

Virgin Islands  
Agricultural Experiment Station  
Report No. 7  
September 1974

Potential Returns from  
**GOAT AND SHEEP ENTERPRISES**  
in the U.S. Virgin Islands



VIRGIN ISLANDS AGRICULTURAL EXPERIMENT STATION  
Fenton B. Sands, Director  
St. Croix, U.S. Virgin Islands

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**COVER PHOTO: Mixed breeds of sheep on pasture, St. Croix.**



## FOREWORD

This report, "Potential Returns from Goat and Sheep Enterprises in the U.S. Virgin Islands," is one of a series of feasibility studies sponsored by the newly created Virgin Islands Agricultural Experiment Station, College of the Virgin Islands. These investigations were financed totally with Federal funds made available to the Station under the provisions of the Hatch Act, Amended.

Preparation of this report was accomplished by contracting for the services of the following team of specialists: Dr. William L. Park, Chairman, Department of Agricultural Economics, Rutgers University, New Brunswick, N.J. and Dr. Robert L. Park, Professor of Animal Science, Brigham Young University, Provo, Utah. This team conducted the study and wrote the manuscript for this report.

The objective of these studies was to try to determine the agricultural enterprises, both plant and animal, that have economic potential on the Virgin Islands. It is my belief that the agricultural industry must be economically sound in order to be viable.

On the Virgin Islands, agriculture has been on the decline since the early part of the 1960's. The average number of farms, farmers, and production of agricultural commodities (with the exception of fluid milk) have all declined at a consistent rate. Among the questions which are uppermost in the minds of many people are: What factors have been responsible for these declines? Can these downward trends be stopped and perhaps reversed? What is the future of the agricultural industry, particularly on St. Croix where 85 percent of the farmland is located? This report on goat and sheep enterprises, along with the others, sheds some light on these questions.

These feasibility reports have also revealed the areas where lack of training and education on the part of the farmers has adversely affected production. These subjects have now become part of the new program of the V.I. Extension Service. At the same time, the lack of information about the response of crops and livestock in this environment, which also limits production, has been recognized. These gaps in our knowledge have become the basis for the planned research program of the V.I. Agricultural Experiment Station. Thus, these studies have given more direction to the efforts of the Extension and research programs of this land-grant institution. More importantly, the results of these studies are expected to be beneficial to full- and part-time farmers, as well as to potential investors.

This series of reports rests squarely on the belief that a revival of agriculture would contribute substantially to the general welfare through increased output of goods and services and by providing additional employment. Moreover, expanded production and marketing of farm products could provide greater, and in some cases, cheaper sources of nutritious foods for consumers.

A more fully developed agriculture would complement the major industry—tourism—in two ways. First, visitors would be pleased to be served local products, especially tropical fruits and vegetables, by hotels and restaurants where such products are often not now available. Second—and perhaps more important—an expanded agriculture would tend to preserve the environment of exotic tropical islands. Most visitors and some permanent and semi-permanent residents come to the Virgin Islands to seek this environment. If this attraction is destroyed, the basis of the major industry of the Islands will be undermined.

The Virgin Islands Agricultural Experiment Station gratefully acknowledges the cooperative assistance and contributions from many St. Croix farmers; Rudolph Shulterbrandt, Commissioner, V.I. Department of Agriculture and his staff; and Bennett S. White, Jr., project consultant and former USDA agricultural economist, now retired.

Fenton B. Sands, Director  
March 1974

## SUMMARY AND CONCLUSIONS

Goat and sheep raising has long been the traditional livestock enterprise for small landowners in the Caribbean area. Moreover, there is a demand for goat meat and mutton in the Virgin Islands that is not likely to be met by large-scale commercial operations.

The amount of land devoted to grazing in the Virgin Islands has been declining in recent years, in spite of the fact that the climate and forage grasses are well-suited to animal agriculture.

This report describes four simulated benchmark farms for the production of goat meat and mutton on a small scale. These benchmark farms, or models, are based on actual operating conditions but do not necessarily reflect conditions on a particular farm. It is expected that the small operations will be supplemental to other farm enterprises or off-farm employment.

Capital requirements, including land and ani-

mals, would range from \$331 to \$386 per adult animal, depending upon circumstances. Land can be leased for \$20 per acre per year, and less if the potential operator does not own the land required by the enterprise.

The average return to family labor for a 20-acre goat operation and a 20-acre sheep operation is estimated at \$2.01 and \$1.55 per hour, respectively. The hourly rate of return to labor on a 5-acre operation is slightly less. Labor income per hour under alternative conditions can be quickly determined by using the breakeven charts provided in this report.

It is evident that at prevailing lease rates for land, family oriented goat and sheep operations can indeed be profitable as supplemental family enterprises. They provide an opportunity for families living in rural areas to create employment for older children and homemakers that is not generally available to them.

# Potential Returns from GOAT AND SHEEP ENTERPRISES

by

WILLIAM L. PARK and ROBERT L. PARK

Goat and sheep raising has long been the traditional livestock enterprise for small landowners in the Caribbean area. The flocks were usually very small and supplemental to other income-producing activities. In recent years, the interest in small flocks of goats and sheep has continued not so much as a principal means of livelihood, but as supplemental to *off-farm* income. As a part-time activity, much of the care of the animals is entrusted to family members who otherwise would have little opportunity to earn money. There is a need to determine whether small-animal operations can be profitable under present Virgin Islands conditions. There is also a need to assess the contribution that small-animal agriculture might make toward improving the socio-economic welfare of lower income families.

