

ADVANCES IN LIVESTOCK INVESTIGATION AND DEVELOPMENTS IN SANTA CRUZ, BOLIVIA¹

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The methodology of the work programme of the livestock section of the Centro de Investigacion Agricola Tropical and the British Tropical Agricultural Mission (CIAT/BTAM) is described.

The most important factors limiting productivity and profit are identified by investigation and their solution is looked for among the published literature of studies undertaken in a similar environment. If this is not available and if data from local experience cannot be obtained, then the solution will be looked for through experimentation.

The adaptation and implementation of the identified means of resolving the problem is encouraged by extension and demonstration on private farms. In some cases it is necessary to initiate development projects in order to provide the necessary infrastructure for the implementation of the solution.

In the field of milk production, the most important problem was the identification of genotype that could live, and reproduce satisfactorily in the tropical environment. It was demonstrated that crossbred cows (half and three quarter Holstein or Brown Swiss, half or one quarter zebu/criollo) are superior to pure Holstein or pure Brown Swiss conga.

A need was identified to conserve and improve a tropical breed in order to maintain a crossbred population. A programme of conservation and selection of the Criollo breed was initiated for this purpose. An organization to assist communities of 8 small farmers to purchase and manage superior bulls is being formed.

In Meat production, the low weaning percentage was identified as the main limiting factor which could be economically improved by the adoption of well known good management practices. The adoption of these practices is being encouraged by a programme of demonstration and extension.

Key words: Extension, dual-purpose cattle, weaning percentage, tropical milk production, Criollo

The Department of Santa Cruz, Bolivia lies between 13° and 20° S and covers 370,000 km² of which 7% is Andean foothills. The remainder is part of the eastern plain of Bolivia with an average altitude of 390 metres. Average annual rainfall increases from the south east to north west (500-2500mm) and the main annual temperature is 23.4°C.

There are 17,512 agricultural properties with cattle covering a total area of less than 70,000 km² with an average farm and herd size of 378 hectares and 56 head respectively (Table 1). Apart from these farms, 35,803 cattle are owned by 2,781 people who have no land titles. The total of 20,293 cattle owning farmers utilize less than 20% of the department of which nearly 75% is undemarcated forest.

The great majority of cattle herds are small with low productivity. Table 2 shows that land is rarely a limiting factor as even the smallest category have a high percentage of uncleared forest within the property.

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Table 1:
Data of ranches with more than 500 head of cattle in the Bolivian lowlands. (Data from census of CORDECRUZ 1978)

No. of head	No. of properties	Average herd size	Average No. of females over 3 yr	Average No. of calves under 1 yr	Apparent weaning percentage
501-800	160	643	273	87	32
801-1500	101	1076	475	149	31
1501-2500	29	1947	814	258	32
2501-	23	4506	1527	692	45

Table 2:
Average characteristics of small and large scale livestock farms in the department of Santa Cruz

	Farms under 300 hectares	Farms over 300 hectares
Number	17426	2867
Average size (hectares)	53	2037
Percentage forest	30	38
Percentage cultivated land	9	1.2
Number of female cattle over 3 years	9.6	95
Number of cattle under 1 year	4.2	33.1
Number of cattle between 1-2 years	3.2	37.9
Number of cattle between 2-3 years	2.8	36.2

The larger farmers buy immature males from the small farmers for growing and fattening on their natural pasture lands which explains the decrease in numbers of yearlings and two year olds on the smaller farms and their increase on the larger farms. Table 2 also shows that the small farmers have 30% of their property forested and the large farmers 38% indicating that labour and capital to convert the forest to pasture are limiting factors to productivity rather than farm size.

By products of cotton, soya and sugar and of rice and wheat milling industries are available to the livestock industry.

When the livestock section of Centro de Investigacion Agricola Tropical/ British Tropical Agricultural Mission (CIAT/BTAM) commenced in April 1976, the main problems and bottle-necks of the livestock industry had not been identified as few records existed and none had been analysed. Most of the beef was produced by

extensive methods from zebu/criollo cattle and many properties were managed by untrained personnel in the absence of the owner. As the price of beef was controlled so that the producer received less than \$US0.90/ kg dead weight until November 1979, investment of capital or management skills was not encouraged by the market.

Broiler chickens and eggs were being produced by sophisticated organizations in controlled environments and these were not encountering specifically tropical problems. Sheep and goats were neither numerically or economically important and the pig industry was depressed.

The price of milk and its products was very high compared to that of beef (1:4.9) and the production of farm-house cheese under a dual-purpose management system is traditional and it is often manufactured far from the market particularly during the wet season. For this reason the greater part of livestock development was taking place in the dairy industry where there apparently existed an urgent need for investigation.

