SWINE PRODUCTION SYSTEMS IN CENTRAL AMERICA: LIMITING FACTORS, PROSPECTS AND RESEARCH REQUIREMENTS[1/]

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ABSTRACT

Central America has an expanding gap between animal protein supply, and consumption because of a large population growth rate (3%), a limited agricultural frontier and low agricultural production rate (2.4%). Pork constitutes the second most important source of protein, however yearly per capita consumption is low (2.3 Kg), as well as is production and productivity. Commercial intensive units comprise 2% of the swine population and 17% of the total pork production, whereas 98% of the population are raised as 2 to 5 pig family units. Commercial units make use of modern technology, however limited supply of feedstuffs and competition with poultry and humans for grains cause cyclic constraints and limit their expansion. Family units average one litter per sow per year and 3 pigs per litter which reach market at 60 Kg weight in 18 months with a feed conversion of 15.1. Economic studies characterized this activity as wasteful and unprofitable, however this activity is prevalent and permanent among small and subsistence farmers. Recent surveys indicate that small farmers view pig farming as a cero or very limited cash investment operation. This situation could explain the failure of outreach efforts based on improved technology that require investments on protein, vitamins or mineral supplements. Research trials which take into account farmers limitations and attitudes, based on lower nutritional standards, use of grass and legume forages and one or two crop "balanced" rations promise an improvement over traditional systems and could improve productivity of a large segment of the swine population of Central America.

INTRODUCTION

The relative importance of agriculture in the Central American region (Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua and Panama), is beyond question. With close to 65% of its economically active population

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devoted to agriculture, with 95% of its exports based on agricultural products and with 30% of the Gross National Product (GNP) originated by agriculture, this area is particularly dependent of this activity for its development (SIECA-GAFICA, 1975).

The population of the region numbering 8 million inhabitants in 1950, reached 17 million in 1975 and 36 million inhabitants are projected by year 2,000. The rural proportion of the population is projected to decline slowly by year 2,000, from 73 to 65%, however in absolute terms the rural population will grow from 11.6 (1970) to 23.2 (2,000) millions (IDB, BIRF, AID, 1978).

A large proportion of food crops and animal products are produced by small and medium size holdings (0.5 to 35.0 Ha), while large farms are devoted to export products (cotton, sugar cane, bananas, beef, etc.). Production and productivity rates have decreased in the last decade, increasing the gap between growing population needs and agriculture outputs.

The Tropical Agricultural Research and Training Center (CATIE) is devoted to the improvement of living standards of rural population in Central America, through cooperative actions with national research institutions, developing research methodologies and technologies suited to the socio-economic and environmental realities of the small farmer of the area. The research strategy involves the system approach, with an interdisciplinary team working in close contact with the small farmer. Current research covers cropping systems, animal production systems mixed animal-crops systems, and agro-forestry systems.

The present report covers activities related to current research on swine production systems in the Central American region.

CATIE'S SYSTEM RESEARCH METHODOLOGY

CATIE, and the national research institutions of Central America have been working in recent years towards the development of a whole farm or systems research methodology whose results are capable of increasing total farm outputs, small farmer net income and living conditions.

Improved small farms systems are target area specific and promote efficient use of local resources and by products, with technological levels adapted to the ecological and socio-economic limitations. Improved systems, (1) will have different alternatives in crop and animal management, to facilitate the decision making process for the farmer, (2) will promote the conservation and rational use of natural resources and (3) will increase significatively production, productivity and net farm income (CATIE, 1977).

The main stages included in the research methodology are:

1. Selection of target research areas
2. Base line study
3. Design of first approximation model
4. Components research
5. Design of second approximation model
6. On the farm system validation
7. Technical and economic adjustment of alternatives in the system
8. Transfer to small farmers

1. Selection of target research area

Since neither CATIE, nor national research institutions can operate on natiowide research program, resources are concentrated in one or two selected zones. The target research areas are selected using as criteria the national priorities for the region, concentration of small farmers, homogenity of production systems, local institutional resources, roads, markets, representativity of ecological areas of the country and potential for productive and socio-economic improvement.

For the present project two areas of each Central American countries have been selected as target research areas.

2. Base line study

The main objectives of the base line study are: a) to obtain an accurate description of small farm systems characteristics and socio-economic conditions, b) to identify limiting factors for production an productivity, c) to identify marketing channels, d) record the main environmental variables influencing the systems and e) define the geographical boundaries of the area or specific area of applicability for the improved farming systems.

