



Centro Internacional de Agricultura Tropical

SMALL FARM SYSTEMS PROGRAM

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PROGRESS REPORT



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# SMALL FARM SYSTEMS PROGRAM - PROGRESS REPORT

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## I INTRODUCTION

The goals of CIAT include the increase in quantity and quality of food in tropical Latin America, and an improvement in the general living conditions of rural people, through the introduction of improved technology and the use of more efficient agricultural practices. The integration of crop and animal production technology, and the relevance of available technology to the complex problems of the small farmer, are of increasing concern to CIAT and its collaborators. How can traditional farming systems be modified to increase production and income, and to improve the nutrition of the small farm family?

Previous documents which have outlined the CIAT interest and planning in this area include The Agricultural Systems Program A Course of Action (McClung, 1973) and the Small Farm Systems Program A Program Document (Franklin and Scobie, 1974)

During the first six months of 1974, the implementation of the principles and activities set forth in the program document has been initiated. An interdisciplinary team has integrated efforts to pursue the goals outlined in the document through field visits with farmers and development specialists, consultation with national agencies, and group interaction in evaluating data and ideas. The objectives, methods and working focus of the team have evolved during this time, and it is desirable to summarize the results in relation to the basic concepts detailed in the January program document. This progress report includes a condensed background and philosophy for the program, a statement of specific objectives, and a summary of activities during the period since January. From this experience, criteria have been established for zone selection, general models of the small farm situation developed, and an emphasis placed on training personnel

## II. BACKGROUND AND PHILOSOPHY<sup>1/</sup>

A fundamental characteristic of tropical Latin American agriculture is the simultaneous existence of a limited but highly commercialized farming sector on one hand, and a numerically large sector of small family farm units which operate at a near subsistence level on the other. Past emphasis in research has been on the development of technology for farmers in the commercial sector, physically located in the most favorable ecological regions, with relatively large, capital intensive holdings and access to technical assistance, credit, agro-chemicals, markets and transportation. The major orientation of this sector has been toward production of export crops, and not basic foods

In Latin America, the primary production of food crops is concentrated with the less favored small farmers, who have limited access to production inputs, credit, storage, transportation and other institutional or commercial services. If food production is to increase substantially, there must be an emphasis on development and integration of a crop/animal technology which is appropriate to the small farmer, and consistent with the real constraints which limit his adoption of currently available technology. An additional important factor is the new emphasis by governments in the zone on finding solutions to alleviate rural poverty. This requires an increase in real income for the farm family, which can only result from an increase in production and the opportunities for employment in traditional agriculture.

The definition of "small farm" in CIAT is the farm enterprise in which production and productivity are low, real income is low, and the principal source of labor is the farm family. This is a broad and functional definition, and small farmers may operate in cooperatives, small-scale individual hillside farms, large ranches in the llanos region, or large land reform holdings such as La Maquina,

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<sup>1/</sup> Condensed from Program Document (January, 1974) and "Una Metodología de Ingeniería de Sistemas para Trabajo Interdisciplinario en la Agricultura" (June, 1974)

Guatemala (20 ha) or the Agrovilas in the Amazonia of Brazil (100 ha) Small farmers have had little opportunity to improve their situation through agricultural activities. However, they reach decisions based on their perception of potential success or failure as a result of adopting new technology in much the same way as the commercial farmer. With the additional needs to provide food for their families through home production and minimize the risk inherent in any change of crop or cultural practices, through a long experience in agriculture they have developed production systems which have given them near optimum results within their ecological, economic and political environment.

With this concept in mind, it is essential to comprehend existing systems before attempting to change them. How does the farmer view his current system, and why does he consider this an optimum investment of his labor and limited resources to produce income and food for his family? We must fully understand the farmer's present system and his decision making process, his goals and perception of the total environment in which he operates, in order to offer him alternatives which will solve his most urgent production problems and lead to increased income and improved well-being.

A logical process for understanding the farmer's situation, and for developing relevant and useful alternatives, includes the following steps in research and application of results.

1. Analysis of present (traditional) systems

Typical systems of tropical agriculture in Latin America are being studied. Through an analysis of production and consumption on the farm, we are describing how the farm family uses resources of time, land, energy, crops, animals, information, and available services to produce food and income in the context of the total environment.

2. Synthesis of prototypical farming systems

Insights from the analysis phase are being used to create physical and analytical examples of prototypical farming systems, in which we can predict and test the impact of new technology.

3. Design of improved agricultural systems technology

Analysis and synthesis of farming systems leads to specification of alternatives which are feasible for introduction into small farms in order to better achieve farm family and national food production goals. With an understanding of the complex environment in which the small farmer operates, and the constraints which influence his production decisions, we can select cultural practices, crop/animal species mixes and levels of inputs to be tested on experiment stations or family farms.

4. Validation of the process

The process will be validated by demonstrating that farm families in a selected area can achieve their objectives through adoption of a technology synthesized by this process, and that the same procedure may be applied by national development agencies as a method to identify problems and generate relevant solutions to help farmers achieve their goals.

5. Implementation

Implementation or application of the process is the role of national agencies, and CIAT will collaborate with them in specific zones in the development of new technology, the design of alternative systems, the testing of these systems on the farm, and in training development personnel in use of the process. Our involvement in implementation will allow a study of the applicability of this process within the context of a national program and a specific small farm environment.

