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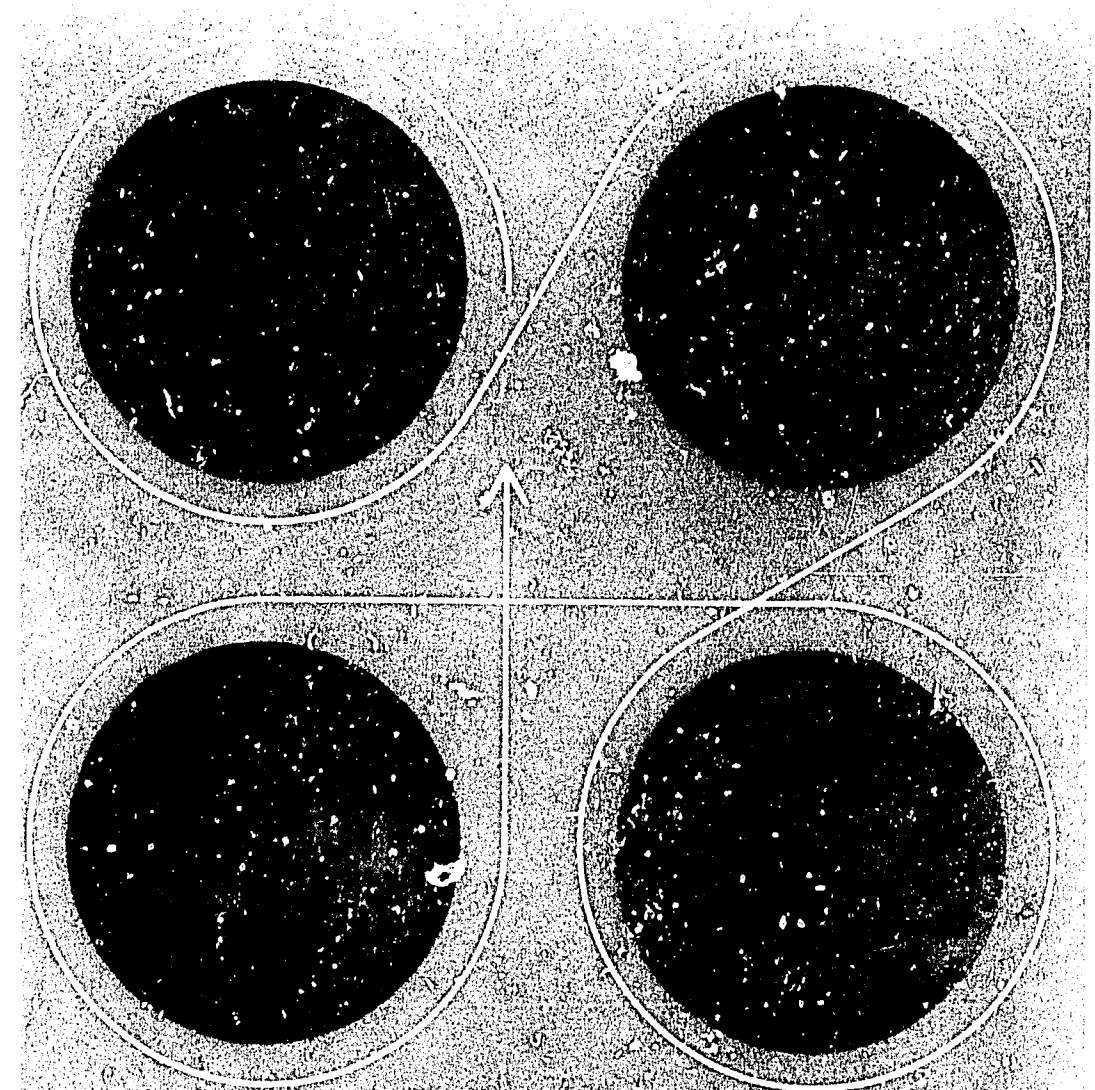

DECISION MAKING BY LIVESTOCK/CROP SMALL HOLDERS IN THE STATE OF VERACRUZ, MEXICO

Andres Aluja and Robert E. McDowell

DEPARTMENT OF ANIMAL SCIENCE

New York State College of Agriculture and Life Sciences
A Statutory College of the State University
Cornell University, Ithaca, New York

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by

Andres Aluja and Robert E. McDowell

Department of Animal Science
Cornell University
Ithaca, New York 14853

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INTRODUCTION

The role of agricultural production, including the livestock subsector, has diminished in Mexico's gross national product (GNP) due to the industrialization and urbanization process. A decrease in agricultural output and population growth in the past decade has caused a shift from self-sufficiency in food production to a net import of basic foods. Efforts are made to reverse this trend by implementing programs such as the Mexican Food System: SAM - 1976 (Mexico, Serfin, 1980) and the National Food Production Network: PRONAL - 1983 (Mexico, FIRA, 1983) with the objective of increasing output at all levels of the agricultural sector and related industries.

Land reclamation programs to increase agricultural production have been carried out in south eastern Mexico. In the tropical state of Tabasco, reclamation of ill-drained zones in the Chontalpa was performed with the intention of intensifying agriculture and livestock production (Scherr, 1983). In the Papaloapan Area, large portions of the tropical rain forest were replaced by grasslands and intensive agriculture (Scherr, 1983A and Ewell & Poleman, 1980). Many of these projects have not been successful. Re-evaluations have pointed out the need to consider the preferences and attitudes of farmers when changes in their modes of production are intended. Before introducing any development programs it is important to study the motives, attitudes, resources and limitations of the individuals or groups involved (Shaner, Philipp and Schmehl, 1982). This is important to the livestock sector as it has been rather dynamic, increasing from 26% of GNP in 1960 to 37% in 1979 (Mexico-SARH, 1982).

The objective of this report is to identify and quantify the motives, attitudes, resources, limitations and other factors important in farmer decision making on small and medium sized livestock/crop farms in the central part of the State of Veracruz, Mexico. The motive and attitude components are stressed because government agencies have recommended the use of such practices as planting improved grass pastures, the use of milk breeds of cattle and artificial insemination. Farmers have given low acceptance or shown complete indifference to the proposed changes.

PROCEDURES

Area Characteristic

The area is located in the north-central part of the State of Veracruz. It comprises the four counties (municipios) of Atzalan, Martinez de la Torre, Tlapacoyan and Vega de Alatorre. The study was conducted in cooperation with the Centro de Investigacion, Ensenanza y Extension en Ganaderia Tropical (CIEEGT) of the Facultad de Medicina Veterinaria y Zootechnia (FMVZ) of the Universidad Nacional Autonoma de Mexico (UNAM) in Mexico City. CIEEGT is located 360 km northeast of Mexico City on the Federal road Mexico City - Nautla and 5 km from the city of Martinez de la Torre (Figure 1).

The area is characterized by undulated relief and savannah which can be divided into two main geographical areas, the coastal plain of the Gulf of Mexico (0-500 m), and hill area (>500 m). The main area of study was the coastal plain.

The climate is classified as Af(m)(e) (Garcia, 1973), hot and humid with rains year round. There is no clearly defined dry season. The mean annual precipitation is 1500

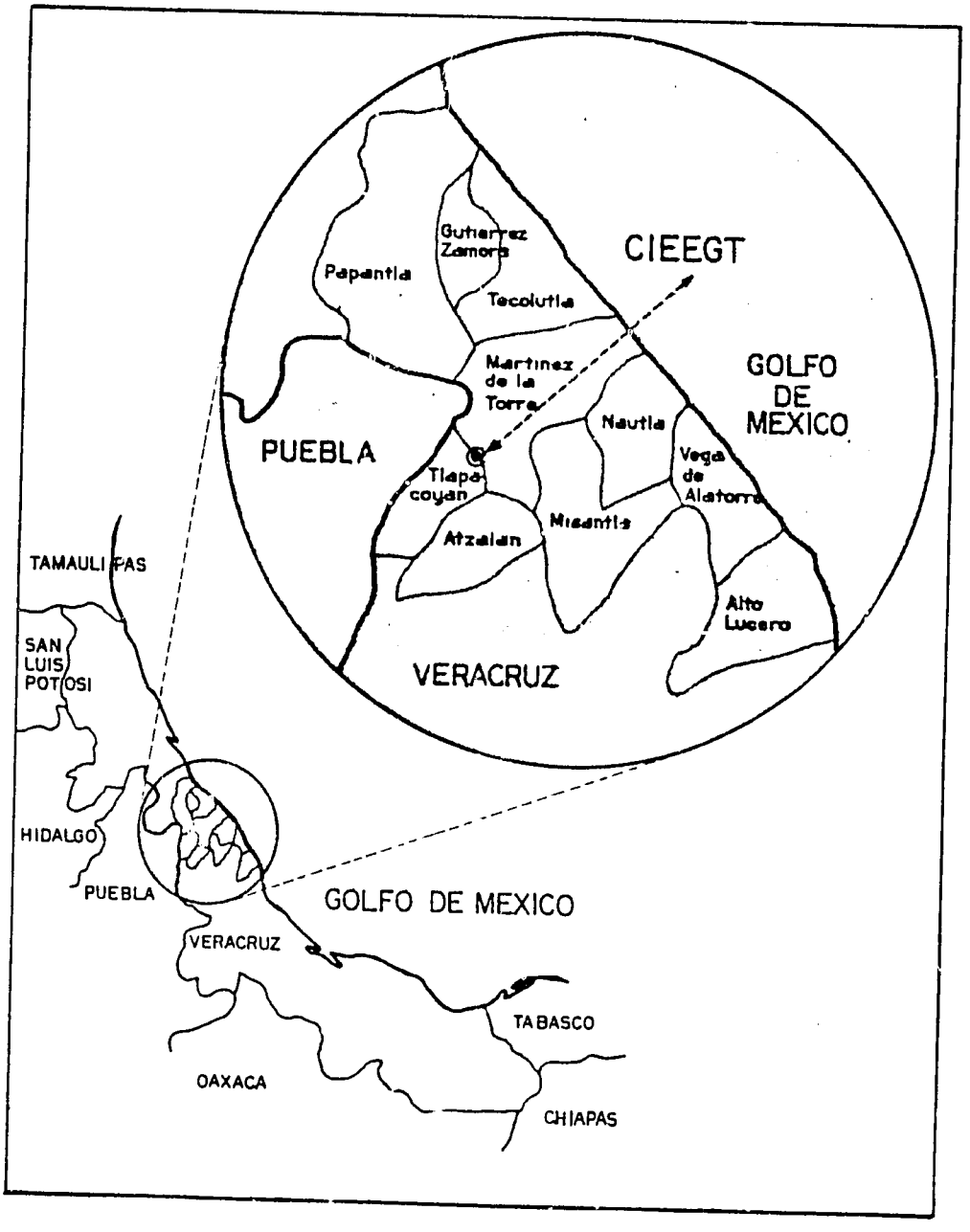

Figure 1. CIEEGT and its surroundings

mm, 75% of which falls between May and October, with September the highest. The annual temperature is 23.5°C, with a thermal oscillation between 7 and 14°C (Garcia, 1973) (Table 1).