Base line studies are carried in three stages: a) preliminary study of census data and other secondary information; b) single static project survey and c) dynamic or follow up continuous surveys.

3. Design of first approximation model

Based on system description and main limiting factors identified by the base line study, a first approximation qualitative model is designed.

The model will describe the possible options in management, resource allocation or system modifications required to overcome the major constraints and will "estimate or guess" the improvement level of the new system.

The model is used to identify the critical areas were research, basic or applied, is needed and will determine the research requirements of each target area.

4. Components research

Experiments are designed and carried out in those areas in which there is inadequate or incomplete technical information. Results will provide information on nutritional, animal health, and management alternatives required to increase the quantitative knowledge of the first approximation model. Research is carried out on small farms, and farmer management is considered as an additional factor in the evaluation. Also, a data bank will be compiled with experimental results from other sources that provide technical answers to problems in the system.

5. Design of second approximation model

Based on component research, a second approximation model is designed and will include quantitative and qualitative description of the interrelation of its components. At this stage a better estimate of the improvement level will be obtained.

6. On the farm system validation

In a selected number of farms and with the farmers cooperation, improved production systems are transferred and evaluated. Comparisons are made with

the prevailing systems and farmers receptivity and attitude toward the improved sytems are evaluated.

7. Technical and eocnomical adjustment of alternatives in the system

Based on the validation, final adjustment are made in the technical and economical components of the improved systems.

8. Transfer to small farmers

Improved systems are prepared as outreach documents and transferred to extension, outreach or technology transfer institutions for widespread use on the target area.

Final considerations

Based on the area description, small farmers needs and the efficiency of resource utilizations, decisions are made as to whether an improved technology should be applied to (1) improve management of existing production systems, (2) substitution of crops and animal species within existing patterns or (3) the creation of a complete new cropping, cropping-animal, and animal production system. Concerning the latter possibility, completely new system testing will seldom be done until a rather good understanding of local factors and interactions, farmer attitudes and a satisfactory design capability has been developed. Careful consideration must be given to assure that the proposed technology can be made compatible with farmers objectives and capabilities within the limits of available resources.

SWINE PRODUCTION SYSTEMS

General characteristics

Swine populations and total pork production of Central American countries are presented on Table 1. In general, all countries show low total pork production with regard to its swine populations. Light carcass weight and limited numbers of animals slaughtered are common characteristics in these countries.

In this geographic area, 97 to 99% of the swine population are raised in family units, while commercial intensive units comprise 1 to 3% (Table 2). There are significant differences among these two systems with regard to some production characteristics. Intensive swine farms represent 17% of total pork production with only 2% of the population (Table 3). Productive traits shown on Table 4 indicate very low production standards for family units or traditional systems, while intensive farms have acceptable production parameters.

Commercial swine production

Several factors are influencing the distribution of the swine population. Commercial units have a limited rate of expansion in established and new farms. Limited supply of feedstuffs, competition with humans and poultry for cereals, state controled pork prices, low beef prices, inefficient or non existant carcass quality controls and sanitary regulations, etc., are among the main factors that cause cyclic constraints and limit their growth.

Feeding costs are high, and so is the price of pork urban markets, limiting consumption to higher income groups that pay for quality products, but with a restricted consumption volume.

TABLE 1. SWINE POPULATION AND PRODUCTION IN CENTRAL AMERICA

Country	Heads, Thousands		%	Carcass Weight	Total Pork Production
	Population	Slaughtered		Kg	.000 TM
Costa Rica	224	108	48	42	4.8
El Salvador	421	207	49	32	6.8
Guatemala	886	454	51	29	13.2
Honduras	710	355	50	35	12.4
Nicaragua	615	286	46	31	8.2
Panama	195	81	42	35	2.8

Source: SIECA-GAFICA 1974

Censo Agropecuario Panama 1971

TABLE 2. SWINE PRODUCTION SYSTEMS IN CENTRAL AMERICA

Country	Production System	
	Traditional	Intensive
Costa Rica	99	1
El Salvador	98	2
Guatemala	97	3
Honduras	99	1
Nicaragua	98	2
Panama	98	2

Source: SIECA-GAFICA 1974

Censo Agropecuario Panama 1971

TABLE 3. PRODUCTIVITY OF SWINE SYSTEMS IN CENTRAL AMERICA

	Production System	
	Traditional	Intensive
Extraction Rate	47	170
Carcass Weight	30	70
Pork Production	83	17
Regional Prevalence (%)	98	2