## 6. Evaluation

It is important to develop methodology for evaluating the impact of new technology on farm income and human welfare. This methodology will be useful to international and national institutions as a guide to the allocation of limited research and development resources to the activities which will have the greatest potential impact.

This process outlined in the above steps will provide guidelines for identifying limiting factors on the farm and selecting research procedures to solve these problems. It will provide a framework for predicting the probable adoption of research results and the impact on food availability and incomes of that adoption. It will provide alternative ways for the farmer to reach his objectives. As a dynamic process, this sequence of steps will be useful in planning and analysis of multiple cropping/animal systems, timing of investment and changes on the farm, and sequencing the introduction of other new technology.

The CIAT Small Farm Systems Team operates in collaboration with national agricultural development agencies and the CIAT commodity teams to provide information and methodology for identifying problems and predicting the impact of solutions. The ultimate clients of CIAT, and of the Systems Team, are the farm families and consumers of Latin America that benefit from the implementation of research results by national agencies.

### III. SPECIFIC PROGRAM OBJECTIVES

The CIAT Small Farm Systems Program strategy emphasizes the rapid adaptation and utilization of existing technology which is relevant to the problems limiting production on the farm, and which can be applied to improve the income and nutrition of the farm family. To avoid expensive and time-consuming traditional experimental procedures with numerous replications on the experimental farm, we shall emphasize putting together appropriate existing practices, whether from available experimental results or from empirical results of the better farmers. This will include consid-

eration of the climatic, agronomic, physical, socio-cultural and economic factors associated with the production of food crops and animals. As outlined in the procedure above, we are testing the most relevant alternatives which are available to solve identified limiting factors which prevail in specific areas of the lowland humid tropics. The specific program objectives are

- A. Assemble appropriate technology for small farm operations in the lowland humid tropics, so as to develop alternatives for the family, in terms of decisions to sell or consume plant and animal products, and to enable the family to take advantage of favorable markets, reduce risks, improve nutrition and accumulate capital. This will include the following criteria
- a. Optimal utilization of available natural resources - time, sunlight, land, water, soil fertility - and family labor and capital.
  - b. Improved use of plants and animals as marketable products, food for family, feed, manure, power source and transportation.
  - c. Distribution of products (food, feed, and cash) throughout the year, consistent with other objectives.

Once the technological feasibility of alternatives has been demonstrated at the farm level, further simulations of the farm situation will be required under varying policy assumptions with respect to the costs and availability of inputs, including credit, marketing costs, and level and types of risk. Testing the applicability of technological possibilities requires the assembly of various "policy-alternatives" which deal with the non-technological factors affecting small farmers. These need to be considered in discussions with farmers, and with personnel from government and international agencies as to their desirability and feasibility. This objective may be summarized as follows

- B Explore with farmers, national and international agencies concerned with agricultural policy in general, the credit, marketing, extension, cooperative forms of organization, and land reform alternatives to identify the best ways in which to implement new technology.

The unique challenge to the Small Farm Systems Program is that of dealing with all the complexities of the total small farm systems of production of both plant and animal products. These complexities require the utilization of methods and concepts of many disciplines, even at the level of the individual farm. Our task becomes more complex as we recognize that we cannot simply deal with the technological aspects of production at the farm level, but must also consider the policy aspects associated with implementing these technologies. These larger policy issues will require investigations and coordination with national agencies at the local as well as the national level, and should involve those international agencies which are funding some of the major national programs affecting small farmers.

Although specific zones and certain groups of small farmers are confronted with a series of problems and limitations which may be unique to their complex micro-environment, there are lessons to be learned from each specific zone, and also a probability that part of the optimum solution or combination of technological factors may apply in other zones. This attempt to generalize from each experience and gradually develop a more rapid and efficient approach to problem identification and solution leads to the third objective.

- C. Develop an efficient and useful process for the identification and analysis of existing farm systems, so as to facilitate the rapid application of agricultural technology in the development of rural areas.

The development of a "general model" or procedural methodology should provide a tool to understand major constraints, and primary interactions among the principal factors in small farm agriculture. The identification of those elements which are commonly present, or usually interact in a similar way over a range of small farm situations will further our understanding of general principles which operate on the farm, and lead to more rapid recognition of specific problems and relevant solutions in a new situation.

The professional orientation and problems facing different groups concerned with agriculture vary sufficiently widely that it is not likely that we will find any combination of technology and policy which fully meets the needs of any single client group. The technologists at national and international research stations typically aim at maximizing production of a particular commodity, and are not usually concerned with its direct application to the small farmer. Moreover, most of them have been trained under systems of agriculture which emphasize optimum production per man rather than per unit of land or per unit of capital. Policy makers, on the other hand, need to consider the optimum use of national resources, not just within agriculture but also between other sectors which compete for the same funds. Farmers would like to get some kind of optimum return, but they would also like to minimize risks. Each of these groups has a different set of problems and priorities, and one of the more challenging tasks of the Small Farm Systems Program will be to seek both technological and policy alternatives which satisfactorily meet the needs of farmers as well as the national and international planning and financing agencies. A generalized process which can be applied in specific zones or situations to recognize production-limiting constraints and analyze alternative policies is a long-term goal of the program.

