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PARTICIPATORY TECHNOLOGY DEVELOPMENT IN A MARKET- DRIVEN ENVIRONMENT - A Case Study on Marilissa Farms

Norman R. Gibson and Rishi K. Basdeo
Caribbean Agricultural Research and Development Institute
University Campus, St Augustine, Trinidad and Tobago

ABSTRACT

The Caribbean Agricultural Research and Development Institute (CARDI) identified the need for agricultural technology development to be market driven to afford regional producers a competitive edge even in their domestic markets. This paper looks at participatory technology development on Marilissa Farms, a CARDI small ruminant project farm in Trinidad. An examination of the impact of technical and business development interventions (undertaken between 1994-97) is made on a production system which is geared primarily towards the provision of high quality lamb into a niche market developed and implemented by CARDI.

Increases in the quality and size of forage banks and pastures (from 1.2 ha to 4.4 ha) over the period contributed to a decrease in average monthly concentrate feed and health costs from TT$9,000 to TT$3,500 despite a 10 fold increase in the sheep population. Consequently ewe mortality rates due to pregnancy toxaemia have been reduced from 36% to 0.7% with corresponding decreases in lamb mortality from 65% to 20%. With an increase in the size of the breeding flock from 23 to 226 breeding ewes between October 1994 and October 1997, Marilissa Farms is on target to stabilize at 500 breeding ewes by the end of 1998 without any external sourcing of breeding ewes.

This will facilitate an estimated target annual production of 22,000 kg of dressed lamb carcasses supplied under strict market quality control parameters compared to a 700 kg production level in 1994. It is expected that revenues from sheep production at Marilissa will increase from the 1994 level of TT$15,000 to TT$530,000 via supplies to the CARDI- developed niche market alone.

INTRODUCTION

It is without a doubt that agricultural research, particularly in the Caribbean region, must be prioritised and focused on the needs of producers and players in the region's agricultural sector. Tripp (1991) indicated that "the idea of planned agricultural change needs to be organised around an understanding of farmers' conditions and priorities." Given the increasing levels of globalization of markets and threats of economic liberalization to the region's agricultural sector, producers need to be guided by production and marketing strategies which would allow them to effectively compete in the harsh and dynamic environment in which they are mandated to operate.

Hosein, et al (1995) noted that more than 25% of the meat consumed in CARICOM comes from sheep and goats. This is particularly true for Trinidad and Tobago (T&T). Domestic production levels in T&T have however seldom exceeded 5% of the total quantities consumed with shortfalls being facilitated via cheaper lamb, mutton and chevron imports. To enhance the competitiveness of producers in Trinidad, CARDI developed a highly specialised niche market for "fresh chilled local lamb" with the country's largest supermarket chain. Significant strides have been made in streamlining local small ruminant production systems to cater for this market through on-farm research and Participatory Technology Development (PTD).

Bechstedt (1996) identified that the PTD farmers were a powerful resource of change. Researchers and farmers act as collaborators in simultaneously developing and validating on-farm technologies. These technologies are realistic and readily adopted by farmers because they consider the availability of resources and the external environment in which the farmer operates.

Marilissa Farms in Trinidad is owned and operated by Mr Lincoln Thackorie. Through strategic technical and business development interventions by CARDI, Marilissa Farms has moved from a subsistence production level in 1994 to the single largest supplier into the niche market managed by CARDI. The farm has also been developed into a production system model which facilitates the transfer of technologies developed on-site to other small ruminant farmers.

METHODOLOGY

On farm visits by the CARDI Animal Scientist and Research Assistant were the essential means used to develop a sound working relationship with the farmer. Initial investigations encompassing a review of existing farm records and interviews with the farmer and workers were conducted in 1994. These investigations revealed the following constraints in the sheep production system:

(i) high lamb mortality rates
(ii) high ewe mortality rates due to pregnancy toxaemia
(iii) inadequate/poor quality forage
(iv) non existence of pastures
(v) high concentrate feed costs
(vi) lack of structured markets

To enhance this production system to satisfy the requirements of the niche market developed by CARDI it was necessary to advise on a number of management practices incorporating:

- Business development
- Animal nutritional requirements (forage development and by-product feeding)
- Health maintenance
- Breeding management and general husbandry (including record keeping)

Technical assistance was facilitated by routine site visits over the period. Each visit lasted from 1-4 hours depending on the complexity of the problem being addressed. The farmer also benefited from several workshops conducted by CARDI on small ruminant production and breeding management. He also made site visits to the Blenheim and Studley Park Sheep Breeding and Multiplication facilities in Tobago and held active discussions with members of the Tobago Sheep Farmers Association (TSFA) as well as numerous other local producers.

