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Swine Commodity Team

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Introduction

Since the onset of CIAT's development, the Swine Program has been working with the broad objective of producing more meat from the existent swine population, thereby providing more animal protein for human consumption. The program contributes to the increase in pork production, especially in the tropics, through its training, international cooperation and research activities. The objective of this Position Paper is to present the proposed orientation of the future activities of the program. Before discussing these proposals, we will give some of the characteristics of swine production in Latin America, review the program's history of development, and summarize the programs' achievements to date.

Characteristics of swine production in Latin America

Swine is a widespread agricultural commodity in Latin America, with a total pig population estimated at 71 million head, producing 1.9 million tons of pork (FAO, 1975). Of the total meat produced in this region, pork contributes 17 percent, ranking second in importance to beef, which accounts for 65 percent. Although the swine population in Latin America amounts to approximately 11 percent of the world population, pork production in the region represents only 4.6 percent of the world total (Table 1). A parameter commonly used for evaluating swine production efficiency is the annual extraction rate defined as the percentage ratio of slaughtered pigs to the total population; the overall extraction rate for swine production in Latin America is in the order of 40 to 50 percent, which is significantly lower than the world aver-

Table 1. Swine population and productivity in the world, developed countries and Latin America. *

Parameter	World	Developed countries	Latin America
Swine population (million head)	674.2	171.0	70.7
Pigs slaughtered (million head)	630.5	246.5	31.0
Pork production (million t)	42.4	17.3	1.9
Extraction rate (percentage)	94	144	44
Carcass wt per pig (kg)	67.3	70.2	62.8

* Adapted from FAO, 1975. Production yearbook, Vol. 29.

age (94%) and only one third of that obtained in the developed countries (144%). These data clearly indicate that the main problem of pork production in Latin America is low production efficiency, especially at the small-farm level, where most of the pigs (ca. 85%) are raised.

Because of the reduced number of staff on the Swine Commodity Team, it would be impossible to cover all countries in the Latin America region effectively. Rather, it is considered preferable to concentrate efforts on the countries where the Swine Program has been working actively: Bolivia, Colombia, Costa Rica, Ecuador and Peru. Data on two other countries (Paraguay and Venezuela), where with a relatively limited effort the scope of the program could be eventually expanded, will be also presented.

The statistical data (FAO, 1975) on swine production in these countries are presented in Table 2. With the exception of data from Ecuador and Paraguay, which appear to be under- and overestimated, respectively, we are dealing with countries with pork extraction rates in the range of 60 to 70 percent. In addition, average carcass weight of slaughtered pigs for these countries ranged from 30 to 65 kg per animal, compared to 67 kg for the world average and 70 kg in the developed countries. Important complementary information that is difficult to obtain is the age at which pigs reach market weight; observations at the sites of the swine collaborative projects indicate that pigs need 12 to 18 months to reach market weight.

Several factors have been suggested as responsible for the overall low swine productivity in Latin America. During the last few years our collaborators have been dealing with swine producers in their areas of action and

Table 2. Swine population and productivity of selected Latin American countries. *

Country	Population (million head)	Slaughtered	Production (1000 t)	Extraction rate (%)	Av carcass wt (kg)
Bolivia	1.15	.69	21	60	30
Colombia	1.87	1.24	76	66	61
Costa Rica	.22	.16	8	71	50
Ecuador	2.20	.83	42	38	50
Peru	1.90	1.19	70	63	59
Paraguay	.80	.85	51	106	60
Venezuela	1.79	1.00	65	56	65

*

Adapted from FAO, 1975. Production yearbook, Vol. 29.

their observations were presented at the last Workshop on Swine Production in Latin American held at CIAT in October 1977. The following are some of the common features of swine production in Latin America, notably in the countries where CIAT has established collaborative projects:

- Swine production is traditionally operated as a secondary livestock enterprise, lacking government support, and is not considered as part of integrated agricultural development projects.
- The extensive, small farm type of production using native pigs is widespread although improved breeds are being accepted rapidly.
- Swine productivity is low under prevalent conditions, and practically no extension service is available to small- and medium-sized farmers. The number of professionals and technicians specialized in swine production is very limited.
- In addition to the aforementioned factors, the most important constraints for swine production development are limited availability of conventional feedstuffs, deficient health programs, inadequate marketing systems, limited processing of pork, and restricted financial support.

