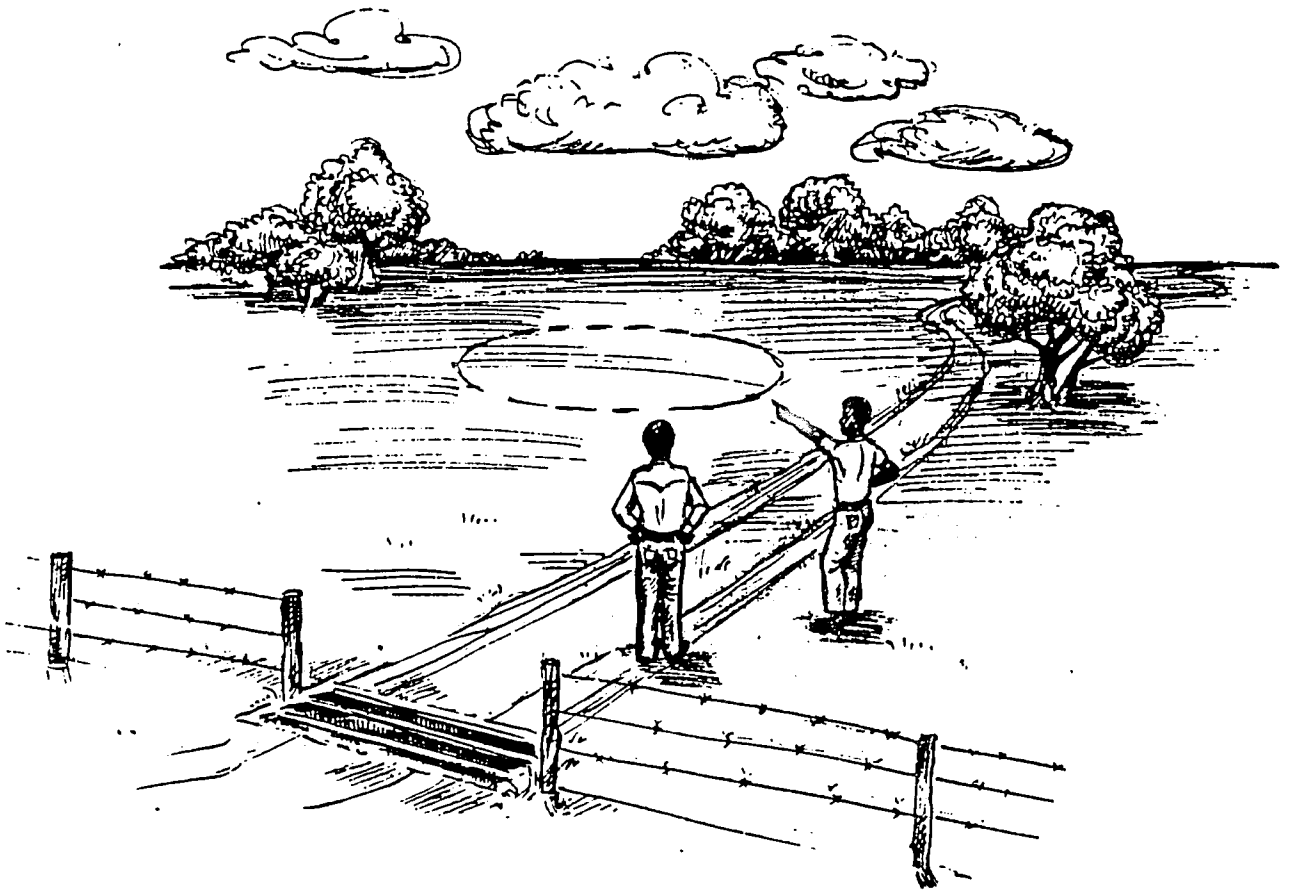
The economic benefits from an improved feeding program should be very substantial. The average kidding rates of goats may be raised from the present estimates of 100% to approach the desired 150% for the breeding herds of goats; kid losses maybe substantially reduced from 35 - 40% to 25 - 30%, the years needed to produce a marketable full size animal may drop to one to two years from the present two to three years, and the yearly off take of marketable animals from the herd increased from the present 8% to 14%.

In general, productivity of ruminants may become more efficient, so that 1/3 to 1/2 as much feed will be needed under good

management, to produce each kilogram of meat. Yearly milk flow may be greatly increased in amount and duration. The common cycle of producing weight gains in the season of rains, followed by losses from depravation and starvation in the prolonged dry season, can be overcome by ensuring year--round feed supplies. When adequately fed, the control of animal diseases should become more effective, and the husbandry of the livestock can be well organized to meet needs of the breeding herd, of the young stock, of the lactating animals, and of those being grown for market or local slaughter.

With the breeding herd maintained in healthy conditions, it will be possible to institute livestock improvement programs in indigenous herds by selection of superior does and sires and controlled breeding to propagate the superior stock.

STEPS FOR ERECTING STAFF SAV-R SILOS



Step 1 - Location

When chosing a site for the silos consider:

a. Location of crop for minimum hauling distance and time.

b. Access for forage tracks and wagons.

c. Location of goats for convenient out-feedings.

The site should be level, have good surface drainage and not be in a rodent-infested or windy area.

Step 2 - Preparation of the Site

Mark a circle 20 feet in diameter for a large silo, 16 feet in diameter for a medium silo, and 11 feet in diameter for a small silo. Rake the outer two feet of the circle until the area is free of sharp sticks and stones which would prevent good contact of the silo to the ground for air-tight seal. Remove forage from the area two feet outside silo area to prevent rodent and insect damage to silo both before and after filling. Use insecticide in case of severe infestation.

Step 3 - Preparing the Plastic Silo

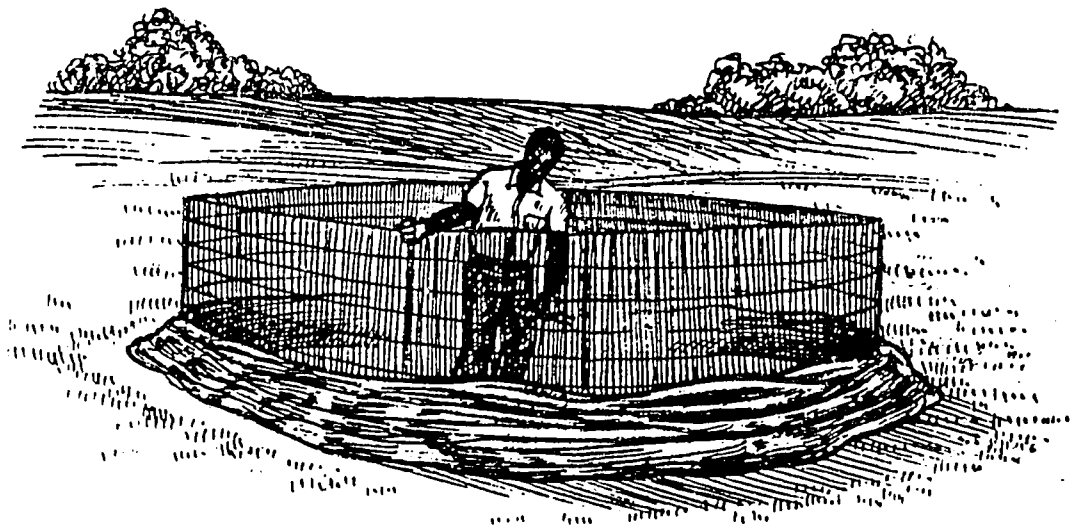
The silo is shipped int he form of a flat tube opened at both ends, and folded for convenience in unpacking.

a. Remove from the box and open the tube at one end.

b. Gather the silo together until silo is in the shape of a ring with about 12-14 inches left lying flat on the inside of the ring. The force flap which will make a bottom air-tight seal with the ground.

c. Place the gathered silo on the perimeter of the marked-out circle and pull flat toward the center.

d. When preparing the silo always carry rather than drag into place and avoid walking on the plastic.

