

A STRATEGY FOR THE IMPROVEMENT OF EXISTING SMALL RUMINANT PRODUCTION SYSTEMS AMONG SMALL-SCALE FARMERS IN THE COMMONWEALTH OF DOMINICA

c. Kenneth Jenner Carlyle Armour, 1992

A thesis submitted by Kenneth J.C. Armour in partial
fulfillment of the requirements for the Degree of Master of Arts
in International Development Studies at Saint Mary's University

April, 1992

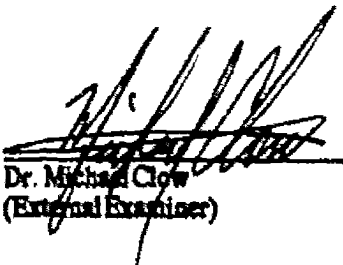
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ISBN 0-315-74455-3

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TABLE OF CONTENTSPAGE

<u>LIST OF TABLES</u>	III
<u>LIST OF DIAGRAMS</u>	IV
<u>ABSTRACT</u>	V
<u>ACKNOWLEDGEMENTS</u>	VI
<u>CHAPTER ONE -- INTRODUCTION</u>	1
<u>CHAPTER TWO -- THE RATIONALE FOR IMPROVING SMALL RUMINANT PRODUCTION SYSTEMS AMONG SMALL-FARMERS IN THE COMMONWEALTH OF DOMINICA</u>	7
<u>CHAPTER THREE -- ADVANTAGES AND DISADVANTAGES OF SMALL RUMINANT PRODUCTION SYSTEMS IN DEVELOPING COUNTRIES</u>	13
<u>CHAPTER FOUR -- THE CASE FOR IMPROVING SMALL RUMINANT PRODUCTION SYSTEMS AMONG SMALL FARMERS IN DEVELOPING COUNTRIES</u>	21
<u>CHAPTER FIVE -- THE INSTITUTIONAL, CULTURAL, SOCIAL AND RELIGIOUS CONSTRAINTS REGARDING DEVELOPMENT/IMPROVEMENT OF SMALL RUMINANT PRODUCTION SYSTEMS IN THE COMMONWEALTH OF DOMINICA</u>	28
<u>CHAPTER SIX -- THE PRESENT STATUS OF SMALL RUMINANT PRODUCTION SYSTEMS IN THE COMMONWEALTH OF DOMINICA</u>	35
<u>CHAPTER SEVEN -- A SYSTEMS APPROACH TO IMPROVING SMALL RUMINANT PRODUCTION SYSTEMS IN THE COMMONWEALTH OF DOMINICA</u>	53
Characterization of the system.....	58
Analysis to identify constraints and practical options for their resolution.....	60
Design and evaluation of interve- ntions to existing systems.....	81
Implementation of technically, economically and socially feasible interventions.....	94

<u>CHAPTER EIGHT -- CONCLUSIONS.....</u>	96
<u>BIBLIOGRAPHY.....</u>	99

LIST OF TABLES

<u>TABLE</u>		<u>PAGE</u>
1	Land Distribution in Dominica (1982).	3
2	Dominica Youth Unemployment Rates 1980-82 (by age group).	4
3	Composition of banana export rejects at different stages of maturity and preservation.	74

LIST OF DIAGRAMS

<u>DIAGRAM</u>	<u>PAGE</u>
1 Flow diagram for an integrated family farm producing crops, animal products and energy.	57

ABSTRACT**MASTERS THESIS****A STRATEGY FOR THE IMPROVEMENT OF EXISTING SMALL RUMINANT
PRODUCTION SYSTEMS AMONG SMALL-SCALE FARMERS IN THE
COMMONWEALTH OF DOMINICA**

**C. KENNETH JENNER CARLYLE ARMOUR
APRIL, 1992**

During colonial rule the Caribbean island's were incorporated into the colonial system as primary producers. As a result of this incorporation Caribbean economies were outwardly geared to satisfy the needs of the metropolis rather than inwardly to satisfy local needs. Caribbean countries still live with this legacy. They export sugar, cocoa, bananas and other cash crops or minerals, and import finished goods and food.

Dominica is a classic example of this colonial model. In 1986 bananas provided 64% of the islands export earnings. Most of the arable land is devoted to the growing of bananas while at the same time food imports totalled US\$ 8,964,000 in 1986.

The Dominican economy is also plagued by high unemployment. In 1986, 33% of the economically active population were unemployed. There is therefore an urgent need for diversification of the economy.

The need for economic diversification takes on even greater urgency with the conclusion of an integrated market in the EEC in 1992, and the eventual removal of the preferential access and pricing system for Dominican bananas in the traditional United Kingdom market.

Given the desperate need for economic diversification in the Dominican economy this thesis will argue that small ruminant production systems are very well suited to limited resource groups and improvement can be accomplished through the use of practical and affordable technologies/methods. Through the utilization of a systems approach framework it will be shown that small ruminant production systems can be significantly improved among small-scale farmers in Dominica, thereby, increasing their incomes and in so doing improve the economic position of the rural economy, reduce the islands' dependence on food/meat imports and contribute towards the agricultural and economic diversification of the economy.

ACKNOWLEDGEMENTS

I wish to thank a number of people who have provided assistance and guidance in the preparation of this thesis. I would like to thank Dr. Henry Veltmeyer, Gerry Cameron and Dr. Michael Clow who read the earlier drafts and offered many valuable comments and suggestions. In particular, I would like to thank Dr. Henry Veltmeyer who guided me through the entire process and showed considerable patience throughout.

I would like to thank the secretary of the International Development Studies Programme, Ms. Agnes James for her patience. I would also like to thank Doug and Sandra of the Inter-library loans department of the Patrick Power Library for their assistance in locating the majority of the material used in this thesis. My sincere thanks and gratitude is also extended to the staff of the Livestock Division of the Ministry of Agriculture in Dominica for their assistance in the preparation of this thesis.

Finally, I wish to thank my parents, and my wife Dianne for their unwavering support and inspiration in the preparation of this thesis. Without them this thesis would not of been possible.

CHAPTER ONE

INTRODUCTION

The Caribbean region possesses a favorable agricultural climate and ample arable land however, the islands are unable to feed themselves. The introduction and establishment of the plantation economy model in the region during the period of colonial rule explains this contradiction. Essentially the establishment of the plantation economy resulted in the islands been incorporated into the colonial system as primary producers, reflecting the Mercantilist system of economic policy which was becoming the dominant view in Europe. According to Mercantilist theory, a nation could accumulate wealth by controlling colonies which would supply raw materials for industry, and also provide a captive market for the goods produced. Due to this form of incorporation, the economies of the islands were outwardly geared to satisfy the needs of the metropolis rather than inwardly to satisfy local needs (Sunshine, 1988; Handie, 1989).

In a collection of essays on the Caribbean titled "Rethinking Caribbean Development" George Schuyler, one of the editors, explains this outward orientation of caribbean economies. "A colonial engine drives the

economies of Caribbean countries - they export sugar, cocoa, bananas and other cash crops or minerals, and import finished goods and food. They produce relatively little of what their people need but a great deal of what Europeans and North Americans want" (Schuyler and Veltmeyer, eds. 1988).

Dominica is a textbook example of this colonial model. The island attained formal independence from Great Britain in 1978. However, a brief look at the economy will demonstrate that formal independence did not equate with economic independence.

Like most former colonies Dominica remains underdeveloped and dependent on a few traditional export crops and markets. The economy revolves around the production and export of bananas. In 1986 bananas provided 64% of the island's export earnings with half the population of 80,000 (mid 1987) dependent on income from bananas (Charles, 1987; World Bank Country Study, 1988).

The majority of bananas are grown on family plots of 1 to 5 acres. A reflection of the unbalanced distribution of land, as a high proportion of small farmers account for a low share in land ownership (Table 1 overleaf).

 Table 1: Land Distribution in Dominica (1982)

Acres of bananas	: 13,000
Number of grovers	: 5,095
% under 1 acre	: 70
% 1 - 5 acres	: 25
% over 5 acres	: 5

Source: Food and Agriculture Organization, The World Banana Economy 1970-1984. FAO Economic and Social Development Paper 57, Rome, 1986.

Because banana production is such a vital cash earner, other forms of agriculture are accorded less priority. There is consequently a shortage of basic foodstuffs and significant dependence upon food imports. In 1986, food imports totalled US\$ 8,964,000, with meat/chicken/fish imports valued at US\$ 1,920,000 (FAO trade yearbook, vol. 40, 1986; FAO yearbook, Fishery statistics, vol. 67, 1988).

The need for diversification is beyond question. Aside from the extreme economic vulnerability of dependence on one export crop for the majority of export earnings, the Dominican economy is also plagued by high unemployment. In 1986, among an economically active population of approximately 25,000, 33% were unemployed (World Bank Country Study, 1985; Sunshine, 1988). The situation is even more severe among youths (Table 2 overleaf).

Table 2: Dominica Youth Unemployment Rates 1980-82
(by age group)

<u>Country</u>	<u>Unemployment rate %</u>	
	15-19 yrs	20-24 yrs
Dominica	55.7	23.8

Source: Central Statistical Office, Vital Statistics Bulletin, Vol 1, no 1, Port of Spain, Trinidad and Tobago, 1986.

The present Dominican government is fully aware of the need to diversify the islands economy. According to the World Bank the government's investment priorities are:

- (i) execution of agricultural sector projects aimed at agricultural diversification;
- (ii) expansion of its hydroelectric facilities; and,
- (iii) development of supporting infrastructure to expand agriculture, manufacturing and tourism (World Bank Country Study, 1988).

The need for economic diversification takes on even more urgency with the conclusion of an integrated market in the EEC in 1992, and the eventual removal of the preferential access and pricing system for Windward Island bananas in the traditional United Kingdom market (FAO Agriculture Series, No. 23, 1990).

The recently-signed (December 1989) Lome Convention (Lome IV) which will have a life of ten years has however

given Caribbean governments some breathing space. For bananas, the protocol resumed the provisions benefiting traditional suppliers. In particular, the Windward Islands*, Jamaica, Belize and Suriname will continue their exports to the United Kingdom at unit prices significantly in excess of the world market level (FAO Agriculture Series, No. 23, 1990).

This thesis will argue that through a systems approach framework the technology and methods of (a) integrated farming concepts (b) the urea-molasses block lick (UMBL) (c) silage making, (d) crop residue utilization, and (e) processing of animal by-products can greatly improve small ruminant production systems among small-scale farmers in Dominica, thereby, increasing their incomes and in so doing improve the economic position of the rural economy, reduce the islands dependence on meat imports and contribute towards agricultural and economic diversification.

* Dominica, St. Vincent, St. Lucia, and Grenada.

In chapter two the rationale for improving small ruminant production systems among small-farmers in Dominica will be outlined.

In chapter three the advantages and disadvantages of small ruminant production systems in developing countries will be explored.

In chapter four the case for improving small ruminant production systems in developing countries will be discussed.

In chapter five the institutional, cultural, social and religious constraints regarding development and improvement of small ruminant production systems in Dominica will be addressed.

In chapter six the present status of small ruminant production systems in Dominica will be examined.

In chapter seven a systems approach to improving small ruminant production systems in Dominica will be outlined.

Finally, in chapter eight conclusions regarding the material presented in this thesis will be advanced.

CHAPTER TWO

THE RATIONALE FOR IMPROVING SMALL RUMINANT PRODUCTION
SYSTEMS AMONG SMALL-FARMERS IN THE COMMONWEALTH OF
DOMINICA

In the aftermath of the Second World War the Caribbean economy faced a decisive turning point. The population and labour force were growing, but the plantation economy system with its inequitable land distribution and reliance on export oriented agriculture could do little in the way of absorbing the regions expanding labour force.