BUSINESS DEVELOPMENT AND MARKETING RESULTS

The Relative Value of Sheep And Goat Enterprises At the start of the project, the farmer focused on goat rearing as the mainstay of his livestock production system.. With the development and emergence of a highly structured and organised market for lamb, there were obvious advantages to be obtained by shifting production from chevron to lamb. The farmer responded to market forces which guaranteed a specific price for lamb and he was able to considerably reduce the hassle and irregular purchase intervals of butchers and traffickers (Hosein. et al 1995).

In addition, under his predominantly cut and carry system, the sheep recorded faster growth rates and more efficient feed conversion than the goats. This led to a planned reduction in the size of the goat herd and a systematic increase in size of the sheep flock. This decision was essentially based upon market forces, production efficiency considerations and certainly not least of all, the level of technical support CARDI was offering to sheep producers. This latter consideration in fact provided much of the impetus that was needed for the farmer to feel secure in the decision he was taking. It was felt that without this level of technical assistance, the farmer would not have pursued this course. The indication here is that with the backing of a reputable agricultural research and development organisation, the farmer believed in the future prospects of the endeavour, since his long-term technical requirements (responding to market forces, and production constraints) were being met.

The impact of marketing on the development process at Marilissa farms is dealt with in a later section.

Number of Breeding Ewes

This is a parameter that immediately sets out the scale of an enterprise and generally distinguishes between subsistence production at one end of the scale and commercial production at the other. It is generally recognised by the CARDI research staff in Trinidad (resulting from simulated production models) that the minimum economic unit suitable for sheep production in Trinidad is approximately 50 breeding ewes.

The long term plan for Marilissa Farms is to stabilise at 500 breeding ewes. Expanding the production base is however a slow process, due mainly to the unavailability of quality breeding stock. In 1996, CARDI assisted in securing two pedigree Barbados Blackbelly rams from exporters in Barbados for this farm. Additionally, continuous monitoring of the farm enterprise has lead to progressive changes in the farmers' management of sheep production.
This is necessary to ensure that the farmer is fully equipped to adequately manage a large commercial flock. This can only be realised by continuous technical support throughout the growth period, until the 500 ewe system can be validated.

MARKETING

CARDI, having identified one of the obstacles to the expansion of the region's small ruminant sub-sector as limited marketing alternatives, successfully established a high value niche market for domestically produced lamb in 1994 for producers in Trinidad and Tobago. This niche afforded producers a premium price for their product. Small ruminant producers are regularly forced to accept lower prices to compete with high levels of the imported product (Aziz and Bennett 1993). Mr Thackorie is one of the farmers who took advantage of this CARDI-led marketing initiative.

This marketing arrangement sought to supply 'fresh chilled local' lamb to a chain of upscale retail centres in Trinidad while providing sheep producers with a secure market at a guaranteed price for their product. It is a collaborative effort between CARDI, the Sugarcane Feeds Centre (SFC) which is a local livestock research institution and HILO Food stores Limited (the largest supermarket chain in the country).

Market studies conducted by CARDI in 1995 estimates the demand for fresh chilled local lamb to be between 39,000 - 43,000 kg of meat annually at seven of the 18 upscale retail centres belonging to the HILO supermarket chain.

The Marketing Arrangement

On a phased basis, schedules of delivery for live animals and carcasses are developed by CARDI (after monitoring potential output from project farms) and forwarded to the retail centres and suppliers. These indicate the dates of delivery and quantity of live animals and carcasses scheduled for delivery to the abattoir and respective retail outlets.