Most of these limiting factors are interrelated, but because of their economic importance in the cost of pork production, the availability of feedstuffs is the most important factor to be considered in swine production development programs, notably in tropical areas. CIAT collaborative projects have been oriented towards the development of pork production in association

with increased agricultural production; special emphasis has been placed on the role of pigs as converters of agro-industrial by-products (rice polishings, sugar cane molasses, waste bananas) and of tropical crops, such as cassava, with potential for swine feeding.

Because of the low swine production efficiency, there is ample margin for improving it. Several steps have been taken by the CIAT Swine Program to improve production in Latin American countries; and although the main broad objective of increasing pork production will always remain, some changes in the approach to the problem have occurred since the program began.

History of the Swine Program at CIAT

The Swine Production Unit, formerly the Swine Production Systems Program initiated operations from the inception of CIAT's development. Throughout these years the Swine Program activities have been extensively reviewed, notably by the IDRC-appointed External Review Team (1974) and by the TAC Quinquennial Review Panel (1977). In addition to the external reviews, the Board of Trustees' Program Committee has evaluated the activities of the Swine Production Unit annually, submitting their recommendations to the Board. The Program Committee Report to the Board in May 1975 recommended a reexamination of the status and future of the Swine Program in 1978.

During the first five-year period (1969-1974), the Swine Program gave major emphasis to research activities, especially in the area of swine nutrition and feeding. In research, primary attention has been given to the evaluation and development of life-cycle feeding systems based on tropical feed-

stuffs. The main reason for this emphasis is that feed costs represent approximately 75 to 80 percent of total production costs and little was known about the appropriate utilization of some tropical crops as animal, especially swine, feedstuffs. Most of the research work was done in collaboration with the Instituto Colombiano Agropecuario (ICA) and the Instituto Nacional de Investigaciones Agropecuarias (INIAP) in Ecuador. At the same time limited, research-oriented training activities were developed to train professionals who formed the initial staff of the Swine Production Programs in Ecuador, Bolivia and Peru.

In 1974, the External Review Team recommended that " the major emphasis of the Swine Commodity Team should be the training of national groups of an effective size to provide a core for a national program." In relation to the international collaborative projects, the Review Team recommended that " the major impact of the Swine Commodity Team in its outreach programs should be in the management field." Based on these and other recommendations, the Swine Program shifted the emphasis of its activities to training; and after appropriate implementation, the first postgraduate training course in swine production was offered in 1976. Simultaneously, the international cooperative projects in Bolivia, Costa Rica, Ecuador and Peru were strengthened, and local training activities at these sites were promoted. Limited inputs in research were continued as a complementary support for training and international cooperation activities. In 1977, the report of the TAC Quinquennial Review Team supported the work of the Swine Commodity Team and recommended that this program should be maintained within CIAT's core budget.

Achievements of CIAT's Swine Program : 1969-1977

Training

A total of 73 professionals, classified by countries and periods, have been trained by the Swine Program (Table 3). Of the 26 professionals trained during the period 1969-1975, three were doctoral candidates (Nigeria, 2 and Germany, 1) and four were candidates for a MS program (Ecuador, 2; Colombia, 1; Costa Rica, 1); thus 19 professionals were trained as graduate interns in swine production with emphasis on swine research in this six-year period. After the shift in emphasis of activities, 47 professionals received graduate training in swine production in a two-year period (1976-1977).