Rather than embark upon a fundamental agrarian reform which would of created employment, economic development and altered the existing status quo, the policy makers of the day opted for the "Industrialization by Invitation" development model which essentially left all of the existing institutional structures intact (Mandle, 1982).

The concept of the "Industrialization by Invitation" development model was for U.S. corporate investment to create new industries in the region to replace the decaying plantation system. Led by investments in minerals, manufacturing and tourism, whole new sectors appeared in Caribbean economies (Sunshine, 1988).

The proponents of the "Industrialization by Invitation" model argued that the corporate firms' profits would be reinvested locally and industrial skills and technology transferred to the region. The reality of the situation was however quite different. The multinationals repatriated their profits and invested hardly anything back into the local economies. The firms brought in North Americans to fill most technically skilled jobs, while West Indian workers received low wages for routine assembly-type work (Sunshine, 1988).

Industrialization went farthest and fastest in Puerto Rico, Trinidad and Jamaica. This was due to their relatively large domestic markets in which some of the goods produced could be sold locally. The smaller islands such as Grenada, St. Vincent and Dominica however, had little infrastructure and were therefore ill positioned to attract foreign investment. To this day they remain heavily dependent on agricultural exports, especially bananas (Sunshine, 1988).

Furthermore, the new industries were integrated not with the economies of Caribbean host countries, but with the economies of their home countries where their headquarters were based (James, 1963). They depended on duty-free imports of machinery and parts from abroad.

Decisions were made in foreign corporate boardrooms with concern for profits, not for the development needs of the Caribbean. Caribbean governments who were the "beggars" could exert little influence over the decisions of their powerful guest (Sunshine, 1988).

The other side of this process was a growing Caribbean dependence on imported food and consumer goods. Prime agricultural lands were turned over to the multinationals for manufacturing, mining and tourism. At the same time, advertising by foreign firms helped shift people's taste away from local foods and towards imports. The result was a steadily climbing food import bill (Sunshine, 1988). By 1974 the Commonwealth Caribbean food deficit reached crisis proportions, with an annual food import bill for the year of US\$ 500 million (Axline, 1984).

Overall, despite the introduction of new industries, the "Industrialization by Invitation" development model did little to alter the development pattern inherited during colonialism. The Caribbean economies are still gearing their production to the needs of the developed countries. As on the old sugar plantations, the management, capital and technology for production are still imported from the industrialized countries, and all

the products and profits return there.

We can argue that, given the regions dependence on food imports and subsequent drain on foreign currency reserves, the improvement of small ruminant production systems at the small-farmer level should benefit the Dominican economy in the following ways.

- 1) It should help alleviate dependence on meat imports, and in so doing save scarce foreign exchange.
- 2) It will alter demand and supply factors: goat meat and mutton are expensive relative to other meats such as beef and poultry. This reflects inadequate supply factors which improved production systems will rectify.
- 3) It will be a source of income generation among small-farmers.
- 4) The establishment of village level cottage industries utilizing goat and sheep by-products will generate employment among young women.
- 5) Through multiplier effects it will have a positive impact on the Dominican economy at both the micro and

macro level.

- 6) Through the utilization of crop residues by ensiling methods, and introduction of the urea-molasses block lick (UMBL) technology the need for imported concentrate feeds will be diminished, resulting not only in cheaper feed cost at the small-farmer level but also a saving of foreign exchange.

Aside from the benefits outlined above, there are several other reasons for fostering small farmer development in developing countries (FAO Economic and Social Development Paper, No. 87, 1990) such as Dominica and the Caribbean as a whole.

- 1) Small producers are a significant and vital sector in agriculture. Policies targeting them are likely to have a far-reaching impact on poverty alleviation and augmentation of food production.
- 2) Small farmers numerically constitute a significant portion of the rural population. Their development must be an integral part of agricultural development strategy in order to promote greater equity by counteracting the tendency to increase farmer income disparities, owing to inequalities in basic economic,

social and technological structures, etc.

- 3) Small farmers with meager land resources relative to labour would have to increase their efficiency to enable them to increase agricultural output, employment and income. Even a small incremental income has a higher level of marginal utility and is extremely valuable to them compared to the same increment with a large farmer.
- 4) Because of the large number of small farmers, they hold great potential as consumers, and can act as an engine for growth, if this potential is adequately tapped. Increasing their income will generate demand for consumer goods, with consequent multiplier effects on growth, and will contribute to self sustaining development.

So far I have shown there are several benefits to be gained from improving small ruminant production systems in Dominica. I have also argued why small farmer development in developing countries is a basic prerequisite for development. The question to be addressed now, is how this small farmer development can be accomplished, or in our case how can small ruminant production systems at the small farmer level be improved.

CHAPTER THREE

ADVANTAGES AND DISADVANTAGES OF SMALL RUMINANT PRODUCTION
SYSTEMS IN DEVELOPING COUNTRIES

The advantages of small ruminants among low income groups in developing countries are numerous. In order to document these advantages two case studies will be examined in the first instance, and then several other advantages will be listed.

The first case study is from the marginal areas in semi-arid Querataro Mexico. Focusing on milk production from ninety Granadina and French Alpine crossbred goats the study indicated that these animals produced significant benefits to nine people. The benefits were income, permanent employment, social security, and a salary level equivalent to that in Mexico City. This was achieved through the production of twenty five thousand litres of milk annually, which in turn produced four and a half tons of excellent quality cheese. It was suggested based on the results, that it is feasible in Mexico city to develop family farms that can be self-supported through the production of goat's milk (Castro, 1987).

The second case study by Knipscheer et al., (1983) indicates that the involvement of rural households in West

Java Indonesia in raising small ruminants is large. One out of every five farmers kept sheep or goats, and participation by farmers was as high as thirty percent. The contribution of goats and sheep to the total farming income is substantial and was about fourteen, seventeen and twenty six percent for the lowland, upland and rubber plantation situations, respectively. The study also indicated that the income share of the small ruminant enterprise increased as the farmer's resource base, especially land, decreased.

The two case studies have shown that small ruminants have the potential not only to act as an income supplement among low income groups but can also be used to develop family farms that can be self supported through the production of goat's milk. Aside from the benefits outlined in the case studies however, there are also several other advantages to small ruminant production systems among limited resource groups in developing countries. The advantages are as follows;

- a) Sheep and goats are small, ranging in mature weight from 15 to 75 kg. This small size is directly associated with important traits such as earliness of maturity, quantity of product (meat, milk, skins), and nutrient requirements for maintenance (World Bank

Technical Paper, 1983). Perhaps their greatest advantage relative to large ruminants is their suitability to small holdings (Timon, 1986).

- b) Earliness of sexual maturity leads to shorter generation intervals, and thus increases potential response to selection over given time. Sheep and goats reach market weight and condition and start lactating often within their birth year (World Bank Technical Paper, 1983).
- c) Goats have a higher reproductive rate than cattle or sheep. Age at first kidding is 13-14 months on experimental stations and 14-18 months under village conditions (ILCA, 1979). Wilson (1976) observed in the Sudan that the average age at first kidding was 9.7 months.
- d) Sheep can produce a consumable lamb within seven or eight months after conception without it having to be fed concentrates. Under some circumstances, it is possible to have three gestations in two years and multiple births are common in some breeds. Litter sizes of two to three are not uncommon in the case of the Barbados Blackbelly (Huss, 1982).

- e) Because of their small size, goats likewise sheep are easily and conveniently slaughtered when butchering facilities are not available and the family prepares and consumes its own animals (Sonmez, 1973).
- f) Without refrigeration, a family cannot afford to slaughter a large beast such as a cow or buffalo, nor can it sell one that is needed for draught purposes; a smaller goat or sheep can be slaughtered or sold more easily (Turner, 1991). Small size is also associated with small yields of milk per lactating female. These small quantities are often well suited to the daily needs of subsistence families who have limited ability to preserve surplus food products (World Bank Technical Paper, 1983).
- g) Small size generally makes sheep and goats easier to handle, especially by women and children. Housing and pens require simpler, less robust construction, while dipping in barrels rather than vats is possible (World Bank Technical Paper, 1983).
- h) Goat, likewise sheep, keeping in small economic units is basically a low-cost production utilizing production factors with low or no opportunity cost (Peters and Deichert, 1984).

- i) In addition to their use for sale and home consumption, sheep and goats have other functions; in particular they are a form of investment. Storage of wealth in the form of livestock is necessary in developing countries in which land is communally owned and where there is no other form of investment. As a source of wealth, sheep or goats are not subject to the high inflation rates common in developing countries, and they can increase in number after a disaster (such as a drought) much more rapidly than large ruminants (Gatenby, 1986).
- j) The ownership of dairy goats makes a significant contribution to the nutrition of the rural poor. One litre of goat milk contains about thirty two grams of protein and represents seventy percent of the daily requirement of a lactating or pregnant mother. It is adequate for a child up to eleven years of age. The Calcium supply of 1.7 grams per litre is also adequate to meet the daily requirements (Devendra, 1979).
- k) Sheep and goats have adaptive capacities to survive and produce in difficult environments be they arid, high altitude or extremely cold. Generally small ruminants are efficient converters of forage feeds

whether they are farmed in temperate, arid or semi-tropical conditions (Timon, 1986). Small ruminants produce about twice as much meat per animal unit in the tropics as cattle (Terrill, 1983).

- l) Small ruminants compete well with other livestock in quality of meat produced. Meat from small ruminants is generally more tender than grass-fed beef because the animals can be marketed at a much younger age. In many countries lamb and mutton are preferred, while some prefer goat meat, but almost everyone will eat sheep and goat meat if the price is relatively low. Sheep and goats can supply high efficiency and low cost of production (Terrill, 1986).
- m) In terms of efficiency of meat production, this is approximately the same between species. However, the indisputable advantage that goats, likewise sheep, have over cattle is that cattle cannot exceed an annual reproductive rate of 1.0 whereas goats and sheep can easily achieve 1.5. Since reproductive rate is dominant in meat production, biomass production from goats and sheep is clearly much higher than in cattle (Devendra, 1987).
- n) Kolff and Wilson (1985), have reported that when

sheep are owned by women, they contribute to their independence and improve their social position. Okali and Sumberg (1985), have also recorded a marked interaction between livestock ownership and household decision making.

- o) Goat and sheep dung can be used for fuel or fertilizer (Turner, 1991). Indirectly, the recycled excreta can produce methane (for household use) by anaerobic digestion and organic fertilizer from the final effluent (Preston, 1982).

In terms of the disadvantages regarding small ruminant production systems in developing countries four main ones can be listed;

- a) Due to their small size small ruminants are more susceptible to predators, including theft.
- b) Small per head product yields are a disadvantage under commercial conditions, especially when labour cost are relatively high.
- c) Goats and sheep cannot be used for draught power.
- d) Concerns have been raised about environmental damage

by small ruminants, especially when farmed under extensive systems where they are allowed to roam freely in herds.

Awareness of the environmental concern and the need to implement environmentally sustainable strategies is reflected in goat production in Fiji. "Since the uncontrolled multiplication of goats and likewise sheep could have a serious adverse effect on the environment and vegetation, further development of the national goat flocks needs to be under stratified, semi-intensive and intensive production systems and this policy is now been followed by the farmers" (Hussain et al., 1983).

Overall, the evidence suggests that the advantages of small ruminant production systems in developing countries, outweigh the disadvantages. Of the disadvantages, the environmental aspect can be singled out as one of major concern, however, as the Fiji example has shown this need not be the case.

