

Hair Sheep Production in the U.S. Virgin Islands

Management Practices and Economic Analysis



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Introduction

Sheep production in the Caribbean is limited to the production of animals for meat with no measurable demand for wool producing animals. Since resources are limited in many areas of the tropics, the use of sheep for meat production is partly based on economics. Sheep can be raised on small plots of land, require less feed than cattle, produce multiple offspring and have a short inter-birth interval. In addition, it is easy for a family to purchase and store an entire sheep carcass as part of their food budget.

The environment found in the Caribbean has led to the development of livestock management systems and practices that are unique to the region. Because of the relatively small size of the U.S. Virgin Islands (USVI) there is little land available for growing crops that can be used for livestock feed. In addition, the geographical isolation of the islands makes it cost prohibitive to import much grain for livestock. The majority of livestock farmers on the islands use forage as their main source of feed for animals. Rainfall is limited to certain times of the year and can limit the growth of forages.

Hair sheep are ideally adapted to USVI and Caribbean conditions. The predominant breed found in the USVI is the St Croix White, which is a breed of hair sheep. There are also small numbers of Barbados Blackbelly hair sheep. Caribbean hair sheep breeds were developed from animals that were brought to the West Indies from Africa on trade ships. Once established in the region, the sheep thrived on the tropical grasses and, over time, livestock farmers selected animals that possessed traits which made them suitable to the local environment and production systems. Some of the traits that were selected for in hair sheep breeds include an absence of fleece, breeding at all times of the year, prolificacy and a tolerance of internal parasites.

In many areas of the Caribbean the amount of land available for agriculture is limited and

sheep are the only feasible option for livestock production. However, the economics of hair sheep production in this area has not recently been explored, and enterprise budgets pertaining to hair sheep production in the USVI have not been developed. This report is aimed at providing information on: (a) management practices, (b) initial establishment costs, and (c) annual maintenance costs of hair sheep production in the USVI. This information is directed at helping both existing and prospective sheep producers make better decisions. Budgets are included for two herd sizes: 100-head and 350-head operations. The information used to develop the budgets and the management aspects of the sheep flock was derived in part from the University of the Virgin Islands Agricultural Experiment Station (UVI-AES) Animal Science Program research sheep flock.

Production, cost and return information in the budgets are estimates only. Ultimately, each producer has a unique set of circumstances that will necessitate a unique set of budgets. The enclosed budgets can be used as a guide in this process. In fact, each budget contains a column entitled "Your Farm" to facilitate the process of tailoring these budgets to an individual situation.

St. Croix, USVI.		Your Farm
	Amt.	
	\$13,163	
	\$990	
	\$1,856	
	\$16,009	
	\$750	
	\$750	
	\$476	
	\$136	
	\$332	
	\$40	
	00	

Farm Management

Fencing

Sheep can be easily confined to pastures using wire fencing supported by posts. A common form of wire fence is commonly called goat wire (Figure 1). This material consists of a wire mesh with 6-inch spaces in a square pattern and is purchased in rolls of 320 feet. To support the wire fence some type of post is needed. Wood and metal are both acceptable for this purpose. To install wood posts a hole needs to be dug in the ground. This can be done manually with a post hole digger or by using an auger on a tractor. The metal posts are pushed into the ground using a post pounder. Wooden posts have a shorter lifespan than the metal posts. The wire fence is then attached to the wooden posts using staples or to the metal posts using fence clips.

Another type of fence that can be used to confine sheep is an electric fence (Figure 2). Electric fences can be powered by standard household current, batteries and/or solar panels. Electric fences can be set up to be permanent or portable. Portable electric fences are useful in managing pastures by allowing the farmer to confine the sheep to a specific area within a pasture for limited duration grazing. The fence can easily be moved to give the animals access to other areas of the pasture. In the case of adult rams, it may not be wise to use an electric fence without first conditioning the rams to the fence and the shock it can deliver, since they tend to be larger and more aggressive about getting to grass or females in heat.

The fence is used to confine the sheep and also to divide the pastures into paddocks for the rotational grazing system (see *Pastures* section). Gates should be put into the fence at convenient locations for moving animals or access to the pastures by vehicles (trucks, tractors). Fences have to be maintained routinely to keep them in good condition. Repairs need to be done when there is a break in the fence or posts need to be replaced.

Fences can also serve to deter predators from entrance into

the pastures. In the USVI the most common predator is dogs, although there are some cases of theft as well. Even though no fence is 100% effective in keeping out predators, they do provide a deterrent. Electric fences provide a negative stimulus in addition to providing a physical barrier. Maintenance of fences will also help in keeping predators out. Any breaks in the wire or damaged posts should be repaired as soon as they are detected to maintain the integrity of the fence line.



Figure 1. Wire fence supported by metal posts. Fence is attached to the posts by metal clips after the posts are pounded into the ground.



Figure 2. Electric fence powered by solar panel and a battery. The fence is easily moved to partition sections of the pasture.

Pastures

Sheep pastures should be managed in a rotational grazing system to best utilize the available forage. By rotating the sheep through a set of paddocks the grass quality will increase and some degree of weed control will be achieved. It is also a way of using ungrazed pastures as forage banks to assist in getting through the dry season. Pasture layouts for breeding ewes and growing lambs are shown for the small (98 ewes) and large (338 ewes) flocks in Figures 3-6, respectively.

In the USVI the major forage species in most pastures is guinea grass (*Panicum maximum*; Figure 7). Another beneficial plant that is found in many pastures is the legume leucaena, locally known as tan-tan (*Lucaena leucocephala*; Figure 8). An undesirable plant found in many pastures is casha (*Acacia spp.*; Figure 9), which has numerous large thorns. The thorns make the plant unpalatable to

the sheep, in addition to causing physical injury to the animals that do browse it. Hurricane grass (*Bothriochloa pertusa*; Figure 10) is also found in many pastures, but it is a less desirable forage species due to poor production and nutrient content.

Initial pasture preparation should be done to remove any areas of brush and undesirable plants. While doing this procedure it would be beneficial to leave some trees in the pasture to provide shade for the animals. It may also be beneficial to level any high spots or fill in low spots to control water runoff and make it easier to run the fences. After the sheep have grazed a pasture and there is only stubble remaining, it is beneficial to mow the remaining grass with a tractor and a bush hog. This makes the entire pasture uniform in the height of the grass and helps to prevent faster growing weeds from overgrowing the desirable forage species.