Two training courses, one of six months and another of six weeks, were offered in 1976 and 1977, respectively. For the first course funds were supplied by IDRC, CIAT, AID, the Banco de Mexico, the Associacao de Credito e Assistencia Rural do Amazonas and the Federal Republic of Germany; for the second course funds were provided by BID, IDRC and CIAT. Approximately 60 percent of the course time was devoted to practical production training, mainly in swine enterprises located in the Cauca Valley. The remaining 40 percent was dedicated to theoretical training in classroom activities covering the areas of management, genetic improvement and breeding programs, nutrition and feeding, animal health, statistics and economics. In addition to the Senior and Junior Staff of the Swine Commodity Team, CIAT professionals from Training and Communications, Biometrics and Animal Health participated as lecturers. Swine specialists from Colombian institutions also provided valuable help in complementing the course lectures.

Table 3. Professionals trained by the Swine Program from 1969 to 1977, classified by countries and by periods.

Country	Period			Total
	1969-1975	1976	1977	
Argentina	-	-	1	1
Bolivia	4	3	2	9
Brasil	-	1	2	3
Colombia	5	3	9	17
Costa Rica	3	-	1	4
Ecuador	5	-	1	6
El Salvador	-	-	2	2
Germany	1	-	-	1
Guatemala	-	1	-	1
Honduras	-	1	2	3
Mexico	1	4	-	5
Nigeria	2	-	-	2
Nicaragua	1	2	-	3
Panama	1	1	1	3
Paraguay	1	4	-	5
Peru	1	-	4	5
Republica Dominicana	1	-	-	1
Thailand	-	-	2	2
Total	26	20	27	73

Since 1976 training activities constitute the basic strategy of the Swine Program to accelerate the transfer of technology process, as well as to form a network of professionals working in national institutions which are involved in development, extension, training or research activities in swine production. These teams continue receiving support from the Swine Program through technical assistance, visits by the Swine Commodity Team to their places of work, organization and participation in regional, national or local seminars, participation in workshops and in collaborative research projects.

Seminars and workshops

Central American Seminar on Swine Production

The first Central American Seminar on Swine Production was organized by the Universidad de Costa Rica, the Ministerio de Agricultura, the Banco Central of Costa Rica and the Swine Program of CIAT. The Seminar was held in San Jose from November 8-13, 1976 and was attended by more than 100 participants from Central American countries and Panama. Swine specialists from Costa Rica (some of them ex-trainees of CIAT), from other regional institutions and CIAT's Swine Commodity Team presented the most relevant aspects of swine production technology that could be applied in Central American swine development programs. The organization of this type of seminar is a complementary activity to the swine training courses at CIAT.

Workshop on Swine Production in Latin America

Training per se will not be efficient unless there is a periodic reassessment of the problems in swine production and solutions proposed. For this reason a total of 35 ex-trainees of the Swine Program, working with national

or regional institutions, gathered at CIAT for a workshop on Swine Production in Latin America on October 17, 1977. The following countries were represented at the workshop (numbers in parentheses indicate the professionals from each): Bolivia (6), Colombia (6), Ecuador (5), Paraguay (4), Mexico (3), Nicaragua (3), Honduras (2), Panama (2), Guatemala (1), Brazil (1), Costa Rica (1) and Peru (1).

The objectives of the workshop were to review the situation of national and regional programs for development of swine production, with special emphasis on the collaborative projects established by the CIAT Swine Program; to sharpen the focus on the limiting factors for expansion in swine production and accordingly to plan future strategies for their solution; and, to establish an international cooperative swine production network.

The conclusions and recommendations of the workshop are summarized in the following paragraphs:

- To undertake technical, economical and marketing feasibility studies for the integration of agricultural development and swine production as a special component. These studies should lead to the establishment of regional programs within a given country.
- To support swine development programs for small- and medium-sized farmers, but with an entrepreneurial focus. Associative or cooperative projects for small farmers dedicated to swine production are advisable.
- To intensify and increase extension services for transferring swine

technology, notably at the level of small producers. Integration of research or experimental work with extension service is required.