According to a 1964 livestock inventory on St. Croix, the average farm flock consisted of 18 head of goats or 25 head of sheep.<sup>1</sup> Over 80 percent of the goats and 65 percent of the sheep were in flocks of fewer than 100 head. The 1970 Census of Agriculture for the Virgin Islands reported that goat and sheep numbers have fallen only slightly in recent years and that flock sizes are still relatively small. In 1970, there were 2,721 head of goats and 2,185 head of sheep reported on St. Croix, the principal agricultural production area in the islands. These numbers, incidentally, include only reports from farms that sold \$100 worth of farm products or more. By mainland standards, the numbers of animals are very small, but in terms of the Virgin Islands population which has a strong preference for goat meat and mutton, they are significant.

Goats and a Virgin Islands wool-less breed of sheep are well adapted to local conditions. They

like the forage and browse, and the mild climate poses no problems for shelter. There is a strong preference for goat meat and mutton by the native population, a demand which will likely prevail for many years.

Objectives of this study were (1) to determine the profitability of goat and sheep raising on small land holdings in the Virgin Islands, and (2) to determine the range of profitability of goat and sheep raising on small farms under alternative sets of conditions.

## PROCEDURES

Because of the rather wide range of conditions to which the cost and return estimates might be applied, four simulated benchmark farm units were set up. These benchmark farms represent typical and potential operations which exist or might exist on St. Croix. Basic cost and returns estimates were converted to equations to facilitate a sensitivity analysis of selected economic variables.

The benchmark farms are (1) a 5-acre goat farm, (2) a 20-acre goat farm, (3) a 5-acre sheep farm, and (4) a 20-acre sheep farm. Although larger operations might prove feasible, they were not included in this analysis because they would tend to be commercial operations rather than family-oriented backyard operations which are the subjects of this report.

In keeping with the nature of family-farm operations, labor income is that which remains after production costs and returns on investment at prevailing interest rates are paid or satisfied. Land cost is charged to the enterprise at its capitalized prevailing rental value for agricultural purposes, even though the market value of the land might be substantially higher. Any value of land above the farm value is assumed to be development value, or "real estate" value, and not chargeable to the enterprise.

<sup>1</sup> Livestock inventory conducted by R. Park, O. Skov, et al., U.S. Dept. of Agriculture, Kingshill, St. Croix, Sept. 1964.

## RESOURCE BASE

The total cost approach is based on estimates for investment cost, taxes, replacement allowances for facilities and equipment, animal health, repairs, interest on operating capital and cost of supplemental feed. Labor is assumed to be provided by family members, who, in turn, receive the income from the enterprise. Sales values are computed on the basis of f.o.b. farm prices, which is the current practice on St. Croix. With practically no exception, goats and sheep are sold at the farm to butchers who arrange for the transportation of the animals to the slaughter facility.

While the authors were at St. Croix, it was reported that dogs cause substantial damage to goat flocks if the goats are not penned and protected at night. Substantial losses are incurred each year from theft. Such losses, although impossible to predict in individual cases, are accounted for in an average way in the analysis.

Open-ended interviews were held with typical goat and sheep farmers on St. Croix and with livestock specialists to determine production practices, input-output relationships, replacement rates, birth and death rates, animal weights and the like. Carrying capacity was computed from established nutrient standards for forage and grain concentrates in relation to animal TDN (total digestible nutrient) requirements.<sup>2</sup> In addition, the carrying capacity was computed as a function of birth and death rates, age of weaning, age of sale of young fat stock, replacement rates and death rates. Estimates computed in this manner were found to be reasonable in light of actual experience.

When the benchmark farm models were completed, standard cost estimates were reduced to equation form. Labor income as a residual claimed by the family was computed at (1) sale prices ranging from 45¢ to 75¢ per pound liveweight, f.o.b. the farm, (2) daily labor requirements ranging from 1 to 3 hours for the 20-acre operation, and (3) one-quarter to three-quarters of an hour per day for the 5-acre model. These data were then presented as breakeven estimates.

<sup>2</sup> Nutrition standards were taken from "United States-Canadian Tables of Feed Consumption and Nutrient Requirements," National Academy of Sciences, 1969-70, and from Morrison's *Feeds and Feeding*, Morrison Pub. Co., Ithaca, N.Y.

The well-tended farms and agricultural enterprises of the Virgin Islands have a long history of excellent productivity since colonial times. The major agricultural production region in the islands under the U.S. flag is located on St. Croix. It is a small, relatively dry tropical island located in the Caribbean Sea approximately 900 miles from Miami and 1,500 miles from New York City. St. Croix is approximately 6 miles wide and 23 miles long and has a land area of about 54,000 acres.

Historically, the more significant enterprises on St. Croix included sugarcane and cotton and to some extent fruits and vegetables. Livestock operations were an important source of essential protein for the local population. Goats and sheep were an especially important means of meeting such needs.

### *Grazing Land*

Today, the sugarcane and cotton operations have ceased and fruit and vegetable production is not practiced on a large scale. Small-animal livestock enterprises are still a significant source of protein for the native Cruzan population. When sugarcane production on a commercial scale stopped with the 1965-66 crop year, it was hoped that the land released could be used to produce forage and pasture to support animal agriculture. Although the opportunity for developing a viable livestock industry seemed to exist, these industries have not flourished as anticipated. According to the agricultural census, land area in farms declined from 39,539 acres in 1964 to 20,470 acres in 1970 (Table 1). The land used for grazing purposes declined even further—from 19,611 acres to 7,584 acres in the same period, a reduction of 61 percent. The amount of potential pasture is still large, even though the population increase on the island and its attendant demand for land have been relatively high.

It is estimated that between 7,000 and 8,000 acres of improved pasture are being used by the beef industry.<sup>3</sup> Less than this amount is being used for dairy purposes and a small but undetermined area is devoted to forage for small animals such as

<sup>3</sup> See Park, William L. and Park, Robert L., "Profitability of Beef Production in St. Croix, U.S. Virgin Islands," V.I. Agricultural Experiment Station, 1974. See also Appendix Table A-1.