Live animals are normally delivered by the producer on Monday afternoons to the approved abattoir (SFC). The animals are subsequently fasted for 12 - 24 hours (given only water), slaughtered on Tuesdays (under strict veterinary public health codes) and hung in a chilling unit at 4°C for 24 - 48 hours. The whole carcasses are then packaged and delivered to the respective outlets on Wednesdays and Thursdays. Payments are made directly to the supplier by the purchaser within two weeks of delivery of the carcasses to the retail outlet. These are based on the carcass weight at the point of delivery. For the purpose of payment CARDI issues an invoice on behalf of the supplier.

Results of marketing

While the marketing initiative was officially launched in July 1994, Mr Thackorie did not supply this market until November 1994. Table 1 illustrates on an annual basis the relevant data for animals supplied by Marilissa Farms. Perhaps the two most important items on the table are the number of animals supplied and the revenue generated per carcass. Both are represented graphically in figures 1 and 2.

Table 1. Comparative Supply Data For Marilissa Farms (1994 to 1997).

	1994	1995	1996	1997	Total
Number of animals	8	43	36	60	147
Total pre -slaughter weight (kg)	332	1682	1122	2280	5416
Total hot carcass wt (kg)	162	827	529	1094	2612
Average hot carcass wt (kg)	20.2	19.2	14.7	18.2	17.8
Total cold carcass wt (kg)	152	799	516	1049	2516
Average cold carcass wt (kg)	19.0	18.6	14.3	17.5	17.1
Average revenue per carcass TT$	377.00	406.00	312.00	420.00	388.00

During the period November 1994 to Deeember 1997, Marilissa Farms supplied a total of 147 live animals into the marketing programme. Of these, 137 were rams since ewes produeed on the farm were added to the flock to inerease productive capacity. These 147 animals were slaughtered at an average live weight of 37 kg each and produced a total of 2612 kg of fresh (hot) meat. This translates into an average hot dressing percentage of 48.2%. After being ehilled, packaged and delivered to the retail centre, however, the weight upon which payments were made (delivery weight) was equivalent to 2516 kg. This represents an average cold earcass weight and eold dressing percentage of 17.1 kg and 46.5% respectively. The careasses supplied experieneed a shrinkage rate of 3.7% during the chilling and distribution process.

The marketing arrangement thus far has generated TT$56,913.00 in gross revenues for the producer at an average price of TT$388.00 per carcass over the period. This includes two 10% cumulative price increases from the original priee of TT$19.84 to TT$21.82 and subsequently to TT$23.99 per kg during the period of supply.

Strategic Interventions

Several interventions were made by CARDI to address the constraints which were previously identified. The sueeess of these interventions were however
largely due to the responsiveness of the farmer. Tables 2 and 3 respectively summarises comparative produetion and farming systems information and critieal areas of impaet data during the pre and post intervention periods.

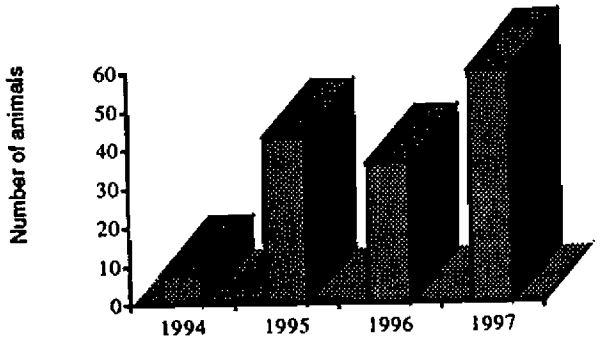

Figure 1: Number of animals supplied

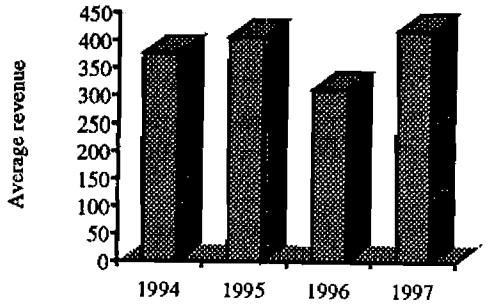

Figure 2: Average revenue per carcass (TT$)

Table 2. Production and Farming Systems Information for Marilissa Farms.