CHAPTER FOUR

THE CASE FOR IMPROVING SMALL RUMINANT PRODUCTION SYSTEMS
AMONG SMALL-FARMERS IN DEVELOPING COUNTRIES

The advantages/benefits of small ruminant production systems, among low income groups in developing countries has already been documented. This positive relationship between low income groups and small ruminants is reason enough to argue that improvement of small ruminant production systems at the small-farmer level is justifiable and logical, since poverty alleviation is a basic cornerstone of development.

The question therefore, is not whether to improve or not, but how easy is it to improve small ruminant production systems at the small-farmer level?

A review of the literature on small-farmer adoption, modification, or rejection of improved technologies, reveals a wide array of studies and approaches, ranging from individual project case histories, to analyses of large-scale survey data, to models of farmer's decision-making with respect to specific introduced technologies. From this wide array of studies and approaches, three critical lessons on small-farmer adoption of new technologies can be abstracted. The lessons are:

- 1) Small-farm families are receptive to change and small-farm systems are dynamic. The concept that "traditional" agriculture is static is misleading.

The widely held notion that small-farmers are conservative and resistant to change is, as the literature shows, highly misleading. There is ample evidence that small-farm households actively pursue economic opportunities and experiment with new technologies when they are compatible with the socio-economic organization, resource endowment and goals and needs of the farming household (Brady, 1981).

The majority of small-farmers are active experimenters, both with indigenous and introduced technologies, as has been documented by most investigators who have carried out in-depth analyses of small-farm systems. Brush (1977) documents considerable experimentation with potato varieties among Andean farmers. Johnson (1971, 1980) gives examples of Brazilian sharecroppers experimenting with new crops, new varieties, and new agricultural techniques. Franzel (1984) reports that a CIMMYT study in Kenya found small-farmers to be active experimenters with maize varieties. In an area of Mexico stereo-typed by extension agents as very "conservative", Devault (1975) found that ninety six percent of the farmers had experimented with chemical fertilizers in the five years since their general

introduction into the region.

Gerhart (1975) documents one of the most successful cases of high yielding variety (HYV) adoption by small-farmers. Within ten years of the first introduction of hybrid maize, in two out of the three regions of Western Kenya included in the survey, the adoption rate among small-farmers was ninety to one hundred percent. Moreover, the rate of adoption was very rapid. The mean lag time between farmers hearing of the new seed and using it was only one and a half years, considerably faster than the five year lag time for American farmers in Iowa in the 1920's and 1930's (Gerhart, 1975).

Brady (1981) provides a second example of small-farmer's rapid adoption of a new technology appropriate to their conditions and goals in the Iloilo province of the Philippines. Here within four years of introduction, a new, intensified, multiple cropping system based on an early maturing rice variety was been used on over fifty percent of the cultivated land in the region. This occurred despite the significant change in technology and management practices required.

- 2) Small-farm families are selective and adaptive in their adoption and use of recommended practices and technologies.

Small-farm families are, in general, careful decision-makers who test and select carefully among alternative technologies and production strategies and then adapt them to their particular farming conditions and needs as they endeavour to adjust to their physical, social, and economic environments (Abalu et al., 1984; Barlett, 1980; Barlow et al., 1983; Byerlee and Collinson, 1980; Franzel, 1984; Gladwin and Butler, 1984; Horton, 1983, 1984; Murphy 1983; Norman et al., 1982; Torte, 1984).

The adoption studies show that complete technological packages are rarely adopted by small-farmers. Rather, their common conclusion is that farmers select from an array of introduced technologies and recommended practices those that are most appropriate for the specific environmental and economic conditions in which they are working.

In project analyses, however, adoption is frequently defined as the utilization of the complete package of recommended practices. The small-farmer's selective adoption of components of a technological package or their

modification of recommendations is thus misconstrued and they are classified as "non-adopters" and characterized as conservative and resistant to change.

- 3) No single attitude, trait, factor, or farming condition explains the patterns of small-farm adoption of all new innovations.

Farmers apply different choice and evaluation criteria to different technologies and the criteria employed vary among farmers depending on their household's goals for production and consumption and the resources and factors of production to which they have access.

All of the adoption studies mentioned earlier demonstrate that mono-causal models which propose small-farmer's "attitudes" as a general explanation of (non)-adoption behaviour are not supported by the literature (Whyte, 1981). What factors could possibly render small-farmers throughout the world all bearers of such personality or attitudinal traits as fatalism, resistance to change, distrust of inter-personal relations, lack of innovativeness, lack of empathy, or unable to defer gratification, as proposed by those who espouse this approach (Dilon, 1979; Foster, 1965; Rogers, 1969)? In the multivariable analysis of the large-scale surveys of adoption patterns carried out by the international

centers, no single farmer trait, such as age or education, emerged as significantly correlated with adoption when in the presence of other variables (Gerhart, 1975; Perrin and Winkelmann, 1976). In Berry's (1975) detailed case study of development of the cacao industry in Western Nigeria early innovators could not be distinguished by personality traits, but rather by different access to economic opportunities.

In light of the above evidence we can argue that given the appropriate environment and opportunity the small-farmer will adopt new technologies willingly provided its economic viability is demonstrated to them.

Looking specifically at the improvement of small ruminant production systems at the small-farmer level, Gatenby (1986) points out that small ruminant production systems can be improved without radical changes in method. Economides (1986) also reports that immediate results in increasing efficiency of production can be obtained with improved nutrition and management practices and disease control. Devendra (1986) also reports that the incorporation of urea into cereal straws to release ammonia or spraying of ammonia directly into the cereal straws, and the use of urea-molasses block licks (UMBL) has had considerable success. These two innovations are

significant in that they represent two major success stories in Asia. Finally Leng (1984 & 1987) documents that the introduction of urea-molasses block licks (UMBL) to provide urea and a wide range of nutrients to tethered ruminants fed crop residues, is having a remarkable impact on ruminant production particularly in India, and its use is now been extended into many countries, particularly in Africa.

Overall, it can be concluded that the evidence presented in this chapter has served to dispel the myth that small-farmers are conservative and resistant to change. The evidence shows that small-farmers will adopt new technologies willingly if they are compatible with the socio-economic organization, resource endowment and goals and needs of the farming household. Secondly, the evidence regarding improvement of small ruminant production systems at the small-farmer level has shown that improvement is possible without radical changes in methods, and the improved technology/methods appear to be gaining acceptance by the small-farmer. Taken together these conclusions support the hypothesis advanced at the beginning of this chapter that improvement of small ruminant production systems at the small-farmer level is justifiable and logical once these improvements are compatible with their limited resource endowments.

CHAPTER FIVE

THE INSTITUTIONAL, CULTURAL, SOCIAL AND RELIGIOUS
CONSTRAINTS REGARDING DEVELOPMENT/IMPROVEMENT OF SMALL
RUMINANT PRODUCTION SYSTEMS IN THE COMMONWEALTH OF
DOMINICA

Institutional: The main institutional barrier to improvement of small ruminant production systems in Dominica has been a general lack of priority by the State regarding the development of small livestock such as goats and sheep at the small-farmer level as an avenue for increasing domestic meat production and enhancement of welfare considerations.

This lack of priority by the Dominican State regarding development of small ruminant production systems at the small-farmer level, is not localized, rather it is symptomatic of most developing countries and international development agencies. "A recurring theme of the study is the lack of recognition of the current and potential role of small ruminants in many developing countries. This is manifested not only by a lack of support within developing countries, but also within international donor and lending agencies" (World Bank Technical Paper, 1983). Devendra (1986) also supports this view. "The fact remains, however, that despite the wide importance and apparent

advantages, both species have not been accorded adequate attention, compared for example to cattle development".

Recently however, the Dominican State took steps to rectify this situation. In 1983 Dominica became a member of the Inter-American Institute for cooperation on Agriculture (IICA) and the IICA office was opened in the capital of Roseau in 1984. An immediate area of priority identified by the state was that of small livestock development (Charles and Borland, 1990).

The argument can therefore be made that given the Dominican States recent committment to development of small livestock the major hurdle confronting the improvement of small ruminant production systems has been surmounted.

The other four institutional factors that could adversely impact on development of small ruminant production systems are;

(i) Marketing channels (ii) Credit facilities (iii) Availability of agricultural extension services, and (iv) access to land.

(i) Marketing channels: At the present time marketing

channels for food crops and livestock are not well developed. "Marketing of the major export crops bananas and coconuts is well organized and properly coordinated... Serious deficiencies prevail in the handling and distribution of other crops and livestock products (World Bank Country Study, 1985).

In the short to medium term, inadequate channels should not adversely impact on small ruminant production systems for two basic reasons. First, due to the infancy of the production systems keeping them at the village level is logical and practical. Secondly, most goats and sheep are sold on the hoof at the village level, negating the need at this time for complex marketing channels. It can be argued that the village level informal marketing system is relatively sophisticated, as all a buyer has to do is ask around and he/she will be directed to a seller.

(ii) Credit facilities: The sources of credit in Dominica are, the commercial banks, the credit unions, the Dominica Agricultural and Industrial Development Bank (AIDB), and the informal credit institution known as "sub".

With the exception of the AIDB which was established in the early 1970's none of the financial institutions mentioned above are geared to provide agricultural credit,

rather their lending policies favour purchases of durable and semi-durable goods. The small amount of agricultural credit given by these institutions is concentrated in the banana industry, since it is one of the few crops with a guaranteed market (Marie, 1979).

Credit therefore, other than for traditional crops is limited. This situation however, should not impact negatively on development of small ruminant production systems in Dominica. According to Terrill (1986a) small ruminant production can be started with very little capital expense. Small-farmers can start with a few head and increase numbers through reproduction. Equipment needed requires only minor expenditure and can often be improvised.

Given Terrilla's finding which is further supported by Huss (1982) who reports that the relatively small size and low cost of small animals makes them more freely available to low income households who have neither space nor capital for a large animal. It can be argued that limited credit facilities do not appear to be a major problem.

It can also be argued that given the Dominican States commitment to development of small livestock, credit facilities for improvement of small ruminant production

systems should become more readily available.

(iii) Availability of agricultural extension services: At the present time the extension services of the Ministry of Agriculture are inadequate to reach the small-farmer. The ratio of extension officer to farmer is relatively low and the ministry is constrained by inadequate service centres, poor coordination of support services and low farmer training. However, these are being rectified with medium term technical assistance provided by external donors (World Bank Country Study, 1985).

(iv) Access to land: Although land distribution in Dominica is relatively unbalanced (see table 1) with a high proportion of small-farmers accounting for a low share in land ownership, this factor is not expected to be a major problem in the development and improvement of small ruminant production systems.

The farming of small ruminants under intensive conditions whereby they are stall fed on crop residues and supplemented with urea-molasses block licks (UMBL) requires minimal land. Peters and Deichert (1984) document the fact that goat, and likewise sheep, keeping in small economic units is basically a low-cost production utilizing production factors with low or no opportunity

cost. Knipscheer et al., (1983) in their study of rural households in West Java also reveal that the income share of the small ruminant enterprise increased as the farmer's resource base, especially land, decreased.

In light of the above findings it can be argued that a Dominican small-farmer with one acre of land, can rear a few goats and sheep in a relatively small enclosure built from local materials such as scrap wood and banana/coconut leaves, and in turn feed these animals on reject bananas supplemented with UMBL.

Given the dominance of bananas in the Dominican economy virtually all small-farmers grow bananas. Waste or reject bananas are also a fact of life. Through the rearing of a small number of goats and sheep the small-farmer can now utilize a waste product.