The vegetation in the area is abundant and varied. The coastal region is characterized by mangrove and palm trees over sandy, water-logged soils. An important part is savannah made up of grasses and other herbaceous plants created by the clearing of tropical forests; they alternate with acacias and some cactaie. These areas have been increasing and are principally used for livestock. Crops such as oranges, coffee, bananas, sugarcane, corn and beans, are produced for food and cash

The soil of the area is principally derived from degradation of sandstones deposited by rivers which have existed during the formation of the area. The texture of the base material varies from sandy-clay to clay-sandy, with an average clay content of 35-40%. When dry it forms a hard pan which is known locally as "tepetate". The surface cover contains medium quantities of organic matter (0.8%), adequate in sulphur but short in calcium, phosphorus, nitrogen and molybdenum. The soil is acid, with a pH from 4.1 to 5.2. Depth varies according to the soil topography but is usually 10 to 30 cm. Due to its texture, it has a deficient drainage and is quite susceptible to rain erosion (CIEEGT, 1979).

This study was the second part (dynamic survey) of a project that had the primary objective of describing those production systems with a livestock component in four counties. Because of economical and logistical reasons, no more than twenty farms could be included in the survey since it was deemed necessary to visit them monthly. Since there was some contact with the producers who had participated in the first survey, farms were chosen from the 78 farms that produced milk; however 51 were eliminated for one or more reasons:

a) not located in the coastal strip (0-500 m);

b) did not use family labor;

c) owner or his family did not live on the premise; or

d) main income was other than from the cattle subsystem.

Nineteen farms agreed to full participation.

Two questionnaires were developed: a) single point baseline (used in the first visit) and b) cyclical (used in monthly visits). The period January-March, 1982 was spent acquainting farmers and surveyors with the procedures. At the end of this period, minor adjustments were made. Collection was April 1982 to April 1983. The farms had 6 to 100 head of cattle.

Open-ended questions were avoided as much as possible. However, when present, procedures were developed to codify. All the information (single point baseline and cyclical) was analyzed together to obtain a description of the farming systems of the area. When trends were observed, the farms were divided into various groupings (e.g., location, size) which could assist in explaining the variation in some parameters, such as milk production, farm size and family income.

Assumptions and procedures used in making economic evaluations were:

- value of land was not considered.

Table 1. Mean monthly temperature (°C) and total precipitation (mm) of four locations in Central Veracruz

Temperatures (mean)

Station	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Mtz de la Torre[1]	18.6	19.8	22.0	25.5	27.5	27.7	26.7	27.4	26.4	24.5	21.3	19.0	23.8
Misantla[1]	17.7	19.1	21.3	24.5	26.5	26.6	25.8	26.0	24.9	23.3	20.6	18.6	22.9
Fanal de Nautla[1]	19.2	20.1	21.9	24.4	26.0	26.0	25.8	26.3	25.3	24.1	22.1	19.9	23.4
Vega de Alatorre[2]	18.3	19.6	22.2	25.7	27.4	27.7	27.1	27.7	26.7	24.7	21.7	19.4	23.9
Average	18.4	19.7	21.9	25.0	26.9	27.0	26.3	26.9	25.8	24.1	21.4	19.2	23.5

Precipitation (total)

Station	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Mtz de la Torre[1]	64.3	66.4	77.4	70.8	87.6	119.7	141.7	109.6	308.1	205.4	160.1	102.6	1513.7
Misantla[1]	105.0	98.6	121.5	110.6	98.7	193.2	245.1	200.3	380.5	274.5	192.3	142.0	2162.8
Fanal de Nautla[1]	53.3	50.6	69.5	56.6	55.5	121.9	139.2	93.9	233.5	155.4	105.1	69.5	1204.0
Vega de Alatorre[2]	41.0	39.2	54.3	58.7	62.5	128.9	180.5	67.3	192.3	176.0	130.1	49.1	1179.9
Average	65.9	63.7	80.7	74.2	76.1	140.9	166.3	117.8	278.6	202.8	146.9	90.8	1515.2

Source: [1] Mexico, SAG, 1976, [2] Gomez-Pompa, A. 1966

- values used are Mexican pesos. (A series of devaluations occurred during the study. In July, 1982 the rate was 50 pesos/per U.S. dollar; in September, 1982 the rate changed to 70 pesos; in December, 1982 it was 150 and in April, 1983 around 155. These conversions are approximations since the Mexican government let the peso float in order to reach its real value.)

- interest over capital was 5%. (Due to the inflation in Mexico, 100% during 1982 and 80% during 1983, real interest rates were negative since banks could not afford to pay above 100% rates. By July 1983 the real interest rate for the trimester (July-September) was 2.3% (Mexico - FIRA, 1984). It was considered reasonable to use an overall rate of 5%.)

- only those facilities, equipment and tools used for livestock purposes were included in the investments.

- additions of buildings, equipment, machinery, tools and cattle throughout the year were included at half the total price to average the differences due to month of purchase.

- when drastic changes occurred in the farm inventory, interest over capital was calculated, averaging the initial and final inventories.

- depreciation was calculated linearly at 10%.

- managing fees were charged at 5% of the value of production.

- rent of land was charged at 100 pesos/head/month.

- to calculate carrying capacity, native grasslands were assumed to carry one animal unit (AU per ha); improved grasslands carried 1.2. AU equivalents used were:

Adult cows	=	1.0 AU
Bulls	=	1.2 AU
Heifers and steers	=	0.7 AU
Calves	=	0.4 AU
Horses, mules, burros	=	1.2 AU

- labor was paid 200 pesos/day April-September, 1982, 220 October-December, 1982, and 250 January-March, 1983.

- there was over 100% increase in the price of cattle January 1981-May 1983, partly was real but a high percentage was due to inflation. (Since the Mexican government has little experience in dealing with high inflationary processes, no adjustment indexes have been developed (Mexico-FIRA 1984). For the purpose of this study, price of cattle was obtained by averaging the price of all cattle sold. However, when prices were higher, they were used.) The minimum or average prices (pesos) were:

Cows in herd	26,000
Culled cows	20,000
Heifers	16,500
Calves	10,500
Bulls	29,000
Bull-calves	20,000
Horses	20,000
Burros or mules	15,000

- only the period April 1982 to March 1983 was considered for the economic evaluation.

Definitions used were adapted from Stanton (1973) and Avila (1983), as follows:

- investment was considered as the total market value of cattle, buildings, and other permanent structures, tools, and the value of improvements during 1982-83.

- value of production (VP) included all goods sold, consumed, or gifts, change in inventory due to production (births) and in-kind payments from the use of resources on or off the farm.

- variable costs (VC) were those that changed with the level of production during the period of analysis.

- fixed costs (FC) were those incurred by the producer independently of the level of production.

- net income (NI) was defined as the difference between the value of production and the total costs (fixed and variable costs).

- farm family earnings (FFE) was the residual after paying business expenses resulting from farm production and the use of business resources. FFE was used to pay for land use, labor, capital and management provided by the family.

- returns to all capital and management (RCM) were calculated by adding interest charges or rent paid to the farm family earnings. (Family labor used in farming was deducted from the total.)

- rate of return to all capital and management (RRCM) was the return to capital and management divided by the average amount of capital used in operating the business expressed as a percentage.

- net return to farming labor and management (NRFLM) measured the success of labor and management, calculated by adding interest payments to family earnings and deducting the use of all capital at an accepted market rate (5%), being the residual attributed to labor and management.

- net return to labor (family and hired) (NRL) measured the efficiency of workers on the farm. It was calculated by adding the cost of labor (family and hired) to the net income and deducting the management fee. The residual was divided by the total days that were labored on the farm.

- number of A.U. per hectare was calculated by dividing the total AU by the number of hectares used for livestock.

RESULTS

From the nineteen farms originally included in the study, six were deleted. Reasons varied from the farm being sold with the new owner not interested in continuing, to a lack of cooperation from the producers in providing information. No trend was identified with respect to those farms that were left out and herd size.

Farms were divided into two regions, Coastal and Inland, two sizes and the year into three seasons. These divisions were used in those cases where some trends were identified that would assist in better understanding the data. The Coastal Region included farms 1, 2, 4, 5, 6, 7, and 8, loated <100 m above sea level; the Inland Region included farms 10, 11, 12, 13, 16, and 18, located 101 m to 400 m above sea level. Size A, small farms, were those with up to 30 head of cattle (farms 4, 6, 7, 8, 12, and 16), and size b, large farms, with 31 up to 100 head of cattle (farms 1, 2, 5, 10, 13 and 18).

Cows were considered young if they had less than two calvings and adult cows with three or more calving.

Seasons were based on rainfall pattern and temperatures: 1, November-February; 2, March-June; and 3, July-October.

Farms 10 and 11 had different objectives. Farm 10 had, in addition to crossbred cattle, steers for fattening purposes. Data for this farm was only included in the general averages. Farm 11 was a specialized dairy farm with grade Holsteins. Data from this farm was included in the average only for animal health.

Description of Farms

Figure 2 presents a qualitative model of the farms using the notation proposed in Figure 3. Inputs (sources) are found on the left. They constitute money, fuel, construction materials, electricity, food, labor, technical assistance, government policies, relations with community and church, level of education, agricultural and livestock inputs, transportation and land. Some are utilized directly, but others are stored in the socio-economic subsystem until used (represented by storage symbol).

In the upper left side, outputs of the system are depicted (market): peppers, citrus, bananas, coffee, wood, sheep, cattle, swine, milk, cheese, eggs and poultry. When the farmer bought inputs to maintain production, the system paid; when sales were made, money entered the system. This movement is represented by the money flow symbol (solid line represents product flow and dotted line money flow). In the case of a loan, for which interest was paid, two money flows were diagramed in opposite directions. The internal flows of the system (and their interactions) are represented by solid lines. For the sake of clarity, not all lines are diagramed in Figure 2. They were substituted by a symbol which represents a "subsystem" and is labeled with the name of the subsystem to which the line was originally bound.