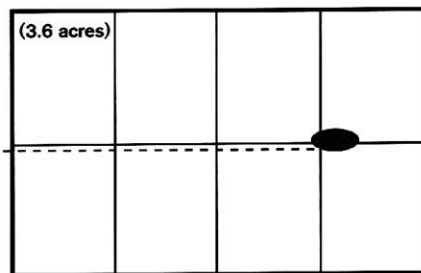


Figure 3. Representative pasture layout for the ewe flock in the small scale operation (98 ewes on 29 acres). The dotted line represents a water line and the gray oval is a portable water trough.

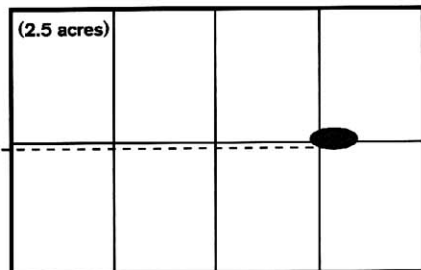


Figure 4. Representative 20-acre pasture layout for raising weaned lambs in the small operation (173 lambs per year).

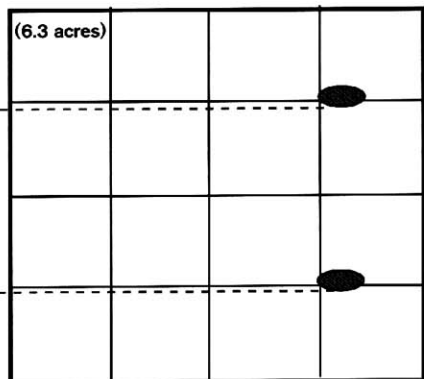


Figure 5. Representative 101-acre pasture layout for ewe flock in the large operation (338 ewes).

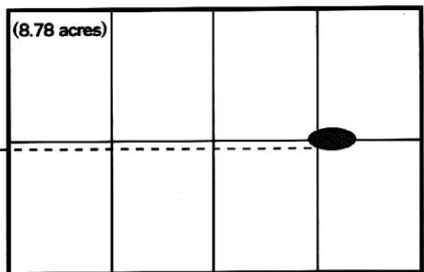


Figure 6. Representative 70-acre pasture layout for raising weaned lambs in the large operation (609 lambs per year).

Stocking rates of sheep on tropical pasture should be maintained at levels that will allow best use of available forage. A average stocking rate of 3.3 head/acre is suitable for the USVI, but this can be adjusted to suit the particular forage availability on individual farms based on rainfall amounts and time of year.



Figure 8.



Figure 7.

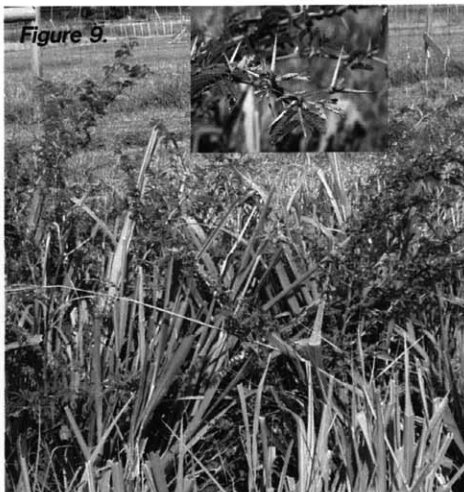


Figure 9.

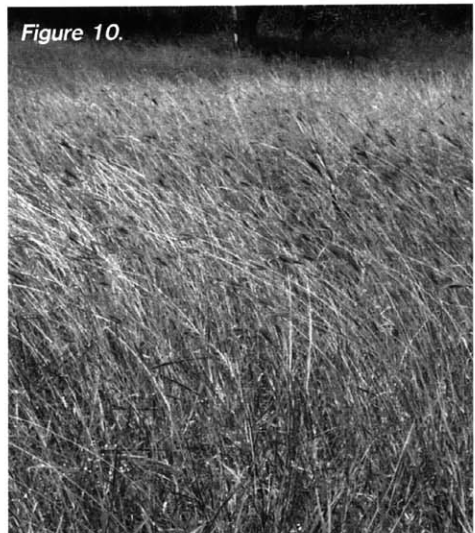


Figure 10.

Figure 7. Guineagrass (*Panicum maximum*) showing typical appearance of good pastures in the USVI.
 Figure 8. Tan tan (*Lucaena leucocephala*) is a legume found in many of the pastures throughout the USVI.
 Figure 9. Casha (*Acacia* spp) is a weed found in many pastures. The spines on the plant (see inset) make it low in palatability and increase the potential to injure animals.
 Figure 10. Hurricane grass (*Bothriochloa pertusa*) is low in nutrients and palatability, but it is an aggressive forage species in pastures.

Animal Management

Breeding Ewes

Hair sheep (Figure 11) in the USVI can breed at all times of the year due to lack of significant changes in photoperiod (i.e., length of day light) throughout the year. Due to this trait it is possible to keep the ewes with the rams at all times and produce lambs at all times of the year. Ewes will produce an average of 1.8 lambs per lambing (Figure 12). This may be lower in young ewes lambing for the first time or in ewes older than 7-8 years.

In order to take advantage of seasonal markets, such as civil and religious holidays, it would be desirable to utilize a finite breeding period when the ewes are exposed to the ram. This would lead to the production of a consistent supply of lambs for sale at a specific time of the year. In addition to having adequate numbers to meet market demand, it also provides for a more uniform product by having lambs of similar age and weight at any given time.

Another benefit of using specific breeding periods is the ability to control which rams are bred to which ewes. If more than one ram is kept with the ewes at all times of the year, sire determination is difficult without resorting to costly blood testing. By using single sire mating a farmer can

use animals that have been selected for specific production traits such as weaning weight, growth and muscling. This will provide opportunities for the farmer to increase the quality of animals within the flock.