Table 1.—Use of land in the Virgin Islands for pasture or grazing, 1964 and 1970

Item	Census year		Percent change from 1964
	1964	1970	
Total number of farms -----	466	212	-55
Total land in farms (acres) -----	39,539	20,470	-48
Cropland harvested (acres) -----	5,134	737	-86
Average size of all farms (acres) -----	85	97	+14
Number of farms using land for grazing -----	279	100	-64
On farms of up to 49 acres -----	181	70	-61
On farms of 50 to 174 acres -----	57	15	-74
On farms of 175 to 499 acres -----	24	7	-71
On farms of 500 to 999 acres -----	9	4	-56
On farms of 1000 acres or more -----	8	4	-50
Land used for pasture or grazing (acres) -----	19,611	7,583	-61
On farms of up to 49 acres -----	1,046	662	-37
On farms of 50 to 174 acres -----	2,766	850	-69
On farms of 175 to 499 acres -----	4,332	1,186	-73
On farms of 500 to 999 acres -----	3,532	1,921	-46
On farms of 1000 acres or more -----	7,935	2,964	-63
Average amount of land per farm used for pasture or grazing (acres) --	70.3	75.8	+7.8
On farms of up to 49 acres -----	5.8	9.5	+63.8
On farms of 50 to 174 acres -----	48.5	56.7	+16.9
On farms of 175 to 499 acres -----	180.5	169.4	-6.2
On farms of 500 to 999 acres -----	392.4	480.2	+22.4
On farms of 1000 acres or more -----	991.9	741.0	-25.3

Source: Census of Agriculture, U.S. Department of Commerce, Computations by the author. Land use reported in the 1970 Census was for actual use during 1969

goats and sheep. Several thousand acres on St. Croix could be used for small-animal production, if the economic incentives to do so are present. The actual location of such lands has not been accurately identified but is under study.

Several non-agricultural factors on St. Croix have exerted major influences on land use on the island and are significant in evaluating the potential land resource available for livestock production in general and small animals in particular. First, the population of St. Croix increased from 22,000 in 1965 to 41,000 in 1972, as reported by the V.I. Dept. of Commerce. This growth has generated a strong demand for land for housing and commercial uses which was not provided by existing population centers. An important segment of this population increase was composed of mainlanders who had the financial resources to successfully bid for land in prime locations. It appears that most housing development has not taken place

on the prime farmland; but through the market process, land at all locations of the island has taken on values far in excess of that justified for agricultural purposes.

Second, the improvement of roads and the acquisition of automobiles has placed virtually every part of the island within the housing demand zone. Third, industrial demands are increasing. Fourth, it is becoming increasingly difficult to find competent farm workers at wage rates which make it possible for agricultural enterprises to be economically viable. There is also some evidence that land tenure patterns have influenced the use of land for farming purposes. The leasing of large areas of land by absentee owners to local farmers for relatively short periods tends to discourage capital investment for agricultural development on a long-term basis. Such practices have encouraged livestock enterprises, but within an environment of uncertainty.



## Climate

In general, the climate on St. Croix is favorable to goat and sheep production. Temperatures are mild and well within acceptable ranges, thereby making extensive buildings for shelter unnecessary. The average annual rainfall is about 43 inches per year, but is highly variable from place to place on the island, from month to month during the year, and from year to year (fig. 1). There is a reasonably predictable wet season from August to November during which the water-plant balance is favorable.<sup>4</sup> The remaining months usually do not receive sufficient moisture to maintain continued plant growth. St. Croix is usually free of the most violent storms which spawn in the Caribbean, but occasionally large amounts of rain will fall during short periods of time.

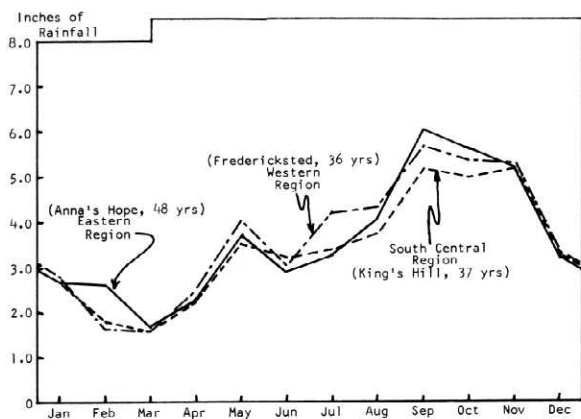


Figure 1.—Average annual rainfall, selected weather stations, St. Croix, U.S. Virgin Islands, long term normal rates. Source: U.S. Weather Bureau; chart by the authors.

## Labor

Because of a social stigma associated with agricultural labor, qualified farm workers tend to seek employment elsewhere. A large share of the farm workers are not native Cruzans, but are "green carders" from other islands in the Caribbean not under U.S. jurisdiction. The labor market in which

<sup>4</sup> For detailed information, see Bowden, Martyn. "Water Balance On a Dry Island," Geography Pub. Dartmouth, Pub. No. 6, 1968. See also Appendix Table A-2.

agriculture competes is also strongly influenced by higher wage rates paid by large industrial concerns. This factor in itself will make commercial goat and sheep operations unacceptable to most entrepreneurs. On the other hand, the above stigma does not tend to exist if the enterprise is owner-operated and controlled. Thus, the labor market is not considered to be a limiting factor for family goat- and sheep-production units as described in this report.