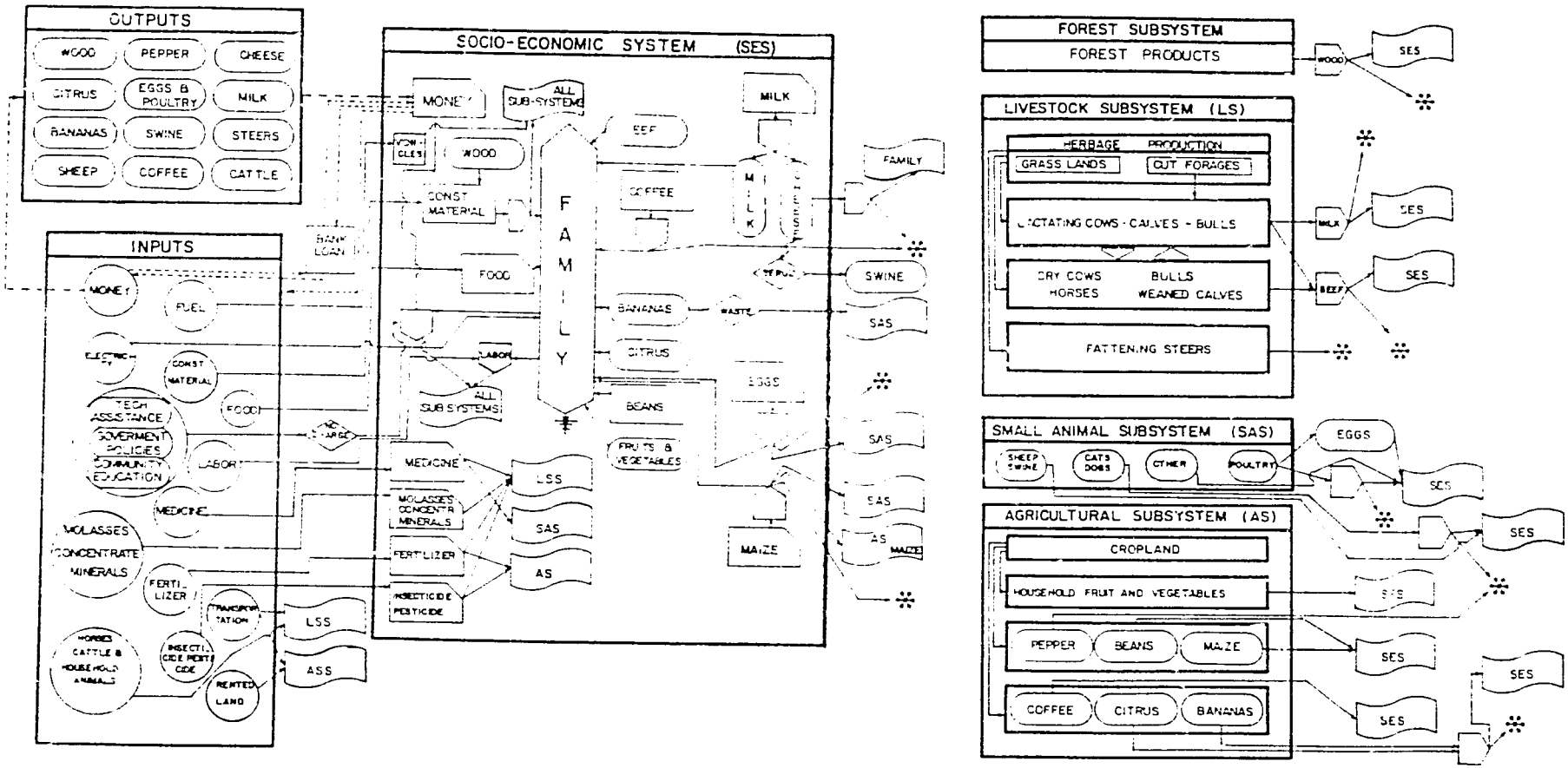

Figure 2. Qualitative model of farm used in study.

Source:	external to the system such as energy; goods needed for production
Storage:	products that are going to be used eventually; does not produce additional energy
Subsystem:	Used when input or output interacts with specificed subsystem
	Living beings of the farm such as family, insects, cattle, etc.
Product:	generated by the system
Decision:	interaction among flows; event can be influenced by a number of factors
	Components of the farm without considering the internal process of each one
Market:	sale of products generated by the subsystems
Condition:	in order for the event to happen the condition has to be fullfilled
Sink:	losses that occur in all processes due to energy being transformed into heat
Money flow:	used when a money transaction takes place
Internal flows:	represents the flows and interactions of the system

Figure 3. Symbols used in the qualitative model (adapted from Odum, 1971 and Hart, 1980)

Average distance to the nearest road was 300 m; seven farms were situated on the roadside, four less than 0.5 km away and two from 0.5 and 1 km. Ten were near a dirt road and three near a paved one. Average distance to the nearest town was 7.4 km (range 3-15 km).

Only one unit had electricity for farm purposes, but three farms had electricity for household use. Eight of the producers were 30 to 50 years of age; the remaining 5 were above 50. Ninety-two percent were married and had 4.9 family members that were economically dependent (54% had 1 to 4, 38% 5 to 8, and 8% greater than 8). With respect to literacy, 70% were literate, 15% were illiterate and the remaining 15% did not answer the question. When asked about mass media communication, 54% read a newspaper at least once a month, 100% listened to the radio at least once a day, and 24% owned and watched television regularly.

Physical Resources

Land

The average land area used for livestock purposes was 26.3 ha and 4 ha for agricultural purposes. Seventy-seven percent of the farms had land for agriculture. Only two farms rented land for agricultural purposes. Those renting land already owned some crop land.

Land was variable in value. Although the quality of land had some influence on price, the location with respect to ejidos was an important factor. Land near an ejido (peasant cooperative) risked a greater chance of invasion. When ejidos are overpopulated, they try to obtain additional land by invading private properties and using legal procedures to incorporate them into the ejido. It has been the experience of farmers that the farther away from ejidos, the greater the land security. This affected price greatly. For example, in early 1982, Farm 1 stated that the price of one hectare of pasture land was around 60,000 pesos. The area surrounding this farm had several ejidos. By comparison, Farms 6 and 7 were situated in an area "free of ejidos" and the same amount and type of land was valued up to 250,000 pesos. Agricultural land usually was priced between 60-100% higher than pasture land.

Facilities and Equipment

Nine farms had a house on the premise. These were constructed with a combination of wood, bricks and cement and were from 2 to 46 years old. Thirty-one percent had some type of storage facility, ranging from a shed to a full-sized room. All farms had perimeteral fences, generally made from wood posts and 3 to 4 strands of barbed wire. Twelve had a covered milking shed which consisted of a small holding pen for the calves and a general milking area. Construction varied from wood with composition roofing and dirt floor to concrete-steel structure with aluminum roofing and cement floor. All farms had a stockyard varying from 50-300 m^2. Only one had a handling facility (shute and restraining stall). One farm had a silo structure. Fifteen percent had feeding bunks and molasses dispenser. Nine farms had salt dispensers (usually a dug out tree trunk). Five had a well that was used for household and/or watering cattle; six had a water tank which was used as a watering facility and/or household purposes.

All farms owned at least one milk container (range 1-5) and bucket for milking. Size varied from 15-40 liters for containers and 3-10 liters for buckets. Ten farms had horse saddles; twelve owned sprayers for tick control. One owned a forage chopper.

electricity generator and wheelbarrow. Two had water pumps which were used either for household purposes or watering cattle. All farms had agricultural implements such as hoes, shovels and machetes. Three farms owned fumigators, used for banana and coffee plantings. Two owned tractors, with plows and platform cart, used for farm chores or transportation to and from town, and four owned vehicles (2 pick-ups and 2 cars).

In general, all facilities and equipment were of very simple design and no superfluous material was present, with the exception of Farm 2 which was located where a large dairy formerly operated. Capital investment in construction and equipment was low; farms used their restricted resources efficiently.

Cropping

Three farms had no crops but could incorporate land into agriculture. Farm 2 had an avocado grove that could start producing with some work. Farm 5 had some lots which had produced crops in past years. Farm 12 rented some orange groves. Of those farms with crops, 30% had monoculture (bananas or coffee), 40% had two crops either intercropped (corn - beans, corn - pumpkins, orange - bananas, bananas - lemons) or two crops such as coffee and corn, and 30% had three or more crops intercropped (coffee - oranges - bananas, corn - beans - pumpkins) or a combination intercropped with individual crops (oranges and corn - beans, coffee - bananas - oranges and corn - beans or green peppers).

Farmers gave several reasons for intercropping or having more than one crop: a) to produce their own staple crops (corn and beans) and some cash crops (oranges, bananas and coffee), b) diminish risk of losing all income related to agriculture. A widely cited example was the price decrease of citrus in December, 1982 due to closure of the U.S. border by USDA because of a possible outbreak of a bacterial-related disease. However, price of bananas and coffee increased which helped to overcome the loss in citrus income.

Land was prepared for annual crops either once or twice per year (January-February or June-July), using draft animals, tractors, or a combination, but never solely by hand. The preparation was usually done by hired labor. Fertilization and insect disease control was performed regularly. Annuals were usually grown for home consumption except for peppers which were used as a cash crop. For perennial crops (citrus, bananas, and coffee), the main activity took place during pruning (February-March). At that time fertilizer was applied. Fumigation against insects and diseases was principally done on banana plantations. No other preventive practices were common. When problems arose, producers asked neighbors, agricultural supply stores or government agencies about control measures.

None of the farms grew sugarcane, a traditional crop in the area because large extensions of land would be necessary to make it economically feasible, it would be in direct competition with the livestock enterprise, or land was not considered suitable for crops.

Commercialization of annual and perennial crops was principally by middlemen who would market the products in the larger urban areas such as Mexico City. Annual crops like bananas and coffee were harvested by owners and picked up at the roadside by the buyer. Citrus was generally sold in the grove with the middlemen responsible for harvesting.

Producers made efforts to create their own marketing organizations; at times with the help of government agencies. Results have been mixed since middlemen control

the whole marketing structure. Banana producers were able to create a successful cooperative. The government tried to set up a coffee collection network by offering advantageous prices but due to the bureaucratic process, producers sometimes waited 2-3 months for payment. Since cash flow was a concern, they tended to accept lower prices from private buyers who paid cash.

Livestock

Table 2 contains an itemized inventory by class and farm at the beginning. The final inventory looked very similar, with an average of an additional cow per farm. Only Farm 5 had a considerable loss of cattle due to termination of a contract. On the average, there were 32.5 head; 13.9 were cows, 7.5 heifers and 5.6 female calves. Female cattle made up 73% of the total. There were 13.7 (36%) heifers and female calves for replacements when necessary. Only one farm did not possess a bull and one had two. The average was one bull per farm. Bull calves (to be fattened as steers) were on three farms. One farm had 89% bull calves for fattening. There were 5.3 male calves (generally sold betwen 200-250 kg weight). Farm 11 did not keep calves. They were sold shortly after birth.

When location was considered, Inland farms had a higher proportion of cows and heifers and lower percentages of calves than Coastal farms. Both areas had approximately the same proportion of female cattle (heifers and female calves) for replacements (38% Coastal vs. 40% Inland). Size showed marked differences; percent cows were 19 points higher for small farms (56% small farms vs. 37% large farms). Size of farm was related to replacement ratio, 1:0.5 for small farms vs. 1:1.1 for large farms.

Although household animals were not included, they were important too. The most common species were fowl, of which poultry was the majority with 38 head. They were present on all farms. Turkeys and ducks were in lower proportions but not on all farms. Fowl was used as a source of protein (eggs and meat) and to complement the cash flow by selling eggs and live birds. The returns were important in some instances to ease the "cash flow squeeze" that farmers encountered at times. Seven farms owned swine. Farm 10 owned 71% of the total amount. When present, farmers had 2 to 3 gilts and usually hired the services of a boar for services as needed. Only one farm had sheep. This species is becoming more popular in the area since the demand for lamb and sheep meat has increased considerably. It has become a profitable secondary enterprise, especially in combination with citrus groves, where sheep can harvest grass which would need removal either manually or chemically.

Horses, donkeys or mules were present on nine farms. They were principally used for livestock-related activities and as a means of transportation when roads were not accessible to motorized vehicles due to adverse weather.

Household animals, such as poultry, were taken care of by the female members. Their diet consisted of household waste, some corn and scavenged products.

Pasture Management

Grazing Systems

At the beginning of the study, five farms (38%) reported use of rotational grazing. However, on later visits, the surveyor became aware of differences in what was understood by the term rotation. The traditional definition of grazing one paddock and letting the remaining rest and regrow was not used. Farmers understood rotation as: a) herding

Table 2. Cattle inventory by farm (initial).