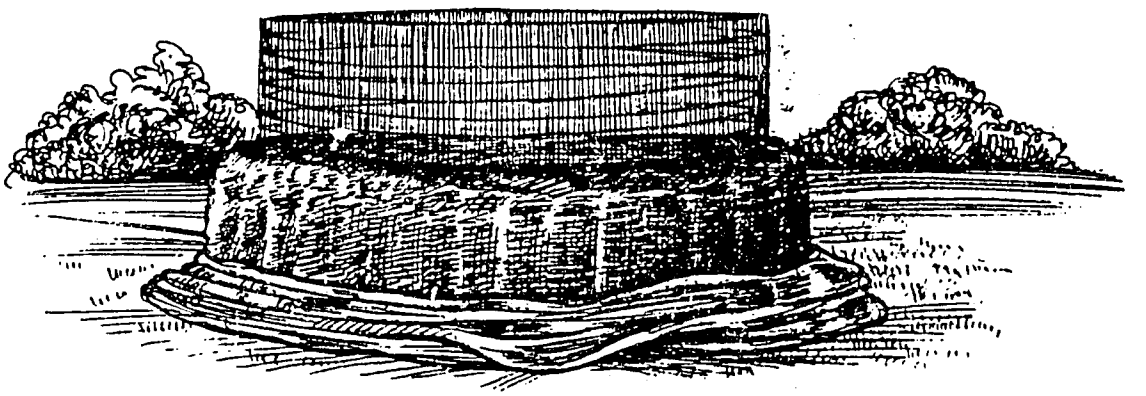


Step 4 - Constructing a Form for the Stack

a. Select a strong section of snow fence (shade fence) or other suitable material - 64' long for a large silo, 55' long for a medium silo, and 37' for a small silo.

b. Overlap the ends three feet so fence forms a circle and tie the ends firmly.

c. Place the fence inside the ring formed by the silo, resting on the lip of the plastic rather than on the gathered portion of the plastic. Protect plastic from any sharp protrusions.



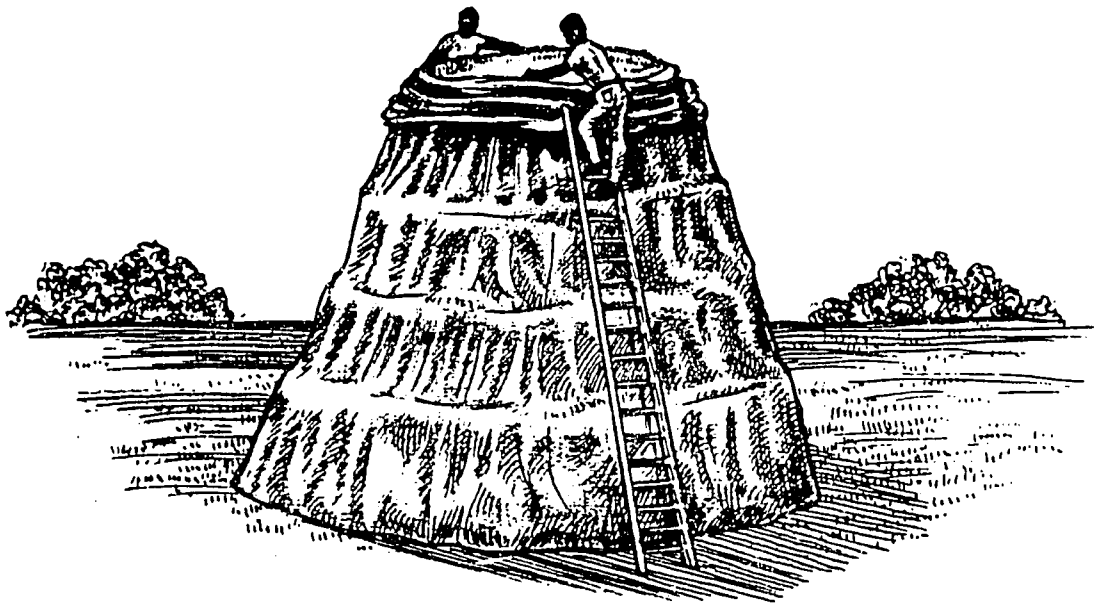
Step 5 - Building the Stack

a. Start by filling the foam with silage, packing thoroughly as you go, to prevent later sloughing, using any traditional filling method (shovel, spade, fork, etc.).

b. When a well-packed layer of silage 12-18" deep has been placed inside the form, lift the form about two inches so the bottom no longer rests on the plastic. Make sure the silage is well packed against the foam has been filled, the foam can be pulled vertically as the stack is formed to make a stack with vertical sides, for greater capacity, or the fence can be removed as in Step 4 and made 1-3 feet shorter to form a wedding cake structure. In either case the silage should be well packed for stability.

c. The filling can be continued to a height of 10 feet on the sides with a crown of 15-18 feet in the center.

d. With corn silage, special effort pack the silage well should be made to prevent slippage of the silage. Placement of the cobs away from the perimeter will assist in stability.

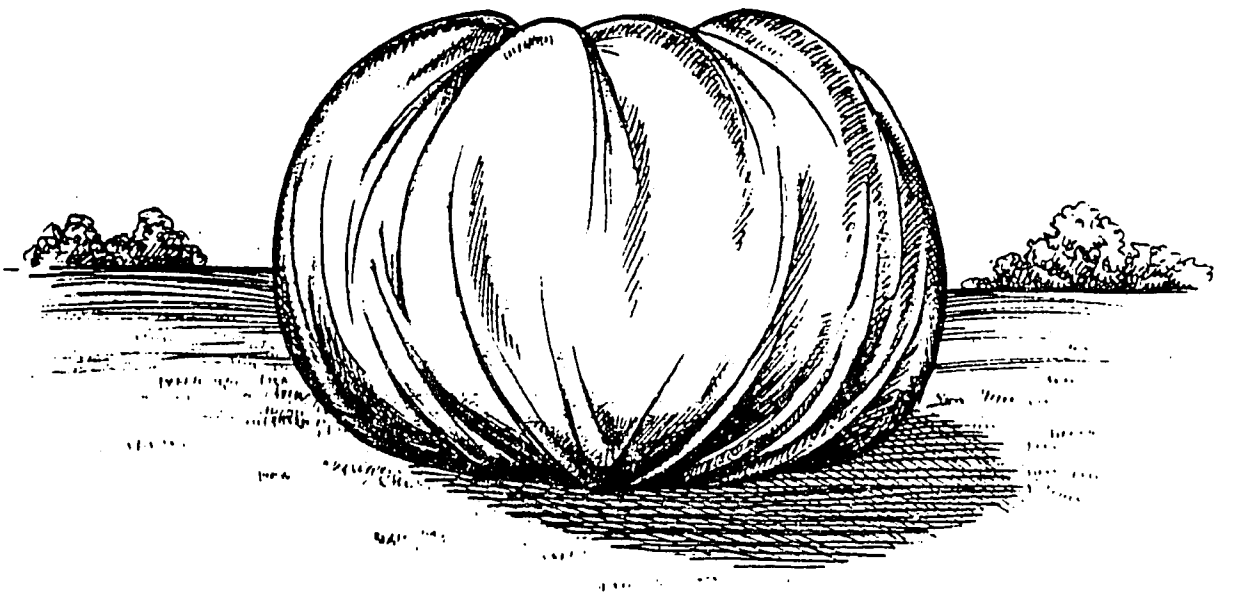


Step 6 - Closing the Silo

a. Remove the snow fence, unfold the plastic silo and open it to the top over the sides so that it can be gathered at the top to form a knot.