Based on the study by Knipscheer et al., (1983) it can be argued that small ruminant enterprises have the potential for relieving some of the effects of the economic and social inequities in the Dominican society. The limited access of the Dominican small-farmer to land resources is therefore not envisaged to impact negatively on small ruminant production systems.

Cultural: There are no cultural constraints regarding the consumption of goat meat or mutton in Dominica (Livestock Division, Ministry of Agriculture, Dominica, 1990).

Social: There are no social stigmas attached to the consumption of goat meat or mutton in the Dominican society. On the contrary goat meat and mutton are considered delicacies due to relatively high prices relative to other meats such as chicken and beef, to be able to afford mutton or goat meat on a regular basis is considered a sign of economic prosperity, thus enhancing one's social stature. At the present time goat meat and mutton retail for approximately EC\$7.00 per pound in comparison to chicken and beef which retail for approximately EC\$4.50 and EC\$5.00 per pound respectively (Livestock Division, Ministry of Agriculture, Dominica, 1990).

Religious: The majority of Dominicans belong to two main religious denominations, the Catholic religion which dominates and the Methodist religion. There are also other denominations such as Pentecostal and Baptist with limited congregations. None of these churches however, forbid the consumption of goat meat or mutton (Livestock Division, Ministry of Agriculture, Dominica, 1990).

CHAPTER SIX

THE PRESENT STATUS OF SMALL RUMINANT PRODUCTION SYSTEMS IN
THE COMMONWEALTH OF DOMINICA

The literature on small ruminant production systems in Dominica is very limited. The information outlined here is based on a handful of pamphlets and documents obtained from the Livestock Division of the Ministry of Agriculture in Dominica.

Goat population 1990: 8,000 (approx)

Sheep population 1990: 7,000 (approx)

Genetic pool

Sheep:

Of the approximately seven thousand sheep in Dominica, the majority are local "creole" sheep, comprising 61.5 percent of the sheep population. Local sheep are divided into two groups:

- a) Local hair type (44.5%) descendants of West African hair sheep.
- b) Local wool type (17%) descendants of temperate wool breeds imported from the United Kingdom.

An additional 26 percent of the sheep are crossbred local and improved breeds. The remaining 12.5 percent are improved breeds, which have been imported in recent years to upgrade the production potential of local sheep. They are the Black Belly (12%) a hair breed from Barbados. And, the Katahdin (0.5%) a heavy hair breed from the USA (Charles and Borland, 1990).

Goats:

Data on the goat population in Dominica is not as specific as that for sheep. However, of the approximately 8,000 goats in Dominica 90 percent are local "mongrel" goats, descendants of four main breeds, the British Alpine, Saanen, Anglo-Nubian and Toggenburg (Livestock Division, Ministry of Agriculture, Dominica, 1990).

The remaining 10 percent can be subdivided into two groups:

- a) Improved breeds (5%): Recently, three improved breeds have been imported to upgrade the production potential of local stock (Livestock Division, Ministry of Agriculture, Dominica, 1990).

British Alpine: The British Alpine is a highly

developed milk breed, which originated in the Swiss and Austrian Alps. It has been introduced into the West Indies, Guyana, Madagascar, Mauritius and Malaysia. In the West Indies yields of up to 4.5 kg per day have been obtained in the second and third lactations (Devendra and Burns, 1970).

Saanen: Saanens originated in West Switzerland. They are good milkers and have been introduced into Puerto Rico, the West Indies, Fiji, Ghana, Kenya, Malaysia and Australia. In most instances they have produced well. However, there appears to be a tendency for them to be sensitive to strong sunlight, thus, shading from the sun and good indoor management are necessary.

Saanen goats have been very popular in the West Indies and lactation yields of about 800 kg over 250 days have been achieved. They have also been crossed with local and crossbred Puerto Rican x Barbados goats in Puerto Rico, and it was found that the latter (1/2 Saanen, 1/4 Barbados, 1/4 Puerto Rican) gave the best milk yield of about 280 kg during a lactation period of 270 days (Devendra and Burns, 1970).

Anglo-Nubian: The Anglo-Nubian goat breed, which is of mixed origin, owes its distinctive features to imported

goats of Indian Jamnari and Egyptian Zariby (Nubian) type, and is one of the most outstanding breeds both in appearance and performance.

The Anglo-Nubian is recognised as a very useful dual-purpose (meat and milk) breed. It has proved to be most suited to tropical climates and has consequently been used widely for upgrading indigenous stock for meat and milk in various countries, such as the West Indies, Mauritius, Malaysia and the Philippines (Devendra and Burns, 1970).

- b) Improved crossbreeds: The other 5 percent consists of improved crossbreeds. The result of crosses of indigenous stock with the improved breeds mentioned above (Livestock Division, Ministry of Agriculture, Dominica, 1990).

Major Diseases and Parasites

Disease, the opposite of animal health, may also be defined as any abnormality in the functions and tissues of the animal body (Devendra and McIeroy, 1982).

The major diseases and parasites affecting goats and sheep in Dominica are (Livestock Division, Ministry of Agriculture, Dominica, 1990):

- a) Mastitis (occasional).
- b) Bloat.
- c) Foot rot.
- d) Tetanus (occasional).
- e) Parasites: internal and external.

a) Mastitis: Mastitis is an inflammation of the mammary gland (udder or milk giving gland) of animals. The symptoms are heat, pain, and swelling of the udder, there will usually be some discoloration of the tissue and abnormal milk (Devendra and McIeroy; Thomas, 1983).

Prevention and control: While the disease usually responds well to antibiotic injections and infusions, these are usually unavailable and too expensive for small farmers. Prevention, through care in milking and attention to hygienic practices is the recommended course of action (Devendra and McIeroy, 1982; Thomas, 1983).

b) Bloat: Basically bloat stems from the animals inability to get rid of gas produced in the first compartment of the stomach--the rumen. This inability can result from mechanical causes such as blockage of the oesophagus by pieces of banana, roots, etc. If not relieved, it will result in death due to reduced ability to exchange oxygen in the blood. The symptoms are pain,

discomfort and difficulty in breathing, the animal will also have a full left flank, jutting up and out, that sounds like a drum when thumped.

Prevention and control: Swift treatment is necessary. Force the animal to stand and walk. Tie a stick or rope in the mouth for the animal to chew on. This stimulates saliva and helps reduce bloat. The major prevention measure is to provide adequate amounts of coarse roughage especially when animals are fed lush legumes (Devendra and Mcleeroy, 1982; Thomas, 1983).

c) Foot rot: Foot rot is caused by the invasion of the animals foot by bacteria, the disease is usually spread from infected carrier animals into the soil and then to the uninfected feet. Lameness is the first symptom. The sole and the sidewall of the diseased foot appear ragged and rotten and have an extremely bad odour. Sheep develop the condition more readily than goats. Wet soil and filth increase the possibility of disease outbreaks (Thomas, 1983).

Prevention and control: Remove the dead, rotten foot tissue with shears or a sharp knife. Trim down until healthy tissue is found. Some bleeding will occur. This is necessary to remove the diseased tissue. Spraying the area

with a solution of chloramphenicol or ten percent formalin, or forcing the animals to walk through a ten percent formalin or a thirty percent copper (II) sulphate foot bath can be beneficial. The best method of prevention is to remove the animals from dirty and wet areas for about four weeks so the organisms in the soil will die or decrease in number. Regular trimming of the feet will also help prevent the disease (Devendra and McIeroy, 1982; Thomas 1983).

d) Tetanus (Lockjaw): This is the well known disease "lockjaw" that affects all mammals including humans. The disease is spread when bacteria enter living tissue, which may occur in a puncture wound or any type of wound that may close up and seal off. The bacteria grow and produce the toxin (poison) which causes the symptoms.

Symptoms of tetanus usually appear seven to fourteen days after the organism enters the body and include general stiffness or hardness of localized muscle groups, such as those in the head and neck. The stiffness and soreness progress to other parts of the body, and after twenty four to forty eight hours, the complete body is stiff or hard (Devendra and McIeroy, 1982; Thomas, 1983).

Prevention and control: Treatment is usually

unsuccessful; over eighty percent of the infected animals will die. Large doses of penicillin injected into the muscles, plus sedatives or tranquilizers and 100,000 to 200,000 IU of tetanus antitoxin are required for treatment. Treatment usually is not practical.

Fortunately, a permanent form of prevention is rather simple. Two doses of tetanus toxoid can be given thirty days apart, with a yearly booster shot. This will adequately protect adults for at least one year. Very young kids and lambs, up to three weeks of age, can be protected with as little as 150 to 300 IU of antitoxin each (Thomas, 1983).

e) Parasites:

Internal:

The presence of the internal parasites protozoa and helminths can have an adverse effect on animal health and therefore result in serious economic loss. Symptoms of infestation include diarrhoea, often mixed with blood, and a general unhealthy looking animal. In most cases however, the severity of infection is greater in young animals than in adults (Devendra and McIeroy, 1982; Thomas, 1983).

Prevention and control: Reducing the extent of infestation calls for good management such as attention to hygienic practices, proper pasture rotation, proper stocking rates, and regular drenching with an appropriate drench, the most effective been the broad-spectrum types such as tetramisole which must be used with tetrachloromethane. Also well fed animals are less subject to infestation than poorly fed ones (Devendra and McIeroy, 1982; Thomas, 1983).

External:

External parasites such as mites and ticks will adversely affect the health of the animal unless properly controlled (Devendra and McIeroy, 1982; Thomas, 1983).

Prevention and control: Lime-sulphur/nicotine sulphate dips are a standard control measure for mites. Insecticides, e.g. toxaphene, lindane and DDT, to control ticks may be applied directly on the host animal or to the infested premises. The most common practice is to dip or spray the infested animal(s) (Devendra and McIeroy, 1982; Thomas, 1983).

Production and Management Systems

Sheep:

In 1984 at the Dominican governments request the Inter-American Institute for Cooperation on Agriculture (IICA) approved the implementation of a sheep development project on the island.

The general objective of the sheep development project which was implemented between 1985-88, was to expand and develop a viable sheep industry capable of contributing significantly to the agricultural diversification of Dominica by developing self sufficiency in mutton production at a farm and national level (Charles and Borland, 1990).

In 1985, the sheep population in the project area was 472 shared among seventy farmers interviewed. In 1987, the population increased to over 600 mainly on small crop/livestock holdings involving eighty five farmers.

Survey of Sheep Production and Management Systems (Dominica)

In 1985 personal interviews were conducted with

seventy sheep farmers in the North Eastern District of Dominica. According to the data obtained, four sheep farming systems were identified.

1) Sheep tied were	67%
2) Sheep at large	17%
3) Cut-and-carry	8%
4) Fenced savannah	8%

In all of these production systems the main enterprise were livestock for meat and pen manure.

Results of the survey indicate that traditional methods of sheep production and management are the norm in most sheep rearing operations. Eighty four percent of all sheep raisers routinely tethered their animals along roadsides and other grassy areas or allowed their animals to roam freely, grazing over large areas.

These sheep were reported to have a number of nutritional problems which were related to their grazing patterns as well as to the lack of protein and other supplements to their diets.

High death rates associated with intestinal parasites were common among sheep reared using traditional

practices. High mortality in lambs was also prevalent. Strangulation was common among tethered animals and losses due to theft and attacks by stray dogs were quite frequent among tethered animals as well as those which grazed freely.

Although the majority of sheep raisers used traditional methods of management, there was a noticeable trend towards the adoption of more modern, improved methods. Sixteen percent of all sheep raisers had planted improved grasses, provided adequate housing for their animals, fed them a protein supplement and used a regular programme for controlling internal parasites.