Farm No.	Cows	Heifers	Bulls	Bull Calves	Calves	Calves	Total
1	37	24	2	6	14	16	99
2	11	5	1	1	9	6	35
4*	6 + 4	3	1	0	3 + 2	3 + 1	23
5*	9 + 5	8	1	0	8 + 2	9 + 2	44
6	5	3	1	0	2	2	13
7	10	2	1	0	3	2	18
8	8 + 1	5	1	0	2	4	20
10	9	3	1	48	4	2	67
11	3	3	0	0	0	0	6
12	15	5	1	0	3	2	26
13*	16 + 6	4 + 2	1	2	6	6	35
16	7	2	1	0	1	4	15
18	29	28	1	0	10	14	82
Total	181	97	13	57	69	73	490
Avg.	13.9	7.5	1	4.4	5.3	5.6	37.7
%[1]	37	20	3	12	14	15	100

*The numbers after the plus sign are cattle that are not property of the farmer but he receives half of the calf crop and all the milk produced as payment for keeping them.

[1]Percentage of total head

animals to areas with larger forage supply within one pasture (but no grazing control was afforded by fencing), b) moving animals among pastures which are divided by geographical barriers such as rivers, roads, cliffs, etc. (even though both pastures were continuously grazed), or c) both (a) and (b).

Only three farmers had pastures divided by fences. Rotation of cattle occurred with no set time span, being influenced by forage availability. In general, the concept of rotational grazing for native grasses, used as a method to increase productivity, was unclear to farmers. This was not surprising since not even researchers have been able to reach a concensus on its value with native grasses (Lansbury, 1960). Crowder and Chheda (1982) mentioned that continuous grazing is the most common way of managing native grasses of low productivity. This agreed with the findings, since nine farms (70%) grazed their pastures continuously.

Farm 11 used a zero grazing system. Only harvested grass was offered. It came from 0.5 ha of elephant grass Pennisetum purpureum, and cut forage from roadsides and nearby orange groves. Farm 13 also had a 0.25 ha plot of elephant grass used to supplement calves. In general, harvested forage was not a common practice due to the labor involved. Seven farms divided their herds for grazing purposes. The most common system was keeping the lactating cows in the pastures nearest to the milking shed.

Pastures

Farmers devoted 23% of their livestock activity time to controlling weeds or cutting back overgrown pastures. Weed control was a normal practice except for two farms (4 and 6). This time was well spent, since the average percent of weeds present was 10%. Weeds were defined as plants located in an area in which there is no use for them (Garcia, 1984). Table 3 shows some of the species of grasses, legumes and weeds. Farm 4 alternated crop land with pasture land which proved to be effective in weed control. Farm 6 mentioned that the appearance of weeds was minimal after sowing star grass (Cynodon plestostachyus), an aggressive grass that did not let other species proliferate.

Of the remaining eleven farms, eight used chemicals as the main method of weed control and three used manual control. None used mechanical methods (e.g., tractors). When chemicals were used, only those plants considered as weeds were sprayed, however, the surveyor observed that the farmers sprayed chemicals on most plants that were not grasses. Farmers did not differentiate between native legumes and weeds since they could not tell them apart nor did they know about their higher feed quality. Burning of pastures was used to some degree for weed control and overgrowth. Farmers believed this practice would enhance the palatability of the pastures since cattle would ingest regrowth. Burning was performed primarily in March and April, before the rainy season when plants were still dormant. Overgrowth of the summer months was used as "standing hay" during the winter months (November-March). As soon as that season passed, pastures were burned to maximize regrowth and open overgrown patches.

The area was relatively free of insect pests and plant diseases, but due to the increasing popularity of improved grasses, the attack by a Lepidoptera larvae of the Geometridae family became common. Farmers tried to control these attacks when they appeared rather than to prevention. Only Farm 12 fertilized elephant grass. All others found that fertilization was too costly to adopt as a regular practice.

Grasses with the highest proportion in the stands were Paspalum spp and Axonopus spp, up to 60%. These grasses form a light cover due to high rhyzome production and possess a deep root system. They are part of the vegetation created after clearing rain

Table 3. Most common grass, legume and weed species found in the area of study

Grasses		Legumes		Weeds
Paspalum	conjugatum	Desmodium	canum	Lantana camara
	virgatum		incanum	Cyperus spp
	notatum		scorpiurus	Bacchams conferta
			triflorum	Conostegia arborea
				Gunnera mexicana
Axonopus affinis ssp		Mimosa	pudica spp	Alnus arguta
				Inga edulis
				Prunus capuli
Sporobolus spp				
		Galopogonium mucunoides		
Setaria spp		Crotalaria mollicula		
		Diphysa spp		
Cynodon dactylon		Centrosema spp		
		Calliandra spp		
		Cassia spp		
		Chamaecrista spp		
		Gliricidia sepium		
		Stylosanthes spp		
		Macroptilium atropurpureum		
		Teramnus unanatium		
		Indigofera spp.		

forests. They are susceptible to seasonal changes (low temperature and precipitation). They stop growth during winter months and the dry season, but become active when precipitation and temperatures are adequate.

Legumes made up the smallest proportion, about 6.3%. Such a small amount and a high variability was because farmers considered them weeds and tried erradication. Also, the acidic soils of the area were deficient in such microminerals as molybdenum (CIEEGT, 1982).

Table 4 shows percent DM (dry matter) in grasses and legumes and estimated yields. Season effects are obvious. Species such as Axonopus affinis and Paspalum dialatatum grow extremely slow, at 10-15°C (Cooper and Tainton, 1968).The area of study had temperatures below 15°C during December-February and precipitation less than 85 mm January to May. These two factors caused yields to be low January to May. Percent DM was high during February and April. Such high values could have affected forage intake. The grass-legume ratio was similar from January through September (with the exception of July which was abnormally high). It decreased from October to December. This variability is common in grasslands because of its dynamic nature, in addition to the heterogeneity that grazing animals add through patchy and choosy defoliation (Harper, 1978).

Quality of Forages

Average DOM (digestible organic matter) for grasses was 78%, with a CV of 8.53%. The average CP was 8.1 with highest values March to April and lowest in June when not much growth was taking place. Average DOM for legumes was 69% (CV 10.22%) which was lower than for grasses. Lower DOM in legumes was caused by the presence of chemical substances such as tannins (Baker, 1978).

The CP of grasses was marginally adequate during the first five months of the year and declined thereafter. Even if CP content of legumes was higher than for grasses, the quality of those present (Table 4) was not enough to increase the percent CP of the total diet significantly. The low nitrogen content of feeds in the area could potentially cause protein deficiencies which would be reflected in low milk yields and average daily gains (ADG).

Values for monthly digestible dry matter (DDM) available (kg/ha) per hectare are in Table 5. On the average, there was 620 kg of grass DDM and 23 kg of legume available for grazing. For grasses, quantity was high in August but low in March and May. Legume DDM was high October to November but low in July. Carrying capacity (CC) was calculated by dividing 60% of the total DM (to protect the grasses and legumes from overgrazing) by the amount of TDN needed by a 400 kg cow producing 4 kg of 4% fat milk (NRC, 1978). On the average, CC was 2.9 AU/ha. Lowest CC was during March and May and highest in August. These periods corresponded to the driest and wettest periods, respectively. The seasonal pattern of pasture growth becomes a major problem from the management point of view (Raymond, 1970, and Edye, Williams and Winters, 1978). Considerable grass growth occurred during the rainy season, which started in June (Table 1). Pastures were commonly understocked since farmers adjusted CC on the DDM available during the dry season. DDM decreased from December to May. This period was characterized by almost no plant growth.

Supplementary Feeding

Salt supplementation was used on 92% of the farms. Farmers did not offer it on a regular basis, but did on those occasions when there was a reason to round up cattle

Table 4. Standing forage mass (kg/ha)

Mo.	% DM[1]	Dm Available (kg/ha) Total	Grass	Legume	Grass/Legume Ratio
Jan	22.37	1098	990	63	16:1
Feb	38.15	1815	1415	78	18:1
Mar	30.80	1120	934	59	16:1
Apr	38.70	1345	1146	52	22:1
May	25.64*	1588	927	45	21:1
June	25.04*	1612	1343	75	18:1
July	30.65*	1438	1289	12	107:1
Aug	22.13*	1767	1536	83	19:1
Sep	24.61*	1631	1364	99	14:1
Oct	25.58*	1566	1212	206	6:1
Nov	27.51	1719	1364	190	7:1
Dec	28.77	1559	1264	139	9:1
$\bar{x}$	28.33	1521	1232	91.75	
S.E.	1.58	66.97	56.78	16.87	
C.V.	19.32	15.25	15.96	63.69	

[1]Average DM content grass plus legume

*Fitted values

and "they remembered", which happened 3-4 times per year. It was usually common table salt, mixed with a commercial mineral mixture. Farm 4 did not deem it necessary to offer salt. The fact that cattle did not present any evidence of major mineral deficiencies does not mean that imbalances did not exist. Inadequate mineral relationships in feedstuffs may be a significant factor in the performance of livestock but these inadequacies may be overshadowed by other nutritional deficiencies such as energy and/or protein and therefore, are difficult to identify.

Only Farm 11 offered concentrates on a regular basis. The owner considered that feeding only forages did not fill the nutritional requirements for desired milk production. Two farmers used by-products regularly (molasses and bananas), especially during the winter season (December-February). The owners stated this benefited the cattle. The remaining farms used some by-products (corn stover, surplus bananas, corn cobs, etc.), according to availability. However, when asked if they would consider using them regularly, the general answer was that they could not afford it or it was difficult to obtain them in sufficient quantity.

The surveyor visited a number of feed distributors and sugar mills to inquire about availability of molasses. It is produced during December-May. Even if in stock, two factors hampered farmers from freely obtaining molasses: a) the bureaucratic process involved in the purchase (sugar mills in Mexico are run by a government agency), and b) a deficient distribution system. A number of other by-products such as citrus pulp, banana stems and leaves and coffee pulp and hulls, are available in the area on a seasonal basis in limited quantities.

Milk Output

The system used by most farmers was designated as dual purpose, beef and milk production (DP). In this system, the calf is an integral part of the process. At each milking (once per day between 5:30-7:00 a.m.) the calf is allowed to suckle each teat briefly to encourage milk letdown. The calf is then tied near the mother (usually in front or on one side). The cow is partially milked and turned out with the calf to allow it to consume the remaining milk. Farmers believe that their cows would not let their milk down properly and/or had shorter lactations if the calf is not present at milking. Different methods were used to leave enough milk for calf growth. Usually, when the calf was less than 2 months of age it was left one whole quarter of milk. Afterwards, intake was regulated by partially milking all quarters and leaving only residual milk. The challenge to the producer was to remove and sell as much milk as possible while allowing enough to keep the calf in good condition.

Farm 10 had cows and a group of 48 steers for fattening purposes. Steers are common in the area. Usually producers (within this size group) either give priority to the cow-calf operation or fattening steers, but not both.

On Farm 11, management procedures were more sophisticated (cows in confinement, cut grass and concentrates). Cows were milked twice per day and calves sold as early as possible.