b. With a length of sash or other smooth cord, tie off the silo in the same way as a bag or grain. Failure to tie the knot air-tight will allow air to enter and permit spoilage.

c. Later after the silage has fermented, ball up the plastic to take up the slack with smooth cords at intervals around the silo to prevent wind damage.



Step 7 - Fermentation and Seepage

a. Gases given off by the fermentation of the silage will cause the silo to inflate like a balloon soon after closing. The silo will stretch to contain this gas (CO_2) which will diffuse through the vinyl plastic while preventing the entrance of air. While the silo is inflated, it should be inspected for any holes which might have been made during filling. If there are holes, patch them with adhesive tape.

b. On warm days (over 80 degrees F), the fermentation may be faster than the gas can diffuse through the plastic and cause excessive inflation with possible bursting. So, on warm days, make a small knife cut to allow gas to escape and close with a patch after three days.

c. Seepage from the silage will drain off into the ground or if desired, can be drained off by making a small slit near the bottom which can later be closed by patching or tying.

PROTECTING

Since the silo can be damaged by animals and rodents, the silo should be protected from animals by fencing, and protected from rodents and insects by removing edible materials near the silo and on the silo. Any holes should be immediately repaired.

OUTFEEDING

Most silage can be outfed from the top by opening the knots on the silo after placing a cord tightly around the silo at the depth to which silage will be fed so as to prevent air from being allowed to contact the sides below the feeding depth. It is desirable to reclose the silo after removing silage to preserve the best atmosphere for silage preservation.

RE-USING

After silage has been outfed, the silo should be swept clean and stored away from rodents and insects. Before re-use, it should be inspected well for holes which can be easily repaired. Many silos have been filled 6 to 8 times with careful use.

IV.

RATIONS

Below are suggested rations utilizing crop residues and by-products from Hinche and Port-Au-Prince areas.

A.

HINCHE

I. Requirements of a 20 Kg goat

Maintenance Requirements:
Digestible Energy = 1.18 Mcal
Digestible Protein = 26 g/d
Dry Matter/Animal/Day = 400 g

INGREDIENT	Amount (grams)	Crude Protein (%)	Crude Protein (grams)	DE (kg)	DE (Mcal/kg)
Rice Bran	100	7.30	7.30	3.12	.312
Corn Bran	190	9.63	18.30	3.80	.722
Wheat Bran	100	9.35	9.35	3.63	.363
Soybean Meal	10	59.25	5.92	3.87	.039
TOTAL	400	85.53	40.87	14.42	1.436

II. Ration for a 20 kg goat maintenance plus low activity plus a growth rate of 50 g per day.

Maintenance + Low Activity =	1.47 Mcal DE/day	46 g/day
Growth =	0.44 Mcal DE/day	14 g/day
TOTAL	1.91 Mcal DE/day	60 g/day

HINCHE

INGREDIENT	Amount (grams)	Crude Protein (%)	Crude Protein (grams)	DE (kg)	DE (Mcal/kg)
Rice Bran	375	7.30	27.37	3.12	1.17
Cottenseed Meal	25	34.75	8.69	3.79	.09
Andropogon Hay	200	14.10	28.20	3.33	.67
TOTAL	600	56.15	64.26	10.24	1.93

III. Requirements of a 10 kg goat
Growth Requirements (Maintenance + Medium Activity):
Digestible Energy = 1.05 Mcal + 0.44 Mcal (for growth)
= 1.49 Mcal
Digestible Protein = 23 g + 10 g (for growth) = 34 g
Dry Matter/Animal/Day = 360 g

INGREDIENT	Amount (grams)	Crude Protein (%)	Crude Protein (grams)	DE (kg)	DE (Mcal/kg)
Rice Bran	50	7.30	3.65	3.12	.156
Corn Bran	200	9.63	19.26	3.80	.760
Wheat Bran	50	9.35	4.68	3.63	.182
Soybean Meal	60	59.25	35.55	3.87	.232
TOTAL	360	85.53	63.14	14.42	1.330

At this level 1.33 Mcal can only support 32 g/day gain.
(0.28/0.44 x 50 = 32 g)
1.33 - 1.05 = 0.28 Mcal available for gain.

B.

PORT-AU-PRINCE

I. Requirements of a 20 kg goat
   Maintenance Requirements
   Digestible Energy = 1.18 Mcal
   Digestible Protein = 26 g
   Dry Matter/Animal/Day = 400 g

INGREDIENT	Amount (grams)	Crude Protein (%)	Crude Protein (grams)	DE (kg)	DE (Mcal/kg)
Elephant Grass	300	10.54	31.62	3.26	0.97
Cracked Corn	550	12.71	69.91	3.78	2.07
Wheat Bran	500	9.27	46.20	3.56	.89
Fish Meal	30	24.81	7.44	3.64	.10
TOTAL	1380	67.30	155.17	14.24	4.03

PORT - AU - PRINCE

III. Requirements of a 10 Kg goat
Growth Requirements: (Maintenance + Medium activity)
Digestible Energy = 1.05 Mcal +0.44 Mcal (for growth)
= 1.49 Mcal
Digestible Protein = 23 g +10 g (for growth) = 34 g
Dry Matter/Animal/Day = 360 g

INGREDIENT	Amount (grams)	Crude Protein (%)	Crude Protein (grams)	DE (kg)	DE (Mcal/kg)
Wheat Bran	50	9.24	4.62	3.59	0.18
Sorghum Bran	50	13.28	6.64	3.63	0.18
Wheat Bran	200	10.08	20.16	3.71	0.78
Soybean Meal	60	24.81	14.89	3.64	0.18
TOTAL	360	57.41	46.31	14.57	1.32

At this level 1.32 Mcal can only support 31 g daily gain (0.27/0.44 x 50 = 31 g)
1.32 - 1.05 = .27 Mcal available for gain.

The rations presented are for use primarily during the long dry season or periods of minimum rainfall. It is recommended that efforts be made to utilize grasses and legumes during the growing seasons to make hay and /or silage for dry season feeding. The nutrient composition of various tree leaves, crop residues, by-products and forages in particular seems to be adequate for animal requirements during the growing period as long as quantities are not limited. Emphasis was placed on utilizing locally available feeds for formulating the various rations.

APPENDIX TABLES

Analyses of Grasses, Legumes, Crop By-Products, Crops Residues, Shrubs and Forbs from the Hinche, and Port-Au-Prince and Vicinity Areas.