Among those farmers who used improved management methods, about half had developed a rotational grazing system in enclosed pastures. The remaining half of these farmers had begun employing the "cut-and-carry" system of providing adequate forage for their animals. Sheep raised under these two systems clearly seemed to be healthier animals and they seemed to develop much more rapidly than did animals under traditional conditions.

Farmers using improved methods of sheep production and management expressed clear preference for these methods over the traditional methods. Both the cut-and-

carry and the rotational grazing methods were found to be preferable to the older methods in terms of profitability and productivity. Farmers also gained greater satisfaction from their efforts in using these improved methods even though they required additional time and labour.

Summary and Conclusions of Sheep Project (Dominica)

1) Summary:

Farmers who previously used only one traditional method of sheep rearing were able to incorporate improved husbandry techniques into their livestock operations. The success of these farmers is evident from their positive net income and growth of their flocks.

While most of the farmers in this study were successful in increasing their net income, and/or increasing their flock size, these benefits were not spread evenly across the study group. Farmers in this study who were most successful used the cut-and-carry system exclusively. Each farmer using this system had a positive net income. Incomes of two of these three farmers were sizable and increases in the size of their flocks were significant as well.

This finding is supported by studies from Pakistan (Haq, 1951 and Wahid, 1965) on the returns from goats under intensive conditions, indicating that rearing goats was very profitable. Wahid estimated that the returns were approximately twice that of the cost of inputs. He also reported that in areas where goats are concentrated, their products contribute about fifteen to twenty five percent of the mean rural income.

Further support comes from a Malaysian study by Peters and Deichert (1984) on the pattern of goat production in low-income economic units. They report that in spite of the fact that average total cost in the intensive system are considerably higher than in the other systems (semi-intensive, extensive and semi-extensive) net income per doe still favours the intensive system.

The use of the cut-and-carry system in combination with the rotational grazing system seemed to produce results more favorable than those obtained from use of the rotational grazing system alone. One farmer using only the rotational grazing system had a small positive net income but a significant decrease in flock size.

Results of using the cut-and-carry system and the rotational grazing system were much more favorable than

results from using the traditional system. While the traditional system generated a positive net income, the decrease in flock size was very substantial, limiting the ability of the farmer to continue to raise sheep, particularly if traditional methods were to be continued.

It was anticipated that labour required to raise sheep would be greater for the cut-and-carry system than for systems in which sheep grazed for their forage. Some differences were noted, but it is not clear that labour requirements are higher for the cut- and-carry system than for others.

2) Conclusions:

The information collected during implementation of the project demonstrates that farmers are very capable of mastering the use of improved methods of sheep raising and successfully using these methods in their individual livestock operations. Farmers demonstrated good ability to use improved methods of sheep raising to generate income for themselves and their families and to increase the size of their flocks.

Taken together, results show that the cut-and-carry and the rotational grazing systems are more profitable

than the traditional method of sheep raising. The cut-and-carry system was, however, found to have definite advantages over the rotational grazing system. Exposure and attacks by dogs accounted for all deaths to animals raised using the rotational grazing system and the traditional method of sheep rearing. Death due to these causes was eliminated by confinement in pens in the cut-and-carry system greatly increasing the profitability of a sheep rearing operation. Elimination of deaths through the confinement of animals was achieved without significant increase in time or in expenditures for feed and medication.

Results of this evaluation provide the basis for further study emphasizing increasing profitability through use of improved feed rations. Animals in this study were given rations consisting only of coconut meal and forage, with salt and minerals on a sporadic basis. All animals were given the same feed regardless of their age, sex or function. This represents an area in definite need of modification trials.

Information from this study pertains to flocks generally and not to different breeds within flocks. There appears to be considerable difference, however, in the rate of development of individual sheep within flocks.

This observation suggests the need for identification of breed and other characteristics which influence the efficiency of growth and development of sheep.

Goats:

Information on goat production and management systems is not as detailed as that for sheep. A reflection of the fact that a study on goat production systems is not yet available.

In general however, the recently completed sheep development project described earlier has increased the awareness of small-farmers regarding the benefits of improved management methods as compared to traditional methods.

It can therefore be argued that many of the beneficial results obtained in the sheep project are equally applicable to farmers rearing goats. Furthermore, as pointed out in the sheep study, the Dominican farmer is very responsive to improved animal management systems, thus we can assume that a certain percentage of goat farmers have adopted some of the improved management systems. Also it must be taken into consideration that farmers rearing sheep and goats are not mutually

exclusive. In many cases farmers will own both species (Livestock Division, Ministry of Agriculture, Dominica, 1990).

Overall the information documented in this chapter has shown that the traditional extensive system of small ruminant production is still the norm among small-farmers in Dominica. However, the recently completed sheep development project on the island has also shown that given the opportunity small-farmers will willingly adopt improved management and production methods once the benefits of these improved methods are demonstrated. It can therefore be concluded that at the present moment small ruminant production systems in Dominica are still largely traditional, but the evidence demonstrates the potential among small-farmers to respond enthusiastically and willingly to adoption of improved methods of production in order to increase the economic prosperity of themselves and their families.

CHAPTER SEVEN

A SYSTEMS APPROACH TO IMPROVING SMALL RUMINANT PRODUCTION
SYSTEMS IN THE COMMONWEALTH OF DOMINICA

A review of the literature shows that over the last two decades researchers have realised small ruminants in developing countries are part of a complex agricultural system and therefore, cannot be studied in isolation. "One component, such as smallstock, cannot be looked at in isolation. They interact with the environment, they have nutritional and social implications, they serve many different functions, social, religious and economic, and they represent wealth, status, liquidity and insurance against risk" (Spedding, 1988).

This "new" approach to the study of small ruminants, known as the "systems approach" is aptly described by the World Bank; Sheep and goats in developing countries contribute primarily as an integral, but not dominant component of production systems. Therefore, project and other activities should emphasize the systems approach, rather than treat sheep and goats as an independent commodity (World Bank Technical Paper, 1983).

Overall, therefore, farming systems research aims to take a global approach and examine all the farm

enterprises acting together in the context of the socioeconomic, managerial, and physical environments. Within this framework, the small ruminant production system can be investigated as a subset as long as the interrelationships with other components are taken into account (Norman & Collinson, 1985).

The four principal steps in the systems approach to improvement of agricultural systems are:

- a) Characterization of the system: resource inputs, product outputs, operational processes and interactions among them.
- b) Analysis to identify constraints and practical options for their resolution.
- c) Design and evaluation of interventions to existing system.
- d) Implementation of technically, economically and socially feasible interventions (Fitzhugh, 1987).

After the Second World War many former colonies attained independence and began developing their economies. For livestock production, models from North America and Europe were imported, in the mistaken belief that they would be appropriate in the newly developing states.

In these models the principal feed resources are cereal grains, oilseed meals and high-quality roughage

from harvested forages. With such rich feed resources, very high levels of animal productivity can be achieved, encouraging development of extremely intensive, specialized production systems. Agriculture (i.e., crop production) has become divorced from livestock production, and mixed (animal/crop) farming systems are the exception rather than the rule.

The majority of developing countries, especially those in tropical regions cannot follow these practices for two fundamental reasons. First, there is frequently a net deficit of cereal grains, and the high cost of imports, both in financial and economic terms, means they must be used primarily for human consumption. Secondly, mixed farming systems are the rule and not the exception in developing countries (Preston, 1982; Turner, 1991).

The inappropriateness of North American and European livestock production models in developing countries, has finally been realised, and is now being addressed.

Livestock production systems in developing countries must be developed within the concept of a mixed animal/crop farming system utilizing crop residues as their main source of food (Devendra, 1988; Spedding, 1988). Preston (1982) points out that in this system, as

compared to the Western model discussed above, whatever level of supplementation is used, the level of animal performance will always be less than the genetic potential, but must not be viewed as a negative aspect of the system. This viewpoint is also supported by Devendra (1986) who argues that; For successful application, acceptable feeding systems are simple, practical, within the limits of the farmer's capacity and resource availability, convincing, and consistently reproducible. Moderate to low levels of animal performance may be biologically inefficient, but could be more economically viable than high levels of performance, especially with the existing limitations of small farm systems.

In order to compensate for moderate to low levels of animal production in the mixed farming system described above it is useful to consider the concept of the "integrated farming system" whereby crop and livestock production systems are integrated. In this system crop residues are used as livestock feed and the animal waste products such as faeces and urine are fed into a biogas digester which produces methane for household use such as cooking. Finally the effluent from the digester is used to fertilize ponds for aquatic plant/algae production in which fish are reared (Preston, 1990).

Nielsen and Preston, (1981) have developed a practical model of an integrated farming system applicable to mixed farming systems in developing countries (Diagram 1). The advantages of this strategy are as follows:

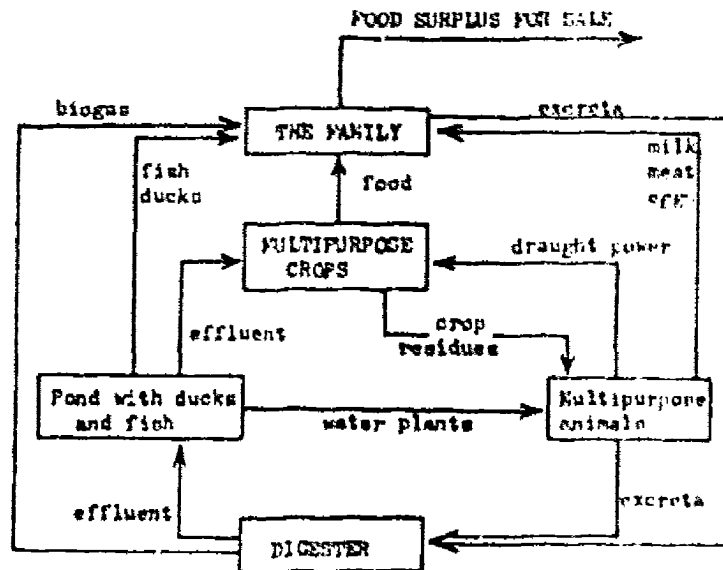


Diagram 1. Flow diagram for an integrated family farm producing crops, animal products and energy.

The growing of cash crops requires inputs of fertilizer and fuel. Both of these inputs can be obtained, at least in part, from an associated livestock unit which, in turn is fed mainly on the crop residues.

The livestock unit can provide draught power, milk and meat. Indirectly the recycled excreta can produce methane (for the household and for crop drying) by anaerobic digestion and organic fertilizer from the final effluent.

Introduction of a fish pond in the cycle between the digester and the crops will provide additional food and income from the fish, while the pond surfaces can grow nutritive aquatic plants to supplement the crop residues.

The reduced rates of productivity for individual activities - unacceptably low for profitable management in a specialized livestock unit - are compensated by the multiple end-products in an integrated system geared towards making the farming unit self-sufficient through utilization of solar energy, atmospheric nitrogen and natural rainfall.

Given the above approach, the improvement of small ruminant production systems in Dominica can now be addressed as a subset within the mixed animal/crop system prevalent on the islands.

a) Characterization of the system

Small ruminants in Dominica are held mainly by small limited-resource farmers for whom cash crop production (mainly bananas) is the primary activity. Most bananas are intercropped with coconuts, fruit trees and other crops. The average farm size is 2.55 acres, with average banana yields per acre of four tons (Livestock Division, Ministry of Agriculture, Dominica, 1990; FAO Economic And Social Development Paper, No. 57, 1986).