## Other Factors

Adequate roads, power sources and communication links exist for the operation of family goat and sheep enterprises. Supplies, equipment and production inputs, although generally available, are difficult to obtain in comparison to availability in established agricultural areas. Since St. Croix is a small island, such items must be imported, thereby subjecting farmers to inconvenience and, occasionally, aggravating delays. Nevertheless, these problems are not great enough to make family goat and sheep operations impractical.

There is a small government-owned and operated slaughterhouse on St. Croix with sufficient capacity to handle production substantially above that which it is now handling.

## SPECIFICATIONS OF BENCHMARK UNITS

As mentioned earlier, the four benchmark farms were identified to reflect alternative conditions under which family goat and sheep operations might be organized. Actually, the benchmark farm is a computed model of actual operating conditions but will not necessarily represent any individual farm. If an operation is more or less efficient than that specified here, its profitability will also be proportionately greater or smaller. The models are also designed to allow users to insert alternative prices and labor inputs in estimating profitability.

Benchmark farms are not considered to be commercial operations. They are descriptive of family operated business which supplement regular family income which in most cases will be off the farm. Therefore, the measure of profitability is defined as labor income per hour. It is the residual after the costs of production are met including interest on investment and depreciation.

Separate analyses were made for goats and sheep,

primarily because the birth rate for goats is reported to be higher than that for sheep. To reflect different sizes of operations which might exist on the island, the benchmark farms are specified to contain either 5 or 20 acres of pasture. Detailed specifications of the models are shown in Table 2.

The carrying capacity of the pasture and supplemental grain concentrate was computed by determining the amount of total digestible nutri-

ents (TDN) which ordinary guinea grass pasture will produce under average rainfall conditions and relating that value to the nutrient requirements of the herd or flock as it might be composed at a point in time. A standard herd composite was defined as a herd unit (HU). It is expressed as pounds of TDN per year required to support the herd composite. For example, a herd with 10 brood females would also contain 5.8 nursing kids

**Table 2.—Specifications for benchmark goat and sheep operations, St. Croix, 1974**

Item	Benchmark farm			
	Goats		Sheep	
	5 Acres	20 Acres	5 Acres	20 Acres
Carrying capacity at a point in time: <sup>1</sup>				
Brood females	7	29	8	30
Nursing young	4	17	4	15
Growing young	2	8	2	7
Sires	1	1	1	1
Total	14	55	15	53
Herd replacement rate:				
Culls at 7 yrs. of age (%)	14	14	14	14
Death and theft loss (%)	10	10	10	10
Annual birth rate (%)	350	350	300	300
Number of gestation periods	1.5-2	1.5-2	1.5-2	1.5-2
Age of young at time of sale (mos.)	3	3	3	3
Weight of animals (lbs.):				
Brood females	80	80	80	80
Young stock at time of sale	50	50	50	50
Sires	120	120	120	120
Number of young stock for sale annually	21	85	20	74
Sale prices (cents/lb.):				
Young stock, liveweight	60	60	60	60
Old stock, liveweight	50	50	50	50
Feed sources: <sup>2</sup>				
Concentrate per day (lbs.)	0.5	0.5	0.5	0.5
Pasture (lbs. TDN/acre/yr.)	1,500	1,475	1,500	1,475
Source of labor	Family	Family	Family	Family
Farm value of land/acre	\$200	\$200	\$200	\$200

<sup>1</sup> See Appendix Table A-2. This is a composite of the herd. Since young stock are marketed at 3 months of age and females gestate up to two times a year, the total number of animals handled during the year is substantially greater than reported here. Carrying capacity is determined by dividing the total digestible nutrients (TDN) required by the herd composite into the TDN in the available feed.

<sup>2</sup> Grain concentrate is fed to adult animals for 180 days per year. The lbs. of TDN produced per acre is based on typical operating conditions on St. Croix. Well-managed pasture may yield substantially higher than that reported here. See Appendix Tables A-1 and A-2.

and 2.9 weaned kids if the following conditions are met: (1) the annual birth rate is 350 percent, (2) kids are weaned at 2 months of age, and (3) young stock are marketed at 3 months of age. Details of these computations are given in Appendix Tables A-1 and A-2.

The physical layout for these family operations is rather simple. Pastures are fenced into 2.5 to 3 acre units to permit pasture management. Fences are strong, consisting of a net wire plus two barbed wire strands. Holding pens are provided to reduce losses from dogs and thievery. It is assumed that water for the herds will be provided by the farm well. A small shelter is provided to store the supplemental feed and, as conditions may require from time to time, to protect a few animals. Equipment is limited to small hand tools. It is assumed that acacia and other brush will be controlled without the aid of large power equipment.

### **COSTS AND RETURNS ESTIMATES**

The enterprise is expected to pay for the cost of capital and depreciation whether or not these are incurred as a part of current operations. For example, if a family owns its land free and clear, the cash flow due them will be greater than presented here because they can enjoy interest income as well as labor income. Similarly, if the operation is using existing fences, the depreciation charge represents a replacement allowance for future expenditures. This item is also an addition to cash flow.

#### ***Investment and Operating Capital***

The major investment capital required for the enterprise is for land and fencing. Total investment capital per adult animal ranges from \$331 to \$386, depending upon the size of the operation and the specie of animal (Tables 3 and 4). Land is charged to the enterprise at its capitalized rental value. At the time of this study—July 1973—land was being leased to farmers for agricultural production for \$20 per acre or less. At a capitalization rate of 10 percent, the capitalized value would be  $\$20/0.1$  or \$200. Prevailing interest rates at the time of this study ranged upward from 7.5 percent per year. The higher capitalization rate represents a risk factor on agricultural capital.

Fences, holding pens, buildings and the like are costed in at their replacement value. Depreciation or replacement allowance is determined by using the straight-line method (Tables 3 and 4).