Activities with the dairy industry. Some para-statal organizations had planned the large scale importation of Holstein Friesian cattle to replace the zebu/criollo animals that the majority of livestock owners still possessed. There were 5000 Brown Swiss and 7500 Holstein Friesian cattle already in the tropical area of Santa Cruz and two surveys had suggested that production was satisfactory. The livestock team of CIAT/BTAM doubted the validity of these surveys because in its farm visits the amount of milk produced and the number of surviving calves observed were much less than those reported. The veterinary and extension services were limited and it was suggested that if high losses and low yields occurred in the better farms managed by relatively experienced and well educated people, then the proposed new importations would not benefit the new buyers.

Because of the size of the projects and the serious risks involved, it was decided to invest virtually all of the resources of the livestock team in a recording programme of the dairy farms including the different production systems, breeds and crosses of cattle being used in order to obtain reliable data.

The programme is described and the results are discussed by Wilkins et al (1979) but the important points are the following:

1. The importation of females of European dairy breeds for milk production is not profitable.
2. The mating of European dairy bulls with zebu/criollo cows results in the first two generations in vigorous crossbreds that can produce milk economically.
3. The crossing of the second generation, the three quarter exotic, with a European dairy bull results in a seven eighths exotic that has lower fertility and much higher calf mortality than the half and three quarter exotic and with no increase in milk yield (for example see Table 3).

The advantages and disadvantages of some alternative mating programmes to avoid this undesirable effect and maintain crossbred populations are discussed by Mason (1974) and Wilkins et al (1980).

It is believed that cows of European dairy breeds are not profitable in the area because of a combination of the following factors:

1. The high cost of the cow
2. High calf mortality
3. Low fertility
4. Appetite reduced by high temperature and humidity (Bianca 1965) Low digestibility of the pastures of the humid tropics, including improved pastures, compared to those of the temperate zones (French 1957; Butterworth 1967; Stobbs 1974). Because of the effect of reduced appetite combined with low pasture digestibility, high yielding cows must be fed concentrates for all their production needs and for some of their maintenance requirements.
5. The debilitating effect of parasites including ticks.

Many deaths of exotic calves are caused by anaplasmosis and babesiosis. All calves reared in this tick infested environment contract these diseases in the first six months of life. If the survivors are continually reinfested with infected ticks they will maintain a resistance to these diseases that will only break down in the case of severe stress. The probability of recovering from these diseases is much greater in the case of calves indigenous to the tropics than in that of exotic calves. In the case of crossbred calves the probability declines with increasing percentage of exotic blood (see Tables 3 and 4).

Table 3:

Performance of cattle on farm 141, Santa Cruz (Wilkins et al 1979)

	Percentage Brown Swiss blood		
	50%	75%	88%
Number of cows	20	50	32
Mean milk yield/cow/year (kg)	1820	1737	1661
Coefficient of variation	45	30	47
Cows calving in year (%)	85	78	75
Calf mortality (%)	7	8	15

Table 4:

Calf mortality on farm 341

Breed or cross	Percentage mortality
Zebu/criollo	11
1/2 Holstein	19
3/4 Holstein	29
Holstein	42

It is certain that early treatment will reduce mortality but nevertheless many indigenous and crossbred calves contract and recover from these diseases without showing marked signs of sickness, .

Although it is certain that the mortality of exotic calves can be reduced, that parasites can be controlled and that high levels of concentrate can be fed to exotic cows, milk production by crossbred cattle is more practicable and economic. Recently the price of milk has declined greatly in relation to the costs of production and because of this the crossbred cow will remain economically superior, at least in the immediate future.

This investigation that utilized virtually all of the time of the livestock team until the end of 1978 resulted in the abandoning of the plans of large scale importations of female dairy cattle and in the acceptance of the use of zebu/criollo cows for mating with European dairy bulls to produce crossbred females that can produce milk economically in mixed farming systems.

As the majority of farmers still had zebu/criollo cows, they could use Holstein Friesian bulls for these and the next generation without problems. Thereafter a need would exist for bulls of a selected tropical breed in order to maintain a crossbred population. A programme was initiated in 1978 for this purpose in which the criollo breed was conserved and selected as a gene pool from which superior bulls could be obtained for crossbreeding programmes. Fifty cows of superior type were purchased and milked for one lactation and the poorest were then sold and replaced by purchase. This selection programme continues and in January 1981 the herd consists of 65 cows that are inseminated with Criollo semen purchased from CATIE, Costa Rica. Semen will also be purchased from Mexico, Venezuela and Brazil.

Table 2 shows that there are over 17,000 farmers who have an average of less than 10 cows and the individual ownership of a bull in such small herds is both uneconomic and undesirable for genetic reasons. The maintenance by a small farmer of two bulls, one of an exotic and one of a tropical breed is obviously not feasible.