It is not always necessary to split the flock into smaller groups



Figure 12

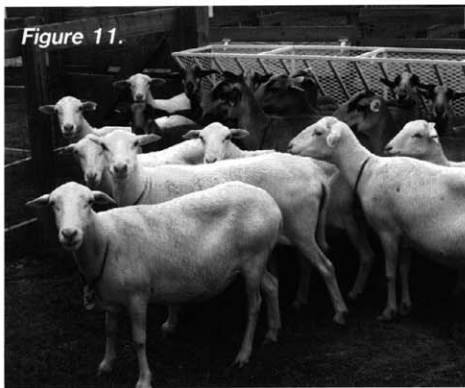


Figure 11.



Figure 13.

Figure 11. A group of St Croix White and Barbados Blackbelly hair sheep ewes in a pen.

Figure 12. A group of St Croix White ewes and their lambs in a guineagrass pasture.

Figure 13. St Croix White ram and ewes in pen for single-sire breeding. The ram is wearing a marking harness to aid in determining when each ewe is bred.

to utilize single sire breeding. Since the ewes are in heat at 17-day intervals, on any given day there should be 5-6% of the ewes in heat. For example, in a flock of 100 ewes, one would expect to have 5 or 6 ewes in heat on any given day. If the ram is placed with the entire flock for a limited time period he will have the opportunity to breed 5 to 6 ewes each day. In order to keep track of which ram is the sire of which lambs, the ewes can be isolated from the ram for at least a 14-day period in between breeding

periods and then exposed to a second ram. This will provide a natural break in the lambing period that can be used to identify lambs from specific sires. In addition, a marking harness can be worn by the ram and the crayon marks left on the ewes will assist in identifying which ewes a ram has bred (Figure 13). By using a different color for each ram it will also be possible to detect ewes that do not conceive and cycle back for breeding by another ram.

Rams

The rams can be kept in a single paddock with adequate forage for much of the time (Figure 14). The only time that rams would leave the paddock is during the breeding season or when they are sold. The use of the single sire breeding and rotating rams into the flock will allow for rams to rest between breeding periods. Due to their libido (i.e., desire to breed) the rams may experience some weight loss during exposure to ewes, and the rest period in the ram paddock will allow them to recover the lost weight.

Example for a flock of 100 ewes:

Breeding:

7 days with ram A x 5 ewes in heat/day = 35 ewes bred by ram A in 7 days

Remove ram from flock for at least 14 days

7 days with ram B x 5 ewes in heat/day = 35 ewes bred by ram B in 7 days

Lambing:

35 ewes produce lambs of ram A

Approximately a 14-day break in lambing

35 ewes produce lambs of ram B

The cycle can be repeated with rams A and B or new rams can be used at each subsequent breeding period.

Lambs

The use of defined breeding seasons will lead to defined lambing seasons. Since gestation in hair sheep averages 146 days, the time that lambing will occur for ewes that were exposed to the ram at a specific time can be determined. This allows the farmer to allocate resources, such as labor, to be available at the time of lambing. If the ewes were exposed to the ram for the first 7 days of



Figure 14. A group of St Croix White and Barbados Blackbelly rams in pasture.

June, then the lambs from those matings would be born during the last week of October. This coincides with the rainy season on St Croix when the forage availability is high, which means that the ewes would have adequate nutrition to produce sufficient milk to raise their lambs.

Lambs can be weaned at 63 days of age with no detrimental effects on their growth. At this point in lactation the ewe will still be producing around 2 lbs. of milk per day, which is not enough to support the lamb completely. At this time the lambs are already eating grass to supplement the milk from the ewe. The ewe's milk production must be "dried up" in order to prevent udder problems such as mastitis. A method to dry up the ewe at weaning is to place her in a pen with her lambs without access to water for 24 hours. After that time the lambs should be removed and placed in a secure area and provided with feed, hay and water. The ewes should be kept in the pen without water for another 24 hours and then returned to the pasture with the rest of the flock. Withholding water from the ewe for this time period causes her ability to produce milk to decrease, and when the lamb is removed the stimulus to produce milk is also removed.

Once lambs reach the target weight of 65 lbs., they can be sold for slaughter. Of course, some lambs may be kept as replacement breeding animals within the flock or sold as breeding stock to other farmers.

Replacement Animals

Replacement animals are those that are added to the breeding flock to replace animals that have died or were culled for various reasons. It is possible to raise

Example of using a selection index:

Average weaning weight of all lambs in flock = 25 lbs.

Lamb A weaning weight = 30 lbs.

Lamb B weaning weight = 20 lbs.

Index for Lamb A = $(30 \div 25) \times 100 = 120$ indicating that Lamb A has a 20% higher weaning weight than the group average

Index for Lamb B = $(20 \div 25) \times 100 = 80$ indicating that Lamb B has a 20% lower weaning weight than the group average

your own replacement animals if accurate breeding records are maintained. This is necessary to minimize the amount of inbreeding within a flock. By using specific rams within sub-groups of the flock, genetic lines can be maintained and inbreeding can be kept low.

Replacement animals should be selected based on their genetic merit as well as their production traits. If the flock is managed as a purebred flock then breed characteristics also need to be included in the selection criteria. Selection indexes can be generated for several traits of interest to producers. An index is a method of comparing an animal's performance in a given trait to the performance of contemporaries within the flock. It is usually based on a percentage scale with 100% representing animals that are average within the group. Any animal with an index value greater than 100 would be suitable for selection as a replacement.

Replacement males and females should be selected from lambs that were born as at least twins. Birth weight and weaning weight are two indicators of the growth potential of an animal and should also be used in the selection process. In the case of ram lambs, testicular size should also be considered since it is a good

indicator of the potential for that ram to produce sperm cells.

Ewe lambs will begin to exhibit estrous cycles by around 7 to 8 months of age, but it may not be desirable to breed them at this age. The animals will be small and still growing, and the extra burden of a pregnancy can suppress their growth rate and lead to a smaller adult size. As a rule of thumb, ewe lambs should be at least 70 lbs. at the time of their first breeding. Ram lambs will reach puberty at about 7 months of age. Depending on the number of ewes in a breeding group, a young ram can be used for breeding by 10 months of age with very little impact on the growth of the ram. Young rams should be exposed to only 15-20 ewes for their first breeding period while adult rams can breed 25-30 ewes.