Small ruminants are kept mainly for meat and pen manure with the average herd/flock size per farmer been 2-3 animals. Sheep and goats are also reared together, as

it is common to find a farmer with a couple sheep and a goat or vice versa. The traditional extensive system of production and management, whereby goats and sheep are tethered on roadsides or grassy areas, or allowed to roam freely over large areas is utilized. In this system little attention is paid to the nutritional or health aspects of the animals. Animals therefore, suffer from a host of nutritional deficiencies and health problems (Livestock Division, Ministry of Agriculture, Dominica, 1990; Charles and Borland, 1990).

The persistence of traditional methods of livestock production in Dominica can be explained in terms of an economic resource allocative framework. As already documented the Dominican economy revolves around the production and export of cash crops, grown mainly by small-farmers with a limited resource base. It was also shown that small ruminant development until recently, had been accorded low priority by the state.

Given the low economic status accorded small ruminants in the economy it is logical to expect that allocation of resources for their production will receive low priority in the farmers resource allocative decisions. The traditional extensive system of small ruminant production, with its corresponding low economic inputs is

therefore, practical and logical.

From the evidence so far however, it would seem that the Dominican small-farmer is very willing and capable of adopting improved methods of small ruminant production, once he/she is shown the economic benefits of such methods (Charles and Borland, 1990).

Given the recent commitment of the Dominican state to development of small ruminant production systems, and the results of the IICA sheep project on the island, traditional small ruminant production systems on the island appear to be in a transitional phase of development at the present time, which so far seem to be benefitting the small-farmer.

b) Analysis to identify constraints and practical options for their resolution

The institutional, cultural, social and religious constraints regarding development of small ruminant production systems in Dominica have already been documented. It was shown that given the Dominican states recent commitment to development of the species the major institutional hurdle appears to have been surmounted. In terms of the others it was shown that in the short to

medium term they should not have an adverse impact on development of the production systems.

According to the Livestock Division of the Ministry of Agriculture in Dominica and the recently completed IICA sheep development project on the island the major constraints to improvement of small ruminant production systems in Dominica are; management, nutrition and health. The IICA development project showed that with improved management, health and nutritional practices small-farmers were able to see almost immediate results with their animals. It also showed that Dominican small-farmer is very receptive to improved production methods once they are relatively simple and inexpensive and the economic benefits are readily apparent.

Steinbach (1987) and Devendra (1988) propose four ways of improving small ruminant production systems in the tropics.

- 1) Management
- 2) Genetics
- 3) Nutritional
- 4) Health

1) Management:

Improved management of small ruminant production systems has proven to be quite successful among small-farmers in the developing countries. As documented earlier the intensive management system appears to be superior to the traditional extensive system of management prevalent in developing countries. It was shown by the IICA sheep development project in Dominica, and supported by other studies that the cut-and-carry (intensive) system of management although requiring more capital for shed construction, etc., resulted in greater economic benefits to the farmer than traditional methods. It also showed that farmers were willing to adopt it since almost immediate economic benefits were realised.

The cut-and-carry intensive system of management therefore, would appear to be a practical and feasible option for improving small ruminant production systems among small-farmers in Dominica.

2) Genetics:

Genetic improvement is a simple, relatively cheap and permanent way of increasing animal production, but disease control and better nutrition also make major contributions (Turner, 1986).

As documented in chapter six the Anglo-Nubian, British Alpine and Saanen goat breeds have shown good promise in the tropics for upgrading indigenous stock. In Dominica these three breeds are reported to be performing well. The Barbados Blackbelly sheep known for its high lambing rate, has also been introduced into Dominica and according to local sources is performing well (Livestock Division, Ministry of Agriculture, Dominica, 1990).

A practical and successful model of implementing genetic improvement can be seen in Cyprus. Economides (1987) reports that after the establishment of the Republic of Cyprus in 1960, efforts were geared toward the development of livestock production and the attainment of a greater degree of self-sufficiency in meat and dairy products. Since 1960, the sheep and goat industry has advanced considerably. Productivity per animal has increased significantly and total production of meat and milk has also increased. The composition of the sheep and goat population has shown marked changes, with the traditional fat-tailed sheep and local goats giving way to improved dual purpose milk and meat breeds.

The breed improvement was accomplished through schemes such as:

Rams on loan: Rams issued on loan through this scheme remained the property of the government. The grantees (selected flock owners) used the rams for the servicing of their animals and returned them to the government on an agreed-upon schedule.

Issue of ewes at subsidized prices: Participants were issued up to twenty ewes at subsidized (fifty percent) prices. They agreed to return (within a period of three years) one female weaned lamb for every ewe they had acquired, or else pay the full value of the animals.

Animal resale centre: This scheme provided for the purchase, by the government, of Chios ram lambs and ewe lambs from progressive livestock breeders, with resale of these animals to other interested livestock farmers.

Advisory and extension work: All aspects of sheep and goat management are discussed during organized courses of instruction at the farmer's training centres, during night lectures at villages, and during visits to sheep and goat units.

A breed improvement scheme such as this is practical and feasible and can be implemented by the Ministry of Agriculture in Dominica, given the States commitment to

development of smallstock.

3) Nutritional:

Sheep and goats require a diet consisting of the essential components of food (energy, protein, minerals, vitamins, free fatty acids and water) (Gatenby, 1986).

Given the realization of the inappropriateness of imported Western livestock models and the acceptance of less than biological efficiency in animal performance, research on improving the nutrition of goats and sheep has focused on improving the nutritional, digestibility and palatability aspects of local crop residues and by-products through simple, affordable and practical methods.

There are three basic treatment methods utilized in the improvement of crop residues and by-products:

- (i) Physical treatments
- (ii) Chemical treatments
- (iii) Microbiological treatments

(i) Physical treatments:

Various physical treatments, such as chopping, grinding, pelleting, and high pressure steam, have shown beneficial results in terms of increasing voluntary intake and performance by ruminants and monogastric animals fed on by-products (Donefer, 1973, 1977; Jackson, 1978).

All of these methods however involve costs, in terms of labour, equipment, energy (fuel) and time. Thus, they do not appear to be practical options for the small-farmer.

(ii) Chemical treatments:

Studies on treatment of crop residues with chemicals such as Sodium, Calcium Hydroxide, Ammonia and urea have shown substantial increase in the performance of animals fed chemically treated by-products in comparison with those fed untreated materials (Khajarnern and Khajarnern, 1985; Kristensen, 1981; Arndt et al., 1980; Klopfenstein, 1981; Berger et al., 1980; Morris and Mowat, 1980).

Treatment of crop residues with urea appears to be a viable option/method for the small farmer, as it is

readily available, inexpensive and simple. The other chemical treatments are not only relatively more expensive, but could also expose the farmer to possible health and pollution hazards.

Ammoniation using a 4% solution of urea (40 g urea dissolved in one litre of water per kg of straw) is a simple process that can be carried out at the village level. The urea solution is then sprinkled on the straw by the use of a watering can or a tin can with many holes in it. The application need not be uniform as the ammonia formed on hydrolysis will penetrate into the moisture in the straw. The sprayed material is then stacked. An air tight cover is preferable to prevent the loss of gaseous ammonia, but is not essential. The method therefore, does not require special equipment or trained personnel to implement it (Jayasuriya, 1985).

However, although urea treatment of crop residues appears to be a viable option for the small farmer there is one major limitation.

Because of poor management or improper formulation, the feeding of high levels of dietary urea may result in a rapid accumulation of ammonia in rumen fluid. This is accompanied by a rise in rumen fluid pH with rapid

absorption of ammonia across the rumen wall. When the rate of ammonia absorption exceeds the capacity of the liver to convert it to urea, ammonia accumulates in the blood and toxicity may result. Death occurs within 0.5 - 2.5 hours after the initial symptoms are observed (National Academy of Sciences, 1976; Lewis *et al.*, 1957).

The toxicity hazards of feeding dietary urea to ruminants has however been solved through the urea-molasses block lick (UMBL) technology. The main limitation to the application of the urea technology is the difficulty of adding it (urea) to the diet in a convenient way, and the toxicity hazard of doing this incorrectly. Incorporating urea in solid molasses-based blocks has overcome these difficulties and has been widely accepted by village livestock owners and by pastoralist (Leng and Preston, 1984; Preston and Leng, 1985; Sansoucy, 1986).

Due to the reasons given above chemical treatments of crop residues will not be explored. The alternative UMBL technology however, will be examined, as it appears to be a viable and practical option at the small-farmer level.

The literature on the urea-molasses block lick (UMBL) technology attest to the fact that it is practical, feasible and has been readily accepted by the small-

farmer in the developing world. The practicability of utilization of energy blocks at the farm level is no longer in question and an improvement in livestock performance is guaranteed. In Africa multinutrient blocks have been readily accepted by pastoralist as well as by small milk producers (Preston and Leng, 1987; Sudana and Leng, 1987; Sansoucy et al., 1986; Sansoucy, 1986; Sansoucy and Aarts, 1987; Sansoucy et al., 1988).

Pickstock (1985) has reported that in times of drought when the energy and protein reserves of animals fall to dangerously low levels, molasses - urea mixture can be fed in amounts of up to 2 kg a day thereby helping to satisfy both energy and protein needs. The use of liquid molasses and urea have had there problems (ILCA, 1986; Sansoucy, 1986). According to Sansoucy (1986) these problems are easily solved through the use of the UMBL technology whose advantages are in the handling, storage, transportation and even in the actual feeding.

El Naga (1985) also reports that in North Africa the use of the UMBL technology has shown good promise. Distributing UMBL's at the water wells and spreading in the pasture area during the summer months resulted in a decrease in lamb and kid mortality, production of more milk and an increase in the digestibility of the pasture's

dry matter by twenty eight percent.

The results of a recent study in Kenya by Mwendia et al., (1990) investigating the possibility of the farmer making his/her own concentrated energy blocks from the locally available ingredients, has shown that it is simple, practicable and affordable.

The technology of making energy blocks for dry season feeding is both simple and practicable... The economic saving is considerable over purchased commercial blocks although the real benefit may turn out to be the improved livestock performance since the farmer can alter block composition to suit his/her needs (Mwendia et al., 1990).

(iii) Microbiological treatments:

Ensilage:

The earliest and most extensive use of fermentation principles in the animal feeding context is in making silage, when continued aerobic respiration is followed by fermentation of ensiled material. Silage is the name given to the succulent material produced by a process of controlled changes from herbage of high moisture content. The process of making silage is known as ensilage. The medium in which the fodder is normally ensiled is called a silo (Oldfield, 1973; Livestock Manual For The Tropics, 1983). However a recent study by Otieno

et al., (1990) on the feasibility of using synthetic gunny-bags and molasses as an additive for ensiling small batches of common forages on small-scale farms in Western Kenya has shown great promise.

The concept of silage making is not well established in the developing countries. McCullough (1975) argues that following World War Two, silage production in the affluent developed countries was engulfed by the "mechanization" revolution of the fifties and sixties. Harvesting and storage of crops soon became a race to see who could develop the most complicated and expensive machinery, with the silage itself becoming less important than the equipment used to handle it. These trends caused many developing countries either to conclude that silage was too expensive for them or to try to emulate the silage production systems in the developed countries with an obvious waste of valuable development funds.

Silage making is a simple inexpensive technology that can be utilized by the small-farmer once certain fundamental principles are followed. McCullough (1975) points out that the silo has only three functions in the ensiling process:

- to provide a solid surface to permit compaction of the mass to eliminate air;

- to protect the ensiled materials from air and water during the storage period;
- where desired, to aid in the removal of silage by providing a base for unloading equipment.