#### IV FIELD ACTIVITIES IN SPECIFIC ZONES

Field involvement during the first six months has included preliminary visits to five specific zones, and further in-depth activity in two of these. The initial visits and first detailed studies have given some insight on survey procedures, perception of problems by farmers and research/development personnel, first approximations on relevant available technology, and a preliminary general model for the major interactions in the zones. The zones included will be described briefly, along with results of the visit or involvement and preliminary conclusions. The zones are (1) Agrovilas on the Transamazonica Highway of Brazil, (2) Yurimaguas region in eastern Peru, (3) Eastern llanos of Colombia, (4) North coast area near Monteria, Colombia, and (5) La Maquina on the Pacific coast of Guatemala. Also included is a preliminary report on the national agencies involved in small farmer problems and development of this sector in Colombia.

##### A. An Agrovila on the Transamazonica Highway in Brazil

The systems team anthropologist, Stillman Bradfield, visited an Agrovila at kilometer 46 west of Altamira on the new Transamazonica Highway, an ambitious national program which includes a 5500 km road from Recife to the Peruvian border, and branch roads to the south and to the Guianas in the north. These low jungle zones with rolling hills beneath a massive forest cover are virtually unknown in terms of crop and animal exploitation, and solutions to all problems have to be found quickly to keep the colonization moving on schedule, reach production levels which can begin to pay for the huge public investment, and warrant continued construction of the road into new areas. The Agrovilas, or rural communities, include a population center laid out along the main road, with some 50 houses, an office, clinic, warehouse, water tank, small school (grades 1-4) and chapel. Each colono has a 100 ha block in which he is allowed to clear 50 ha for crops or livestock production. Although the main highway is completed, side access roads to many

lots are not even started, hence many colonos have no road access to their lots. There is no assurance that they will be able to move the first rice crop to market. To insure a regular income to the family, a sizable proportion of the households in the Agrovila have found it necessary to spend their entire time working at other things than clearing and planting their lots.

Factors which are considered by each family in developing strategies for exploitation include (1) what the environment can stand, (2) the immediate needs of the family, (3) market possibilities in the current situation, and (4) the long-run possibilities and needs of the family. Present strategy is to clear a patch each year to plant in rice, and in the following year this is sown with maize, beans and cassava - the main subsistence crops of the family. Other crops include bananas, sugar cane, white sweet potatoes, fruits (papaya, mango, jack fruit, cashew, pineapple) and vegetables (lettuce, okra, tomatoes, eggplant, kale, green peppers, cabbage, cucumbers). Black pepper is currently a favorite crop for farmers who want a high value-density product to export from this isolated area. Cattle operations are a part of the future plans, and most colonos see themselves moving toward perennial crops combined with livestock, with enough subsistence crops to meet the family's needs.

Problems limiting production in the zone are complex. Necessary inputs such as seed, credit and technical assistance have not always been available when needed. This is a large and important zone, and communities in this type of climatic region will be considered for future involvement of the Systems Team as experience is gained in other zones and support becomes available

#### B. Huallaga River Basin in Peru

The team anthropologist, Stillman Bradfield, made a preliminary visit to Yurimaguas and Tingo Maria in the eastern region of Peru. He observed the present production and potentials of the lowland jungle area, the technology available to

increase production, the socio-cultural and economic factors operating in the region, and the recent government changes which have a direct influence on agricultural development. The agricultural focus in Yurimaguas has been on plantation and export crops, with minor activity in cattle and food crops. Bananas, rice, yuca, maize and beans are cultivated in a cycle of two years, and then the forest is allowed to take over for a three to seven year period. According to Ministry of Agriculture data, plantain and rice are the most profitable food crops in the area. There is virtually no use of fertilizers, insecticides, herbicides or improved seed in the area. Competition for labor from the oil fields, a severe lack of transportation, low prices for products, lack of credit, technical assistance and machinery, and weeds seriously reduce production potential in the zone. In spite of abundant land, water, sunlight and favorable temperatures in the jungle region, limitations to production include poor soil fertility, plant and animal diseases, and a lack of technology appropriate to this zone. Development will depend on better information on how to utilize the environment, new and well-adapted varieties, and improved services such as transportation, marketing, production inputs, labor, credit, storage facilities, and machinery. Organization of cooperatives for cattle raising and crop production, as well as providing services (tractors, production inputs) is moving slowly in the zone. There have been many changes of policy and personnel during the current social transformation in Peru which have slowed the implementation of development in the jungle areas. Coastal and sierra zones continue to receive greater emphasis due to (1) high cost of establishing infrastructure in the jungle, (2) greater urgency of solving production and social problems in zones where population pressure is greater, (3) greater emphasis on retention of labor, technical and managerial personnel in other zones, and (4) serious technological problems in this new area. Development of the jungle zone in Peru remains a difficult technological and social challenge, but this zone has great production potential which may be of more direct

interest to the Systems Team in the future.

C Eastern Plains (llanos) of Colombia

CIAT research experience in the llanos was supplemented by an exploratory visit by Piet Spijkers (team sociologist) from Villavicencio on the edge of the zone across Meta Department by land through Carimagua into Vichada Department.

The acid and infertile soils of the llanos are well drained clay-loams with a smooth to gently rolling topography, have excellent physical properties and can be modified by sufficient applications of lime and fertilizers. Agricultural productivity is limited by high costs and limited availability of production inputs, long distance to markets, and lack of adequate transportation arteries.

Beef cattle management, pasture improvement, and animal health have been emphasized by CIAT and ICA, and there has been modest agronomic research on cassava, field beans, maize, rice and cowpeas <sup>1/</sup> Fruit, crop and pasture species which are well adapted to the extremely acid soil conditions include mango, plantain, citrus, cashew, brazil nut, rubber, cassava, tropical yams, and many forage grasses and legumes. There is a serious shortage in this zone of both cereal grains and food legumes for adequate diets. The CIAT commodity programs and soils program have found that cowpea was the most promising grain legume, while rice was the best cereal grain crop.