Flock Health

In the USVI there are few animal diseases that cause severe losses in sheep. One of the major concerns is internal parasites. Because of the high temperatures and the rainy season, intestinal worms can have a negative impact on animal productivity.

Lactating ewes are under the additional stress of milk production and will lose weight during

their lactation. Therefore, ewes should be dewormed twice during the lactation.

The flock at UVI is treated with a deworming medication at the start of the lambing period and 4 weeks later (Figures 15-17). The lambs themselves are treated at 7 and 11 weeks of age. Once the lambs are weaned and grazing pasture they can be wormed at 6-8 week intervals, depending on the time of year.

Since the rainy season is more suitable to the life cycle of parasites and parasite numbers increase, the time between treating animals should be shorter at this time of the year. Young lambs should also be vaccinated against enterotoxemia (*Clostridium perfringens C & D*) and tetanus (*Clostridium tetani*) at 7 and 11 weeks of age (Figure 18). Adults should be vaccinated annually. For an example of a deworming schedule and medications see Tables 1 and 2, on page 12.

Because the hooves continually grow and may not wear down adequately it is necessary to trim hooves on adult sheep. The time when this needs to be done will vary throughout the year depending on how much wear is apparent on the hooves.



Figure 16.



Figure 17.

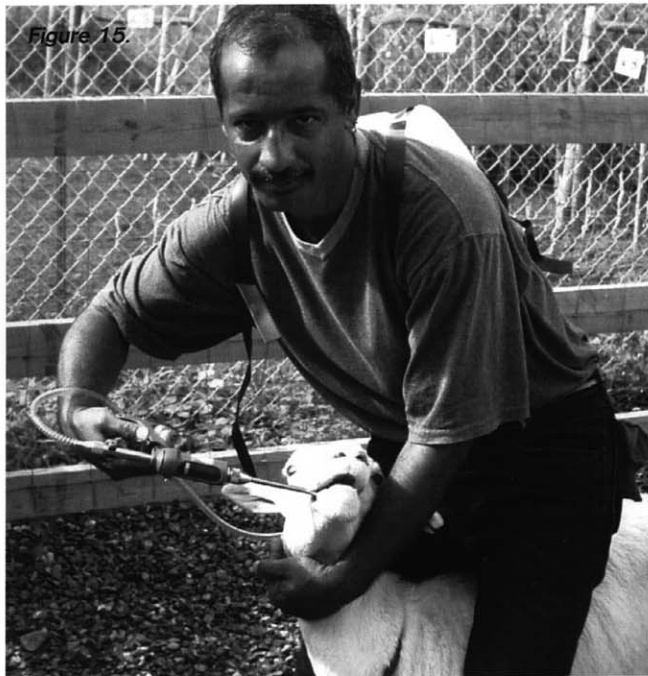


Figure 15.



Figure 18.

Figure 15. Oral administration (drenching) of deworming medication to a ewe.

Figure 16. Backpack style drenching gun and reservoir used to administer deworming medication to sheep.

Figure 17. Common deworming medications used in sheep. All of these can be orally administered.

Figure 18. Clostridia and tetanus toxoid vaccine administered to young lambs and adult sheep.

Table 1. Deworming schedule used at UVI-AES Sheep Research Facility.

Lambs:

- First deworming at 7 weeks of age
- Second deworming at 11 weeks of age
- Once on pasture, dewormed at 6-8 week intervals, depending on time of year

Ewes:

- 2 weeks prior to breeding (first time ewes)
- 2 weeks prior to lambing (first time ewes)
- Start of lambing (all ewes in flock)
- 4 weeks after lambing starts (all ewes in flock)

Rams:

- Every 3 to 6 months as needed

Lambs and adult sheep should be randomly tested for parasite loads by a veterinarian throughout the year and treated as needed.

Table 2. Common dewormers used in sheep.

Commercial Product	Compound
Ivomec®	ivermectin
Valbazen®	albendazole
Levasole®	levamisole
Panacur®	fenbendazole
Synanthic®	oxfendazole

Feed and Water

As long as there is adequate forage in the pastures there will be no need for supplemental feed for the adult sheep. For a brief time after the lambs are weaned they can be given supplemental feed to aid in their growth (Figure 19). A feed containing 16 % crude protein fed at a rate of 4.5% of body weight per day can produce an average daily gain of 0.3 lbs. per day in hair sheep lambs. The lambs will also need to have access to some type of roughage at this time, either hay or fresh grass (Figure 20).

Sheep will consume approximately 2.5 gal/head/day of water under grazing conditions found in the tropics. A consistent supply of clean, fresh water is important for the fitness of the animals. Water containers should be kept clean to aid in preventing outbreaks of diseases within the flock. The water needs to be provided so that the sheep have access to it at all



Figure 19. Feed bunks made of PVC pipe can be used to keep feed clean and dry. The wooden brackets help to stabilize the bunk and prevent animals from spilling the feed.

times and this can be done by using plastic water troughs placed in the pasture (Figure 21). To maintain the level of water in the trough a float valve that shuts off automatically can be used. Water can be delivered to the troughs by using buried PVC pipes or by using a large tank to transport water. The source of water and its location in relation to the pastures will determine what means is used to carry water to the sheep.

Mineralized salt blocks should also be placed in the pastures for the sheep (Figure 22). These provide minerals that may not be available in sufficient amounts in the forage. During the dry periods of the year it may be necessary to provide the sheep with hay when forage is low. This can be done using round bales and either feeding a limited amount to the sheep each day or by letting them have unlimited access to the entire bale. The first method will be less wasteful but will require more labor. The preferred method can be determined to suit the needs and resources of individual farmers.

Figure 20.

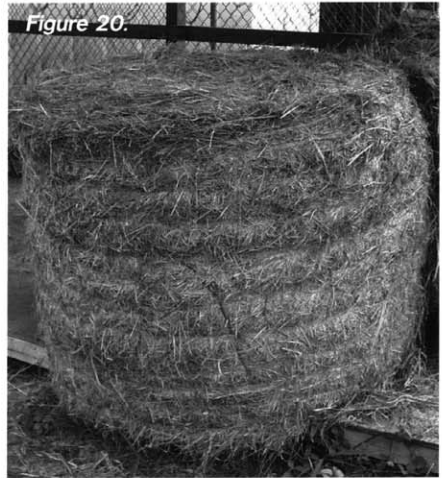


Figure 21.