HINCHE AREA GRASSES FEED ENERGY

FEED STUFF	DM %	ASH %	CF %	TDN %	NFE %	EC %	CP %	DE CATTLE MCAL kg	DE GOAT MCAL kg	DE SWINE MCAL kg	ME CATTLE MCAL kg	ME GOAT MCAL kg
Guinea Grass -1-	94.40	10.27	24.07	73.69	48.37	4.05	13.24	3.25	3.28	3.25	2.66	2.69
Guinea Grass -2-	88.86	10.17	26.64	79.63	38.62	10.31	14.26	3.51	3.52	3.51	2.88	2.89
Guinea Grass -3-	93.17	9.49	25.94	73.09	41.34	4.56	13.67	3.22	3.30	3.22	2.64	2.71
Angleton -1-	90.6	9.85	20.62	76.76	51.97	5.13	12.43	3.38	3.40	3.38	2.77	2.79
Angleton -3-	93.07	8.38	23.05	75.81	54.66	3.66	10.24	3.34	3.28	3.34	2.74	2.69
Napier -2-	94.16	10.67	22.40	83.41	43.03	10.32	13.52	3.68	3.58	3.68	3.01	2.93
Mae Michel	92.64	7.41	22.03	78.55	58.26	6.46	7.68	3.46	3.43	3.46	2.84	2.82
Sorghum -1-	85.98	10.23	24.40	80.48	41.04	10.28	14.04	3.55	3.56	3.55	2.91	2.92
Sorghum -2-	92.22	10.19	30.47	77.30	38.66	9.23	11.45	3.41	3.39	3.41	2.79	2.79
Dry Hay Andropogoni	93.37	11.36	23.46	58.59	35.77	10.21	14.10	2.58	3.33	2.56	2.12	2.73
Tomaki -1-	93.08	11.80	23.91	73.79	48.02	4.72	11.55	3.23	3.24	3.23	2.65	2.66

1 = Early Growth 2 = Mid-Season 3 = Mature

HINCHE AREA LEGUMES FEED ENERGY

FEED STUFF	DM %	ASH %	CF %	TDN %	NFE %	EE %	CP %	DE CATTLE MCAL kg	DE GOAT MCAL kg	DE SWINE MCAL kg	ME CATTLE MCAL kg	ME GOAT MCAL kg	ME SWINE MCAL kg
Dividivi - 1 -	92.24	3.10	3.34	05.72	66.88	3.05	24.23	2.90	3.90	2.90	2.38	3.20	2.64
Dividivi - 2 -	93.56	3.57	1.79	87.05	69.36	4.39	20.97	3.80	4.25	3.18	3.88	3.48	3.56
Leucaena - 1 -	91.93	8.62	7.54	83.78	52.19	4.23	27.19	3.69	3.68	3.69	3.30	3.01	3.34
Leucaena - 2 -	95.16	6.93	5.52	84.81	45.95	6.78	35.39	3.79	3.95	3.74	3.06	3.24	3.32
Bayahonde - 1 -	98.00	7.54	9.64	84.25	60.47	6.48	15.87	3.71	3.74	3.71	3.04	3.08	3.44
Bayahonde - 2 -	94.87	5.23	9.45	84.65	46.17	7.07	32.07	3.73	3.93	3.73	3.06	3.22	3.36
Pigeon Pea - 1 -	99.34	6.54	6.64	85.36	58.91	6.16	21.65	3.76	3.84	3.76	3.09	3.15	3.44
Pigeon Pea - 2 -	91.61	6.76	6.53	83.99	48.93	6.53	31.31	3.70	3.96	3.70	3.04	3.25	3.32
Campeche - 1 -	92.75	5.88	6.53	80.16	51.28	2.76	33.55	3.83	3.76	3.53	2.90	3.08	3.15
Campeche - 2 -	89.94	8.53	8.72	78.79	58.00	2.88	21.86	3.47	3.59	3.47	2.85	3.94	3.18
Cassia Leaf - 1 -	94.80	1.24	21.80	74.38	49.39	4.77	13.90	3.28	3.35	3.28	2.69	2.75	3.06
Cassia Leaf - 2 -	91.82	8.34	6.40	83.51	57.84	6.62	25.79	3.68	3.82	3.68	3.02	3.14	3.34

1 = Early Growth 2 = Mid-Season

HINCHE AREA TREE-LEAVES FEED ENERGY

FEED STUFF	DM %	ASH %	CF %	TDN %	NFE %	EE %	CP %	DE CATTLE MCAL kg	DE GOAT MCAL kg	DE SWINE MCAL kg	ME CATTLE MCAL kg	ME GOAT MCAL kg	ME SWINE MCAL kg
Benzolive	92.23	5.06	3.61	87.13	43.77	8.02	39.57	3.84	4.10	3.84	3.15	3.35	3.38
Mango Leaf	92.33	7.32	7.50	98.52	51.64	10.31	23.22	3.90	4.00	3.90	3.20	3.28	3.56
Potato Leaf	92.56	9.97	6.18	84.71	59.26	7.72	16.86	3.73	3.78	3.73	3.06	3.10	3.45
Elm	92.90	10.33	5.83	82.04	54.26	6.36	23.21	3.62	3.73	3.62	2.97	3.07	3.30
Spanish Plum	94.09	9.21	6.61	78.22	61.06	2.59	20.52	3.45	3.58	3.83	2.83	2.93	3.17
Panama Gum Leaf	92.00	12.88	5.47	77.42	60.87	3.37	17.46	3.41	3.49	3.41	2.80	2.86	3.15
Hog Plum Leaf	94.43	8.06	5.80	80.38	60.23	3.00	22.89	3.54	3.66	3.54	2.91	3.00	3.23
Avocado Leaf	90.03	7.53	6.15	87.61	64.34	7.95	14.02	3.86	3.86	3.86	3.17	3.16	3.60
Sweet Cassava	90.04	8.11	2.30	87.55	40.98	10.19	38.47	3.86	4.10	3.86	3.16	3.36	3.40
Sour Cassava	90.97	7.30	5.58	88.10	46.75	7.61	32.83	3.88	3.94	3.88	3.18	3.23	3.47
Cotton Leaf	91.54	12.30	6.43	76.61	45.29	45.29	4.43	31.54	3.33	3.58	3.33	2.94	2.98
Mantain Leaf	91.67	9.96	7.12	81.80	58.02	6.42	18.47	3.61	3.71	3.61	2.96	3.04	3.33
YAM (Dioscorea)	93.00	11.72	10.62	76.65	31.20	10.32	36.13	3.38	3.81	3.36	2.77	3.12	3.22
Trumpet	92.67	10.15	6.28	86.97	52.87	10.38	20.30	3.83	3.91	3.83	3.14	3.20	3.52