In order to make good bulls available to small farmers where artificial insemination (AI) is not practicable, an organization is being planned that will assist and advise on community bull schemes. It is intended that this organization should assist groups to select and transport bulls and will advise on the interchange of bulls between communities after three years to minimise inbreeding . The bulls will only be purchased in herds that use AI and maintain records and the organization will also benefit the bull breeders in finding a market and identifying its demand.

Recommended feeding regimes for dairy cattle in the dry season are based on the grazing of grass legume mixtures in accordance with the findings of Paterson 1979; Paterson and Horrell(1981) and Paterson et al(1981). The grazing of *Lablab purpureus* in maize stover is also recommended. These pastures and forages can be supplemented where necessary with a concentrate based on cottonseed cake and rice bran.

Beef Production: A price rise of beef to \$US 1.56/kg deadweight in November 1979 made the beef industry more remunerative although production systems would have to continue to be extensive in order to be profitable.

The livestock census of 1978 showed that there were 400,000 females of over three years of age in the department while there were only 167,500 calves of less than one year of age. This suggests an average weaning rate of less than 40% and obviously low cow productivity is a major constraint to profitability of the beef industry.

Detailed recording on two large and six small properties showed that weaning rates of over 70% were being obtained and that fertility on many properties could be raised economically by implementing low cost, well established management practices. This agrees with the findings of Bauer (1979) in the Beni, Bolivia. In other words the weaning rate could be raised considerably by demonstration and extension without the need for research.

A programme has commenced that has as its initial objective the raising of the annual weaning rate of the area to 65% which would result in the production of 118,500 more weaned calves per year from the same population of cows.

Initially the programme has concentrated on making the cattle owners aware of the financial advantages of increasing the weaning rate (Martinez et al 1980). This is to be followed by the second stage of demonstrating the feasibility of the recommended methods of improvement on actual private farms.

The methodology of the programme is:

1. To recruit a suitable farm with a cooperative owner
2. To classify the cattle on the farm by sex and age and identify them individually by branding or ear tag.
3. To determine the correct carrying capacity.
4. To identify and cull the cows of low fertility and those with physical defects including old age, and to invest the money realised in the sale in the purchase of bulls and pasture improvement.
5. To terminate the sale of heifers except those of low fertility.
6. To initiate a simple recording system that includes births, deaths, abortions, purchases and sales.
7. To inspect the bulls and to replace them where necessary by purchase. It is known that inbreeding is high in many herds.
8. To commence a mineral feeding programme that will include phosphorous and iodine.
9. To prepare working routines by day, month and year.

The annual work routine will include a mating season (initially for heifers), a weaning programme and a vaccination and parasite control programme.

It is probable that when this programme has generated the initial increase in productivity, further improvement can only be achieved after investigation of as yet unidentified problems.

The majority of cattle have to walk very long distances from the breeding ranch to the place of slaughter and this journey may take three weeks. Many of these cattle are grazed on improved pastures near the city for some months before slaughter and the pasture group of CIAT/BTAM have demonstrated that cattle can be fattened on improved pastures in the zone even during the dry season (Paterson et al 1979; Paterson 1979). The preliminary results of supplementing 280 kg steers that are grazing *Panicum maximum* in the wet season with 750 gms of cottonseed cake indicate that this supplementation is profitable (Table 5).

Table 5:
Preliminary results of an investigation of the effect of the supplementation with cottonseed cake on cattle fattening on Panicum maximum pastures

	Treatment	
	Pasture	Pasture + 750 g cake/head/day
Number of animals	30	30
Average initial weight (kg)	282.8	269.8
Average weight after 60 days (kg)	314.0	326.0
Average daily gain (g)	520	937
Estimated average increase in value of cake-fed steer over grass-fed steer in 60 days		\$US25.22
Cost of cake and feeding for 60 days		\$US 5.64

Pigs: The arrival of a British post graduate student who wished to obtain thesis material has permitted the study of reproductive performance of pigs in the colonization areas in the humid cleared forest lands in the north of the department. Cattle have little importance in this agricultural zone as yet although it is postulated that pastures must eventually be introduced into the rotation as a means of controlling arable weeds as well as the improvement of soil structure and maintenance of fertility.

Conclusion

The philosophy of the livestock section of BTAM/CIAT is to avoid research unless it is absolutely unavoidable. Management levels are very low and a considerable weight of knowledge has been generated in other parts of the tropical world that may be adapted to Bolivian conditions to raise production levels. Investigation is frequently necessary to determine the current situations and identify bottle-necks of production. Once identified, these may frequently be overcome by development, extension or demonstration based on experience obtained elsewhere in similar environments.

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