Figure 22.



Figure 20. A round bale of guineagrass hay that can be used to provide supplemental roughage to sheep during the dry times of the year.

Figure 21. Water trough and float valve used in pastures. The float valve, on the left, helps to maintain a constant level of water in the trough.

Figure 22. Salt blocks are placed in the pastures to supplement the mineral portion of the ration. The old tire rim is used to keep the block off the ground and allow for drainage of rainwater to prevent the block from dissolving too quickly.

Flock Records

In order to keep track of animals in the flock each animal should have some form of identification. Animals can be identified with tattoos, ear tags or neck ropes with tags on them (Figure 23). Tattoos are permanent and will remain with the animal for its entire life. Ear tags and neck rope tags can be lost. The tags and ropes can be purchased in a variety of colors to help establish different groups within the flock.

For instance, at UVI-AES the sheep flock uses all three forms of identification. Breeding ewes have tattoos, ear tags and neck rope tags. Rams have tattoos and ear tags. The tattoo contains the animals ID number as well as the year of birth and is placed in the ears. The ear tag is color coded for year of birth and has the animal ID number on it (Figure 24). The neck ropes are color coded for breeding line and have a second ID number on it.

Flock records should be maintained to assist in making management decisions. Examples of flock records for ewes, lambs, rams and sales are shown in Tables 3-6 on pages 15-16. Important information that should be recorded for all lambs at birth includes date of birth, birth weight, sex of lamb, type of birth (single, twin, triplet), breed and sire and dam identification.

This should be done for live as well as dead lambs. If a lamb dies prior to weaning it should also be noted along with the cause of death. High death losses may be due to a disease, parasites or poor management, and records of this can be used to identify the cause and correct the situation. At wean-



Figure 24.

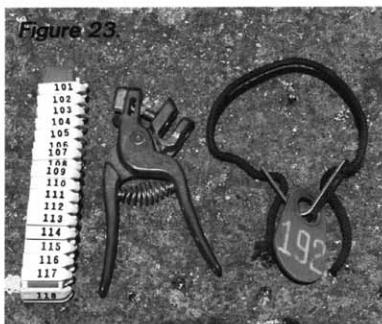


Figure 23.

Figure 23. Plastic ear tags and an ear tagging tool can be used to identify sheep. The neck rope and tag can be used as an additional form of identification.

Figure 24. A young lamb showing the placement of the ear tag (number 60). The tag should be placed in the ear so that it allows room for the ear to grow.

ing the weight of lambs and the number of lambs still alive should be recorded. The dates that the ram is put with the ewes, and the ID of the ram, should be recorded to assist in determining sire of lambs and when to expect lambs to be born.

Information on flock records can be stored in a variety of ways. Many farmers keep handwritten records in notebooks. There are also several computer software packages available for

livestock record keeping. What information is being recorded and how much of it is recorded will determine the method used. Computer software can perform many different operations on the records once they are entered. Pedigrees can be analyzed, inbreeding coefficients can be determined and selection indexes can be generated. Some software can also analyze the financial aspects of the farming operation.

Table 3. Examples of flock record formats for ewe information.

Necktag Number	Ear Tag	Flock	Breeding Group	Wt@ Breeding	Wt@ Weaning	Lambing Date	Sex of Lambs	Lambs Born	Lambs Alive	Lambs Weaned	Total Birth Weight	Total Weaning Weight
422	7028	A	A-2	78	-	2/26/00	F	1	1	1	5.9	24
442	F209	A	A-1	82	-	2/27/00	FF	2	2	2	11.4	45
397	7047	A	A-2	76	71	2/28/00	MFF	3	3	3	16.7	83
466	8187	A	A-4	62	48	3/1/00	MM	2	2	1	8.3	22

Column Headings:

Necktag number – ID number on necktag of ewe

Ear Tag – ID number on ear tag of ewe

Flock – flock designation when there are multiple flocks

Breeding Group – designates which breeding group ewe is in.

Can also be used to indicate genetic line within flock.

Wt @ breeding – ewe's weight at the start of the breeding period

Wt @ weaning – ewe's weight when her lambs are weaned

Lambing date – date lambs were born

Sex of lambs – shows the sex of lambs born

Lambs born – number of lambs born

Lambs alive – number of lambs alive at birth

Lambs weaned – number of lambs alive at weaning

Total birth weight – weight of all lambs born for each ewe

Total weaning weight – weight of all lambs weaned for each ewe

Table 4. Example of flock record format for lamb information.

Ear Tag	Dam	Sire	Birth Date	Sex	Birth Wt	Weaning Date	Weaning Wt	Lambs Born	Lambs Alive	Lambs Weaned	Leave Date	Leave Wt	Leave Cause
20001	7028	8165	2/26/00	F	5.9	4/26/00	24	1	1	1			
20002	F209	F203	2/27/00	F	5.6	4/26/00	23	2	2	2			
20003	F209	F203	2/27/00	F	5.8	4/26/00	22	2	2	2			
20005	7047	8165	2/28/00	M	6.1	4/26/00	33	3	3	3			
20006	7047	8165	2/28/00	F	4.9	4/26/00	29	3	3	3			
20007	7047	8165	2/28/00	F	5.7	4/26/00	21	3	3	3			
20008	8187	7071	3/1/00	M	4.8	5/3/00	18	2	1	1			
20009	8187	7071	3/1/00	M	3.5	5/3/00	22	2	1	0	5/19/00	25	1

Column Headings:

Ear tag – ear tag number assigned to lamb

Dam – ID of the dam

Sire – ID of the sire

Birth date – date lamb was born

Sex – sex of individual lamb

Birth weight – weight of individual lamb

Weaning date – date lambs was weaned

Weaning weight – weight at weaning of individual lamb

Lambs born – number of lambs born in litter

Lambs alive – number of live lambs in litter at birth

Lambs weaned – number of lambs in litter alive at weaning

Leave date – when the lambs left the flock

Leave weight – weight of lamb when it leaves the flock

Leave cause – reason lamb left flock (i.e., died, sold, stolen, etc.)