HINCHE AREA — CROP RESIDUES — FEED ENERGY

FEED STUFF	DM %	ASH %	CF %	TDN %	NFE %	EE %	CP %	DE CATTLE MCAL kg	DE GOAT MCAL kg	DE SWINE MCAL kg	ME CATTLE MCAL kg	ME GOAT MCAL kg	ME SWINE MCAL kg
Rice Polish	95.28	5.97	2.900	90.81	69.02	7.86	14.25	4.00	3.99	4.00	3.28	3.27	3.72
Rice Flour	95.94	0.51	0.045	90.02	87.79	1.76	9.89	3.97	3.97	3.97	3.25	3.25	3.73
Rice Bran	96.2	17.85	17.840	71.40	51.11	5.28	7.30	3.14	3.12	3.14	2.58	2.56	2.96
Wheated Rice Bran	97.64	20.27	23.060	69.55	43.06	7.11	6.49	3.07	3.03	3.07	2.51	2.49	2.91
Heated Rice Bran	97.26	20.15	2.310	65.75	46.51	3.41	8.07	2.90	2.89	2.90	2.37	2.36	2.74
Corn Bran	90.78	3.54	24.020	86.90	52.80	9.94	9.63	3.83	3.80	3.83	3.14	3.12	3.60
Wheat Bran	89.94	5.44	24.240	83.07	52.89	8.07	9.35	3.66	3.63	3.66	3.00	2.97	3.45
Sorghum Bran	87.5	6.97	24.740	84.82	46.76	11.16	10.35	3.74	3.71	3.74	3.07	3.05	3.51
Sorghum Residues	90.04	7.73	25.260	82.41	42.51	10.33	14.17	3.63	3.64	3.63	2.98	2.99	3.38
Silage	88.64	5.78	19.900	80.54	31.51	8.13	34.75	3.55	3.79	3.55	2.91	3.11	3.16
Cottonseed Meal	91.54	12.30	6.43	76.61	45.29	45.29	4.43	31.54	3.33	3.58	3.33	2.94	2.98
Soybean Meal	89.42	8.15	8.520	76.76	18.35	5.81	59.25	3.38	3.87	3.38	2.77	3.18	2.84
Soybean Hull	96.85	5.29	30.220	76.47	47.04	4.67	12.78	3.37	3.04	3.37	2.76	2.49	3.15

CONTINUED

Dividivi Fruit													
	93.37	3.47	3.820	94.08	76.40	8.78	7.51	4.15	4.09	4.15	3.40	3.25	3.92
Green Sundried Pigeon Peal													
	92.36	3.62	11.620	88.75	48.35	9.49	26.92	3.91	3.88	3.91	3.21	3.32	3.54
Mature Dried Pigeon Pea													
	91.02	3.29	12.590	89.57	50.47	9.83	27.31	3.95	4.05	3.95	3.24	3.37	3.57
Seeds & Pods Dayahonde													
	91.93	4.39	10.900	80.96	69.23	1.26	14.21	3.57	3.61	3.57	2.93	2.96	3.32
Sugar Cane Tops													
	93.71	9.75	30.480	70.66	3.36	2.89	10.83	3.11	3.13	3.11	2.55	2.56	2.91
Corn Husk													
	92.55	19.58	30.720	78.52	54.97	4.42	6.31	3.46	3.41	3.46	2.84	2.80	3.28
Lemon Pulp													
	91.07	5.96	5.470	28.57	74.04	2.59	11.72	3.68	3.70	3.68	3.02	3.03	3.44

HINCHE AREA **CROP RESIDUES** **FEED ENERGY**

FEED STUFF	DM %	ASH %	CF %	TDN %	NFE %	EE %	CP %	DE CATTLE MCAL kg	DE GOAT MCAL kg	DE SWINE MCAL kg	ME CATTLE MCAL kg	ME GOAT MCAL kg	ME SWINE MCAL kg
Early Growth Corn Stalk													
	90.29	3.57	19.30	88.69	55.27	10.09	11.76	3.91	3.89	3.91	3.21	3.19	3.66
Tomato Skin Seeds													
	92.30	8.15	31.90	74.32	20.82	8.15	30.94	3.28	3.47	3.28	2.69	2.84	2.94

HINCHE AREA MINERALS GRASSES

FEED STUFF	%	Ca %	P %	Hg %	K %	Fe mg %	Na %	Cl %	Mn mg kg	Zn mg kg	Cu mg kg	Se mg kg	B mg kg
Guinea Grass - 1 -	0.449	0.149	0.379			106.000		50.80	201.0	31.80			
Guinea Grass - 2 -	0.392	0.055	0.124			270.000		21.40	76.5	22.50			
Guinea Grass - 3 -	0.361	0.104	0.078			393.000		38.60	66.4	6.43			
Angleton - 1 -	0.221	0.080	0.130			342.000		37.60	52.6				
Angleton - 3 -	0.419	0.053	0.079			342.000		37.60	52.6				
Napier - 2 -	0.295	0.150	0.149			372.00		23.40	34.0	2.33			
Mme Michel	0.350	0.025	0.100			240.000		31.30	18.3				
Sorghum - 1 -	0.686	0.180	0.256			256.00		43.00	65.0	1.51			
Sorghum - 2 -	0.293	0.128	0.221			288.00		41.20	173.0	2.17			
Dry Hay Andropogon	0.590	0.032	00.096			193.000		9.64	283.0	1.18			
Tomaki - 1 -	0.536	0.169	0.207			107.000		21.50	48.3	5.37			

1 = Early Growth 2 = Mid-Season

HINCHE AREA MINERALS LEGUME LEAVES

FEED STUFF	Ca %	P %	Mg %	K %	Fe mg %	Na %	Cl %	Mn mg kg	Zn mg kg	Cu mg kg	Se mg kg	B mg kg
Dividivi - 1 -	0.254	0.312	0.101		65.0			10.80	28.1	10.80		
Dividivi - 2 -	0.722	0.086	0.121		92.2			68.40	32.0	74.80		
Leucaena - 1 -	2.440	0.162	442.000		196.0			53.00	105.5	32.60		
Leucaena - 2 -	1.520	0.135	0.386		242.0			105.00	35.7	10.50		
Bayahonde - 1 -	2.880	0.096	0.200		275.0			30.80	20.4	2.04		
Bayahonde - 2 -	1.440	0.124	0.278		169.0			43.00	36.9	3.16		
Pigeon Pea - 1 -	1.070	0.232	0.216		385.0			66.30	42.8	6.42		
Pigeon Pea - 2 -	1.130	0.115	0.289		410.0			109.0	07.20	16.37		
Campeche - 1 -	2.150	0.073	127.000		183.0			34.50	64.7	10.78		
Campeche -2-	2.340	0.183	0.166		145.0			33.00	66.0	10.06		
Cassia Leaf - 1 -	0.294	0.169	401.000		38.0			38.00	151.0	5.27		
Cassia Leaf - 2 -	1.990	0.124	0.418		446.0			74.00	54.0	5.44		

1 = Early Growth 2 = Mid-Season

HINCHE AREA MINERALS TREE LEAVES

FEED STUFF	Ca %	P %	Mg %	K %	Fe mg %	Na %	Cl %	Mn mg kg	Zn mg kg	Cu mg kg	Se mg kg	B mg kg
Benzolive	2.99	0.218	0.339		227.7			52	26	21.68		
Mango Leaf	1.98	0.32	0.534		246			7.26	61.7	11.9		
Potato Leaf	1.32	0.187	0.669		227			42	42	41.2		
Elm	2.10		0.216		10.76			31.2	75.3			
Spanish Elm	3.21	0.132	0.429		319			38.3	67	1.06		
Panama Gum Leaf	2.10	0.097	0.361		195			70.6	32.6	1.09		
Hog Plum Leaf	2.36	0.133	0.233		307			56.1	66.7	116		
Avocado Leaf	1.50	0.088	0.443		266			89.9	34.4	55.5		
Sweet Cassava Leaf	1.72	3.010	0.353		133			122	55.5	7.77		
Sour Cassava Leaf	1.34	0.252	0.359		419			129	64.5	6.45		
Cotton Leaf	3.08	0.158	0.270		406			56.8	61.1	7.65		
Plantain Leaf	1.73	0.097	0.353		318			218	49	7.63		
Yam (Dioscorea)	1.38	0.097	0.217		10.7			10.7				
Trumpet	1.46	0.169	0.701		238			42.11	42.11	19.4		