Agronomic research programs have focused on resolving problems of low soil fertility through lime application, adequate fertilizer use and selection of tolerant germplasm for these alluvial soils. Distance from market and high cost/lack of availability of inputs seriously limit productivity. The llanero recognizes problems directly related to his cattle.

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<sup>1/</sup> Spain, J M, C A Francis, R H. Howeler and F Calvo 1974. Differential species and varietal tolerance to soil acidity in tropical crops and pastures. CIAT Tropical Soils Symposium, Palmira, Colombia, February 1974.

enterprise, such as how and when to sell cattle (low prices), and how to buy young stock and from whom (credit, transportation, prices, exploitation). Low calving rates, poor native pastures which require extensive grazing, expensive production inputs such as minerals, chemical fertilizers, and drugs, and parasitic diseases have limited expansion of herds and intensification of the operations in a smaller area per farm. This extensive grazing system has important implications in the region's development. School education is almost impossible, and during the rainy season, it is almost impossible to move from the farm to a hospital, or to arrange for a doctor to visit the farm. Agricultural extension efforts are limited by these same factors. Transportation of food, clothing, and production inputs are difficult and costly. This zone has potential for production, and will be increasingly important as pressure on land in other regions stimulates migration into the area. We must maintain communication with research and development groups working in this region of Colombia.

D. North Coast of Colombia

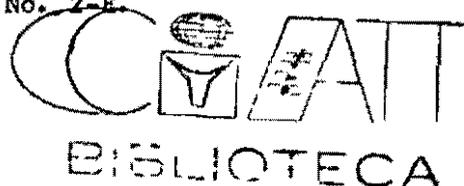
The tropical lowlands on the north coast of Colombia, with both alluvial flooded lowlands and well-drained soils on rolling hills, have been a focus of CIAT interest in the commodity and training programs. An intensive involvement by Loyd Johnson (agricultural engineer) has explored the potentials of rice production in the flooded soils of the north coast, along with practical cultural systems, training schemes and integrated projects with national agencies to move this technology to the farmer. The swine and maize programs have studied production problems on the farm, while economists have evaluated the potentials for swine enterprises in Cacaotal, a village near Monteria. The team anthropologist, Stillman Bradfield, visited this same village and described production systems, factors limiting productivity, and some cultural aspects of the community. Trainees in crop and animal production have lived on farms in the zone to learn

through practical experience the process of problem identification and solution as followed by the farmer.

Human diseases, absence of animal power for wet land preparation, and lack of a suitable crop have limited exploitation of the fertile, naturally-flooded and poorly drained lowlands in Latin America, compared to their traditional productivity in Asia. With the control of yellow fever and malaria, availability of power equipment, and rice varieties suitable to these zones, a production potential is possible through application of available technology. This technology differs from the successful Asian rice culture in that land preparation in water is accomplished with large power equipment, and the crop is established with hand-broadcast, pre-germinated seed rather than transplanted. Hand labor is utilized for planting, fertilizing, spraying for weed and pest control, harvesting and threshing. A validation of the system on the CIAT farm over a two year period produced 719 tons of rice on 1225 ha, an average of 5,860 kg/ha/crop.<sup>1/</sup> A demonstration of this system on the ICA station in Turipaná, and demonstrations with farmers in collaboration with INCORA and ICA, have shown the potential production which will result from adoption of the system on the North Coast. Training of technicians and farmers on the ICA station, plus an internationally financed and locally supervised credit scheme, will move this system onto farms in the area around Montería. A diversification of the cropping system into other species and small animals is under study and testing in the zone. Alternative organizational structures, especially farmer cooperatives, have been shown to improve production efficiency and access to credit and other inputs to increase productivity and income per family

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1/ Johnson, L and A. Diaz D 1974. A continuous rice production system. CIAT Information Bulletin No. 2-E



Cropping and animal production systems in the well-drained rolling hills are highly dependent on land tenure and available resources. Although the majority of this land is still dedicated to extensive grazing and beef production, subsistence farmers in these regions plant associated crops of maize, cassava, yams, cowpeas, pigeon pea, tobacco, tomato, and other food or cash crops. Pigs and chickens are common sources of protein, with ducks and African sheep two potential species for parts of this zone. The potential for commercial swine production on a small farmer scale has been designed and demonstrated in one village in this zone, Cacaotal<sup>1/</sup>, but recent economic analyses of the system suggest that other alternatives may be much more profitable<sup>2/</sup>. Crop production per hectare is high due to intensive labor inputs in a mixed cropping system - predominantly maize, cassava and yams. The yam crop has the highest sale price and generates the most income, although prices tend to vary considerably.

Most serious technological factors which limit production include lack of water, land availability, better varieties and lack of herbicides. Field trials during the current season include herbicide rates and timing in mixed crops, population and fertility levels in the common cropping mixture, and introduction of yams, maize, cassava and cowpea varieties. These are all designed to answer specific production problems identified by farmers in the community in the field with CIAT and ICA technicians. Small farm families in this zone consider good health and education for their children to be highest priority objectives, followed closely by the chance to get credit to buy or rent more land and adopt better technology.

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1/ Wesoloski, G.D 1973. A Study and Program for Swine Production on Small Farms on the North Coast of Colombia, Ph.D. Dissertation, Univ. Illinois.