TABLE 4. SOME PRODUCTIVE TRAITS OF SWINE PRODUCTION SYSTEMS IN CENTRAL AMERICA

Productive Traits	Production System	
	Traditional	Intensive
Number Born	6	10
Mortality to Weaning (%)	40	20
Litter Size at Weaning	2.5	8
Weaning Weight (Kg)	5	15
Age at Slaughter (Months)	18	6
Live Weight at Slaughter (Kg)	60	90
Carcass Yield (%)	65	77
Feed Conversion	15	4
Number of Litters/Year	1	2
Mortality Rate (%)	10	3
Litter Size at Slaughter	2.2	7.7

Source: Modified from "Sistemas de Produccion de Porcinos en America Latina" CIAT. 1972

Commercial intensive swine farms make use of modern technology, improved breeds, crossbreeding programs, balanced feeding, appropiate sanitary programs and acceptable designed buildings are not uncommon.

Feed supply will place a constant restriction on intensive pork production growth, and a very limited expansion is expected for the next decade.

Traditional or small farmer swine production

Swine production is a permanent and prevalent activity among small and subsistance farmers. Low production and productivity (Tables 3 and 4) are consistent characteristics of these systems. Economic studies in the Central and South American Tropics have characterized this activity as wasteful and unprofitable (CIAT, 1971; CIAT, 1973; SIECA-GAFICA, 1974; Juarez, 1979), due to poor feed conversion, high mortalities, low reproductive rates and poor quality final products.

In spite of these shortcomings, small farmers raise pigs constantly and are apparently satisfied with the results. Pigs are raised as cash crops and, any time there are cash shortages or unexpected needs in the family, pigs are sold. When conditions are normal, pigs are bought to be kept on these small farms.

Under this situation it is a fact that the pig plays an important socio-economic role on small farms and the apparent contradiction between poor economic performance and swine prevalence on small farms must be revised.

Characterization of small farm swine production systems

Surveys conducted by CATIE to characterize beef-milk and cropping systems, indicated the prevalence of pigs among small farms (CATIE, 1978; Navarro, 1978).

TABLE 5. TARGET RESEARCH AREA LOCATION BY COUNTRY AND ECOLOGICAL REGION

Country	Areas	
Costa Rica	Guapiles-Cariari lht	Monte Verde-Tilarán mdt
El Salvador	Tejutla mdt	San Miguel mdt
Guatemala	Nueva Concepcion ldt	Tactic mht
Honduras	Comayagua mdt	La Ceiba lht
Nicaragua	 mdt	San Antonio mdt
Panama	Chiriqui ldt	Herrera-Los Santos ldt

lht: low humid tropics mdt: mountainous dry tropics
ldt: low dry tropics mht: mountainous humid tropics

TABLE 6. PRODUCTIVE CHARACTERISTICS OF SWINE PRODUCTION SYSTEM

Traits	System	
	Breeder	Grower-Fattener
Population: (No.)		
Boar	1-2	-
Sows	2-5	-
Feeder pigs	8-16	4-6
Breeds: (%)		
Criollo	77	86
Crosses	20	12
Pure-breeds	3	2
Feeding: (%)		
Produced on the farm	98	100
Purchased	2	-
Production		
No farrowing/year (No.)	1	-
Pigs born alive (No.)	4-6	-
Mortality to weaning (%)	20-40	-
Mortality to final weight	10-20	10-20
Age to final weight (months)	16-24	16-24
Final weight (Kg)	60	60
Age to first mating (months)	16-20	-
Marketing: (%)		
Live sale	77	77
On farm slaughtered	33	33