PORT-AU-PRINCE AND VICINITIES GRASS SAMPLES FEED ENERGY

FEED STUFF	DM %	ASH %	CF %	TDN %	NFE %	EC %	CP %	DE CATTLE MCAL kg	DE GOAT MCAL kg	DE SWINE MCAL kg	ME CATTLE MCAL kg	ME GOAT MCAL kg	ME SWINE MCAL kg	NFE %
Elephant (L)	88.98	11.75	73.92	6.98	6.12	1.70	10.54	3.260	3.260	3.260	2.673	2.673	3.060	62.91
Elephant (L)	89.60	13.15	74.73	6.79	6.65	1.22	15.69	3.295	3.295	3.295	2.702	2.702	3.059	56.30
Elephant (PL)	95.75	12.25	72.47	7.17	8.42	1.25	11.16	3.195	3.195	3.195	2.620	2.620	2.995	59.75
Molasses Grass	92.97	12.99	74.90	6.63	6.89	2.45	13.84	3.305	3.305	3.305	2.710	2.710	3.080	56.50
Pangola Grass	92.81	11.13	76.84	6.76	6.52	4.14	16.61	3.388	3.388	3.388	2.770	2.770	3.139	54.84
Bermuda Grass	93.51	12.20	77.04	6.71	7.20	5.02	13.76	3.397	3.3.97	3.397	2.785	2.785	3.167	55.11
Guinea Grass	92.00	13.76	70.90	5.61	10.72	2.28	18.34	3.126	3.126	3.126	2.563	2.563	2.885	42.29
Guinea Tricholglume	95.55	13.75	72.66	6.99	6.15	2.22	14.71	3.203	3.203	3.203	2.626	2.262	2.980	56.18
Buffel (Nueces)	93.57	13.79	72.94	3.37	6.87	2.01	18.77	3.216	3.216	3.216	2.637	3.637	2.965	55.19
Buffel (Common)	90.45	11.95	76.48	4.43	6.70	3.40	14.23	3.372	3.372	3.372	2.765	2.765	3.140	59.29
Guatemala	96.60	11.13	72.58	7.38	7.69	0.59	13.59	3.200	3.200	3.200	2.624	[illegible]	[illegible].284	59.62
Maize	94.75	13.33	73.33	6.59	6.47	1.71	9.17	3.000	3.000	3.000	2.460	2.460	2.824	62.73
Laurissa	91.57	14.71	71.91	6.56	6.77	2.82	17.92	3.170	3.170	3.170	2.599	2.599	2.982	51.22

L = LEAVES
PL = WHOLE PLANT

PORT-AU-PRINCE AND VICINITIES GRASS + LEGUMES FEED ENERGY

FEED STUFF	DM %	ASH %	CF %	TDN %	NFE %	EC %	CP %	DE CATTLE MCAL kg	DE GOAT MCAL kg	DE SWINE MCAL kg	ME CATTLE MCAL kg	ME GOAT MCAL kg	ME SWINE MCAL kg	NFE %
Elephant-Sirato (L)	88.57	12.56	75.48	6.070	6.750	3.990	17.15	3.328	2.729	2.729	3.079	53.483	3.060	62.91
Elephant Sirato (PL)	92.90	13.50	71.40	6.07	6.99	1.22	15.39	3.148	3.148	3.148	2.581	2.581	2.924	56.34
Elephant (PL)	95.75	12.25	72.47	7.17	8.42	1.25	11.16	3.195	3.195	3.195	2.620	2.620	2.995	59.75
Elephant Leucaena (L)	88.87	13.42	74.81	6.92	4.92	3.37	18.28	3.298	3.298	3.298	2.704	2.704	3.044	54.52
Guinea Sirato	87.10	12.57	73.65	5.47	6.64	2.28	15.35	3.247	3.247	3.247	2.662	2.662	3.016	56.56
Guinea Leucaena	92.70	14.84	70.92	6.60	6.42	1.68	18.20	3.127	3.127	3.127	2.564	2.564	2.887	53.08
Gutemala Teramus	98.15	10.29	74.96	5.78	7.94	1.13	7.38	3.305	3.305	3.305	2.710	2.710	3.123	66.35
Guatemala Siratro	94.00	10.32	75.95	6.91	6.92	0.59	14.46	3.344	3.344	3.344	2.742	2.742	3.112	60.64
Laurissa Siratro	93.32	14.13	70.65	7.07	6.71	0.59	17.58	3.115	3.115	3.115	2.554	2.554	2.880	56.05

PORT-AU-PRINCE AND VICINITIES LEGUMES FEED ENERGY

FEED STUFF	DM %	ASH %	TDN %	ADT %	RDT %	EC %	CP %	DE CATTLE MCAL kg	DE GOAT MCAL kg	DE SWINE MCAL kg	ME CATTLE MCAL kg	ME GOAT MCAL kg	ME SWINE MCAL kg	NFE %
Tamarin	90.47	4.55	81.53	4.05	3.85	1.20	16.86	3.595	3.595	3.595	2.948	2.948	3.329	69.39
Sirato	92.83	16.30	69.90	5.83	4.87	1.71	20.20	3.082	3.082	3.082	2.527	2.527	2.833	50.99
Velvet Bean	93.90	17.95	68.90	8.83	4.10	3.36	23.69	3.038	3.038	3.038	2.491	2.491	2.221	42.07
Flamboyant	93.20	7.13	85.96	3.89	5.50	7.85	17.97	3.790	3.790	3.790	3.108	3.180	3.501	57.66
Glycine	95.65	11.35	74.66	7.10	4.00	1.81	17.77	3.292	3.292	3.292	2.699	2.699	3.042	57.97
Leucaena (L)	92.15	6.84	80.27	6.29	3.32	3.97	27.98	3.539	3.539	3.539	2.902	2.902	3.197	51.60
Leucaena (L)	93.50	8.34	77.16	5.71	4.56	2.92	30.08	3.402	3.402	3.402	2.790	2.790	3.059	48.39
Leucaena (L)	92.70	7.99	77.23	5.43	5.00	2.29	26.56	3.405	3.405	3.405	2.792	2.792	3.086	52.73
Mesquite Pods	83.42	3.18	84.26	3.02	4.23	26.56	9.96	3.715	3.715	3.715	3.046	3.046	3.482	78.26
Swan Pods	78.43	4.40	81.13	6.53	4.57	9.96	15.10	3.577	3.577	3.577	2.933	2.933	3.325	67.35
Calliandra	92.02	8.58	78.72	5.69	2.34	2.58	21.63	3.471	3,471	3.471	2.846	2.846	3.180	59.18