2/ Estrada, R D and A Valdés 1974. Proyecto Cacaotal, Parte I Observaciones sobre la Geografía de Cacaotal y sus Sistemas de Producción, Parte II Observaciones sobre el Ingreso, Producción Agrícola y Perspectivas del Cambio Tecnológico en Cacaotal. CIAT, Programa de Economía Agrícola.

The Systems Team has chosen this zone to work in the two major ecological areas, flooded lowland fertile soils appropriate to rice, and the rolling foothills with a predominance of maize, cassava, yams and other crops. The initial agronomic trials and demonstrations will be followed with socio-cultural, economic and nutritional surveys to better understand the complex small farm systems in this region. More in-depth and appropriate interventions will be predicted from the initial results and implemented in the zone through national agencies already working there. Evaluation of production, economic and nutritional indicators will provide feedback to check our initial impressions of the farmer's system and which interventions would offer the greatest impact. The North Coast of Colombia is designated as a Program Activity Zone of the Systems Team. Considerable time has been devoted to the development of cooperative working agreements with the personnel of the ICA Subgerencia de Desarrollo Rural, and it is envisaged that work on the North Coast will involve a collaborative element with the Rural Development Projects in the area.

E. La Maquina on the Pacific Coast of Guatemala

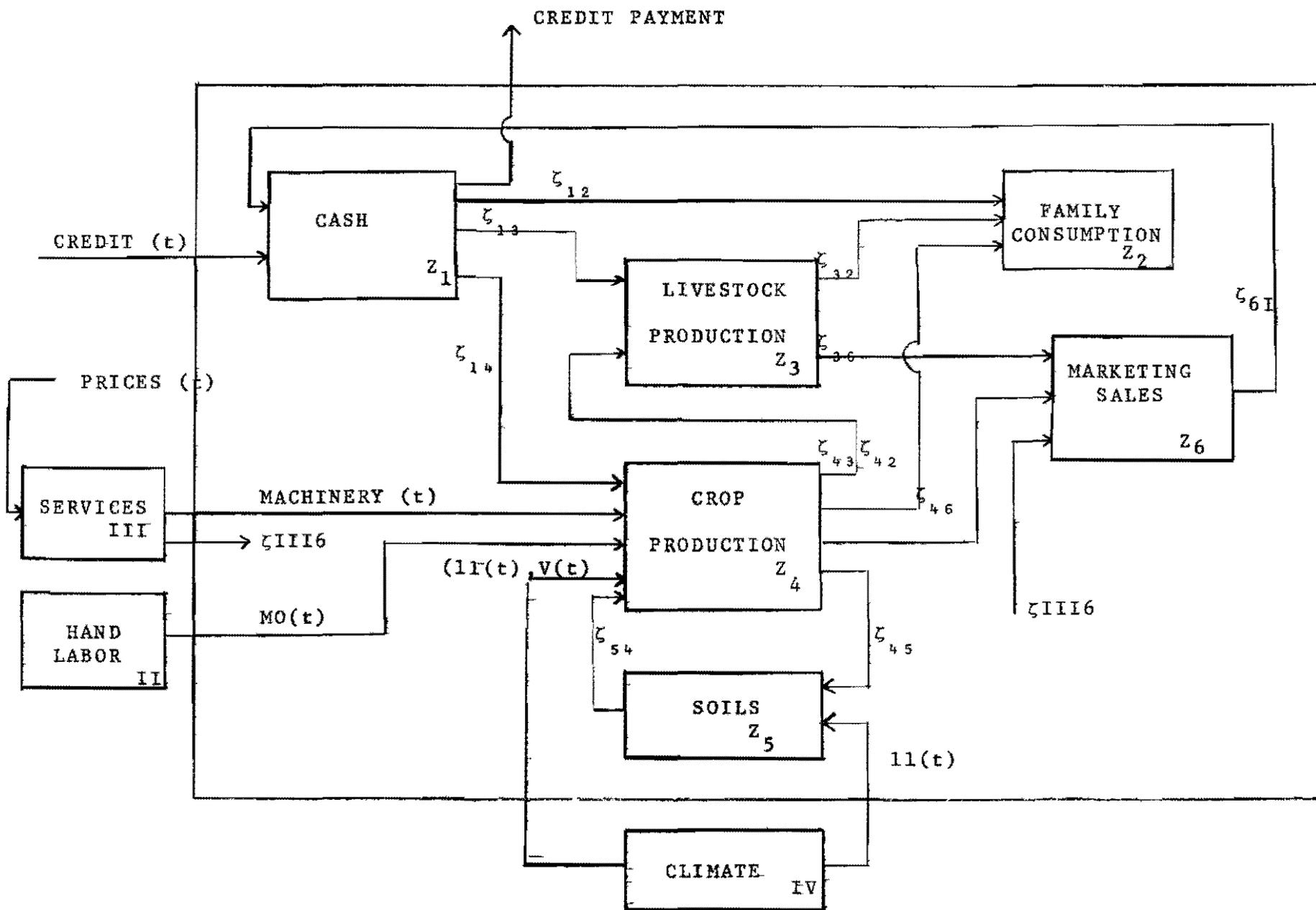
The agrarian reform and development project of La Maquina is located on the Pacific coast of Guatemala in the Departments of Retalhuleu and Suchitepequez. Land was distributed to small farmers in lots of 8 to 20 hectares, beginning about 15 years ago. Principal crops in the well-drained soils in the zone are maize in the first season, and sesame, maize and other minor crops in the second. All crops depend on natural rainfall and residual moisture through the second season, some lower wet areas near the rivers are used for rice cultivation. Although these are small farmers in terms of labor inputs from the family, limited investment in technology and low standard of living, their exploitation of at least 10 hectares of maize in the first season requires the use of rented tractors for land preparation and in some cases planting and cultivation for weed control. All CIAT activities

in this zone are coordinated with the production-oriented program of ICTA, the national research and development agency of the public agricultural sector.