If the silo meets the first two requirements, the cost of its construction is of little significance. Thus, a trench silo dug in firm soil is as useful as a specially engineered and highly automated upright. In Jamaica the pit or trench silo has produced excellent silage. The sides should have a slight slope narrowing towards the bottom. The sides and bottom can be left as they are if the area offers good drainage or they can be lined with (a) polythene (b) concrete. The trench silos consolidation is a simple process as compaction can be effected by trampling (Livestock Manual For The Tropics, 1983).

Since bananas are grown on nearly every small-holding in Dominica, exploring the feasibility of silage from waste/reject bananas is logical, given the fact that the silage making process appears to be relatively simple and inexpensive.

In many tropical countries, the banana plant is nutritionally important as a cheap source of energy and roughage in livestock feeding. By-product feeds from the banana plant include the reject or waste bananas, pseudo-

stems (trunks) and leaves (Hutaqqalung, 1981). World production of banana fruits is estimated at twenty eight million tons annually, of which Clavijo and Maner (1975) have estimated that about twenty percent is available for livestock, representing 5.5 million tons of fresh (1.2 tons dried) bananas. Waste bananas contain about 20% dry matter, 1% protein, 1% fibre, 0.2% fat, 0.08% Calcium and 0.28% Potassium.

Composition and ensiling properties of the banana

The composition of all banana varieties harvested is determined chiefly by degree of ripeness. Table 3 (overleaf) shows the composition of the green and ripe fruit.

Because of its high fermentable sugar content, the banana is easy to ensile (no additives such as molasses are required). On the basis of work done in Guadeloupe (Seve et al., 1972; Le Dividich and Geoffroy, 1973; Le Dividich et al., 1976) the ensiling of bananas can be successfully undertaken if the normal rules of silage making are observed. Ripe bananas compact easily, but bananas to be ensiled green should be chopped.

The silage stabilizes in three to four days and keeps for at least six months. The characteristics of silage from ripe fruit may be more favorable than those of silage from green bananas. But on balance green banana silage is preferred, particularly when sudden peaks occur in banana supplies owing to seasonal factors, market constraints and meteorological conditions.

Table 3. Composition of banana export rejects at different stages of maturity and preservation

	Green 2 to 5 days after picking	Ensilaged green	Ripe	Ensilaged ripe
Physical composition	Percentage of dry matter			
Banana peelings	20		18	
Banana pulp	80		82	
Chemical composition	Percent			
Dry matter content in fresh feed	21.2	29.0	21.7	23.5
Crude fibre ¹	2.7	5.3	3.8	6.1
Crude protein ¹	6.4	3.8	5.3	8.1
Sugars soluble in alcohol at 80° G.L. ¹	1.8	0	73.6	17.3
Starch ¹	72.3	70.9	3.4	6.8
Ash ¹	4.6	3.8	5.2	5.7
pH		4.2		3.8
Lactic acid (g/% DM)		5.3		10.1
Volatile acidity (g CH ₃ COOH/100 g DM)		1.8		3.0
Ethanol		0.2		2.3
Losses as percentage of ensilaged dry matter		13.5		33.9

SOURCE: de Driedrich, Seve and Geoffroy, 1976

¹ On dry matter basis

Use of bananas in ruminant feeding

Banana pulp flour:

Some work has been done, notably in Ecuador (Spiro, 1973; Rihs *et al.*, 1975), on the introduction of banana flour into ruminant diets. Spiro demonstrated that green banana flour could replace fifty percent of the cereal in feeds for young growing and finishing cattle without changing their intake and growth rates. However, the conversion of bananas into flour is a costly process and is not practical at the smallholder level.

Fresh and ensiled bananas:

Trials carried out in Guadeloupe and more recently Costa Rica, on the use of bananas either fresh or ensiled show promising results. In these studies two approaches were followed, one involving the use of bananas as an energy supplement to green forages, and the other using bananas as a basic ingredient of compound feeds that were balanced with fibre, protein, mineral and where necessary, energy supplements.

1) Use as a supplement to green forages:

The first series of digestibility trials conducted with goats in cages (Chenost et al., 1971; Geoffroy and Chenost, 1973; Chenost et al., 1976) provided the following results;

-- In ad libitum (unrestricted access) feeding, when forages and bananas were offered separately in the trough, the two feeds were ingested in such proportions that bananas constituted twenty to forty percent of the total ingested dry matter.

-- When bananas were blended with forages, it was found that the intake of both dry matter and digestible organic matter rose sharply with increasing content of bananas in the ration from zero to twenty percent; dry matter intake was higher for ensiled than for fresh green bananas, with a peak of 1.8 to 2.2 kg/100 kg live weight at the twenty percent level. Beyond this level, dry matter intake remained relatively constant as bananas replaced green forage on a weight for weight basis, while digestible organic matter intake rose slowly.

The second series of trials conducted in Guadeloupe (Geoffroy, [unpublished]) with lactating goats

demonstrated the feasibility of substituting green and ensiled bananas for all the cereals in concentrate feed. The principal results were as follows:

- Total substitution of the cereals with bananas resulted in an increase in dry matter intake.
- Milk production was significantly higher in animals fed green bananas (fresh or ensiled) than in those fed cereals.
- The butterfat content remained low and was not affected by the diet. A low butterfat content makes the milk more palatable and also results in more butter or cheese being produced from a given quantity of milk.
- Weight gains were significantly higher in animals fed fresh or ensiled green bananas than in those receiving cereals.

The third series of trials with growing goats, also conducted in Guadeloupe, showed that half of the conventional concentrates could be replaced with bananas if the ration were supplemented with urea to maintain its nitrogen level (Chenost et al., 1971).

For both milk production and finishing purposes, bananas may be regarded as a good substitute for barley. This was demonstrated in Guadeloupe by Poncet (1973).

Cubillos (1974) also used bananas successfully in Costa Rica as a supplement to green forages. Feeding fresh bananas to steers that were raised on grass made it possible to increase stocking rate, the growth rate of the animals and in consequence, the weight gain per hectare.

2) Use as a basic ingredient of complete feeds:

In order to simplify feed mixing and feeding, a single feed obtained by ensiling all the constituents of the diet (bananas, bagasse, bran and urea) was offered in Guadeloupe to dairy goats and growing kids. The principal results were as follows (Geoffroy and Chenost, 1973; Geoffroy, [unpublished]):

-- The level of silage intake, which was relatively low (2.0 to 2.5 kg/100 kg live weight), increased by thirty to forty percent when five percent molasses was added on a fresh weight basis.

-- The performance obtained with this type of feed was promising; milk production was maintained and the growth

rate of fattening kids was better than that observed with ordinary cereal-based diets.

Use of fresh and ensiled banana pseudo-stems (trunks) and leaves as ruminant feed

Pseudo-stems (trunks) and leaves of the banana plant are useful sources of roughage in many tropical countries. The leaves contain about fifteen percent protein when harvested close to the trunk; they have a high digestibility (65-70%) and are readily consumed by cattle (Ffoulkes and Preston, 1978a).

Rove and Preston (1978) fed different proportions of whole sugarcane and banana tops (Leaves and stems) to cattle. They indicated that rate of weight gain was closely related to the proportion of roughage given as banana tops, probably due to higher protein intake when banana tops were consumed.

In experiments where whole sugarcane and banana tops were compared as the source of roughage for cattle fed molasses ad libitum, weight gains tended to be better for the cattle fed on banana forage than for those fed on sugarcane (Fernandez and Preston, 1978; Salas et al., 1977).

Growing bulls fed various mixtures of banana stem and leaf exhibited higher digestibility on a stem-based concentrate (75%) than on a leaf-based concentrate (65%) (Ffoulkes and Preston, 1978a). There was also a reduction in voluntary feed intake and in digestible dry matter as the amount of leaf increased in the diet, suggesting the role of the leaf protein in providing by-pass protein.

In another trial, growing bulls were fed with various mixtures of chopped whole sugarcane and banana forage (80% stem; 20% leaves) (Ffoulkes and Preston, 1978b). They found that replacement of thirty three percent sugarcane with banana forage increased dry matter intake by about forty six percent and digestible dry matter intake by one hundred and three percent.

Overall, the studies on the feasibility of ensiling reject/waste bananas as feed for ruminants have shown very good promise, it can therefore be tentatively concluded that the ensiling of waste/reject bananas by the small-farmer in Dominica appears to be a very viable option.

(4) Health:

Healthy animals are a function of several

different factors, but proper management techniques and adequate nutrition are crucial. Regardless of how diligent we are however, animals will get sick and require the attention of trained personnel which must be available when the small-farmer needs them.

In chapter five it was shown that the ratio of extension officer to farmer is not satisfactory, however, it was also shown that the Dominican government is taking steps to rectify this situation.

It can therefore, be argued that the adoption of improved methods of small ruminant production by the small farmer will result in healthier animals and a reduction in the use of veterinary extension services. And, given the increase in supply of trained extension personnel the farmer extension officer ratio will get better in the short to medium term. The combination of these factors appears to be in the interest of the small-farmer.

C) Design and evaluation of interventions to existing systems

It has already been shown that small ruminant production systems in Dominica are still largely

traditional, whereby the extensive system of management is utilized with its concomitant drawbacks. In this section I will outline several practical interventions to the existing traditional small ruminant production system in Dominica, with the aim of improving the system so that (a) the small ruminant enterprise can generate income and employment prospects for the small-farmer and his/her family (b) through these increased income and employment effects have a positive economic impact on the rural economy (c) reduce the islands dependence on imported meat, and (d) contribute towards the agricultural and economic diversification of the Dominican economy.

The interventions to the existing system can be categorized into the following headings for discussion purposes:

- 1) Management systems
- 2) Silage making re: waste/reject bananas
- 3) Urea-molasses block lick technology
- 4) Genetic upgrading
- 5) Potential of village based cottage industries utilizing small ruminant by-products.
- 6) Integrated farming concept: biogas production, fish ponds, etc.

1) Management systems:

The evidence presented in chapter six shows the intensive (cut-and-carry) system of management to be apparently superior to the traditional extensive system prevalent in Dominica. This system of management appears to produce almost immediate economic results for the small-farmer, it has also been demonstrated that the Dominican small-farmer will readily adopt this system due to its economic benefits. The major drawbacks to this system however, are the added cost of shed construction and more demands on the farmers time in terms of finding and cutting herbage for his/her animals.

In terms of shed construction it is envisaged that shed frames can be built relatively cheaply through the utilization of waste/reject lumber from the two sawmills on the island and the use of woven coconut and banana leaves for the sides. In terms of roofing a layer of thick plastic sandwiched between a layer of woven coconut and banana leaves can be utilized, a galvanized roof would be ideal, but due to the high cost of galvanized roofing sheets the cost for the small-farmer would be prohibitive. A slightly sloped concrete floor would be ideal, but once again due to the high cost of cement a packed dirt floor with adequate drainage will be sufficient.

In terms of increased demands on the farmers time for finding and cutting herbage for his/her animals, this is not expected to be a problem due to the utilization of waste/reject bananas by ensiling.

2) Silage making re: waste/reject bananas:

Earlier on in this chapter it was shown that silage making is a simple inexpensive technology that can be utilized by the small-farmer once certain fundamental principles are followed. It was also shown that excellent silage can be produced in a pit or trench silo dug in firm soil. The use of synthetic gunny-bags for ensiling small batches of common forages was also shown to hold good promise.