Production And Farming Systems	Net change (%)	Pre Intervention Oct. '94	With Intervention Oct. '97
Size of holding * (ha)	-	5	5
Main Enterprise	-	Goat	Sheep
Main Breed/Type	-	Anglo Nubian	Barbados Blackbelly
Other Enterprises	-	Sheep/Ducks	Goats/Ducks
Number of Breeding does	-56%	450	200
Number of Breeding ewes	+883%	23	226
Number of ducks	+600%	10	70
Number of hired labour	+40%	5	7
Area of improved forage (cut and carry) (ha)	+150%	1.2	3
Area of improved pastures (grazing) (ha)	-	0	1.4
Pen area for sheep and goat (m^2)	+68%	520	875

* Includes infrastructure such as pens, roads and 2 irrigation ponds.

Zero Grazing/ Forage Development

In moving from subsistence to commereial sheep systems production, adequate nutrition is often the first limiting

factor in the tropics. Given the high costs of imported supplements and the inconsistent supply and quality of agro-industrial by-products, it is advisable that as much as possible, ruminant production should hinge on forage based feeding systems. This is the cheapest means of feeding ruminant animals for acceptable levels of meat production. Against this background, the farmer was advised to increase the existing area (1.2 ha) of Elephant Grass *(Penisetum purpureum*) to adequately feed the growing numbers of sheep stock. The Elephant Grass which was harvested at 6-8 weeks and chopped, maintained an average crude protein content of 8%. This material was planted essentially for a zero-grazing system and was especially suited to feedlot lambs. At October 1997 the area of elephant grass was 3.0 ha, representing an increase of 150 %.

Table 3. Critical Areas of Impact.

Areas of Impact	Pre Intervention October 1994	With Intervention October 1997
Average monthly feed costs (sheep and goats)	TT$ 9,000.00	TT$ 3,500.00
Lamb mortality	65%	20%
Ewe mortality due to Pregnancy Toxaemia	36%	0.7%

Grazing Systems For Breeding Ewes

At the start of the project, the farmer had zero hectares of improved pasture. It was necessary to find a grass species that was high yielding, drought tolerant, persistent and of good nutritive value. The species also had to be adaptable to the local ecozone and planting material should also be readily available. The species selected was Coast Cross 1 (*Cynodon spp*), a high yielding, nutritious trailing grass. Just over 1.2 hectares were established with planting material obtained from the Ministry of Agriculture, Land and Marine Resources research centre at Centeno, Trinidad. The reasons for establishing improved pastures included:

- Reducing feeding costs (The labour associated with cut and carry as well as the machinery operating costs of chopping the forage before feeding, the opportunity costs of labour and the reduced reliance on expensive supplements).

- Providing exercise for pregnant ewes (There is a demonstrated need for exercise during pregnancy, as shown by reduced parturition problems, post partum deaths and lamb mortality).

On this farm, the technical advice offered was to use cut and carry for the feed-lot lambs and grazing systems for the breeding ewes. This allows for optimal use of the land and maintains a healthy cost-benefit relationship, as demonstrated by a measured reduction in feed cost over the life of the project.

CRITICAL INDICATORS

Monthly Feed Costs

Even though there was a systematic reduction in the number of goats since the start of the project, there was no commensurate reduction in feeding costs. This was because over the same period, increasing levels of feed were given to the sheep, since it was felt that they were now the mainstay of the farm. At the start of 1996, feed costs (essentially the cost of buying supplements) were still unacceptably high. A comprehensive programme to reduce the level of supplements being fed to the sheep was devised and explained in detail to the farmer. Analysis of feed samples were done to determine nutrient content (crude protein and fibre were used as the main indicators of feed quality).