Principal factors limiting production in the zone include the risk associated with increased investment in the crop, and high winds which occur in July and August, causing at least 20% crop loss. Scarcity of labor at crucial periods, insect attack, lack of improved seed, low on-farm prices for the maize crop, lack of technical assistance, machinery and equipment at the appropriate time, and weeds are all priority problems which limit production and productivity

Specific farm trials were designed during the current season in response to the factors which farmers perceived as limiting their yields. These include (1) use of herbicide, (2) use of insecticide, (3) fertilization with N and P to test the apparent lack of response observed in previous trials in the zone, (4) improved varieties, and (5) changes in land preparation which include deep plowing and incorporation of additional organic matter. These experiments are planted, and will be harvested in September and October.

A location-specific model which quantitatively relates the most crucial factors which interact on the farm in La Maquina is illustrated in the accompanying figure (Franklin, Juri and Hoover, 1974). We are currently modifying inputs in this model, and assessing the potential impact of alternative interventions in this zone. Some of the input data are estimates, as are the potential increases in yield as a result of the intervention. Following the harvest in September, actual field data will be substituted in the model in place of the estimates. Additional quantitative inputs into a more complete model of the small farm in La Maquina will result from surveys in economics and nutrition which are planned or under way. The model represents a first attempt at integrating the principal components of small farmer agriculture, and similar efforts in other Program Activity Zones will lead to an evolution of the general process discussed earlier.



MODEL FOR "LA MAQUINA"

A graduate student is collecting economic and socio-cultural data as background to study production problems and risks. Through collaboration with INCAP, the nutritional status and potential changes in the diet are being evaluated.

At the national level, we are becoming acquainted with the policies and specific functioning of credit, price support, marketing and other agencies whose decisions and activities directly affect the small farmer. The relationship between requirements for credit on the farm, and the real needs and capabilities of the farmer to meet these requirements are under study by ICTA agronomists and CIAT collaborators in the zone. Realistic recommendations for credit policy based on field experience with production alternatives in the zone will be proposed. The impact of price structure and market availability for the maize crop is also a critical factor for the small farmer, and one which will warrant attention.

This zone in Guatemala is of direct interest to our Systems Team, and cooperative work through the appropriate government agencies will receive priority for the rest of this year. La Maquina is a second specific Program Activity Zone which has been established.

#### F Official Institutions in the Agricultural Sector of Colombia

A short-term collaborative study is under way on the official institutions in the agricultural sector of Colombia which are involved with the small farmer. The initial visit explored the definitions which are employed by each institution to identify the "small farmer", and a second visit sought statistical and bibliographical information on the activities of the agency. This detailed information will be organized to produce a general summary of the services and support which are currently available to the small farmer in Colombia.

1 Definitions of the Small Farmer varied among the several institutions, and criteria which were mentioned included farm size, available capital and labor,

use of technology, monthly income, residence on the farm, and total investment. Most agencies used one or at most two of these criteria to define who is included in this group, the "small farmers". Factors which were not mentioned, or seem to have little influence on how this target group is defined by the agencies, include land tenancy, types of crops grown, traditions and customs, family size, and managerial ability. Although certain factors recurred frequently in the stated definitions of the agencies, there was no consensus on how much land, how much income, what level of commercialization, or the amount of investment which adequately described this group. The small farmer was distinguished by a small surplus in production, which is sold and the proceeds capitalized in some form, as compared to the subsistence farmer whose family consumes all the crops and animals produced on the farm.

2 Statistical Data and Biographical Materials were reviewed as to availability and applicability to the projected work of the Small Farm Systems Program. The groups which are most interested in this type of study, and which have the most pertinent information include INCORA (land reform agency), Caja Agraria (credit and sale of agricultural inputs), ICA (research and rural development projects), National Planning (Agricultural Division), and the Coffee Growers Federation. A detailed bibliography was prepared, and this will serve as a resource base for our further work in Colombia in specific zones.

## V CRITERIA FOR ZONE SELECTION

The preliminary visits and limited detailed study and activity in two zones has led the team to certain conclusions on how to focus research strategy and specify criteria for choosing zones for future involvement. These decisions are consistent with the CIAT philosophy that research to solve production limiting factors must focus on the most important of these factors in the context of the

lowland tropics of Latin America, and that results of this research will have little or no impact until they reach the farm. Both the criteria for zone selection and the operational strategy for team operation are dynamic activities, and these will evolve with experience and additional expertise on the team.