Table 5. Example of flock records for breeding rams.

Ear Tag	Flock	Breeding Group	Date of Birth	Wt at Breeding	Date Used for Breeding	Number of Ewes Bred to	Number of Ewes Pregnant	Percent of Ewes Pregnant
8156	A	A-1	7/23/98	82	6/4/99	30	28	93
9256	A	A-3	7/1/98	76	6/5/99	28	26	93
9054	A	A-2	11/15/98	78	10/2/99	32	31	97
5489	A	A-4	10/31/98	62	2/2/00	35	33	94

Column Headings:

Ear tag – ear tag number assigned to lamb

Flock – flock designation when there are multiple flocks

Breeding Group – designates which breeding group ewe is in.

Can also be used to indicate genetic line within flock.

Date of birth – birth date of ram

Weight at breeding – weight of ram at the start of the breeding period

Date used for breeding – date of the start of the breeding period

Number of ewes bred to – the number of ewes in the breeding group

Number of ewes pregnant – the number of ewes that conceived during the breeding period

Percent of ewes pregnant – the percentage of ewes that were exposed to the ram that conceived

Table 6. Example of sales records for a sheep flock.

Date	Animal ID	Weight	Type of Sale	Price / lb.	Total Price	Buyer
6/8/99	1234	70	meat	\$1.50	\$105.00	M. Mouse
3/4/00	4321	68	meat	\$1.50	\$102.00	A. Gore
7/1/00	5678	55	breeding	\$2.00	\$110.00	G. Bush

Column Headings:

Date – date of transaction

Animal ID – the number of the animal that was sold

Weight – weight of the animal at the time of the sale

Type of Sale – indicates if the animal was sold for meat or as breeding stock

Price/lb. – the amount you charged for the animal

Total price – the amount you received for the animal

Buyer – who the animal was sold to

Marketing

Hair sheep are produced for meat production because they have no marketable fiber like wool breeds of sheep. Young animals can be sold to provide a quality product of fresh, lean lamb. Hair sheep weighing 65 lbs. will produce a carcass weighing 28 to 32 lbs. Depending on the marketing system available, the animals can be sold based on live weight or based on the weight of the dressed carcass. If they are sold by carcass weight, then adjustments need to be made to compensate for the lower weight of the carcass com-

pared to that of the live animal in order to receive a similar amount of income.

Example:

Live animal sale for meat

65 lb. lamb sold at \$1.50/lb. = \$97.50

Carcass sale

65 lb. lamb yields a 30 lb. carcass sold at \$3.25/lb. = \$97.50

Sales of young lambs can also be used to provide other farmers with breeding stock. These animals should be of higher quality than the animals that are sold for meat. By only offering high quality animals for sale as breeding stock, other farmers will continue to purchase animals from the flock in the future. Lambs sold as breeding animals can be sold at any weight.

Example:

Breeding ewe or ram sale

35 lb. lamb sold at \$2.25/lb. = \$78.75

65 lb. lamb sold at \$2.25/lb. = \$146.25

Once a market is established for the lambs, management practices should be used to ensure that a consistent supply of quality product is available to meet the market demands. The use of specific breeding periods can be used to produce a uniform lamb crop at a specific time when the market demand is high (See Animal Management – Breeding Ewes).

Economic Analysis

What is an Enterprise Budget?

An enterprise budget provides a summary of the expected annual costs and returns (either on a per acre basis, as is common for field or fruit crops; or on a unit of output basis, as is common for animals) from producing a specific product such as fish, tomatoes, or, in this case, sheep.

There are two types of budgets: a maintenance budget (for all commodities), and an establishment budget (for livestock and perennials). These budgets should be developed *prior* to production of any commodity. Subsequently, they should be updated periodically.

An enterprise budget can be used for several purposes. The main uses are to determine the desired sales price; to control cost; to monitor business profitability; and to help identify the break-even point. They can also provide the information needed to conduct a financial feasibility

analysis as is done in this bulletin.

Thus, *at a minimum*, an enterprise budget should include: (a) the expected revenues from the specific crop or livestock enterprise (including cull and/or secondary product revenues and after accounting for death loss); and (b) the estimated costs (broken down into variable or operating costs and fixed or ownership costs).

Ultimately, costs are an important determinant of profitability; if one does not know what it costs to produce something, it is impossible to determine if it is profitable. Enterprise budgets can assist with this task.

The format used for the enterprise budgets developed in this bulletin is similar to that used in standard farm management books such as Herb and Erickson (1989), and Osburn and Schneeberger (1978).

Summary of Results

This bulletin contains an establishment budget and a maintenance budget for two herd sizes (see Tables 7 through 10, pages 18-21). Each budget outlines the key assumptions and illustrates the process of deriving the computations, when the latter is not obvious. In addition to the enterprise budgets, the results of the financial feasibility analysis are provided.

Based on the information contained in these budgets, it appears that sheep production can be a profitable activity in the USVI. We find that there are economies of scale in sheep production; the estimated production cost for the 350-head operation (\$0.93 per pound) is substantially lower than for the 100-head operation (\$1.41 per pound).

Furthermore, the financial feasibility analysis (see page 22) shows that while the 100-head operation can be profitable for existing sheep producers, the 350-head operation is more feasible in the long run. This has implications both for existing producers and potential producers.