The need for operating capital is not great and generally turns over quite rapidly. Thus, interest is charged to the enterprise on only 25 percent of the cost of items directly affecting the cash flow.

#### ***Costs and Returns***

Costs and returns for the four benchmark units are shown in Table 5. These estimates are based upon the specifications presented in Table 2 and the investment and depreciation costs presented in Tables 3 and 4. The cost of producing goats and sheep, exclusive of the investment and labor income, amounts to 18 and 19 cents per pound liveweight for goats and sheep, respectively, on the 5-acre operation (Table 5). Due to lower facilities cost per head, production costs on the 20-acre operation are lower than on the smaller units. Such production costs amount to 14 and 16 cents per pound for goats and sheep, respectively.

Income from livestock sales is computed f.o.b. the farm. This is consistent with present practices on St. Croix wherein local butchers purchase the animals at the farm and either provide for or arrange for transportation of the animals to the slaughter facility. The number of animals for slaughter takes into account the following factors: (1) a 10 percent death and theft loss, (2) culling rate of 14 percent, (3) herd replacements, (4) the birth rate, and (5) feed availability. Detailed information on estimated sales is shown in Appendix Table A-4.

Returns to family labor obviously depend upon how efficiently the family applies its labor to the enterprise. If the family can operate the 20-acre goat enterprise on 2 hours a day, the hourly return or wage rate would be \$2.01 per hour (Table 5). The sheep operation is somewhat less profitable because of a lower lambing percentage (300 percent compared to 350 percent). The small 5-acre operation can be expected to return \$1.61 and \$1.42 per hour for goats and sheep, respectively. These rates of return are favorable in comparison to wage rates usually available to family members. Even at the lowest rate of return computed in

**Table 3.—Investment and operating capital cost of a 20-acre goat or sheep operation, St. Croix, 1974**

<i>Item</i>	<i>Amount</i>	<i>Years to replacement</i>	<i>Replacement allowance</i>
<i>Investment capital:</i>			
Land (20 acres @ \$200/acre) <sup>1</sup>	\$4,000	—	—
Fencing and gates (1.23 mi. @ \$3,195/mi.) <sup>2</sup>	3,931	15	\$262
Holding pens and feed bunks	100	20	5
Shelter	200	15	13
Miscellaneous equipment	25	5	5
Well and trough (25% of \$1,660) <sup>3</sup>	415	20	21
Sub-total	\$8,671		\$306
<i>Livestock:</i>			
		<i>Goats</i>	<i>Sheep</i>
Brood females (30 lbs. @ 50¢) <sup>4</sup>		(29) \$1,160	(30) \$1,200
Sires (120 lbs. @ 50¢)		(1) 60	(1) 60
Young stock (25 lbs. Aug. @ 60¢)		(25) 375	(22) 330
Sub-total		\$1,595	\$1,590
Total investment capital		\$10,266	\$10,261
Investment capital per adult animal		342	331
Adjusted investment capital <sup>5</sup>		7,930	7,925
Interest on adjusted investment at 7.5%		595	594
<i>Operating capital:</i>			
Animal health		\$ 33	\$ 30
Repairs		93	93
Land taxes		40	40
Supplemental feed		170	176
Total operating capital		\$336	\$339
Interest on 25% of operating capital at 7.5%		\$6	\$6

<sup>1</sup> Any land value above \$200 per acre is assumed to be development value and not chargeable to the enterprise.

<sup>2</sup> Fences consist of net wire plus 2 barbed wires on posts placed on 8 ft. centers and 6 gates for 6 pastures.

<sup>3</sup> Since this is a backyard operation, animals are to be watered at household well.

<sup>4</sup> Number in ( ) represents the number of head.

<sup>5</sup> Depreciable capital is included at 50 percent of original value.

Table 5, the return per acre for labor income is more than \$50.

### SENSITIVITY ANALYSIS

In an effort to make the model benchmark farms more useful to the livestock industry of the Virgin Island, the models were subjected to a sensitivity analysis which consisted of computing family labor income estimates for alternative sale prices and hours of labor per day to operate the unit. The cost analysis was reduced to a simple equation in which the more stable elements were assumed to be constant as presented in Table 5 and the less cer-

tain elements were considered to be variable. For example, family labor income per hour for the 20-acre goat operation would be expressed as follows:

$$\text{Labor income per hour} = \frac{\text{income} - \text{expenses}}{365 \text{ days} \times \text{hours per day}}$$

$$\text{Income} = (85 \text{ head} \times 50 \text{ lbs. per head} \times \text{price}) + \text{sale value of culls of } \$160$$

$$\text{Expenses} = \$648 + \text{interest on investment of } \$595.$$

Therefore,

$$LI = \frac{(85 \times 50) P_g + 160 - 648 - 595}{365H}$$



**Table 4.—Investment and operating capital cost of a 5-acre goat or sheep operation, St. Croix, 1974**

<i>Item</i>	<i>Amount</i>	<i>Years to replacement</i>	<i>Replacement allowance</i>
<i>Investment capital:</i>			
Land (5 acres @ \$200/acre) <sup>1</sup>	\$1,000	—	—
Fencing and gates (0.44 mi. @ \$3,195/mi.) <sup>2</sup>	1,406	15	94
Holding pens and bunks	50	20	2
Shelter	75	15	5
Miscellaneous equipment	25	5	5
Well and trough (.06 of \$1,660) <sup>3</sup>	100	20	5
Sub-total	\$2,656		\$111
<i>Livestock:</i>			
		<i>Goats</i>	<i>Sheep</i>
Brood females (80 lbs. @ 50¢) <sup>4</sup>		(7) \$280	(8) \$320
Sires (120 lbs. @ 50¢)		(1) 60	(1) 60
Young stock (25 lb. avg. @ 60¢)		(6) 90	(6) 90
Sub-total		\$430	\$470
Total investment capital		\$3,086	\$3,126
Investment capital per adult animal		386	347
Adjusted investment capital <sup>5</sup>		\$2,258	\$2,298
Interest on adjusted investment at 7.5%		169	172
<i>Operating capital:</i>			
Animal health		\$ 8	\$ 8
Repairs		33	33
Land taxes		10	10
Supplemental feed		44	44
Total operating capital		\$ 95	\$ 95
Interest on 25% of operating capital at 7.5%		\$2	\$2

<sup>1</sup> Any land value above \$200 per acre is assumed to be development value and not chargeable to the enterprise.