FIGURE 1

SMALL FARM SWINE PRODUCTION SYSTEM

A.- BREEDER

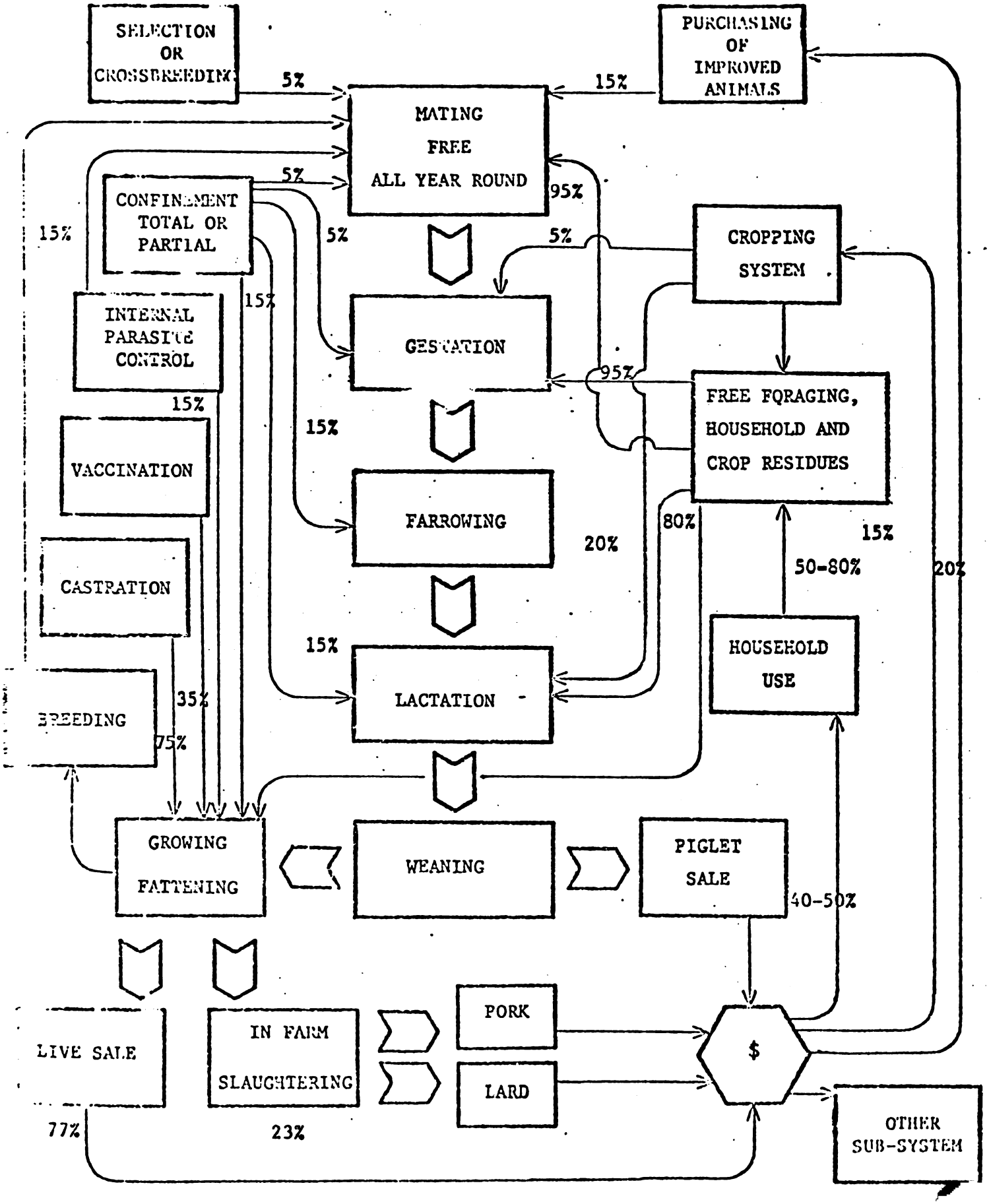
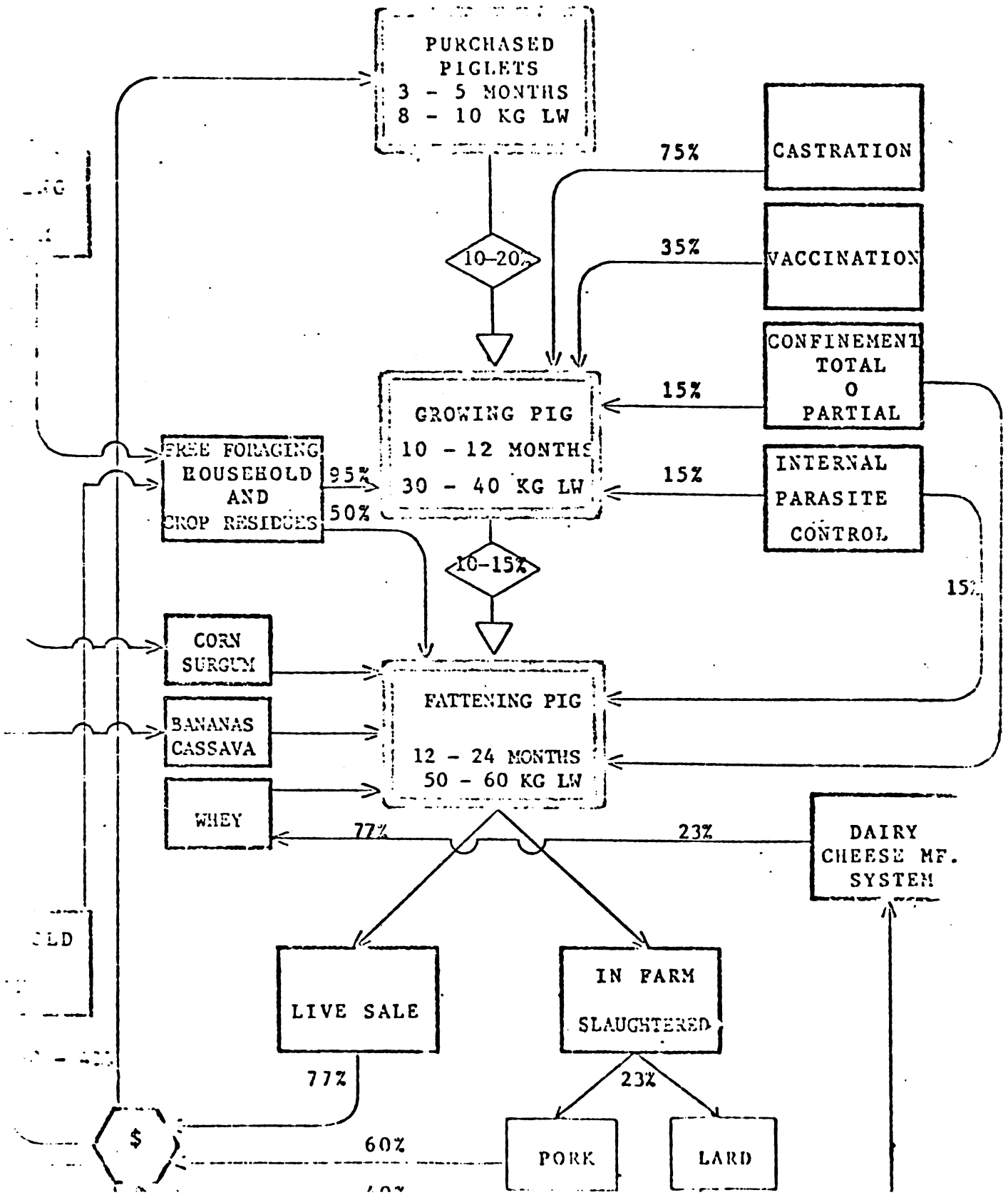