It was found that some animals were being fed in excess of 1.4 - 1.8 kg of a 14% crude protein (CP) ration per day and that in some instances the CP content of the ration was as high as 19%.Since protein is generally the costliest ingredient, it was decided to:

- Reduce the level of CP in the diet to a maximum of 14%
- Institute a feeding regime based upon the physiologieal states of the animals. Reduction of the CP content of the ration was aehieved by reducing the level of brewers dried grain in the diet (the farmer commonly mixed this with a commercial 14 - 16% supplement).

Lactating ewes were fed at higher levels than dry ewes, whereas before all animals were fed the same quantities of supplements. It was suggested that dry animals should be fed at the rate of 0.23 kg/head/day, increasing up to 0.90 kg/head/day in early lactation.

With the development of improved pastures, breeding ewes will be fed supplements only in late pregnancy and during lactation, their maintenance and production requirements being otherwise met from improved pasture. Most of the feeding eosts will then be attributed to the fatteners. As a result of these preliminary interventions average monthly feed costs wcre reduced from TT$9,000.00 to TT$3,500.00. The precise level of feed with respect to total consumption and costs, feed conversion efficiency and their interrelation to carcass quality, market age and market weight, is now the subject of an ongoing research project. The results will be available in the year 2000. As shown in figure 3, real savings were made in feeding cost as a result of the measures outline above.

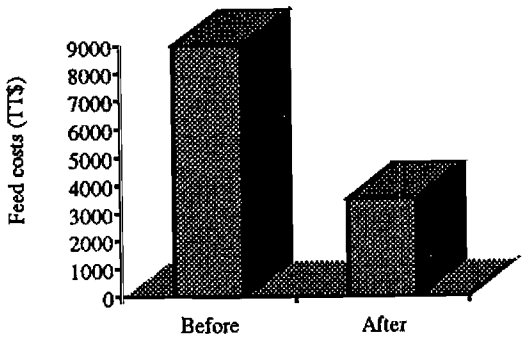

Figure 3: Monthly feed costs before and after CARDI interventions

Lamb Mortality

The viability of sheep production enterprises often depends upon the throughput of lambs. The survival of each lamb is vital and so adequate measures must be taken to ensure that lamb morbidity and mortality are well managed. Ideally, lamb mortality should never rise above 20% and farmers should strive to keep this figure well below 15%. At thc start of the project, lamb mortality was in the region of 65%. Some of this was related to ewe mortality, including pregnancy toxaemia and post-partum shock. Lambs that lost their mothers had a much lower survival rate then than now. Improvements in management have allowed better care to be given to orphan lambs, thereby increasing survival. In addition, the drastic reduction in maternal deaths has impacted positively on lamb survival. With better care being given to pregnant and lactating ewes more lambs have tended to survive to weaning, so that pre-weaning mortality has been reduced to 20%. The main factor impacting on this turnaround is essentially improved management. Lamb mortality is a good indication of the level of management in a sheep production enterprise.

The reduction in lamb mortality recorded after interventions by CARDI's technical staff is illustrated in figure 4.

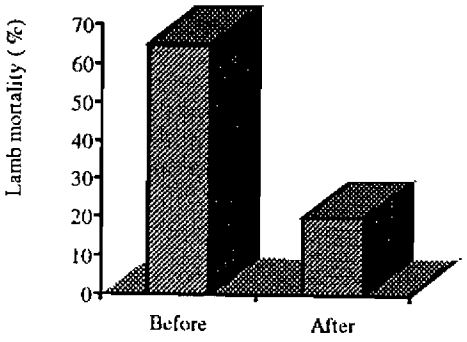

Figure 4: Lamb mortality before and after CARDI interventions

Pregnancy Toxaemia

This is a metabolic disorder that is often fatal. It is also called twin-lamb disease, since it is associated with ewes that have twin or multiple births. It is brought on by severe hypoglycaemia in late pregnancy and it is not easily treated. The best way to deal with this problem is through prevention. At the start of the project, maternal deaths due to pregnancy toxaemia stood at 36%. Each mature ewe death represented lost production capacity that required at least 13 months to replace. This was therefore a problem that impacted significantly on productivity and had to be dealt with immediately.