<sup>2</sup> Fences consist of net wire plus 2 barbed wires on posts placed on 8 ft. centers and 2 gates for 2 pastures.

<sup>3</sup> Since this is a backyard operation, animals are watered at the household well.

<sup>4</sup> Number in ( ) represents number of head.

<sup>5</sup> Depreciable capital is included at 50 percent of original value.

The above equation reduces to:

$$LI = \frac{11.644 P_g - 2.967}{H}$$

Where LJ = labor income per hour

$P_g$  = sale price for young goats (\$/lb.)

$H$  = hours of family labor per day.

Estimates of labor income (LI) for the four models under alternative conditions are presented in Tables 6 and 7.

The equations can also be used to compute breakeven points under alternative conditions. These results are presented in chart form in Fig-

ures 2 through 5. To illustrate their use, consider Figure 2 which is the 20-acre goat operation. If the sale price is 60¢ per pound and you can operate on 2 hours of labor per day, you can determine your wage or labor income rate by finding 60¢ on the vertical axis and moving horizontally until you reach the line marked 2 hours (H), then move down and read the wage rate of \$2.01 on the bottom scale. On the other hand, if you think you can operate the farm on 1.5 hours per day, move across to the line marked 1.5 hours (H) and read the wage rate at the bottom, \$2.68. If you want to make estimates for values not on the chart, use the equations by inserting the proper, or pertinent, values and solve by using simple algebra.

Table 5.—Costs and returns to a simulated 5- and 20-acre family operated goat or sheep enterprise, St. Croix, 1974

Item	Benchmark farm			
	Goats		Sheep	
	5 Acres	20 Acres	5 Acres	20 Acres
<i>Expenses:</i>				
Land taxes (2/acre)	\$ 10	\$ 40	\$ 10	\$ 40
Facilities cost (Replacement allowance)	111	306	111	306
Repairs (@ 2% of original value/year)	33	93	33	93
Animal health (25¢/head/year)	8	33	8	30
Supplemental grain concentrate				
Feed at \$7/cwt.	44	170	44	176
Interest on operating capital	2	6	2	6
Total	\$208	\$648	\$208	\$651
Liveweight of stock sold (lbs.)	1,130	4,570	1,080	4,020
Cost per lb., liveweight (\$)	0.18	0.14	0.19	0.16
<i>Income:</i>				
Young stock sales (50 lb. @ 60¢)	(21)\$630	(85)\$2,550	(20)\$600	(74)\$2,220
Cull brood females (80 lb. @ 50¢)	(1) 40	(4) 160	(1) 40	(4) 160
Total	\$670	\$2,710	\$640	\$2,380
<i>Returns:</i>				
Return to labor and capital	\$462	\$2,062	\$432	\$1,729
Interest on invested capital at 7.5%	169	595	172	594
Family labor income	\$293	\$1,467	\$260	\$1,135
Estimated daily family labor required (hrs.)	0.5	2.0	0.5	2.0
Average hourly return to family labor	\$1.61	\$2.01	\$1.42	\$1.55

**Table 6.—Labor income per hour (LI) for a 20-acre goat or sheep operation at alternative sale prices and daily labor requirements, St. Croix, 1974**

Liveweight sale price <sup>1</sup> (\$/lb)	Hours worked per day (H)				
	1.0	1.5	2.0	2.5	3.0
<b>Goats (P<sub>g</sub>)</b>					
	Dollars				
\$ .45	2.27	1.52	1.14	0.91	0.76
.50	2.86	1.90	1.43	1.14	0.95
.55	3.44	2.29	1.72	1.37	1.15
.60	4.02	2.68	2.01	1.61	1.34
.65	4.60	3.07	2.30	1.84	1.53
.70	5.18	3.46	2.59	2.07	1.73
.75	5.77	3.84	2.88	2.31	1.92
<b>Sheep (P<sub>s</sub>)</b>					
\$ .45	1.59	1.06	0.79	0.64	0.53
.50	2.10	1.40	1.05	0.84	0.70
.55	2.60	1.73	1.30	1.04	0.87
.60	3.11	2.07	1.55	1.24	1.04
.65	3.62	2.41	1.81	1.45	1.21
.70	4.12	2.75	2.06	1.65	1.37
.75	4.63	3.09	2.31	1.85	1.54

<sup>1</sup> Priced at f.o.b. the farm. The prevailing practice on St. Croix is for buyers to pick up the livestock at the farm.

$$\text{Goats—LI} = \frac{11.644 P_g - 2.967}{H}$$

$$\text{Sheep—LI} = \frac{10.137 P_s - 2.973}{H}$$

**Table 7.—Labor income per hour (LI) for a 5-acre goat or sheep operation at alternative sale prices and daily labor requirements, St. Croix, 1974**