- To search for the means of improving the technological level of swine development and to reduce production costs, especially through the displacement of conventional feedstuffs and the maximum use of agro-industrial by-products and nonconventional feedstuffs.
- To improve commercialization systems, encouraging an increase of pork processing and seek the participation of swine producers in marketing and processing aspects.
- To integrate Latin American swine-producing regions and to form a network to avoid duplication of efforts and to permit the more efficient transfer of technology to these areas.

International cooperation

In 1969 international cooperation activities were initiated through joint research projects with ICA in Colombia and INIAP in Ecuador. Valuable information obtained on the use of tropical feed resources, especially cassava and waste bananas, for swine feeding resulted from these cooperative projects. A second phase of the international cooperation activities was initiated in 1974 with financial support from IDRC for the establishment of swine programs in Bolivia and Costa Rica; a locally financed program was also started in Peru. Initial activities were oriented to overcome the lack of properly trained personnel and adequate facilities as these were considered the main limiting factors in these cooperative projects. Simultaneously, the CIAT Swine

Team provided technical assistance in the establishment, operation and orientation of these projects.

These cooperative projects are designed to serve as demonstration units for actively promoting the development of pork production in their regions. Because of the common characteristics of swine production in these countries, the strategy for regional programs is similar to the overall strategy of CIAT's Swine Program. Training activities at local or regional levels are emphasized; training is oriented to farmers and pork producers. Professionals from other national institutions interested in developing swine production in these areas have also been trained at CIAT. It has been found that CIAT can play an important part in the coordination of activities of different national institutions presently searching independently for the same goal of improving pork production. In addition, the swine collaborative projects serve as research centers where transfer of technology is carried out before being applied to practical conditions.

In Bolivia, cooperation was initially oriented to develop a Swine Unit in Santa Cruz through an agreement with the Universidad Gabriel Rene Moreno and the Heifer Project. A swine unit was built with a total capacity for 800 pigs, initiating operations in 1975. Two CIAT-trained professionals are coordinating the project and the main activities have been oriented towards training swine producers, validation of research and distribution of improved breeding stock to local farmers. Ten short courses (one week each) have been offered to local swine producers and farmers, with a total of 140 participants. Approximately 500 improved pigs have been distributed among producers participating in development projects, with technical assistance from the swine unit.

Applied research to solve local production problems has begun, notably on the use of locally available ingredients for swine feeding programs (i.e., rice by-products and the evaluation of a yeast, Saccharomyces cerevisiae, protein).

Technical support has also been given to the Swine Development Project in Monteagudo under the sponsorship of BID and the Comité de Obras Públicas from Chuquisaca. The project was initiated in 1975 with the objective of developing 150 small- and medium-sized swine farms in the maize-producing region of Chuquisaca; these farms receive technical support from four producing centers located in the area, in charge of three CIAT-trained professionals. Through them, CIAT's Swine Program has been giving periodical technical advice.

In Colombia, the collaboration has been basically centered on research projects, especially in the areas of swine feeding (cassava, opaque-2 maize, sugar cane molasses, and cottonseed meal) and evaluation of native pigs (Zungo) in a tropical environment. Recently, a project of swine development for small-sized farmers has been initiated in coordination with ICA, the Caja de Crédito Agrario and the Concentración de Desarrollo Rural; preliminary results suggest the possibility of using a similar approach in other swine development areas in Colombia.

In Costa Rica, CIAT and IDRC have been cooperating with the Universidad de Costa Rica and AID to develop the Swine Unit as an initial step in giving institutional support to swine producers and animal science specialists working in swine development projects. The equipment and breeding stock have been acquired and the program is operating on a provisional farm until the ongoing construction of facilities is terminated. One CIAT-trained professional is

coordinating activities in collaboration with swine specialists from the Ministerio de Agricultura. In 1976 a Central American Seminar on Swine Production was organized through the collaborative CIAT-Universidad de Costa Rica project.