A Geographical and Climatological Diversity

A most preliminary classification of the zones in the humid lowlands of tropical Latin America is based on topography and soils, rainfall pattern and present potential cropping systems which are used in these zones

- 1 Alluvial flooded lowlands, with alternating wet/dry seasons, cover the north coast of Colombia, Venezuela, and the Guianas, much of the Atlantic coast of Central America, the Guayas river basin of Ecuador, and parts of Brazil. These areas are characterized by poorly drained, heavy, and very fertile soils with a tremendous potential for production of rice, taro, sorghum and other food crops when water is controlled
- 2 Alluvial and other well-drained soils, rolling hills, with alternating wet/dry seasons predominate in many of these same zones and often occupy a much greater land area. Soils are less fertile, with nitrogen often a limiting factor and moisture limited to natural rainfall. Predominant food crops include maize, yuca, yams, soybean, sesame, beans and sweet potatoes, although natural pastures and cattle occupy most of these areas at present.
3. High rainfall forest zones, with near continuous distribution of rain through the year, are typified by coastal areas of Central America, the Pacific Coast of Colombia, the Santo Domingo-Quevedo area in Ecuador, and the vast Amazon jungle in Brazil, Colombia, Ecuador and Peru. Soils are highly leached, low in fertility, easily and rapidly eroded when the forest is cleared, and there is only limited experience in food production

outside the traditional expertise in such plantation crops as bananas and oil palm.

4. Llanos or plains zones, with a wet/dry rainfall pattern and highly acid soils, are characteristic of large areas which border the jungle in Venezuela, Guianas, Colombia, Ecuador and Peru, and the large Campo Cerrado of Brazil. Soils with an extremely low pH have a low available phosphorous and often an aluminum toxicity problem. Currently they are used for extensive grazing of native pasture grasses, and some limited research information is available from such stations as Carimagua, Yurimaguas and Brazilia.

These categories are more functional and practical than quantitative, and we have an immediate need to quantify the areas involved and populations directly dependent on these areas. What are their current production levels of which principal crops, and how does this compare with potential production? Are there additional specific zones with agricultural potential which are important in tropical lowlands of Latin America and should be included? The need for geographical and climatologic expertise is becoming apparent.

#### B Criteria for Specific Zone Selection

A number of criteria on which to base selection of zones for program involvement have come from the past 6 months travel and experience. These are the present criteria, and additional experience in the field and with data evaluation will lead to refinement and modification of this list

1. Geographical and climatologic characteristics consistent with one of the above listed categories, within the humid lowland tropics in Latin America.
2. Potential transferability of results to a wide international area within Latin America with a substantial population which can benefit from the results.

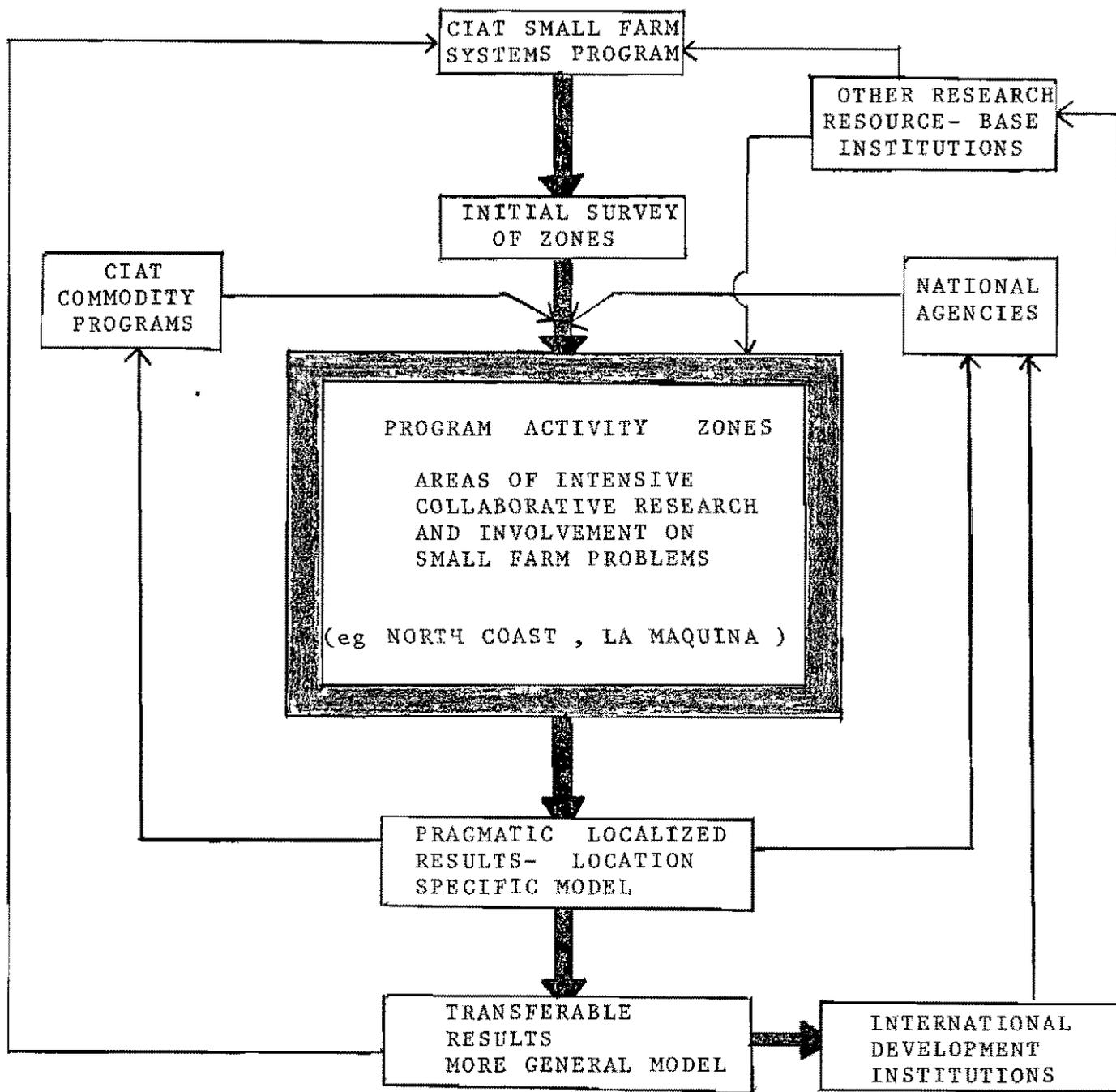
- 3 Infrastructure available, but not fully utilized, especially road systems, markets, urban center as sources of inputs, communications, etc.
- 4 Logistic convenience, and accessibility to research/development personnel as well as farmers from a wide area, if the location is to effectively serve as a successful demonstration of specific types of intervention
5. Large or potentially large rural population, which could benefit immediately from successful organization of useful alternatives which would increase production and income.
6. Present interest and involvement of national agency personnel, whether this is a research organization, extension or land reform agency, rural development project or other commitment by the government to development in the zone.
7. Interest and potential involvement of CIAT commodity program, including yuca, beans, maize, rice, beef and swine, since these zones are potential field testing sites for improved single crop production systems, as well as the integration of these crops and animals into the farmer's total system