**Table 7. Estimated Establishment Costs for Hair Sheep, St. Croix, USVI.
(A) 100-head operation (98 ewes; 2 rams).**

Item	Unit	Qty. (\$ / unit)	Price	Amt.	Your Farm
Site Preparation (60 acres) (varies with site)	tractor hours	40	\$60	\$2,400	
Watering (a) 1" PVC pipe (b) trough & float valve	20 ft.	90	\$9.90	\$890	
		3	\$50	\$150	
Feeding Troughs (8" PVC pipe cut in half)	20 ft.	3	\$75	\$225	
Shed (lumber & tin roof; light fixture)	10'x10'	1	\$1,650	\$1,650	
Fencing (a) 4' goat wire (b) metal T-posts (c) confinement area	300' roll	59	\$150	\$8,850	
	post	1,728	\$5	\$8,640	
				\$1,000	
Purchase of Animals (98 ewes; 2 rams)	lb.	55 lb. Avg.	\$2.25	\$12,375	
Labor for Establishment	hrs.	500	\$6	\$3,000	
TOTAL ESTABLISHMENT COST (excluding land)				\$39,180	

Assumptions:

1. 60 acres of land consisting of a combination of native (guinea grass) pasture and tan tan is available. Also, a water source (well and/or WARA) exists. If not, an average well cost of \$30-50/ft., assuming an average depth of 100'-150', amounting to a total of approximately \$5,000 (including a \$500 pump) can be used.
2. Rotational grazing management (and, therefore, paddocks) will be used. A rectangular (rather than a wagon wheel) fencing system is employed.
3. The 3.3 head/acre stocking rate assumed is for mid-island St. Croix; this will need to be adapted for other areas. For instance, in the East, a stocking rate of 2 animals/acre can be assumed, and, in the West, 5 animals/acre can be used.
4. Additional rams for breeding purposes can be "borrowed" from other farms, as is often the practice.
5. Total costs are rounded off to the nearest \$.
6. A combination of UVI-ACES experimental data, expert opinion, and informal telephone surveys (for selected input prices) is used.

Table 8. Estimated Establishment Costs for Hair Sheep, St. Croix, USVI.
(B) 350-head operation (338 ewes; 12 rams).

Item	Unit	Qty. (\$ / unit)	Price	Amt.	Your Farm
Site Preparation (175 acres) (varies with site)	tractor hours	130	\$60	\$7,800	
Watering (a) 1" PVC pipe (b) trough & float valve	20 ft.	250	\$9.90	\$2,475	
		3	\$50	\$150	
Feeding Troughs (8" PVC pipe cut in half)	20 ft.	6	\$75	\$450	
Shed (lumber & tin roof; light fixture)	10'x20'	1	\$2,350	\$2,350	
Fencing (a) 4' goat wire (b) metal T-posts (c) confinement area	300' roll	123	\$150	\$18,450	
	post	3,680	\$5	\$18,400	
				\$2,000	
Purchase of Animals (338 ewes; 12 rams)	lb. Avg.	55 lb. Avg.	\$2.25	\$43,313	
Labor for Establishment	hrs.	1,000	\$6	\$6,000	
TOTAL ESTABLISHMENT COST (excluding land)				\$101,388	

Assumptions:

1. 175 acres of land, containing a combination of native (guinea grass) pasture and tan tan is available. Also, a water source (well and/or WAPA) exists. If not, an average well cost of \$30-50/ft., assuming an average depth of 100-150', amounting to a total of approximately \$5,000 (including a \$500 pump) can be used.
2. Rotational grazing management (and, therefore, paddocks) will be used. A rectangular (rather than a wagon wheel) fencing system is employed.
3. The 3.5 head/acre stocking rate assumed is for mid-island St. Croix; this will need to be adapted for other areas. For instance, in the East, a stocking rate of 2 animals/acre can be assumed, and, in the West, 5 animals/acre can be used.
4. Additional rams for breeding purposes can be "borrowed" from other farms, as is often the practice.
5. Total costs are rounded off to the nearest \$.
6. A combination of UVI-AES experimental data, expert opinion, and informal telephone surveys (for selected input prices) is used.

Table 9. Estimated Annual Costs & Returns for Hair Sheep, St. Croix, USVI.**(A) 100-head operation (98 ewes; 2 rams).**

Item	Unit	Qty.	Price (\$ / unit)	Amt.	Your Farm
ANNUAL SALES					
(a) Slaughter lambs (live @ 65 lbs. avg./lamb)	lb.	8,775 ¹	\$1.50	\$13,163	
(b) cull ewes (10 ewes/yr.)	lb.	900	\$1.10	\$990	
(c) breeding ram sales (15 rams per year)	lb.	825	\$2.25	\$1,856	
Total Revenue				\$16,009	
OPERATING COSTS					
Pasture maintenance	tractor hrs.	50	\$15	\$750	
Hay purchase	750 lb. bale	10	\$25	\$750	
Pelleted feed (16% protein)	50 lb. bag	56	\$8.50	\$476	
Minerals	50 lb. block	8	\$17	\$136	
Vaccines & deworming	lamb	180	\$1.84	\$332	
Slaughtering	head	135	\$4	\$540	
Labor (part-time; 20 hrs./week)	hrs.	1,000	\$6	\$6,000	
Water, electricity & gasoline				\$2,000	
Interest on operating capital	\$	10,484	10%	\$1,048	
Total Operating Cost				\$11,532	
Returns Above Operating Cost				\$4,477	
FIXED COSTS					
Property Tax	acre	60	\$3.75	\$225	
Interest on average annual investment (excluding land)	\$	\$19,590 ²	10%	\$1,959	
Repairs & depreciation	\$	\$21,405 ³	5%	\$1,070	
Total Fixed Cost				\$3,254	
PRE-TAX RETURNS TO LAND & OPERATOR'S MANAGEMENT (total revenue -total operating cost - total fixed cost)				\$1,223	

BREAK-EVEN PRICE (at current production level) = [fixed cost per pound + operating cost per pound] = \$1.41/lb.

Notes on computations:

¹annual sales of slaughter lambs is computed as follows: [expected lamb crop - death loss - cull rate - replacement rams - breeding sales] x [average lamb weight]. Thus, [180 - 18 - 10 - 2 - 15] x [65 lbs.] = 8,775 lbs.

²interest on average annual investment = [beginning investment + ending investment]/2. Thus, [\$39,180 + 0]/2 = \$19,590.

³amount of repairs and depreciation = total establishment cost (from the corresponding establishment budget) less amounts for site preparation, animal purchase and labor.