The INIAP Swine Programs in Ecuador are located in Santa Catalina (Andean zone), Santo Domingo (tropical northwestern region) and Boliche (tropical southwestern region). Most of the research available on the use of waste bananas and banana meal in swine feeding was done here and is now being applied in some of the banana-producing areas of Latin America. A total of 14 training courses at the local level have been offered during the last two years, with an attendance of 700 farmers; and 1500 improved pigs have been distributed as breeding stock among swine producers in their regions. Technical assistance as an extension service to agricultural cooperatives of small-sized farmers is being widely accepted in the Andean zone.

In 1976 the construction of the Swine Unit at Pucallpa (Peru) was finished as the first step in the cooperative CIAT/Instituto Veterinario de Investigaciones Tropicales y de Altura (IVITA) project. The main objective is to demonstrate the technical and economic feasibility of swine production in this jungal region of Peru. In addition, swine training and development activities are in progress in cooperation with the regional office of the Ministerio de Alimentacion and the colonization project of the Sociedad Agricola de Interes Social (SAIS). CIAT is involved in the technical support of these activities through two professionals who participated in previous training courses at CIAT.

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Research

Prior to 1976 the Swine Program focused its research activities on the nutritive evaluation of tropical feedstuffs - especially cassava and waste bananas - and opaque-2 maize for swine feeding programs. After 1976 most research was basically oriented to support development of international collaborative projects and emphasized the use of agro-industrial by-products and production of microbial protein from cassava.

Research on utilization of cassava as a swine feed was done in collaboration with ICA. Life-cycle feeding programs were developed making maximum use of cassava roots. It was found that cassava roots satisfactorily replaced the cereals as energy sources when supplemented adequately with proteins, minerals and vitamins. Because of its low protein content, cassava-based feeding programs require higher levels of protein supplement than cereal grains. When fed fresh cassava, cultivars containing more than 150 ppm hydrocyanic acid (HCN) were less palatable than those containing lower HCN levels. However, when high HCN-containing cultivars were chopped, dried and fed as cassava meal in a complete diet, pig performance and feed consumption were similar to those for a cereal-based diet.

Waste bananas were evaluated as swine feed through research collaborative projects with INIAP in Ecuador; approximately 30 percent of the banana production in this country is rejected and available as an animal feed. Green and ripe bananas, as well as meal, were evaluated in swine diets. Experimental results demonstrated that ripe waste bananas were a valuable source of energy for swine during the entire life cycle, except during lactation, because lactating sows did not consume adequate quantities to meet their energy needs.

Utilization of banana meal in swine feeding program made it possible to replace approximately 50 percent of conventional energy ingredients.

Feeding trials with high-lysine maize (opaque-2 and vitreous opaque-2, VE-21) demonstrated that a minimal protein supplement was needed to obtain satisfactory performance in swine production. Life-cycle feeding experiments showed that with opaque-2 maize the need of supplementary protein was reduced to approximately one third of that required with normal maize.

Agro-industrial by-products are becoming more important in swine feeding programs since their availability is increasing in several regions of Latin America and their importance as human food is limited compared with the cereal grains. Therefore, the CIAT Swine Program undertook the evaluation of these by-products including rice polishings, sugar cane molasses and cottonseed meal.

Rice polishings were evaluated in several periods of the swine life cycle. Experimental results demonstrated that total substitution of maize by rice polishings in swine diets produced similar performance. Dietary levels of 70 to 75 percent for growing-finishing pigs and 85 percent for gestating-lactating sows were found adequate.

On the other hand by-products such as sugar cane molasses and cottonseed meal have limitations in their use because high levels in the diets produce gastrointestinal disorders and toxicity, affecting animal performance adversely. Experimental work to overcome these limitations was conducted at CIAT. Progressive increments of sugar cane molasses throughout growing-finishing periods allowed the incorporation of 35 percent sugar cane mo-

lasses at the end of the fattening period. Studies performed at ICA and CIAT on the use of high levels of cottonseed meal showed that special care was needed for the growing pigs but adult pigs used cottonseed meal as their only protein source. Validation of this type of technology should be conducted at the regional level before being transferred to commercial producers because of the wide variability in the quality of these by-products resulting from differences in processing methods.