The average milk was 3.7 kg/day during a lactation of 311 days, for a total yield of 1151 kg (Table 6). Roman-Ponce and Roman-Ponce (1981) reported higher yields (4.5 kg/day) and Salmon and Warnken (1982) mentioned daily production of between 3-4 kg. Both reports summarized observations in areas of the Gulf of Mexico but did not indicate if the milk consumed by the calf was included.

Table 5. Digestible dry matter kg/ha and estimated carrying capacity per ha

Month	Digestible Dry Matter (kg)			Estimated Carrying Capacity /ha
	Grass	Legume	Total	
Jan	503	18	521	2.3
Feb	734	22	756	3.4
Mar	459	14	473	2.1
Apr	594	11	605	2.7
May	467	11	478	2.1
June	606	19	625	2.8
July	647	3	650	2.9
Aug	837	25	862	3.9
Sept	686	25	711	3.2
Oct	597	53	650	2.9
Nov	685	47	732	3.3
Dec	635	35	670	3.0
Ave	620	23	643	2.9

Farm 11 had the highest average, which was expected since there were better nutrition practices and a specialized breed. However, when compared with other reports where European breeds are involved, average yield was about 42% lower than reported by Bodisco (1971) in Venezuela, Roman Garcia et al. (1979) in Puerto Rico and Alberro (1980) in Mozambique. Milking was not a year-round activity on all farms. Four farms did not milk from 4-12 months during the 14 months of the study. Different reasons were cited, but the general answer was low productivity (<4 kg milk per day). The most common period when milking was not performed was December to May which coincides with the season of low forage availability. On the average, 55% of the cows in the herd were lactating at a given time, December was the lowest (49%) and August highest (68%).

When farms were divided according to region (Coastal and Inland) differences in milk yield per day were small (3.8 kg vs. 3.5 kg). Small farms had higher daily yields per cow (4.0 vs. 3.3). Small farm owners tended to milk their cows more completely in order to obtain larger quantities to sell. If lactation length is considered, the difference between regions with respect to milk yield per lactation is small (less than 140 kg). When size is considered small farms produced around 230 kg/cow/lactation more than larger farms.

When cows were divided according to season of calving, yields for cows in Season 1 had peak yield during the seventh month after calving (May). Cows in Season 2 and 3 peaked three months after parturition (May for Season 2 and September for Season 3). Peak production was similar between Season 1 and 2 (4.0 kg vs. 3.9 kg) but was higher than Season 3 (3.5 kg). When average daily yields were plotted all cows peaked around May September, which was the period of adequate forage availability (Table 4). Although calvings occurred year round, Season 3 calvers were more nutritionally stressed since the plant growing season ended in September to October.

Lactation length averaged 311 days (Table 6). (Five records were excluded because they were less than 100 days and had an abnormal termination (disease, death).)

Calves were weighed as often as possible. The information in Table 7 was the product of 139 observations. Since only a few calves were weighed at birth, an estimated birth weight (BW) of 30 kg was considered adequate after consulting reports that dealt with this problem (Orozco, 1984; Plasse, 1981). Calves gained 130 kg during the first year (0.36 kg average daily gain, ADG). Gains varied according to periods, being the highest during 170-181 days (0.45 kg). Growth rate of calves was low compared with U.S. beef breeds (Koch and Clark, 1955, and Marlow and Gaines, 1958). Weaning at 180 days, calves would weigh 144 kg. Calves in this study obtained comparable weights at least three months later. The reasons for lower performance are multiple. Factors such as amount of milk offtake for household or marketing purposes, calving season, and plane of nutrition of cows.

It was difficult to determine the amount of milk consumed by the calf. It is possible to estimate milk intake by weighing the calf before and after suckling. The difference in weight would be milk intake but it is stressed that when consumption is low this method may prove inaccurate. An approximation can be made if it is assumed that growth is totally dependent on milk during the first three months. If for each kg of live weight gained, 10 kg of milk are consumed (Warner, 1984), then calves were consuming 2.7 kg/day for an ADG of 0.27 kg (Table 7). After 3 months, some browsing was observed, but it was unclear if it was enough to cause the rumen to become functional.

Table 6. Milk production and lactation length by farm.

Farm No.	Daily Milk Production/Cow	Lactation Length (Days)
1	3.48	390
2	4.22	239
4	3.87	NA
5	2.95	306
6	4.80	NA
7	3.56	302
8	4.01	250
10	2.74	NA
11	5.17	237
12	2.78	338
13	3.85	237
16	3.09	NA
18	3.13	274
Mean	3.67	311

Table 7. Calf weight, ADG and related statistics over four periods

Days after Calving	Ave.	S.E.	C.V. (%)	ADG	#Obs.
0-90	54.36	2.25	24.9	0.27	36
91-180	90.43	2.81	21.11	0.40	46
181-270	130.88	4.63	23.20	0.45	43
271-360	162.00	12.85	29.68	0.35	14

Reproductive Performance

Only 4 farms recorded data adequate for estimating breeding efficiency. All farms used natural services with one or more bulls. Four farmers borrowed bulls. Two farms had bulls year round (a larger producer lent them as young bulls and allowed them to stay until full grown). Of the remaining two, one would pick the bull up from a neighbor and the second (Farm II) took cows to be serviced and paid cash. The other 9 farms either had one or more bulls. Bulls ran with the herd continuously. Farmers stated that heifers were serviced at 2-3 years of age. This was an acceptable estimate since over 80% of first calvers did not have all adult incisors. Zebu cattle, which were the main type in the area, seldom achieve sexual maturity prior to two years of age, irrespective of environmental conditions (McDowell, 1976).

Approximately 50% of the calvings occurred from December to March. This meant that the largest number of cows conceived April to July when forage availability was adequate. There was also a surge of calvings in July. More observations are needed to determine if this pattern is normal.

Average calving interval (CI) for all farms was 486 days (16.2 months). When age was considered, there was a difference of 72 days between young (530 days) and adult cows (458 days). McDowell (1984) mentioned that longer CI's are observed in young cows, irrespective of climatic or nutritional stresses; however, it may be argued that since first calvers were still under developmental stages, nutritional deficiencies could aggravate the problem.

Animal Health

Animal health is an important aspect of a management program. Livestock owners practiced "combat" rather than preventive medicine. Even though they dipped (23%) or sprayed (77%) against ticks (by penalty of law) and 92% vaccinated against blackleg and/or hemorrhagic septicemia and/or anthrax, activities were minimal and irregular. When an animal was sick, farmers consulted the diagnostic lab or a "knowledgeable" person in town 77% of the time and 23% of the time they would go to the local pharmacy.

The California Mastitis Test (CMT) was performed from August 1982 to April 1983 on all lactating cows. The percentage of quarters with positive subclinical mastitis are in Table 8. No difference was found among quarters or months. The overall percentage was 21.6 which is comparable with values from New York State (Merrill, 1984). The incidence of subclinical mastitis of free ranging beef herds was reported as 13-18% (Hunter and Jeffrey, 1975; Haggard et al., 1983). The higher percentages in Table 8 are due to the milking procedures. Farm differences were important. Milkers were divided into two groups: family labor and mixed labor. Family labor was more careful with milking chores. The incidence was 17.6% for family labor vs. 28.6% for mixed labor. Only twelve cases of clinical mastitis were reported. This was surprising because no sanitary precautions (e.g., udder washing, teat disinfection) were taken before, during and/or after milking. One would have expected a higher incidence; however, the possibility of bacterial growth may have been low since the calf had a chance to suckle the udder and left no residual milk.

Two samplings were done on 363 cows for brucellosis; 98.9% had a negative reaction and 1.1% were suspicious, but no positive cases were identified. Animal health authorities in the area are worried because a higher number of cattle are being brought in from temperatre areas and no effective program exists for control of brucellosis.

Table 8. California Mastitis Test (CMT) scores by month and by quarters as indication of subclinical mastitis

Month	AR[1]	AL	PR	PL	Average
Aug	17	16	17	19	17.2
Sep	22	15	21	11	17.5
Oct	23	20	32	31	26.5
Nov	19	26	28	31	26.0
Dec	19	24	19	19	20.5
Jan	24	18	22	18	20.5
Feb	16	21	26	25	22.0
Mar	33	23	24	20	25.0
Apr	11	21	21	26	19.7
Average	20.5	20.4	23.3	22.2	21.6

[1]AR anterior right (quarter)
AL anterior left
PR posterior right
PL posterior left

All farmers were aware of internal parasites. Forty-six percent used control measures at least once per year; 31% twice, and 23% more than two times. All employed an injectable product. However, some confusion existed concerning the type of parasites that were being controlled. There are two lines of products currently on the market: one controls gastrointestinal and pulmonary parasites in addition to fasciola, and the second fasciola controls only gastrointestinal and pulmonary, but for fasciola one needs a special drug. In general, farmers tended to use those products which were least expensive. It was normal practice to treat only those animals with a poor physical appearance. Farmers subjectively treated for internal parasites; that is, no parasite checks were done before treating. Reasons given for not checking were: a) unaware that parasitic populations could be determined by a feces check; b) unfamiliarity with the sampling procedure; and c) diagnostic laboratories were too distant.

Calves tended to be more susceptible to parasites than cows (39.6 vs. 55.2%). Sixty-one percent of the farms had less than 40% positive cases for cows. Five farms were situated in areas where fasciola is common due to waterlogging. This had an influence over the positive cases since control is not efficient. The month of May had an unusually high percentage of positive cases. This could be explained by the onset of the rainy season which produced a surge of parasite populations.

There was an inconsistency between what the farmer and the surveyor considered disease. It is probable that the surveyor did not pose the question clearly or he did not ask it routinely. Farmers did not seem preoccupied with disease because usually no mention was made during the interviews. Incidence was low. Only the death of two calves was reported. Six cows died: three accidentally, one due to calving difficulties, and two due to unknown causes. Reproductive disorders were common. According to farmers, abortions often happened during the 5th to 6th month of pregnancy. They believed that the abortions were due to toxic plants. Reports exist of some toxicities due to plants in the Area (Aluja, 1970) but no mention was made of the effect on reproductive performance. Although disease could be considered a minor problem in the area, further study is needed.

Selected Indicators of Performance

Number of cows per farm was 14 (41% of the total herd), ranging from 5-38% (Table 9). Cow numbers were positively correlated with ha of grasslands available on the farm (0.986) and moderately related to a technological index (TI) (0.641), calving interval (CI) (0.584), and amount of hired labor (0.547). A negative trend was found when compared with AU/ha (-0.611) and kg of milk per cow (-0.317). As number of cows or ha of grasslands increased, CI increased, while AU/ha and kg of milk per cow decreased. When area of grasslands or number of cows increased, farmers were less concerned in obtaining high outputs per head of cattle and depended more on the number of cows to obtain adequate levels of milk and meat to cover their needs. The percent cows in milk averaged 55%, with a range of 35 to 100%. No single indicator had a definite influence on this parameter, but CI was the one most related (0.324). Number of births per farm was 9.6 calvings per year (70% calving). Birth rate was negatively correlated with lactation length (-0.478) and CI (-0.357). Lactation length and CI averaged 311 and 486 days, respectively. These were strongly correlated (0.813). Days dry averaged 175. All three parameters varied widely. Lactation length and CI were moderately influenced by family labor (0.522 and 0.636, respectively). With family labor, cows tended to milk for longer periods of time.