FIGURE 2

SMALL FARM SWINE PRODUCTION SYSTEM

B.- GROWER - FATTENER



As part of CATIE's Small Farm Systems Research Project, a Swine System Research Program was iniciated to develop production technologies suitable for a very large part of the swine population of Central America.

Twelve research areas (two for each country) were selected according to CATIE's system research methodology. Areas were representative of the main ecological regions of Central America. Area location and ecological characteristics are presented on Table 5.

For each area a visual appraisal followed by a survey was conducted in characterize prevalent small farm production systems. Data collected showed no significant differences in swine production structure, management, sanitary or breeding practices among areas. Differences were found in feeding subsystems, that were associated with ecological regions. In the low humid tropics, bananas and cassava were the main feed sources. In low and mountainous dry tropical areas, corn and sorghum were used, whereas in mountainous dry and humid tropics whey was used as main feeding source. In the later region a dairy, cheese manufacturing system was associated with swine systems. In all of the areas a cropping system was associated with swine feeding, using crops or crops residues as swine feeds.

Two systems were identified in all areas: the breeder and the grower-fattener. Breeders accounted for 45% of swine systems and 65% were grower-fattener. systems. Productive characteristics of each system, expressed as ranges, are presented on Table 6. Figure 1 represents the dynamics of the swine systems with prevalence of management, feeding and marketing practices expressed as percent of occurrence.

Part of the survey, evaluated farmer's attitudes toward swine production.