According to the studies already documented waste/reject bananas, either fresh or ensiled, have shown good promise in feeding trials with ruminants. Given the ample supply of waste/reject bananas at the smallholder level in Dominica, and the apparent simplicity of silage making it is envisaged that through the use of the gunny-bag technique and/or construction of a pit silo(s) next to the goat/sheep shed the farmer will be able to ensile a given quantity of bananas at any one time, thus requiring a relatively small amount of time and labour on the part

of the farmer in the feeding of his/her goats/sheep.

The use of waste/reject bananas through the ensiling process is not expected to meet with resistance from the small-farmer since the merits of using his/her waste/reject bananas as feed rather than allowing them to rot is self evident.

3) Urea-molasses block lick (UMBL) technology:

The beneficial aspects of the UMBL technology in ruminant diets has already been documented. According to Mwendia *et al.*, (1990) " by manufacturing his/her own energy blocks using ingredients that are available at fairly controlled government prices the farmer would benefit from a saving of more than seventy five percent the cost of company manufactured blocks".

THE MANUFACTURE OF MOLASSES-UREA BLOCKS (UMBL)

Different processes have been tried and can be grouped in three categories (Sansoucy *et al.*, 1988): (a) The "hot" process (b) The "warm" process, and (c) The "cold" process. For the purposes of this thesis only the "cold" process will be briefly described as it is the most practical at the small-farmer level.

The "cold" process

It has been noted that, in tropical conditions, it was not necessary to heat the molasses in order to obtain a good block when 10 percent of calcium oxide was used as a gelling agent. This observation is of primary importance when blocks are manufactured in a unit separate from the sugar factory as will be the case in Dominica.

The "cold" process has been recently described in detail (see Sansoucy, 1986). A horizontal paddle mixer, with double axes (a cement mixer is also suitable), is used to mix, in the following order of introduction, molasses (50%), urea (10%), salt (5%), calcium oxide (10%) and bran (25%). The mixture is then poured into molds (plastic mason's pails or a frame made of four boards 2.5 m x 0.2 m). After about fifteen hours, blocks may be removed from the mold's and they may be transported by truck after two days.

Calcium oxide may be replaced by cement, but when cement is used it is important to mix it previously with about forty percent of its weight in water, and common salt to be included in the block. This ensures its binding action, as the water in the molasses does not seem to be available for the cement. The quality of the cement is of

primary importance. Mixing the salt with cement accelerates hardening.

The disadvantage of the "cold" process is that it needs some time to set and the final product is somewhat hygroscopic. The advantages are the saving in energy, and the simplicity and ease of manufacture.

Due to the unavailability of data the monetary cost of importing the ingredients from neighboring islands for the manufacture of the UMBL in Dominica cannot be determined at this time. However, it can be assumed that the importation of the ingredients on a government to government level will keep the cost relatively low. Given the benefits of the UMBL technology for the development of small ruminant production systems on the island some form of government subsidy of the price of the urea-molasses block at the small farmer level is envisaged if cost are too high. It is also envisaged that block manufacture can be performed by small farmer cooperatives in strategic locations around the island. Regarding adoption of the UMBL technology by the small-farmer, it is envisaged that once the blocks are reasonably priced and the benefits demonstrated, adoption will be swift.

4) Genetic upgrading:

The merits of genetic improvement of local stock has been demonstrated in the Cyprus model documented by Economides (1987). This model will basically be copied for the genetic upgrading of local stock in Dominica.

a) Rams on loan: Rams of the Anglo-Nubian goat breed and the Barbados Blackbelly sheep breed can be purchased by the Ministry of Agriculture, locally and from neighboring islands. These rams which remain the property of the Ministry can be loaned to farmers for the servicing of their animals and returned to the Ministry on an agreed-upon schedule. In the case where several farmers live relatively close and each has only a few sheep/goats, a ram can be loaned to one farmer under the agreement that the other farmers have access to it also.

b) Issue of ewes at subsidized prices: Farmers can be issued up to five ewes at subsidized (fifty percent) prices on the condition that they agree to return (within a period of two years) one female weaned lamb for every ewe they have acquired, or else pay the full value of the animals.

c) Animal resale centre: A scheme can be set up whereby

the Ministry of Agriculture agrees to purchase Anglo-Nubian ram kids and ewe kids and Blackbelly ram lambs and ewe lambs from "progressive" farmers with resale of these animals to other interested livestock farmers.

d) Advisory and extension work: It has already been documented that the ratio of extension officer to farmer is relatively low. However, this situation is being rectified with medium term technical assistance provided by external donors. Every effort should therefore be made by the Ministry of Agriculture, to have some form of regular information sharing sessions between its extension officer's and groups of farmers at the village level.

The genetic upgrading model outlined above is not envisaged to meet with resistance from the small farmer, as all of the schemes outlined above directly benefit him/her.

5) Potential of Village based cottage industries utilizing small ruminant by-products:

Rural cottage industries have a dual function in small ruminant development;

First, local processing industries will increase the

product value and decrease the cost of transportation by reducing weight and increasing quality. Product preservation (Meat drying, cheese and yoghurt production, skin curing, fibre processing) are valuable possibilities to raise rural incomes and prevent an excessive nutrient export from the area, since a smaller proportion of the animal product is sold, while the processing by-products are recycled. Many of the technologies for product processing are simple, labour intensive, and require little capital. For instance it was shown at Cap Serrat that air-dried skins without chemical treatment can make excellent goat leather, even under difficult environmental conditions. In Syria, different types of goat cheese were produced with technologies almost as simple.

Secondly, local employment opportunities decrease the rate of urbanization and create incomes that, in turn are partially re-invested in buying animal products such as meat, milk, butter and cheese (Steinbach, 1987).

In most developing countries, the full potentialities for the development of hides, skins and animal by-product resources are yet to be realised. It is not uncommon to find a developing country throwing slaughter-house offal's to jackals and at the same time importing protein concentrates and other compound feeds. Waste of this sort,

constituting a veritable drain on national wealth, is a costly luxury a developing country can ill afford (Barat, 1975).

Processing of products from animals in developing countries can therefore, be no longer ignored given the climate of high levels of unemployment and economic austerity.

For the purposes of this thesis the production of one small ruminant by-product will be briefly discussed. The manufacture of cheese from goat and sheep milk. manufacture of cheese was chosen due to the fact that, according to the literature cheese production appears relatively simple, in most cases it does not require refrigeration, there is a relatively short period between actual manufacture and marketing, and last but not least it will be directly beneficial to the rural female population.

O'Mahony and Peters (1987) document the fact that certain cheese varieties can be manufactured using simple procedures that are well suited to the economic conditions of smallholders in Africa. Steinbach (1987) also attests to the fact that the technology for cheese making at the smallholder level is relatively simple. " Many of the

technologies for product processing are simple, labour intensive, and require little capital... In Syria, different types of goat cheese were produced with technologies almost as simple".

It is envisaged that with government or private sector start up capital small village based cooperatives comprised of young women can be trained in the manufacture of different varieties of cheese, thus creating employment and incomes for a group in the society that at the present moment suffers from high unemployment.

6) Integrated farming concept: biogas, fishponds, etc.

The concept of the integrated farm was discussed earlier in this chapter. It was pointed out that in order to compensate for moderate to low levels of animal production in the mixed farming system prevalent in Dominica and developing countries the concept of the integrated farming system is both logical and practical.

The major facets of the integrated farming system that I would like to stress are the concepts of the fish ponds and the digester.

Given the high cost of protein in the form of meat or fish and the fact that most families in the rural sector cannot afford either, the concept of producing fish for home consumption through the use of goat/sheep waste after been passed through a digester makes good economic sense especially from the viewpoint of the poor rural family who may only be able to afford fish once a week. Surplus fish can also be sold, thus enhancing the family's economic welfare.

According to the literature it is recommended that the Tilapia species of fish be grown. It is a very hardy fish, taste delicious, has few bones and grows fast (Edwards and Kaewpaltoon, 1983).

The Tilapia species has already been introduced into Dominica several years ago, thus all that remains to be done is to introduce the farmer to the concept of "fish culture for small farmers" whereby animal excreta is used to fertilize ponds in which fish are reared.

In terms of the concept of a digester in the system that utilizes animal waste for the production of biogas which can be used for cooking, and the effluent used to farm fish and fertilize crops, such a concept holds great promise. Given the high cost of hydrocarbon fuels, few

rural families can afford to buy fuels such as kerosene for cooking purposes, as a result wood is used with dire environmental consequences. Furthermore the use of the effluent as a crop fertilizer is not only environmentally friendly but also reduces the need for chemical fertilizers which not only degrade the environment but are also a economic drain on the small-farmers limited resources.

The integrated farming system which not only recycles the products in the system but also makes the farming unit relatively self-sufficient holds great promise for rural households and the rural economy in the developing world. Given the commitment of the Dominican Government to development of small ruminant production systems at the small-farmer level it is proposed that the next step should be the development of the concept of the integrated farming system among these small-farmers.

d) Implementation of technically, economically and socially feasible interventions

This thesis will be submitted to the Dominican Government in order that the interventions outlined regarding improvement of the existing traditional small

ruminant production systems on the island can be reviewed by the relevant personnel in the Ministry of Agriculture. If the interventions outlined in this thesis are adopted by the Ministry of Agriculture it is recommended that they be first implemented on a sample population of small farmers and young women.

CHAPTER EIGHT

CONCLUSIONS

From the evidence presented in this thesis, regarding the development/improvement of small ruminant production systems among small-scale farmers in the Commonwealth of Dominica, the following conclusions can be drawn.

Caribbean economies are externally oriented. Incorporated into the colonial economic system as primary producers they depend on a few agricultural or mineral exports such as bananas, sugar, cacao, and bauxite for the majority of their export earnings and in turn import finished goods and food. In the 1950's an attempt was made to industrialize the region through the introduction of the "Industrialization by Invitation" Development model. However, this model has done little to alter the export-import framework of the region exemplified by the fact that little structural change has taken place in the islands' economies. In the 1980's thirty years after the introduction of the model, Caribbean economies are still as dependent on a few basic primary commodities for the majority of their export earnings. Essentially therefore, the Caribbean still produces what it does not consume, and consumes what it does not produce.

The Dominican economy is a classic example of this external orientation. In the mid 1980's bananas accounted for over fifty percent of the islands' export earnings, while at the same time approximately nine million dollars were spent on food imports. This situation is not conducive to development for the simple reason that such a situation leads to a drain on the economy through unequal terms of trade, under which the prices of manufactured imports rise faster than the prices of commodity exports.

Aside from the unequal terms of trade relationship inherent in the export-import framework of the Dominican economy, the traditional United Kingdom market for the island's main export crop, bananas, with its preferential access and pricing system can no longer be taken for granted, given the conclusion of an integrated market in the EEC in 1992. The recently signed (December 1989) Lome Convention (Lome IV) which will have a life of ten years has given Dominica some breathing space. The Dominican State therefore, has until the year 2000 to break the "stranglehold" of bananas on the economy.

The only feasible option available to the Dominican State is the rapid diversification of the islands' economy away from the over reliance on bananas. The evidence presented in this thesis has shown that small ruminant

production systems are not only well suited to the limited economic resources of the small-farmer, but also have the potential to reduce the food import bill and in so doing save on scarce foreign exchange which in turn can be used to finance other projects aimed at agricultural and economic diversification. The evidence has also shown that the technology and methods of improving small ruminant production systems and processing of animal by-products at the small-farmer level are simple, inexpensive and practical.

Overall, therefore, given the suitability of small ruminant production systems among limited resource groups in developing countries and the potential for development of cottage type industries which utilize animal by-products for production of processed goods such as cheese and leather the development and improvement of these systems in Dominica is beyond question.

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