No single factor appeared to influence milk yield significantly. There was some influence of AU (0.444) and TI (0.346). Milk production was negatively correlated with CI (-0.596) and in less proportion to animal extraction (AE, -0.356). Milk yield of cows

Table 9. Selected indicators of performance by farm.

Farm No.	No. cows	% Cows in prod	No. births	Lact length	Days dry	Calving interval	Animal units/ha	Yield/kg day	Yield/kg lactation	Yield/lg ha	Animals extracted
1	38(38)[1]	66	25(66)[2]	390	157	547	0.81	3.5	1357	1099	27(27)
2	11(35)	63	10(96)	239	163	402	1.90	4.2	1009	1917	12(36)
4	7(39)	64	2(29)	NA[3]	NA	NA	2.13	3.9	NA	NA	3(17)
5	8(28)	62	7(94)	306	157	463	1.43	2.9	903	1291	13(44)
6	5(39)	63	2(36)	NA	NA	407	1.45	4.8	NA	NA	3(21)
7	11(55)	50	10(91)	302	114	416	2.31	3.6	1075	2483	zero
8	9(39)	46	9(100)	250	154	404	1.70	4.0	1002	1703	3(13)
12	16(57)	35	4(25)	338	NA	NA	0.76	2.8	940	714	11(39)
13	15(44)	41	10(71)	237	185	422	1.03	3.8	912	939	7(17)
16	7(45)	100	5(80)	NA	NA	NA	1.22	3.1	NA	NA	3(18)
18	28(34)	67	22(81)	274	186	460	0.92	3.1	860	791	24(28)
Ave.	14(41)	60	9.6(70)	311	175	486	1.42	3.7	1150	1367	9.6(24)

[1]Number in parentheses expresses % of total herd

[2]Number in parentheses expresses % of total cows

[3]NA = not available

kept for dual purposes was affected more by seasonal factors than stage of lactation. Milk yield per lactation was 1150 kg (range 860 to 1257 kg). It was moderately influenced by milk yield per cow (0.624), lactation length (0.510), and TI (0.588). A negative correlation was found when compared with number of births (-0.466). Farmers stopped milking their cows when yield was 1.1.5 kg/day. Milk yield per ha was 1367 kg, ranging from 714 to 2483 kg. It was positively influenced by AU/ha (0.923) and moderately by daily milk yield per cow (0.628). A negative trend was found with ha of grasslands (-0.610), number of cows (-0.549), and AE (-0.517). Annual extraction (AE) averaged 9.6 head per farm (24% of the herd), ranging between 3 and 27. There was a negative relation with AU/ha (-0.488) and milk yield per cow (-0.356).

Marketing

Dairy products and livestock were commercialized either for regional consumption or transported to larger urban areas such as the City of Veracruz or Mexico City for consumption. Milk was sold in either fluid form or as cheese. Fluid milk was sold to:

-neighbors, sold directly as raw milk.

-local distributors ("boteros"): individuals that picked milk up at the farm, then sold it in nearby towns or specified routes. On the average they picked milk up from 5-10 farms (150-200 liters) then distributed to 40-60 clients (2-3 liters per client). The price difference between that paid to farmers and paid by consumers was 50-60%. Milk was sold raw. Distributors added 10-15% water to the milk before selling. It has become such common practice that whenever milk was not "watered down" consumers complained about the "strong flavor". The boteros were loosely organized as a group and paid dues for a permit to local authorities (500 pesos/yr). Health authorities checked the quality of the product 2-3 times a year. They looked for high bacteria counts or grossly adulterated milk. If found, the distributor was fined. This rarely happened since the service is understaffed and quality control standards flexible.

-pasteurizing plants or Nestle Company (milk was collected at the farm and taken to collection points from which it was shipped to the processing plants for producing powdered or condensed milk). Up to 20,000 liters/day were handled by processors during the summer months.

White cheese (Queso) was produced either directly by the farmer, or by specialized cheese processors. Those farmers producing cheese sold it to neighbors or to small grocery stores in nearby towns. The specialized cheese processors collected milk from farms and took it to their facilities which generally were rudimentary. Size ranged from 400-4000 liter capacity. The majority of the cheese was sold locally. Of 13 farms, 3 sold milk to neighbors, 4 to local distributors, 3 to cheese processors (one started processing his own cheese in November, 1982), one to a pasteurizer and one processed cheese. Average monthly milk sold per farm was 647 kg, range 489-805 kg.

The average milk price received by the farmers was 15.6 pesos/liter. Highest price was obtained when sold to neighbors (18.7 pesos) and lowest when sold to cheese processors (13.4). Price received by farmers for cheese was 181 pesos/kg. Assuming a milk-cheese ratio of 10:1, farmers would be getting 18.1 pesos/liter of milk which is comparable to that obtained when selling to neighbors.

Cattle sales were largely controlled by middlemen. These individuals were contacted by farmers (or vice-versa) whenever they had animals for sale. The price was set according

to the amount paid per unit of liveweight in the nearest urban market. Mexico City was the main guide. During the study, the price for 450 kg steers fluctuated:

April 1982	40/kg
August 1982	65/kg
December 1982	95/kg
April 1983	120/kg

Price of culled cows was 30-40% lower than for steers or calves, depending on their condition. Price for weaned calves (200-250 kg) ranged from 8000-14000. There was no apparent problem in selling cattle throughout the year. Only when the dry season extended 2-3 months longer than normal did producers have a harder time disposing of their cattle.

Meat was sold in local markets. Slaughtering took place daily due to the belief of the consumers that the redder the meat the fresher. Since refrigeration tended to be a luxury, consumers did not buy what appeared to be "old meat".

Labor

Only labor used for livestock and agriculture activities were tabulated (Table 10). Activities such as feeding poultry or pigs or selling goods other than dairy products were not included. These tasks were usually performed by women or minors. Although women and minors played an important role in the system, the study did not take them into consideration.

Labor was divided by age and type, with two groupings, adolescents (<18 years) and adults (>18 years). Both groups were given the same work capacity although adolescent labor might be less "productive". Adolescent labor performed such activities as milking, calf herding and feeding, and spraying for ticks which are activities that did not need a lot of physical effort. Total labor was made up of family labor and hired labor (which in the majority of cases were paid in cash). Only four farms used adolescent labor consistently (8.3% of total). Other farms used minors when certain activities such as herding or harvesting had to be done but it was not a regular basis. Adolescents provided more than a third of the labor on Farms 10 and 18. In one case it was tending cattle before school. Usually, half of the labor was provided by the family. It was a surprise to the surveyor since it was generally believed the farmers did not have the economic resources to pay hired labor. Those hired were usually neighbors, landless farmers or ejidatarios. A common complaint was that labor was becoming more scarce and expensive due to the high level of building construction underway in the City of Veracruz during the past few years. It remains to be seen what will happen to labor supply now that this trend has subsided due to the economic situation.

Almost three times more labor was used for livestock than agriculture (73 vs. 27%), Table 10. This level was expected since participating farms derived more than 50% of their income from livestock. Thirty-eight percent of labor in livestock was used for milking, 22% clearing pastures (weeding), and 13% handling and feeding calves. The remaining 27% was spent on all other activities.

Time spent in different activities must be considered very carefully, especially when focusing on possible changes in the system. For example, farmers spent 75% of their time keeping the operation running. If one of the proposed changes would be for him to keep more accurate records (assuming literacy), it would need to be a simple process. With respect to the agricultural activities, 91.1% of the time was used for

Table 10. Proportion of labor spent per activity for livestock and agriculture

Livestock		Agriculture	
Activity	% of Total	Activity	% of Total
Milking	38.7	Harvesting	50.3
Pasture clearing	22.7	Cultivating	40.8
Calf handling	12.2	Fertilizing	4.6
Milk handling	7.1	Sowing	1.6
Fencing	6.5	Clearing	1.2
Grass cutting	4.5	Fumigating	0.8
Tick bath	3.0	Plowing	0.7
Herding cattle	2.3		
Feeding calves	1.1	Total	100.0
Fumigating	1.0		
Supervising	0.5		
Drenching	0.2		
Vaccinating	0.2		
Total	100.0		

cultivating (40.8%) and harvesting (50.3%). These two activities were totally performed by hand.

When monthly labor requirements by type and age were considered, there was a higher demand from October-December for family adults and September and December for hired adults. Adolescent labor remained quite constant throughout the year. Labor requirements for agricultural and livestock activities increased sharply for agriculture October-December, which was the harvesting season for citrus and coffee (Table 11). Monthly labor for livestock was quite constant throughout the year except for September when it increased sharply. It was during this month that a lot of pasture cleaning occurred. When livestock activities reached their peak (September), agricultural activities were very low. The contrary happened in December when harvesting was at its peak.

Economic Considerations

Based on income, expenses, and inventories of resources available on the farms, a cost-benefit analysis was conducted (Table 12). Farms 10 and 11 were not included since they differed considerably from other farms in their objectives, but on the remaining eleven farms, the most important component of the investment was cattle, 66% of the total; buildings, 26%; and the remaining 8% was machinery, equipment, tools. Coastal farms had a smaller investment in cattle (64% vs. 70%) but higher in buildings (28% vs. 22%). Differences were more noticeable when farms were compared by size. Small farms had lower investments in cattle (59% vs. 71%) but higher on buildings (31% vs. 21%).

The value of production (VP) for all farms was made up of milk receipts (46%), livestock sales (43%), and change of inventory (10%). When VP was considered according to location, milk receipts were similar for Coastal (46%) and Inland (45%) farms. The same was true for livestock sales (40% vs. 48%). A bigger difference was noticed for inventory (14% vs. 7%). Milk receipts were not different between small (43%) and large (47%) farms.

The most important expense in variable costs (VC) was labor (76%), followed by spares and gas (13%), with the remaining (11%) used for the purchase of feed, medicine and miscellaneous expenses. Inland farms spent 90% of the VC on labor vs. 70% for Coastal farms and Inland farms spent only 4% for spares and gas vs. 17% for Coastal. When size was considered, differences were principally in labor; small farms 90% vs. 74% for large farms.

Forty percent of the fixed costs (FC) for all farms were due to the interest on capital. Rent of land and depreciation were 30% each. Rent of land was 37% for Inland versus 27% for Coastal (Coastal farms were smaller). Interest on capital was similar (42% Coastal vs. 40% Inland) and depreciation differed by 9% (31% Coastal vs. 23% Inland). Rent of land was 21% for small farms vs. 34% for large; depreciation made 42% of the FC for small vs. 25% for large. Interest on capital was similar (37% vs. 41%).

Small quantities of money were invested in other than cattle. The amount of improvements per farm was low, meaning that farmers had limited resources to spend in repairing fences or buildings. It is also possible that the surveyor did not pursue the question enough to obtain full details.