TABLE 7. SMALL FARMER ATTITUDES TOWARD SWINE PRODUCTION

	% of afirmative answers
Satisfied with swine production	87
Will expand	15
Profitable	80
Will imporve breed	25
Will improve sanitation	45
Will improve housing	25
Will purchase food-supplements	5
Fair sale price	50
Will use credit	13
Will grow crops-pastures for feeding	35
Will use technical assistance	35

A set of questions were asked and percent of affirmative answers are presented on Table 7.

Swine production systems characterized by the survey showed low productive standards, however these standards were closely related to available resources. Farm size is closely related to food production or availability. Small farmers do not put cash values for crops or crops residues used in swine feeding. A large proportion of crops, unsuitable for marketing or family use, are considered swine feeds with no direct economic value, and pigs are used to revaluate these useless products.

Farmers attitudes explain in part the contradiction between economic studies and farmers concept of profitability of their swine operation. At the same time results of Table 7 give clues as the type of technology that could be readily accepted by small farmers.

Under small farm conditions it will be difficult to use balanced diets, but an improvement could be achieved by the rational use of farm resources.

PROSPECTS AND RESEARCH REQUIREMENTS

Small farm swine production systems comprise 98% of the swine population of Central America. Characterization of swine systems indicates the possibility of increasing production and productivity through technological improvements that make efficient use of farm resources and set productive goals accordingly with resources used.

Research on swine feeding with tropical products have covered a wide range of crops, crop residues and by-products. Research methodologies have tried to incorporate new tropical feedstuffs as part of balanced rations. Controls used

have been in most cases corn-soybean meal diets. Protein quality has been improved through use of amino acids supplements. Nutritional standards used were based on intesive swine production requirements from the developed countries with temperate climates.

Several authors (Babatunde, Fetuga and Oyemuga, 1976; Devendra, 1976; Eusebio, Rabino and Eusebio, 1977) have dealt with the specific problems of balancing swine rations under tropical conditions. In addition it is apparent that native or criollo pigs have lower protein requirements than improved breeds (Gómez-Brenes et al. 1974, Gómez-Brenes et al 1975).

Results from research on cassava roots (CIAT, 1971 to 1975; Gómez, 1977 a; Gómez, 1977 b), sweet potatoes (Zarate, 1956), bananas (Calles et al; 1970; CIAT, 1972; CIAT, 1974), coffee pulp (Braham and Bressani, 1977), sugar (Moncada, Obando and Gallo, 1974), molasses (Quijandría and Blengeri, 1974), rice polishings (Martínez and Bravo, 1971) corn cobs (Villanueva, Montalván and Quijandría, 1974; Fetuga, Babatunde and Oyenuga, 1975) discarted cocoa beans (Omole and Adegbola, 1975) as energy sources and roasted soybeans (Acda, Alcantara and Argañosa, 1975), cassava leaves (Kork, Choo and Hutagalung, 1972), grain legumes (Maner, 1973), cotton seed meal (Obando et al, 1975), forage legumes (CIAT, 1974) etc., as protein sources provide information required for an initial design of swine feeding subsystems.

Research work on the performance of native or criollo breeds, under different nutritional and management conditions provide information on expected productivity in the tropics (Gómez-Brenes et al, 1974, Gómez Brenes et al 1975; CIAT, 1975; Fetuga, Babatunde and Oyenuga, 1976, Cabeza, Buitrago and Owen, 1976).

The most critical area is supply of "appropiate" protein level in diets. Forage legumes (dolicos, kudzu, siratro, stilosantes, etc.) can provide 12 to 16% protein on dry basis (McDowell et al; 1974). Cassava leaves also have a protein content; however more extensive research is needed.

Based on the understanding of small farm production swine systems, research results on feeding with tropical products and performance of native breeds a first approximation model was designed and is presented on figure 3.