Recently, part of the research activities at the Swine Unit have been involved with a joint project with the University of Guelph to produce microbial protein using cassava roots as the energy substrate. A pilot plant was built at CIAT and initiated operations early in 1976. Data obtained with a 200-liter fermentor showed that with a relatively simple fermentation process, a fungus, Aspergillus fumigatus I-21A an asporogenous mutant, grew and produced a microbial biomass containing approximately 35 percent crude protein on a dry matter basis. Efficiency of fermentation (yield of dried biomass in relation to the initial dried weight of cassava being fermented) gave values of 49 and 44 percent for fresh cassava and cassava meal, respectively. The practical characteristics of the process and the preliminary results obtained at the pilot plant suggest that microbial protein production in tropical areas is promising.

Proposed future plans

The primary objective of the Swine Program is to increase pork production in Latin America, notably in the countries where the program has collaborative projects. Because of the characteristics of swine production in this region, the development of projects for small- and medium-sized farmers, through coordinated action with national institutions, is emphasized. Small farms are defined as viable units with 4 to 5 sows, operating at least with a semicommercial approach. The entrepreneurial focus of this minimum-size farming would lead to an economically oriented swine production. Eventually efficient small- and medium-sized operations will develop in the areas with potential for commercial enterprises.

Based on the aforementioned considerations and on the changes introduced in the orientation of the program, the following short-term objectives were established:

- 1) To train groups of professionals in swine production for national swine programs
- 2) To evaluate the impact of the Swine Program and to undertake economic feasibility studies for developing swine production in the selected countries and in new potential areas
- 3) To identify additional factors limiting good productivity and to find solutions for these problems through research at CIAT and in collaboration with national projects

Considering that the Swine Program has been working for several years at CIAT; that a good deal of experimental information, notably in swine feeding, has been obtained; that national swine programs have been reinforced during the last few years; and that physical facilities are now available and functioning at the collaborative units, the Swine Commodity Team suggests that most of the future activities should be basically oriented to the validation of known technology at regional level and to its transfer to practical conditions as soon as possible. In order to accomplish these objectives, the following future activities are proposed:

Training. These activities should continue on the basis of one course per year for groups of 20 to 25 professionals. A four-month course will be offered from July to November 1978; with this course a total of 70 professionals will have been trained in swine production by the end of the year. Based on the present demand for this kind of training, it is proposed that at least three more courses be planned for the 1979-1981 period in order to reach a total of 130 to 150 Latin American professionals over a six-year period (1976-1981). Future needs after 1981 will be determined during the next two years, according to the interest shown by national institutions as well as the decisions to be taken with regard to the future of the program and its international cooperation activities.

Simultaneously, national seminars in countries where there are sizable groups of swine specialists (6-8) will be encouraged. Swine programs in Ecuador, Bolivia and Peru are planning seminars for the next three years. A seminar in Ecuador should be held this year; seminars in Bolivia and Peru are tentatively planned for 1979 and 1980, respectively. This type of

seminar will be prepared for professionals selected from national institutions, both public and private, working in swine production. Although there has been an ever increasing demand for CIAT to organize and participate in seminars in other countries, the Team prefers to strengthen the formation of core groups for the national programs first.

International cooperation

The Swine Program will continue to channel its international activities through the existing cooperative projects in Latin America.

Since Colombia and Ecuador have consolidated national programs, CIAT will increase its support for joint research projects on priority management and nutritional problems that limit regional swine production and have implications in other areas of Latin America.