The proportion of labor for VC was somewhat more variable (70-90%); however, it could be considered enough to classify the farms as labor intensive enterprises. Small percentages of the VC were spent on medicines or feed. This supports the idea discussed in the health section, in that farmers did not practice preventive medicine but rather

Table 11. Percent of total labor by month for agriculture and livestock activities

Activity	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Agriculture	3.2	1.8	2.7	1.5	0.9	1.2	1.5	0.7	0.8	5.1	5.6	7.8	32.8
Livestock	5.8	4.4	5.3	4.6	5.1	5.7	5.6	6.0	9.6	5.4	4.5	5.2	67.2

Table 12. Cost-benefit analysis by location and size of farm (000 pesos)

Parameter	Overall	Location		Size	
		Coastal	Inland	Small	Large
Investment					
Cattle	735	729	802	378	1,209
Buildings	291	314	250	200	360
Machinery & equipment	71	69	74	46	100
Tools	8	10	5	6	11
Improvements (1982-83)	10	12	8	6	16
Total	1,115	1,134	1,139	636	1,696
Value of Production					
Milk	157	157	157	97	230
Cattle	149	139	167	57	260
Change in inventory	35	44	19	71	-8
Total	341	340	343	225	482
Variable Costs					
Feed	0.5	0.4	0.5	0.2	0.8
Medicine	3	4	2	1	5
Spares & gas	9	12	2	2	17
Miscellaneous	3	4	0.4	0.05	0.3
Labor	50	51	47	32	71
Total	65.5	71.4	51.9	35.25	94.1
Fixed Costs					
Rent of land	42	36	52	19	70
Interest on capital	57	57	57	33	85
Depreciation	38	41	34	36	48
Total	137	134	143	88	203

spent whenever disease appeared. No additional feed was purchased other than minerals and salt or some molasses, basing the diet entirely on forages.

Farm 10 had 48 steers being fattened but in relation to investment, VP was low. Net income (NI), return to capital and management (RCM), rate of RCM (RRCM), net return to family labor and management (NRFLM) and net return to labor (NRL) were all negative. However bleak the outlook for this farm may look, it was only temporary. The process of fattening steers on pasture takes from 2-3 years. When the steers were sold VP would rise. This enterprise was cyclic; during the interim period (2-3 years between sale of steers), the farmer experienced a cash flow problem which he overcame by relying on agricultural production (annual crops such as green peppers, beans and corn).

Farm 11 was considered as a specialized dairy farm, with grade Holsteins in confinement. There was also a high turnover of cattle since the owner was involved in livestock trading. VP was high with respect to the cattle investment.

Coastal farms were slightly more efficient than Inland farms, with the exception of farm family earnings (FFE) (Table 13). Farmers in the coastal area made better net return to labor, 845 pesos per day of labor vs. 672 pesos for Inland farms. They also used a higher stocking rate per ha (1.68 Coastal vs. 0.98 Inland). When size was compared, net income, family earnings, return to capital, and net return to labor were approximately double for large farms. This is principally due to size differences. When rate of return to capital, net return to labor and cattle/ha were considered, small farms were more efficient. They used their limited resources to best advantage.

Values for VP, NI, FFE, LE and NRL of all farms were correlated with the biological efficiency indicators, economic indicators (change in inventory, VD, FC, total investments), size of family and hired labor, and the technological index (TI). VP, NI, FFE, and LE were highly correlated with total investments, FC, VC number of cows, ha of grasslands, and family labor. They were moderately influenced by TI, hired labor and CI. There was a negative trend when compared with AU/ha. The general trend was for indicators to rise with bigger farms and larger number of cows. Farms became less efficient with larger size as indicated by the increase in CI and decrease in AU/ha.

DISCUSSION

Participating farmers were well established in the area. The majority were from 30 to 50 years of age, with a reasonable level of literacy. Five farmers were officially involved in community activities such as local government (members of committees) or in local sport teams. All were well respected in the community. Farmers spent at least one day per week developing or maintaining communal ties. They all kept informed of the regional news through radio and regular visits to town. They also had a reasonable idea of prices of agricultural commodities and livestock. The majority tended to avoid contact with government agencies. They had reservations about their effectiveness, however, all seemed to keep up-to-date with their dues, such as taxes.

All farmers organized and managed their farms taking into consideration not only level of income but keeping in mind the nutritional level and basic needs of their families. Rockenbach (1981) observed that farmers in Costa Rica considered that the principal function of the farm was to produce their food and cover basic needs and generate a surplus which would be transformed into cash. Farmers arranged the different components of the farm to provide them with a sustained production level to cover all their needs. Gutierrez (1983) classified the goals and preferences of the Costa Rican farmers and

Table 13. Economic efficiency measures by location and by farm size

Indicator	All farms	Area		Size	
		Coastal	Inland	Small	Large
Net income (pesos)	129,653	133,527	122,874	89,923	177,330
Farm family earnings (pesos)	195,233	194,026	197,345	134,544	268,053
Return to capital and management (pesos)	184,047	186,476	179,796	120,916	259,805
Rate of return to capital and management	15.52%	16.24%	14.25%	17.42%	13.24%
Net return to labor and management (pesos)	147,671	151,812	140,423	101,062	203,601
Net return to labor (pesos)	782	845	672	938	595
Cattle/ha	1.42	1.68	0.98	1.36	1.02

found their main priority was to maximize their nutritional level and quality of food and life (household comfort). Their second priority was to maximize profit, especially if the farm system was commercially oriented. When the author prioritized the farm needs, he found that what owners considered most important was to keep the level of production within the farm high enough to avoid the need to work outside to obtain cash. It also was important to minimize losses because of "liquid" capital constraints. Farmers tended to be risk averse. In order to diminish risks, they tended to diversify and increase self-sufficiency. No such classification as the one proposed by Gutierrez (1983), was attempted in this study. However, through informal discussion with the farmers of the area, similar goals and preferences were identified.

Thirty-three percent of the total capital investment on farms was allotted to buildings (26%), machinery and equipment (6%), and tools (1%) compared to 66% for cattle. Farmers had simple livestock facilities which occasionally were inadequate for activities in which cattle had to be restrained (e.g., vaccination, tick spraying, palpatating for pregnancy); however, they did not do these activities frequently enough to deem such facilities necessary. Improvements in facilities were low (less than 1% investment per year). Repairs were made when imperative. They were given low priority principally because of cash constraints.

Agricultural activities formed an integral part of the systems. Farmers were aware of the limitations of relying only on livestock. They understood the interactions between the crop and livestock subsystems. Rockenbach (1981) classified the interactions as independent, competitive, complementary and supplementary. All were found in this study.

Land interacted independently since pasture and agricultural land remained constant. When it was deemed desirable to increase agricultural production, the tendency was to rent rather than to decrease pasture land. There was a competitive interaction between milk offtake for household or market and that available for the calves. The lower the offtake, the higher the quantity that the calf received and vice-versa.

A complementary interaction existed between the agricultural and livestock subsystems. Livestock provided a constant cash flow through milk sales and liquid capital through cattle that could be readily sold when more cash was needed. Agriculture provided the basic staples (corn and beans) and cash crops (bananas, oranges and coffee) on a seasonal basis. The supplementary interaction was considered the weakest within the system. Farmers had cedar trees which could be sold as precious woods. Increasing the number of trees in the pasture areas did not appear to decrease the production of livestock.

Since crops and livestock behaved autonomously and land resources were generally set for both activities, neither influenced the performance of the other. For example, little of the crop residues were used to feed livestock even in environmentally stressed situations. This feature could be important when modifications in any of the components are considered. A change in the management procedures of the livestock component would not directly affect the performance of crops provided that inputs such as labor and cash expenditures were not diverted from the agricultural component. It is also important when the amounts of agricultural and livestock production are determined.

Pasture management was considered important on all farms. Owners knew that weeds were detrimental and spent considerable time and resources controlling them. Rotational grazing was not common as the practice did not seem to increase quantity or quality of native grasses. Farmers were aware of this. They were more worried about

the seasonal availability of grasses. Most feeds were marginally adequate in quality for animal growth and milk production during the early part of the rainy season but decreased as it progressed towards the cooler and drier months. They relied on overproduction during the summer months and used the excess as standing hay during the dry season even when quality was low. It was surprising that even with high thrust by the extension agents, improved grasses were not adopted widely. Only one farm used improved grass pastures as the main source of forage; however, the majority of farms had some proportion of improved grasses. Although areas of improved grasses produced good quality forage, farmers found them too aggressive. They favored less aggressive grass species which permitted other species such as legumes to enter the swards. They observed that during the dry season cattle would consume legumes and even weeds when grass was in short supply. Since improved grasses usually do not allow these mixtures to survive, farmers favored native species since they did not compete seriously with legumes and weeds.

Only two farmers used food processed by-products regularly during the dry season. They generally were an energy feed source (molasses, bananas) rather than protein which became most limiting during this period. This reasoning can be explained because they were not aware of the differences between energy and protein needs and protein supplements are in low supply in the tropics.

Daily milk yields per cow were relatively constant throughout the year. Farmers were not interested in obtaining high, short-term yields. They preferred constant but low yields over the long term. The preference stemmed from market channels not being developed to handle high production and the need for a consistent cash flow. In addition, because of the dual purpose (DP) nature of the cattle component, enough milk was left for calf development. Calves were weaned between 1 and 1.5 years of age, weighing between 200-240 kg. Compared to beef cattle, in which weaning occurs around 8-10 months (Marlow and Gaines, 1958), weighing 150-180 kg (Koch and Clark, 1955), calves reared under the DP system were at a disadvantage. It remains to be seen if poor growth rate had a permanent effect on replacement heifers. Farmers did not feel their feeding system for calves would cause a permanent stunting effect. Age at first calving was delayed to partially compensate for slow growth of the females. When incisor teeth were checked in bred heifers and first lactation cows, the majority had at least one pair of permanent teeth. This means that age at first parturition was between 3 and 4 years.

Reproductive management was simple. No records were kept other than writing down calving dates. Record keeping was not considered important because farmers felt they could keep track through memory. They appeared accurate in remembering reproductive activities.

Average calving interval (CI) was 16.2 months. If a 12-month CI is optimum, these farms were inefficient. However, trends indicated the contrary. The correlation between CI and economic indicators showed that CI had a positive influence on labor earnings (0.616), value of production (0.605), net income (0.605) and farm family earnings (0.596). Recognizing that the cows were under nutritional stress for five months per year, they would take longer to become reproductively active. It therefore would be difficult and uneconomic to attain 12 month CI's. It is questionable to assume that 12 month CI's be the goal of farms in tropical areas. Farmers were not concerned about lengthy CI's. As long as the cows would calve regularly and produce adequate milk yield, they were content. They were more concerned over repeat breeding as this could require more cash investment or make them suspect their bull was not fertile. Repeat breeders became the first to be culled when cattle were sold.

Animal health was of no great concern since herds were generally in good health. Clinical mastitis was uncommon. If present, cows would be treated with antibiotics. If the infection did not subside, the cow would be turned loose with calf. Some cows had lost a quarter because of mastitis. Farmers did not seem to mind since they obtained similar yields even with three quarters. The incidence of subclinical mastitis was higher than reported for beef cattle. A high incidence was attributed to the milking procedures. Research is inconclusive with respect to the influence of subclinical mastitis on calf growth (Hunter and Jeffrey, 1975; Kirkbride, 1977). No effects were noticed by farmers. Calves were healthy and the incidence of diarrhea low.

Endoparasites were a chronic problem among farms. But evidence showed quite clearly that helminth infections were not severe enough to cause mortality or in many cases even clinical signs of infection. Reductions in productivity of animals with mild helminth infections were often indistinguishable in magnitude from those seen as survivors of severe infections (Barger, 1982). Farmers did not use any organized method of control. If a cow or calf had a shaggy coat or was losing weight, they were treated. Parasites were too subjective for farmers. They could not see them so they did not feel that they needed systematic control.