In this model the critical areas for research are:

a) Use of protein from forage legumes

b) Use of protein from cassava leaves

c) Comparative performance of criollo and criollo-improved breed crosses

d) Effect of managements practices (teeth clipping, desinfection of unbilical cord, castration etc.) on production

e) Total versus partial confinement

f) Low cost housing designs

g) Farm produced diets for piglets

h) Determination of nutritional requirements of native pigs under small farm swine production systems

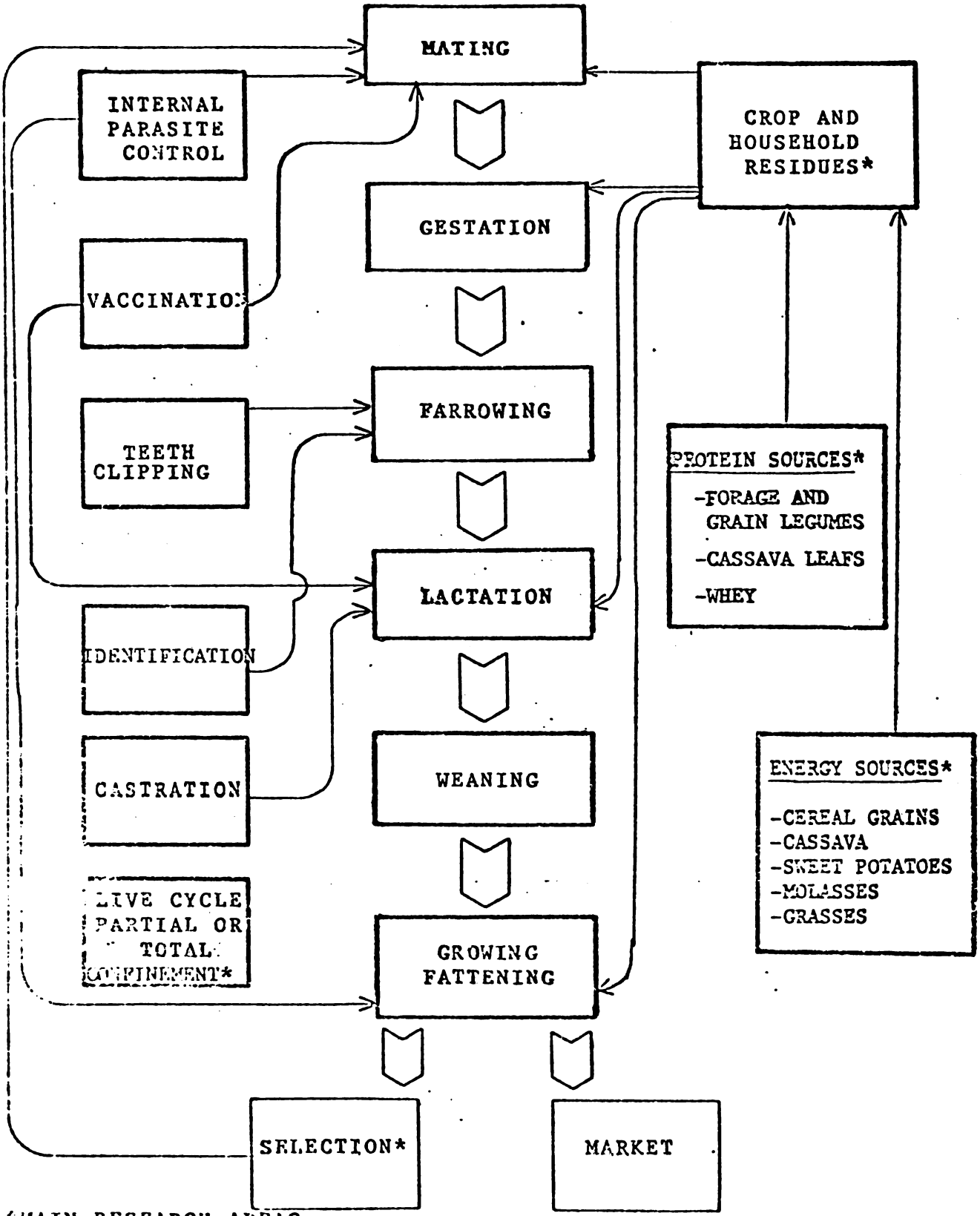
i) Economic appraisal of swine production systems for small farmers

CATIE and national research institutions have designed and are in the process of setting up experiments taht could help understand some of the critical areas in swine production system.

A follow up survey will collect economic information that will be use to determine economic interrelation of the swine system and the farm system.

FIGURE 3

FIRST APPROXIMATION SWINE PRODUCTION SYSTEM



*MAIN RESEARCH AREAS

CONCLUSIONS

Small farm swine production is a permanent and prevalent activity among small farmers of Central America. Low production and productivity are directly related to resources available on the farm. The understanding of farmers attitudes toward swine could give clues for a succsesful extension and research program with productive goals in accordance with resources available on the farm.

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