Liveweight sale price <sup>1</sup> (\$/lb.)	Hours worked per day (H)				
	0.25	0.375	0.5	0.625	0.75
<b>Goats (P<sub>g</sub>)</b>					
	Dollars				
\$ .45	1.49	0.99	0.74	0.59	0.50
.50	2.06	1.37	1.03	0.82	0.69
.55	2.64	1.76	1.32	1.06	0.88
.60	3.22	2.14	1.61	1.29	1.07
.65	3.79	2.53	1.89	1.52	1.26
.70	4.36	2.91	2.18	1.75	1.45
.75	4.94	3.29	2.47	1.98	1.65
<b>Sheep (P<sub>s</sub>)</b>					
\$ .45	1.20	0.80	0.60	0.48	0.40
.50	1.75	1.17	0.88	0.70	0.58
.55	2.30	1.53	1.15	0.92	0.77
.60	2.85	1.90	1.42	1.14	0.95
.65	3.40	2.26	1.70	1.36	1.13
.70	3.94	2.63	1.97	1.58	1.31
.75	4.49	2.99	2.25	1.80	1.50

<sup>1</sup> Priced at f.o.b. the farm which is the prevailing sales point.

$$\text{Goats—LI} = \frac{2.877 P_g - 0.923}{H}$$

$$\text{Sheep—LI} = \frac{2.740 P_s - 0.932}{H}$$

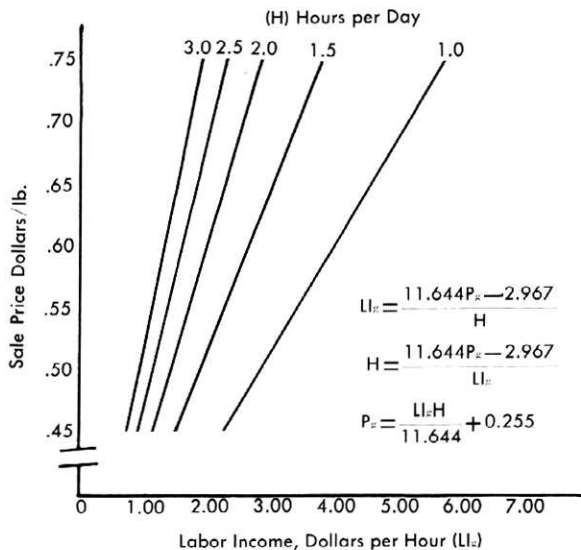


Figure 2.—Breakeven relationships between sale price ( $P_g$ ), labor income ( $LI_g$ ), and daily labor requirements ( $H$ ) for a simulated 20-acre goat operation, St. Croix, 1974.

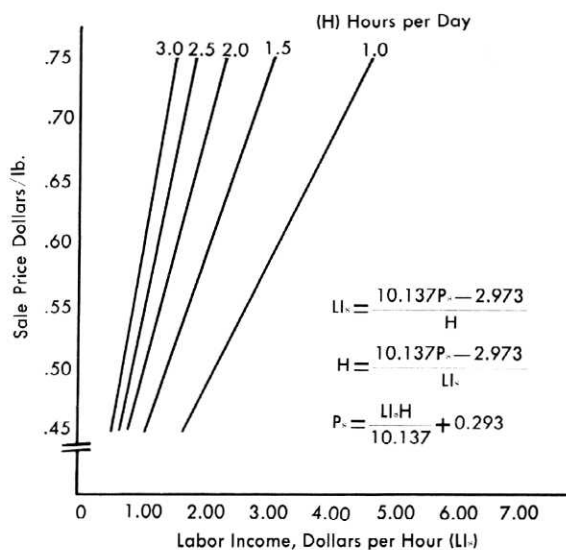


Figure 4.—Breakeven relationships between sale prices ( $P_s$ ), labor income ( $LI_s$ ), and daily labor requirements ( $H$ ) for a simulated 20-acre sheep operation, St. Croix, 1974.

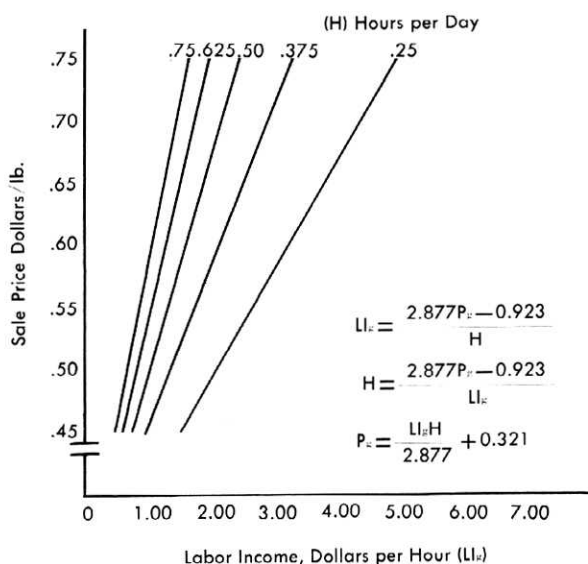


Figure 3.—Breakeven relationships between sale prices ( $P_g$ ), labor income ( $LI_g$ ), and daily labor requirements ( $H$ ) for a simulated 5-acre goat operation, St. Croix, 1974.