Assumptions:

- The following assumptions are made for the sales computation: a lambing rate of 1.8; a replacement rate of 10%; two rams are retained each year for breeding. Finally, a lambing death loss of 10% is used.
- Rotational grazing management is used. Water consumption rate is 2.5 gallons/animal/day.
- The 3.3 head/acre stocking rate assumed is for mid-island St. Croix; this will need to be adapted for other areas.
- Property tax is computed assuming a market value of \$10,000/acre. This, in turn, yields an assessed land value of \$6,000/acre. The commercial tax rate is 0.0125; with the 95% farmland exemption on real property taxes, this results in a tax to the farmer of \$3.75/acre.
- Labor taxes (i.e., social security, etc.) amount to approximately 20% of wages.
- Total revenues and costs are rounded off to the nearest \$.
- A combination of UVI-AES experimental data, expert opinion, and informal telephone surveys is used.

**Table 10. Estimated Annual Costs & Returns for Hair Sheep, St. Croix, USVI.
(B) 350-head operation (338 ewes; 12 rams).**

Item	Unit	Qty.	Price (\$ / unit)	Amt.	Your Farm
ANNUAL SALES					
(a) Slaughter lambs (live @ 65 lbs. avg./lamb)	lb.	34,125 ¹	\$1.50	\$51,188	
(b) cull ewes (10 ewes/yr.)	lb.	3,150	\$1.10	\$3,465	
(c) breeding ram sales (15 rams per year)	lb.	825	\$2.25	\$1,856	
Total Revenue				\$56,509	
OPERATING COSTS					
Pasture maintenance	tractor hrs.	175	\$15	\$2,625	
Hay purchase	750 lb. bale	35	\$25	\$875	
Pelleted feed (16% protein)	50 lb. bag	195	\$8.50	\$1,658	
Minerals	50 lb. block	16	\$17	\$272	
Vaccines & deworming	lamb	630	\$0.81	\$512	
Slaughtering	head	525	\$4	\$2,100	
Labor (part-time; 20 hrs./week)	hrs.	2,000	\$6	\$12,000	
Water, electricity & gasoline				\$5,000	
Interest on operating capital	\$	25,042	10%	\$2,504	
Total Operating Cost				\$27,546	
Returns Above Operating Cost				\$28,963	
FIXED COSTS					
Property Tax	acre	175	\$3.75	\$656	
Interest on average annual investment (excluding land)	\$	\$50,694 ²	10%	\$5,069	
Repairs & depreciation	\$	\$44,275 ³	5%	\$2,214	
Total Fixed Cost				\$7,939	
PRE-TAX RETURNS TO LAND & OPERATOR'S MANAGEMENT (total revenue -total operating cost - total fixed cost)				\$21,024	

BREAK-EVEN PRICE (at current production level) = [fixed cost per pound + operating cost per pound] = \$0.93/lb.

Notes on computations:

¹annual sales of slaughter lambs is computed as follows: [expected lamb crop - death loss - cull rate - replacement rams - breeding sales] x [average lamb weight]. Thus, [630 - 50 - 35 - 5 - 15] x [65 lbs.] = 34,125 lbs.

²interest on average annual investment = [beginning investment + ending investment]/2. Thus, [(\$101,388 + 0)/2] = \$50,694.

³amount of repairs and depreciation = total establishment cost (from the corresponding establishment budget) less amounts for site preparation, animal purchase and labor.

Assumptions:

- The following assumptions are made for the sales computation: a lambing rate of 1.8; a replacement rate of 10%; two rams are retained each year for breeding. Finally, a lambing death loss of 10% is used.
- Rotational grazing management is used. Water consumption rate is 2.5 gallons/animal/day.
- The 3.3 head/acre stocking rate assumed is for mid-island St. Croix; this will need to be adapted for other areas.
- Property tax is computed assuming a market value of \$10,000/acre. This, in turn, yields an assessed land value of \$6,000/acre. The commercial tax rate is 0.0125; with the 95% farmland exemption on real property taxes, this results in a tax to the farmer of \$3.75/acre.
- Labor taxes (i.e., social security, etc.) amount to approximately 20% of wages.
- Total revenues and costs are rounded off to the nearest \$.
- A combination of UVI-AES experimental data, expert opinion, and informal telephone surveys is used.

Limitations of Analysis

The following analysis is based on averages for one study location (mid-island), and pertains to the time period during which this study was conducted. Thus, the estimates can be expected to change over time and by location. There are several factors other than economics which can limit the potential of sheep production in the Caribbean. Wildeus and Collins (1993) find that nutrition, management, and a lack of genetic diversity are the primary constraints to sheep production in the Caribbean. Furthermore, risks involved in sheep production can be sizable, but are difficult to capture in an analysis such as this. From a financial standpoint, the implications of risk are that losses are going to occur occasionally. This, of course, applies to other areas of farming as well. Strategies to manage risks in sheep production (or any other production activity for that matter) include proper planning (including the development of enterprise budgets such as those illustrated herein *before* actually undertaking pro-

duction), insurance, and diversification.

In conclusion, this analysis reveals that for some one willing to incur the potential risks and overcome possible constraints in sheep production, the potential rewards in the form of profit can be sizable.

Financial Feasibility Analysis for Hair Sheep Production

(A) 100-head operation: Based on conditions assumed in the budgets (Tables 7 and 9), although the 100-head operation generates a small profit on an annual basis, when establishment costs are factored in, it yields a negative net present value (NPV) and, therefore, is financially infeasible in the long run.

(B) 350 head operation: Under the conditions assumed in the budgets (Tables 8 and 10), this size operation could be both profitable on an annual basis (maintenance budgets), as well as feasible in the long run (as indicated by the NPV computations shown below).

1. Net Present Value

Assuming a 20-year planning horizon, the NPV for a 350-head sheep operation is as follows:

Cost of Capital	Net Present Value
8%	\$105,028
10%	\$77,602
12%	\$55,649

2. Internal Rate of Return (IRR) for 350-head operation ?

20%

Definitions:

1. NPV is defined as the discounted value of a project's net annual cash flow less the initial investment (i.e., establishment) cost. From an investment standpoint, the higher the NPV, the more desirable the investment (in this case hair sheep).

2. IRR is defined as that discount rate which equates the present value of the project's expected net cash flows to the initial investment cost (in this case, the establishment cost). It can simply be thought of as the project's (in this case, hair sheep) expected rate of return. The higher the IRR, the better from an investment standpoint.

Details on NPV and IRR are available in any standard financial management book such as Brigham and Houston (1998).

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