Bolivia and Peru have just developed swine units in new areas where pork production has excellent potential. These units need strong support from CIAT during the early stages to orient and monitor their activities on swine development and research. In both countries the number of professionals trained at CIAT is being incremented as a basis for initiating regional swine programs. This new phase includes validation of technology and follow-up activities that require CIAT participation for the next three years.

The cooperative swine project with the Universidad de Costa Rica will also require support from CIAT in the immediate future since the swine unit is just being constructed. A complete team of professionals (3-4) will be formed by 1980 to work on cooperative projects with CIAT.

There is an urgent need for an economic approach to pork production in these Latin American countries where international cooperation activities have been established. Feasibility studies on production, marketing and economic aspects must be undertaken to evaluate the impact of the Swine Program in those countries, and to outline future development projects. To achieve this type of work, a Senior Staff position for an agricultural economist should be added to the present Swine Commodity Team. Feasibility studies on promising technological packages designed for different levels of production should be undertaken in collaboration with international projects.

Based on the history and present status of the collaborative projects, the following program of economic feasibility studies is suggested: For 1979, Colombia and Ecuador; and for 1980, Bolivia, Peru and Costa Rica. Early in 1981, the results of these studies and the potential of pork production in these regions should be assessed to determine a chronological plan of action for each. Eventually, feasibility studies would be undertaken for new areas of potential development, such as Paraguay and Venezuela.

Research. The emphasis on validating technology primarily oriented to small- and medium-sized farmers will lead to special considerations in terms of identifying remaining constraints and determining the type of research required to find solutions for this scale of production. Although a great deal of swine technology is available, its application is limited because of other constraints, primarily of an economic or financial nature. The lack of application and adaptation of approved management practices, the poor performance of native pigs under these conditions, and the limited availability of conventional feedstuffs and appropriate supplements appear to be important

constraints that limit swine productivity in the Latin American regions under consideration. In order to overcome these limiting factors the following research activities are proposed:

1. Swine production systems for small- and medium-size farmers. This type of research would be of an applied nature and would measure the effect of approved management practices on swine productivity at regional levels. General management and breeding work should be emphasized at the swine units of the collaborative projects before recommending the most promising practices at the farm level. Depending upon the nature of the experimental work, basic information could, in some cases, be obtained at CIAT to support studies at regional units. Production conditions for the different major agroecosystems should be taken into account in order to develop technological packages for each. Close collaboration between the research-demonstration units and the extension specialists in the areas of work is of prime importance.

In collaboration with the Special Studies Unit, it is expected that a crop scientist would provide support in studying the potential crops suitable for swine feeding at the small-farm level in tropical areas. Crops such as tropical roots (sweet potatoes, cassava, Colocasia, Dioscorea), forage and grain legumes and associations of these crops would be considered within the scope of this level of production. Hogging-off trials and forage management studies with pigs will be needed to learn about the ways of obtaining optimal use of this type of feeding system with minimum inputs. These additional studies will be a valuable complement to the production systems, notably for the small-farm swine producer.

2. Evaluation of improved breeds. Little work has been done with regard to breeds, especially for tropical environments. Results of the CIAT-ICA study at Turipana on the performance of native (Zungo), improved (Duroc), and the respective crossbreds under adequate management conditions indicated that improved and crossbred pigs not only showed a significant faster growth but their feed conversion efficiency was also significantly better than those of native pigs. Furthermore, carcass quality was appreciably improved. The rapid acceptance of improved breeds by the farmers in the areas where the program has collaborative projects suggests that the evaluation of exotic breeds for tropical areas should be emphasized, especially when considering that an important aspect of the development projects is the distribution of breeding stock to farmers.

Studies on the performance of introduced breeds should be planned and initiated in collaboration with national programs. Little work of this type has been done in the collaborating countries. The addition of a management-breeder specialist to the Swine Team would allow the program to broaden its research scope and to complement the application of nutritional-feeding research with other important areas of work in swine production.