PORT-AU-PRINCE AND VICINITIES TREES FEED ENERGY

FEED STUFF	DM %	ASH %	TDN %	ADF %	RDF %	EC %	CP %	DE CATTLE MCAL kg	DE GOAT MCAL kg	DE SWINE MCAL kg	ME CATTLE MCAL kg	ME GOAT MCAL kg	ME SWINE MCAL kg	NFE %
Benzolive	85.86	10.26	79.31	5.37	1.58	5.52	32.76	32.76	3.497	3.497	2.867	2.867	3.126	44.54
Elm	85.55	8.92	77.78	6.69	5.47	3.52	21.92	3.429	3.429	3.429	2.182	2.812	3.140	53.48
Africantane	88.14	10.19	74.47	7.44	6.87	1.20	13.26	3.283	3.283	3.283	2.692	2.692	3.064	61.04
Ramie (PL)	92.70	21.73	67.47	6.50	4.62	4.31	22.51	2.975	2.975	2.975	2.439	2.439	2.721	40.33
Cachiman	92.20	7.97	79.65	4.89	2.64	1.85	14.98	3.512	3.512	3.512	2.880	2.880	3.257	67.67
Banana (L)	93.15	15.37	78.06	5.05	3.34	4.67	10.94	3.442	3.442	3.442	2.822	2.822	3.288	60.63
Papaya	91.25	12.82	75.74	4.78	2.11	3.14	23.29	3.339	3.339	3.339	2.738	2.738	3.048	53.86
Breadfruit	90.80	3.36	85.04	2.44	2.59	1.19	5.94	3.749	3.749	3.749	3.074	3.074	3.554	84.48
Banana Peel	91.46	19.63	73.88	5.30	5.62	6.44	8.88	3.257	3.257	3.257	2.671	2.671	3.068	54.13
Coffee Leaves	93.50	7.36	81.04	4.41	4.63	3.44	17.24	3.573	3.573	3.573	2.930	2.930	3.366	62.92

PORT-AU-PRINCE AND VICINITIES — OTHER PLANTS — FEED ENERGY

FEED STUFF	DM %	ASH %	TDN %	ADF %	NDF %	EE %	CP %	DE CATTLE MCAL kg	DE GOAT MCAL kg	DE SWINE MCAL kg	ME CATTLE MCAL kg	ME GOAT MCAL kg	ME SWINE MCAL kg	NFE %
Water Hyacinth	84.17	14.93	69.91	5.32	4.68	0.61	22.28	3.082	3.082	3.082	2.527	2.527	2.820	52.18
Sweet Potato	85.97	9.80	81.29	6.97	4.23	4.81	5.45	3.584	3.584	3.584	2.939	2.939	3.401	68.74
Chicory	89.45	23.36	66.40	4.29	2.79	2.93	20.26	2.927	2.927	2.927	2.400	2.400	2.690	46.37
Cassava Roots	91.65	2.84	82.05	5.46	8.73	0.59	2.55	3.617	3.617	3.617	2.966	2.966	3.454	79.83
Potato Tuber	87.90	5.86	77.67	6.91	8.39	0.59	10.66	3.424	3.424	3.424	2.808	2.808	3.213	67.59
Weeds	92.70	9.28	77.49	4.02	6.24	1.77	13.66	3.416	3.416	3.416	2.801	2.801	3.185	65.0

PORT-AU-PRINCE AND VICINITIES ENERGY FEEDS

FEED STUFF	DM %	ASH %	TDN %	ADF %	RDF %	EE %	CP %	DE CATTLE MCAL kg	DE GOAT MCAL kg	DE SWINE MCAL kg	ME CATTLE MCAL kg	ME GOAT MCAL kg	ME SWINE MCAL kg	NFE %
High Energy Goat Feeds	85.80	6.02	80.05	2.08	3.81	0.62	19.12	3.529	3.529	3.529	2.894	2.894	3.251	68.35
High Energy Goat Feeds Refuse	85.60	5.70	79.87	6.121	2.45	1.24	19.17	3.521	3.521	3.521	3.887	3.887	3.244	65.23
Goat Feed I	88.50	4.40	86.08	4.93	3.72	5.23	15.89	3.795	3.795	3.795	3.112	3.112	3.112	65.83
Goat Feed I Refuse	88.00	8.64	84.73	3.95	4.0[illegible]	6.79	12.78	3.736	3.736	3.7367	3.063	3.063	3.490	63.76
Goat Feed II	82.90	6.66	84.82	4.99	4.66	5.61	18.08	3.716	3.716	3.716	3.047	3.047	3.432	60.60
Goat Feed II Refuse	86.07	22.50	66.99	4.85	5.29	2.49	13.62	2.953	2.953	2.953	2.421	2.421	2.754	51.85
Wheat Bran	90.00	4.11	81.31	6.36	2.62	1.32	9.24	3.585	3.585	3.585	2.940	2.940	3.307	66.35
Maize Grain + Flour	87.30	2.88	83.65	2.47	3.35	0.63	12.89	3.697	3.697	3.687	3.031	3.031	3.453	77.78
Sorghum Bran	86.60	4.91	82.35	2.20	2.62	0.61	13.28	3.631	3.631	3.631	2.977	2.977	3.380	76.38
Maize Bran	80.35	2.21	84.17	5.58	3.66	1.22	10.08	3.711	3.711	3.711	3.043	3.043	3.487	77.25
Sorghum Grain	87.52	2.70	90.20	0.37	1.63	4.66	12.10	3.977	3.977	3.977	3.261	3.261	3.721	78.54
Corn Germ	88.87	2.68	94.42	3.73	2.27	9.93	12.91	4.163	4.163	4.163	3.414	3.414	3.888	68.48
Blood Meal	77.30	6.36	70.98	2.56	0.44	0.58	85.65	3.129	3.129	3.129	2.565	2.565	2.462	4.41
Fish Meal	83.62	18.30	82.45	2.46	2.32	12.94	24.81	3.635	3.635	3.635	2.981	2.981	3.304	39.17
Hominy Corn Meal	87.50	2.40	87.03	4.37	3.06	3.31	10.39	3.837	3.837	3.837	3.146	3.146	3.603	76.47

CONTINUED

Cassava Peels	89.92	7.45	81.45	4.15	3.50	1.68	4.52	3.591	3.591	3.591	2.945	2.945	3.415	78.70
Corn Flour	85.50	2.57	88.96	4.12	1.96	4.68	10.37	3.922	3.922	3.922	3.216	3.216	3.683	76.30
Hominy Sorghum Feed	88.87	6.08	81.85	5.85	3.86	3.06	13.21	3.609	3.609	3.609	2.959	2.959	3.368	67.94
Cracked Corn	86.90	3.45	85.68	7.40	0.75	3.51	12.71	3.778	3.778	3.778	3.098	3.098	3.530	72.18
Bone Ashed	99.10	5.40	80.53	0.78	2.35	0.00	6.31	3.550	3.550	3.550	2.911	2.911	3.363	85.16

PORT-AU-PRINCE AND VICINITIES	**MINERALS**			**GRASSES**			
	Ca	P	Mg	Fe	Mn	Zn	Cu
FEED STUFF	%	%	%	mg kg	mg kg	mg kg	mg kg
Elephant	0.290	0.0080	0.606	0.0450	0.0046	0.0038	0.0054
Elephant	0.036	0.7310	0.480	0.0100	0.240	0.0037	0.0017
Elephant (P)	0.148	0.3130	0.167	0.0110	0.0019	0.0016	0.0004
Molasses Grass	0.170	0.2620	0.161	0.0140	0.0073	0.0045	0.0032
Pangola	0.108	1.6700	0.446	0.0360	0.0088	0.0039	0.0022
Bermuda	0.76	0.0075	0.021	0.0180	0.038	0.0013	0.0075
Guinea	0.006	0.4180	0.391	0.0470	0.0050	0.0029	0.0023
Guinea Tircoglume	0.165	0.3070	0.722	0.0167	0.0044	0.0033	0.0024
Buffel Nueces	0.181	0.2400	0.577	0.0290	0.0012	0.0043	0.0041
Buffel Common	0.062	0.3030	0.719	0.0450	0.0041	0.0035	0.0061
Guatemala	0.120	0.2940	0.321	0.0014	0.0028	0.0025	0.0003
Maize	0.129	0.4270	0.338	0.0078	0.0010	0.0019	
Laurissa	0.060	0.3900	0.338	0.0098	0.0050	0.0023	0.0026