It was recognised that ewes were being overfed in early pregnancy and were becoming too fat. This meant that in late pregnancy when they needed to take in more nutrients for the rapidly developing foetuses, they simply lacked capacity. This led to glucose deficiency at a critical period.

It was also found that molasses formed an integral part of the diet in the pregnant ewes. Studies have shown that the end products of molasses digestion are precursors of compounds that induce pregnancy toxaemia (Steel and Leng 1973). The other critical factor hinged upon the fact that ewes were reared in a cut and carry or zero-grazing system, which severely limited the amount of exercise available to them. The literature indicates that lack of exercise during pregnancy is a contributing factor to pregnancy toxaemia. At the Blenheim station in Tobago where over 300 ewes are bred each year, pregnancy toxaemia is non-existent. This is largely attributed to the feeding regime and the exercise given to pregnant ewes.

The recommendations made included a reduction (by more than 50%) of the level of supplementation given to the pregnant ewes, the cessation of molasses use as part of the feeding regime, and the introduction of a grazing system for pregnant ewes to allow them adequate exercise each day. These recommendations have led to a reduction in the incidence of pregnancy toxaemia from the extremely high level of 36% in 1995, decreasing slightly to 32% in 1996, and then a dramatic reduction to 0.7% in 1997. This represents a considerable cost saving to the farmer and an increase in production efficiency. This is illustrated in Figure 5.

CONCLUSION

Of the numerous techniques that have been used to transfer and validate technology on farm, farmers themselves

have often been the best means of disseminating the type of technological information that often leads to successful technology transfer. Farmers readily learn from other farmers and once a model farm (farmer) has been established, technology transfer efforts can be better channelled and directed to the larger farming community. Model farm establishment is however a long and sometimes complicated process. It requires long hours working closely with the farmer and though the gains made are significant, the short term interaction with the farmer and the developmental work undertaken must be seen as an investment in longer term technology transfer, if it is to be justified. The results obtained at Marilissa Farms have clearly indicated that farmers, especially the more progressive ones, stand to benefit in real terms from this type of exposure.

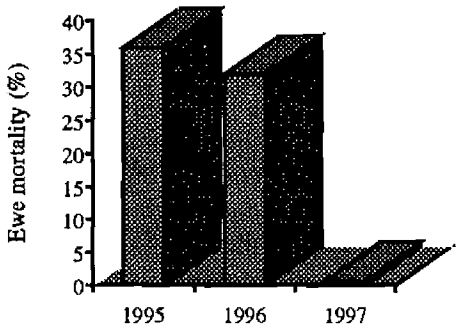

Figure 5: Ewe mortality (due to pregnancy toxaemia) before and after CARDI interventions

The improvements made in biological and economic terms were a direct result of the interventions made in production and marketing. A considerable amount of goodwill has also been established, based upon the reputation of CARDI as a regional agricultural research organisation and the consistent support from its scientific and technical staff. This composite has resulted in the development of an excellent working relationship with the farmer that facilitates on-farm research and development activities and ultimately, the technology transfer process.

FUTURE PROSPECTS

Already, more than 20 small commercial farmers in Trinidad and Tobago have either visited Marilissa Farms or otherwise interacted with Mr Thackorie with respect to his sheep production enterprise. As a result, some farmers have bought stock from Marilissa (mostly breeding rams) whilst others have implemented some of the improved management systems demonstrated there. There are clear prospects for Marilissa to be developed as a full fledged model farm for sheep production. Much of the ground work has already been laid and the development process is well underway. Over the next year, there are plans to purchase additional stock from Barbados to quickly realise the objective of 500 breeding ewes. This will place Marilissa as a technology transfer centre not only for the production of lamb fatteners, but also for pedigree Barbados Blackbelly sheep. This is in keeping with stated CARDI project objectives to establish satellite breeder farms as a means of decentralising the sheep breeding and multiplication activity.

With 500 breeding ewes, Marilissa Farms has the potential to produce 1100 animals (22,000 kg of meat) for this market on an annual basis given that production parameters remain stable at existing levels. At present prices this translates to TT$530,000 in revenues compared to TT$15,000 earned by the Farm in 1994.

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