3. New or nonconventional feedstuffs for swine. A relatively considerable amount of experimental information has been obtained at CIAT during the last few years regarding the use of high levels of agro-industrial by-products and tropical crops, notably cassava, with potential for swine feeding in Latin America. Roots and tubers are important energy sources for animal feeding in the tropics but because of their high water con-

tent, special care should be taken to use them efficiently in swine feeding programs. During the last few years, the need of adequate protein supplements in tropical areas has increased in importance. Conventional protein ingredients are mainly used for humans and poultry; hence research for new protein sources for swine feeding programs is important. This research involves the study of crops such as forage legumes and cassava foliage, and grain legumes. The use of agricultural by-products or tropical crops such as cassava as energy substrates for microbial protein production is receiving more attention. The CIAT-University of Guelph collaborative project for single-cell or microbial protein production from cassava should continue as part of the strategy of producing nonconventional protein sources.

4. Swine production systems in partial confinement. Although land availability is not a present limitation for agricultural expansion in Latin America, there is a worldwide trend in swine production towards total confinement. Especially within the scope of medium-sized farming, partial and eventually total confinement could lead to a more rational use of crops and by-products and also to the use of swine wastes as fertilizer material. Very little is known about confinement systems for pork production in tropical areas, particularly if exotic breeds are introduced. Basic work in this area should be performed at CIAT, especially in the area of housing, management and feeding of breeding stock before starting validation of technology at regional levels.

The foregoing proposed future plans would imply the addition of two full-time Senior Staff—an agricultural economist and a management-breeder specialist—to the present Swine Commodity Team. The four-man team would collaborate

in the program's three major activities, but the agricultural economist would be basically dedicated to the feasibility studies needed for evaluating the impact of the Swine Program in the collaborative projects.

Budgetary considerations. The budgetary implications derived from the request of two additional Senior Staff members to the present Swine Commodity Team have been estimated by the Comptroller's office (Table 4). In addition to these estimates, it is proposed that US\$25,000 should be added to the Capital Budget for the Swine Program for 1979. This sum would be used for constructing an adequate building (US\$20,000) for housing the boars and for two additional offices (US\$5,000) within the Swine Unit for the proposed new staff. The need for appropriate housing for boars had been previously expressed to CIAT Administration but a decision was deferred until the review of the Program by the Board of Trustees.

The Swine Commodity Team realizes that research undertaken by the collaborative programs should be adequately financed; however, it is felt that each national program should seek, in collaboration with CIAT, funding for special projects from national or international agencies interested in the development of swine production in these regions.

Table 4. Proposed budgetary increases for expanding the Swine Program

Personnel	Senior Staff (Man-years)			
	78	79	80	81-82
G. Gómez	1.0	1.0	1.0	2.0
J. Buitrago	1.0	1.0	1.0	2.0
Management-breeder, N.N.	-	.5	1.0	2.0
Economist, N. N.	-	.5	1.0	2.0
Direct costs	Additional budget (US\$ thousands) ^{1/}			
Operations	-	121	264	588
Office equipment	-	4	-	-
Vehicles	-	32	-	-
Capital	-	25	-	-
	-	182	264	588

^{1/} Including allowances for inflation.

Final comments

The Swine Commodity Team proposes that by 1981 the achievements of the program in the international collaborative projects and their regions of action be reviewed and evaluated. At that time a decision should be taken as to the future of the program's activities, in other potential swine development areas in Latin America.

In addition, we should consider CIAT's role in the development of integrated agricultural production for small- and medium-sized farms. Among the advantages that the Center has for working towards the improvement of swine production in Latin America are the following:

- It is the only international center that possesses a specific program where problems of swine production in the tropics can be evaluated.
- The pig herd and Swine Unit at CIAT are among the best facilities in tropical South America.
- A swine production training program for Latin American professionals is already established, the demand for which is ever increasing.
- The collaborative projects established by CIAT in regions with potential for development in swine production form an integrated international network, which is basic in the efficient transfer of technology.

The Swine Commodity Team would like to emphasize that the status quo is an untenable position.