PORT-AU-PRINCE AND VICINITIES	MINERALS			GRASSES AND LEGUMES			
	Ca	P	Mg	Fe	Mn	Zn	Cu
FEED STUFF	%	%	%	mg kg	mg kg	mg kg	mg kg
Elephant Siratro (L)	0.062	0.324	0.068	0.0210	0.0440	0.0255	0.0011
Elephant Siratro (PL)	0.135	0.286	0.355	0.0280	0.0021	0.0019	0.0003
Elephant Leucaena (PL)	0.138	0.316	0.309	0.0160	0.0036	0.0036	0.008
Elephant Leucaena (L)	0.189	0.373	0.934	0.0045	0.0030	0.0028	0.0021
Guinea Siratro	0.108	1.6700	0.446	0.0360	0.0088	0.0039	0.0022
Guinea Leucaena	0.372	0.415	1.316	0.0110	0.0060	0.0046	0.0045
Guatemala Teramus	0.125	0.319	0.224	0.0120	0.1044	0.0038	0.0003
Guatemala Siratro	0.122	-.197	0.202	0.0140	0.0016	-0.0060	
Laurissa Siratro	0.016	0.501	0.525	0.0410	0.0056	0.0078	0.0026
Siratro Laurissa	0.219	0.189	1.046	0.0330			
Laurissa Leucaena	0.142	0.227	0.655	0.0350	0.0079	0.0051	0.0031

PORT-AU-PRINCE AND VICINITIES	MINERALS			LEGUMES			
	Ca	P	Mg	Fe	Mn	Zn	Cu
FEED STUFF	%	%	%	mg kg	mg kg	mg kg	mg kg
Tamarin	0.105	0.160	0.597	0.0400	0.0021	0.0044	0.1780
Siratro	0.169	0.606	0.248	0.0086	0.0079	0.0064	0.0040
Velvet Bean	0.038	0.517	0.213	0.0400	0.0047	0.0063	0.0017
Flamboyant	0.293	0.360	0.622	0.0230	0.0010	0.0025	0.006
Glycine	0.299	0.047	0.774	0.0950	0.0048	0.0038	0.0019
Leucaena (L)	0.299	0.047	0.774	0.0950	0.0048	0.0038	0.0019
Leucanea (L)	0.292	0.322	0.417	0.093	0.0052	0.0033	0.0019
Leucanena (L)	0.253	0.305	0.690	0.0370	0.0042	0.0033	0.0011
Laurissa Siratro	0.016	0.501	0.525	0.0410	0.0056	0.0078	0.0026
Mesquite Pods	-	-	-	-	-	-	-
Swan Pods	-	-	-	-	-	-	-

PORT-AU-PRINCE AND VICINITIES	MINERALS						TREES
	Ca	P	Mg	Fe	Mn	Zn	Cu
FEED STUFF	%	%	%	mg kg	mg kg	mg kg	mg kg
Benzolive	0.231	0.275	0.073	0.0370	0.0010	0.0039	0.0023
Elm (Br[illegible] d' orme)	0.248	0.323	0.467	0.0130	0.0060	0.0039	0.0019
Agricantane	1.242	2.090	1.123	0.0270	0.0063	0.0023	0.0076
Ramie (PL)	0.195	0.158	0.216	0.0210	0.0014	0.0017	0.0005
Flamboyant	0.293	0.360	0.622	0.0230	0.0010	0.0025	0.0006
Cachiman	0.295	0.388	0.607	0.0200	0.0015	0.0044	0.0009
Banana (L)	0.205	0.348	0.988	0.0197	0.0130	0.0024	0.0002
Papaya	0.328	0.668	0.603	0.0322	0.0062	0.0044	0.0013
Breadfruit Fruit)	0.116	0.176	0.220	0.0490	0.0010	0.0019	
Banana Peel	0.187	0.306	0.514	0.0703	0.0051	0.0062	0.0009
Coffee Leaves	0.292	0.218	0.553	0.0181	0.0110	0.0082	

PORT-AU-PRINCE AND VICINITIES MINERALS OTHER PLANTS

FEED STUFF	Ca %	P %	Mg %	Fe mg kg	Mn mg kg	Zn mg kg	Cu mg kg
Water Hyacinth	0.233	0.203	0.725	0.0450	0.0046	0.0038	0.0054
Potato (Sweet) (L)	0.120	0.380	0.430	0.0380	0.0073	0.0039	0.0046
Chicory	0.334	0.306	0.525	0.090	0.0052	0.0070	0.0019
Malanga	0.209	0.553	0.592	0.0260	0.0056	0.0048	0.0009
Cassava Roots	0.133	0.077	0.240	0.0714	0.0014	0.0024	0.0436
Potato Tuber	0.121	0.409	0.193	0.0232	0.0023	0.0032	0.0009
Calllandra	-	-	-	-	-	-	-
Weeds	0.246	0413	0.529	0.0456	0.0038	0.0029	0.00097

PORT-AU-PRINCE AND VICINITIES	MINERALS			ENERGY FEEDS			
	Ca	P	Mg	Fe	Mn	Zn	Cu
FEED STUFF	%	%	%	mg kg	mg kg	mg kg	mg kg
High Energy Goat Feed	0.030	1.2330	0.771	0.0240	0.0041	0.0098	0.0027
High Energy Goat Feed Refuse	0.063	0.2970	0.456	0.0540	0.0021	0.0024	0.0035
Goat Feed I	0.058	0.2860	0.373	0.0390	0.0053	0.0031	0.0021
Goat Feed I Refusal	0.125	0.0057	0.489	0.0310	0.0070	0.0140	0.0028
Goat Feed II	0.042	0.5970	0.301	0.0070	0.0380	0.0062	0.0039
Goat Feed II Refusal	0.059	0.3810	1.278	0.0380	0.0187	0.0057	0.0031
Wheat Bran	0.112	0.9300	0.556	0.0187	0.0163	0.0082	0.0018
Maize Grain Flour	0.112	0.1170	0.435	0.0163	0.0315	0.0061	0.0030
Sorghum Bran	0.122	0.9040	0.335	0.0315	0.0464	0.0076	0.0014
Sorghum Grain	0.112	0.5320	0.373	0.0464	0.0032	0.0059	0.0011
Corn Germ	0.292	0.218	0.558	0.0181	0.0110	0.0082	0.0018
Blood Meal	0.442	0.234	0.198	.2694	4.8	-	0.08
Fish Meal	2.87	2.89	-	-	-	-	-
Hominy Corn Feed	0.04	0.09	-	-	-	-	-
Cassava Peel	-	-	-	-	-	-	-
Corn Flour	-	-	-	-	-	-	-

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