Farmers had very little influence on the marketing structure. The demand for fluid milk in the region was covered throughout the year. Only pasteurizing plants, such as the Nestle Company, accepted surpluses common in the summer months. In order to compete with local distributors who paid better prices, but could not accept large summer surpluses, pasteurizing plants signed yearly contracts. Farms found these contracts disadvantageous, especially during the winter months. However, they were forced to accept the terms if they wanted to sell milk during the summer. None of the farmers in the study had such a contract. Some had contracts formerly but they preferred to take the risk of not selling all the fluid milk and cheese. Those farmers that processed cheese regularly did it because they did not find a market for their fluid milk near them or considered that the quantity produced was not enough to make a daily trip to the market profitable.

Farmers used middlemen to sell livestock. They felt that even if underpaid they could sell cattle anytime which was important for their cash flow situation.

Family labor was an integral part of the system even if it was in a supervisory capacity (as in the case of two farms). Hired labor was important. Fifty-three percent of the activities was by hired help. Sixty percent of the labor was hired for specific tasks (pasture clearing, fencing, etc.) and the remaining performed overall tasks. The activities in the livestock sector were constant throughout the year, except for September when pasture clearing and fencing was done. Hired help was usually the same except for those occasions when pasture clearing was done, seasonal labor was used. Farmers stated that good hired labor was difficult to find. They were concerned about an increase in wages since this was a large part of their costs.

The cost benefit analysis showed that income due to milk and cattle receipts were equally important. The difference was that milk receipts were consistent throughout the year. Labor represented the highest expenditure (77%). All other expenditures were low which meant there was a cash constraint. Even if a traditional economic analysis would lead to recommending the purchase of inputs, such as feed and fertilizer, to increase production, farmers were risk adverse. Increasing expenditures could cause a temporary cash shortage which was avoided as much as possible.

At the time of the study, farmers made efficient use of their resources. There were some areas where improvements could be proposed to obtain modest production increases. If the state or federal government felt that considerable increases in production could be made, major structural changes in modes of production (availability of inputs, marketing channels, and cooperation from the local government agencies) would be needed. The dilemma for government would be whether investment in additional infrastructure would be viable since the farmers did not give high priority to profit maximization.

POSSIBLE CHANGES IN THE SYSTEMS

The success or failure of any change in the system would depend to a large extent on the knowledge of the goals and psychology of the target group (Gutierrez, 1983). Besides physical limitations and/or lack of capital, there are subjective aspects which cause the producer to reject a change. In general, farmers are conservative, value their tastes and preferences, and have a vast, acquired practical knowledge. To provide successful technological packages, researchers must be aware of farmer needs, their limitations and attitudes towards change before making any concrete proposals to rearrange the system. It was noted that farmers experienced cash shortages for several months per year. Webster (1972) points out the phenomenon of liquid cash shortage is widespread in small holder agriculture. Small holders are unlikely to adopt proposed changes which do not take this consideration into account.

The objective of this study was to evaluate the farm system. No attempt was made to define macro-linkages such as national policies, price controls, taxes, subsidies and elasticity of beef, dairy, and agricultural product prices. They can affect the decisions that each farmer makes concerning which activity within the system should be given priority. The adoption of changes is dependent on the economical impact they will have on farmer well being after the macro-linkages have been taken into consideration. Farmers will decide if the proposed changes fit their needs.

The principal constraint of the livestock subsystem was nutrition. Quality feed was not available on a year-round basis. The limiting season was November-May. Farmers relied on forage aftermath during this season. Plant research has focused efforts on solving the seasonality problem by selecting varieties resistant to drought and with increased dry matter yields. Success is measured by changing the distribution of plant nutrients in their target crop to increase yield. This process usually leads to rapid plant growth and early maturity. Quantity of feed may be increased but quality is good for only a short time. The farmers appear to apply appropriate management procedures to the grassland resources they possess. They effectively control weeds and understock paddocks in order to have enough aftermath for the seasons of low plant growth. Some improvements could be made by the use of small areas sown with grasses such as Saccharum sinensis or legumes such as Cajanus cajan which have been successfully grown in the area during environmentally stressful situations. These small areas (fodder banks) could be used as supplements for milking cows and calves. Labor requirements would increase, but forage could be divided into two plots, one that could be grazed and one that could be harvested when time permitted. Leucaena leucocephala, a legume tree native to the area could also be grown on farms. Its prunings could be used as a protein supplement to offset the low content of dry grasses during the dry season.

The area has a number of by-products that could be used such as citrus pulp, banana leaves and stems, sugar cane tops, molasses, etc. Yet, these are hardly worth transport cost unless there are more readily available sources of protein feeds. This means other feeds, such as Leucaena need be incorporated for efficient use of these products. Urea combined with molasses is also a possible means of adding protein to diets.

The proposed changes in the nutritional strategy might not increase milk production significantly but would influence the physical condition of the cattle which should have an impact on the overall performance of the livestock subsystem.

Calf nutrition also needs special attention. Growth rates are slow and evidence shows that permanent stunted growth might result. Calves are not fed for 12-14 hours after separation from the mother. Some farmers use cut forage during this period but it is not a general practice. Cut forages could be used and supplemented with by-products, minerals and water, to increase ADG's. Better growth of calves would have an overall effect on the whole system. Calves would obtain market weights faster. Cows could be rebred sooner. Calving intervals would be shorter with a consequent increase in calf crop. This in turn may lead to over stocking, thus interventions must be carefully evaluated.

Numerous government and private organizations have recommended crossing their small cows with improved dairy breeds to increase the potential for milk yield. Farmers in the study area have not made wide adoption of the practice because they are aware that a larger crossbred cow will undergo greater nutritional stress on their limited resources even though stocking rate may be reduced. The farmers were also aware that the dairy breed crossbred males will be discriminated against in the meat market. With careful watch on both the milk and meat markets, crossbreeding is not highly attractive. Some farmers have used first generation dairy crossbred sires, such as Zebu x Holstein, to introduce about 25% dairy breeding. This practice has met with modest success.

Farmers do not give a high priority to record keeping. However, a small project could be started with those that do keep records to improve the quality of information. Technical assistance would be essential for interpretation of the data. Farmers must be convinced that records can be a useful tool in decision making.

Animal health is of low concern. This is explained by the low death rate of animals. Parasitism presents a potential threat to animals and farmers must be made aware that although parasite levels were not high enough to cause deaths, they decreased productivity. Young stock was more affected by helminths than adults. It could be worthwhile to develop effective control methods for these parasites, provided farmers could be convinced it had economic advantages. Before proposing any procedures, studies are needed on the effect of environmental conditions of the epidemology and population variation throughout the year.

Although farmers seemed content with the market structure for beef and milk, there have been some successful projects in Mexico and India in which marketing was taken over by the producers. These programs have enabled them to increase their income. But before proposing such, careful consideration must be given to the potential that the area offers in supporting such a move.

CONCLUSIONS AND RECOMMENDATIONS

1. Farmers in Veracruz State of Mexico had a multiple production system which principally involved cattle (beef and milk) and agriculture (annual and perennial crop) production. They were aware of the limitations of relying solely on one (cattle or crops). They understood the interactions between the crop and cattle subsystems and used them to an advantage.

2. The livestock subsystem had two well-defined components, milk production to maintain a constant flow of cash throughout the year, and beef which provided seasonal cash. Livestock was also used as a savings account which could be readily converted into cash. Income from milk and beef were equally important.

3. The first priority of farmers was the procurement of their nutritional needs and quality of life. Maximizing profit was secondary.

4. One-third of the capital (excluding land) was in buildings, machinery and tools; the remaining two-thirds in cattle. The facilities were simple and adequate for the needs of the farm. Farmers were not interested in increasing capital in either facilities or animals.

5. Hired labor represented the highest expenditure (77%). A cash constraint was persistent due to low level of cash flow from daily milk sales. Receipts from cash crops were used partly for hired labor but most went to cover debts, interest and taxes.

6. Pasture management was efficient. Weeds were kept down to 10% of the pasture population. Farmers took advantage of the forage growth season (when production was higher than the cattle could consume) and used the excess for grazing during those seasons when the growth of forages was low.

7. Improved grasses were present in some proportion on all farms. Although they produced adequate yield (quantitatively and qualitatively), farmers found them undesirable because they were too aggressive to permit other species such as legumes or other grasses to enter the sward. Even if weeds and legumes were present in small quantities, farmers observed that cattle would consume them when grass was in short supply. Laboratory results indicated that they contain reasonable nutritive value (protein). Further studies are needed to determine their importance as nutritional inputs and to determine if any secondary chemical compounds such as tannins have an effect on nutritive quality.

8. Rotational grazing or fertilization were considered uneconomical practices as yields of native grasses did not pay the cost of fencing and fertilizer

9. Supplementation consisted principally of minerals and salt. By-products, such as molasses or bananas, were used sporadically during the winter season. Since these feeds are high in energy but low in protein farmers did not see advantages in using them regularly.

10. Slow rate of growth was evident in young stock. Increasing average daily gain could raise the overall performance of the livestock system by permitting the weaning of heavier calves.

11. Farmers were interested in obtaining constant milk production throughout the year. Breeding programs aimed at increasing production for short periods, followed by a rapid decline, were rejected since farmers needed to maintain a constant daily cash flow.

12. Reproductive management was simple. Bulls ran year-round with cows to assure a constant calving schedule to maintain milk production. Record keeping was generally by memory. The main concern was repeat breeders. A twelve-month calving interval was not considered optimum even though longer calving intervals had a positive influence on net income, and labor and farm family earnings. As long as cows calved regularly and produced 3-5 kg of milk per day, farmers felt their management was adequate.

13. Farmers were mildly concerned with animal health since death rates were low. Internal parasites were chronic in the area, with young stock being more affected than adults. Studies should be carried out to measure reduction in productivity due to internal parasites and determine if there is a need to implement systematic control programs. It would be important to determine the life cycles and stages in which helminths prevalent in the area are more susceptible for control.

14. The marketing structure of the region was clearly two phases, dairy, which includes a local fluid market, cheese processing and pasteurizing plants (outside the region). and beef, with a local market and middlemen. Farmers did not have much influence over the system, but they did not seem dissatisfied, even when underpaid. It is important for them to have a market structure with daily milk sales and where it is possible to sell cattle year-round in case of need rather than to obtain the most favorable price.

15. Labor provided by the familiy was positively correlated with net income, and labor hired and farm family earnings. The family played an integral part in the system even when 53% of the activities were done by hired labor.

16. Government agencies should set simple surveys to collect production data on milk yields, milk sales and cattle sold and agricultural products generated and marketed. This would enable determinations of the livestock and agricultural outputs of small farms and identify contributions. It is believed that such information would reveal small farmers are an asset rather than liability which seems the current view.

17. Decision making is rational with respect to emphasis in both crop and livestock production. Farmers appreciated that to move from a modest to high level of output of animals and products would not be supportable under present marketing conditions. It is concluded that government should recognize that farms in Veracruz State are supplying local needs through low imputs and the farms contribute more to state and regional food supplies than generally appreciated.

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