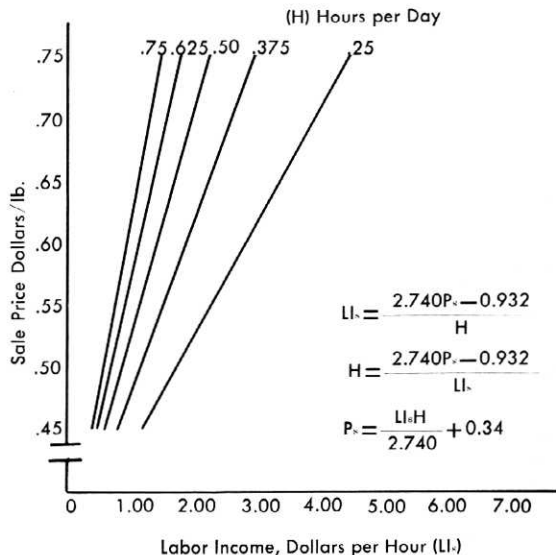


Figure 5.—Breakeven relationships between sale prices ( $P_s$ ), labor income ( $LI_s$ ), and daily labor requirements ( $H$ ) for a simulated 5-acre sheep operation, St. Croix, 1974.



## APPENDIX

**Table A-1.—Annual TDN requirements per herd unit, 20-acre goat and sheep operations, St. Croix, 1974**

<i>Herd Component</i>	<i>Number of head per herd unit</i>	<i>Percent of total</i>	<i>lbs. TDN required per head per day</i>	<i>lbs. TDN required per HU</i>	
				<i>Daily</i>	<i>Annually</i>
<b>Goats:</b>					
Brood females	10.0	52.6	2.2	22.0	8,030
Nursing kids <sup>1</sup>	5.8	30.5	0.5	2.9	1,058
Growing kids <sup>2</sup>	2.9	15.3	1.8	5.2	1,898
Sires	0.3	1.6	2.5	0.8	292
Total	19.0	100.0		30.9	11,278
Adjusted for death loss of 5% per year <sup>4</sup>					10,996
<b>Sheep:</b>					
Brood females	10.0	56.2	2.2	22.0	8,030
Nursing lambs <sup>3</sup>	5.0	38.1	0.5	2.5	912
Growing lambs <sup>2</sup>	2.5	14.0	1.8	4.5	1,642
Sires	0.3	1.7	2.5	0.8	292
Total	17.8	100.0		29.8	10,876
Adjusted for death loss of 5% per year <sup>4</sup>					10,604

<sup>1</sup> Two gestations and 350 percent annual kid crop. Young stock remain in the herd for 3 months at which time they are marketed.

<sup>2</sup> Weaning age is at 2 months.

<sup>3</sup> Two gestations and 300 percent annual lamb crop. Lambs are marketed at 3 months of age.

<sup>4</sup> If a 5-percent death loss occurs uniformly through the year, the feed requirement is reduced by only 2.5 percent.

**Table A-2.—Determination of carrying capacity for 5- and 20-acre goat or sheep operation, St. Croix, 1974**

<i>Item</i>	<i>Benchmark farm</i>			
	<i>Goats</i>		<i>Sheep</i>	
	<i>5 Acres</i>	<i>20 Acres</i>	<i>5 Acres</i>	<i>20 Acres</i>
TDN Produced per acre (lbs.)	1,500	1,475	1,500	1,475
TDN Produced on pasture (lbs.)	7,500	29,500	7,500	29,500
TDN Required per herd unit (lbs.) <sup>1</sup>	10,996	10,996	10,604	10,604
No. of herd units supported by pasture feed	0.68	2.68	0.71	2.78
No. of brood females <sup>2</sup>	7	27	7	28
Grain concentrate fed (lbs.) <sup>3</sup>	630	2,430	630	2,520
TDN in grain concentrate (lbs.)	488	1,883	488	1,953
No. of herd units supported by concentrate feed	0.04	0.17	0.05	0.18
Total herd units supported by pasture and concentrate	0.72	2.85	0.76	2.96
No. animals supported by pasture and concentrate:				
Brood females	7	29	8	30
Nursing young	4	17	4	15
Growing young	2	8	2	8
Sires	1	1	1	1
Total animals	14	55	15	53

<sup>1</sup> See Appendix Table A-1.

<sup>2</sup> Computed at 10 brood females per Herd Unit times the number of HU's and rounded to the nearest whole animal.

<sup>3</sup> Feeding rate is assumed at 0.5 lbs. per day per brood female for 180 days per year or 90 lbs. per year.

**Table A-3.—Estimated fencing cost for 20-acre goat or sheep operation, St. Croix, 1974**

<i>Item</i>	<i>Unit Price</i>	<i>No. units required</i>	<i>Value</i>
Net wire, 150 ft./roll	\$39.95	44	\$1,757.80
Barbed wire, 480 ft./roll	12.50	27	337.50
Steel posts, 7 ft.	2.10	817	1,715.70
Gates	20.00	6	120.00
Total			\$3,931.00

A square 20-acre field with 6 equal sized pastures would require 6,533 ft. of fence (1.237 miles)

Cost of fence per mile=\$3,931/1.23=\$3,195

The 5-acre operation with 2 pastures would require 0.44 miles of fence for a cost of

$0.44 \times \$3,195 = \$1,406$

**Table A-4.—Determination of livestock sales for 5- and 20-acre goat or sheep operation, St. Croix, 1974**

<i>Item</i>	<i>Benchmark farm</i>			
	<i>Goats</i>		<i>Sheep</i>	
	<i>5 Acres</i>	<i>20 Acres</i>	<i>5 Acres</i>	<i>20 Acres</i>
No. of brood females	7	29	8	30
Death and theft loss (10%)	1	3	1	3
Number culled from herd (14%)	1	4	1	4
Number of offspring	25	102	24	90
Less death and theft loss (10%)	2	10	2	9
Less herd replacements	2	7	2	7
Number of young stock for sale	21	85	20	74
Sales value per head (\$):				
Young stock (50 lbs. @ 60¢)	30	30	30	30
Culls (80 lbs. @ 50¢)	40	40	40	40
Total sales (\$):				
Young stock	630	2,550	600	2,220
Culls	40	160	40	160
Total sales value	670	2,710	640	2,380