It is expected that most zones to be selected will meet most of these specific criteria. Both the "La Maquina" area in Guatemala and the Colombian North Coast near Monteria fulfill these requirements.

#### C Small Farm Systems Team Focus

The current focus of the systems team on specific development zones may be summarized in the following diagram. As detailed in this flow chart, five zones were surveyed to date in 1974, and two zones have been selected as intensive Program Activity Zones for the team's activities. The transfer of results from a general model will be of interest to our team in improving the efficiency of data collection, problem identification and selection of viable alternatives for

SMALL FARM SYSTEMS PROGRAM ACTIVITIES AND FOCUS



the farmer. The same process and model may be of specific interest to International Development Institutions, such as banks, foundations and others, in their decisions on resource allocation and loans to national agencies, to farmers through national agencies, and to other research resource-base institutions.

## VI MODEL DEVELOPMENT

The use of models to describe a small farm situation can lead to a better understanding of the importance of major factors or limitations operating on the farm and the interactions among these factors which may seriously affect adoption of new technology or the impact of this adoption. For example, there are no doubt situations where the introduction of a new variety with genetic potential for 2 to 3 times present yields may have no impact due to problems of fertilizer or herbicide availability, transportation or prices on the farm. An efficient method to identify key constraints and the impact of changing these limitations on production, income, nutrition and other goals of the farmer is the processing of primary data from the farm or from several farms in a zone in a computer program which reflects the specific cropping pattern and alternative potential interventions for that zone. A specific case was presented in the section on La Máquina, a coastal area in Guatemala where the team is involved in a detailed study of problems and potential interventions.

From the detailed experience in several zones, some generalities will emerge, as major factors recur as "key" in the production process, and those steps in production where bottle-necks most frequently occur. These experiences will lead to a greater confidence in a general model which was developed during the past several months. In this model, key climatic, socio-cultural, soil, agronomic, and nutritional and economic factors have been organized in a logical manner to reflect the ways in which they interact to influence the farmer's decision and eventual production and income. The factors included were suggested by specialists on the team from each discipline as those most critical in the decision-production process on

the farm. The current description of this dynamic process is presented in the following diagram.

This diagram attempts to relate principal factors in a logical, consistent, communicable and relatively complete way. Major structural and causal relationships which our inter-disciplinary team has specified to date are presented. This diagram cannot be considered an operational model because it does not describe the types of relationships which exist between factors, but simply suggests that certain types of factors (institutional and social factors) affect certain other types of factors (utilization of labor, production, marketing). To indicate that there are structural relationships between principal components in the farming enterprise helps to recognize and include in a broad way the types of variables which are of interest. To obtain a consistent, logical and quantitative description of these structural relationships, a mathematical model of the farming system is needed which can be used in computer simulation.

The large number of factors which operate at farm level, although subject to modification, make direct experimentation with any substantial set of these impossible. It is only possible to develop experiments which allow study of some relations and their technical coefficients in an isolated way (all other factors held constant). With the computer, however, it is possible to represent the essential components of the complex whole, and to vary the conditions and values of the variables to evaluate the possible impacts of changes in technology and changes in external factors.

## VII. TRAINING

The training process is integral to all CIAT commodity programs, and we consider this a critical component of the Small Farm Systems Program. The present crop and animal production specialist courses are well-suited to our team objectives, and selection of trainees from specific development project zones for

**SOCIO-CULTURAL AND INSTITUTIONAL FACTORS**

- Official policy
- Credit policy
- Taxes, education, health
- Marketing
- Communication
- Motivation
- Migration
- Prestige
- Information
- Cooperation
- Land Use

GIFTS

FAMILY CONSUMPTION

FAMILY  
-Age, sex  
-Education

LABOR (FAMILY)  
-Outside Work for Wages  
-help neighbors

LABOR (FAMILY)  
ON THE FARM  
-Neighbors Help

HIRED LABOR ON THE FARM  
-Wages  
-Neighbors

NON-AGRICULTURAL LABOR  
-Construction  
-Hunting, fishing

CREDIT

CASH

CROP PRODUCTION

LIVESTOCK PRODUCTION

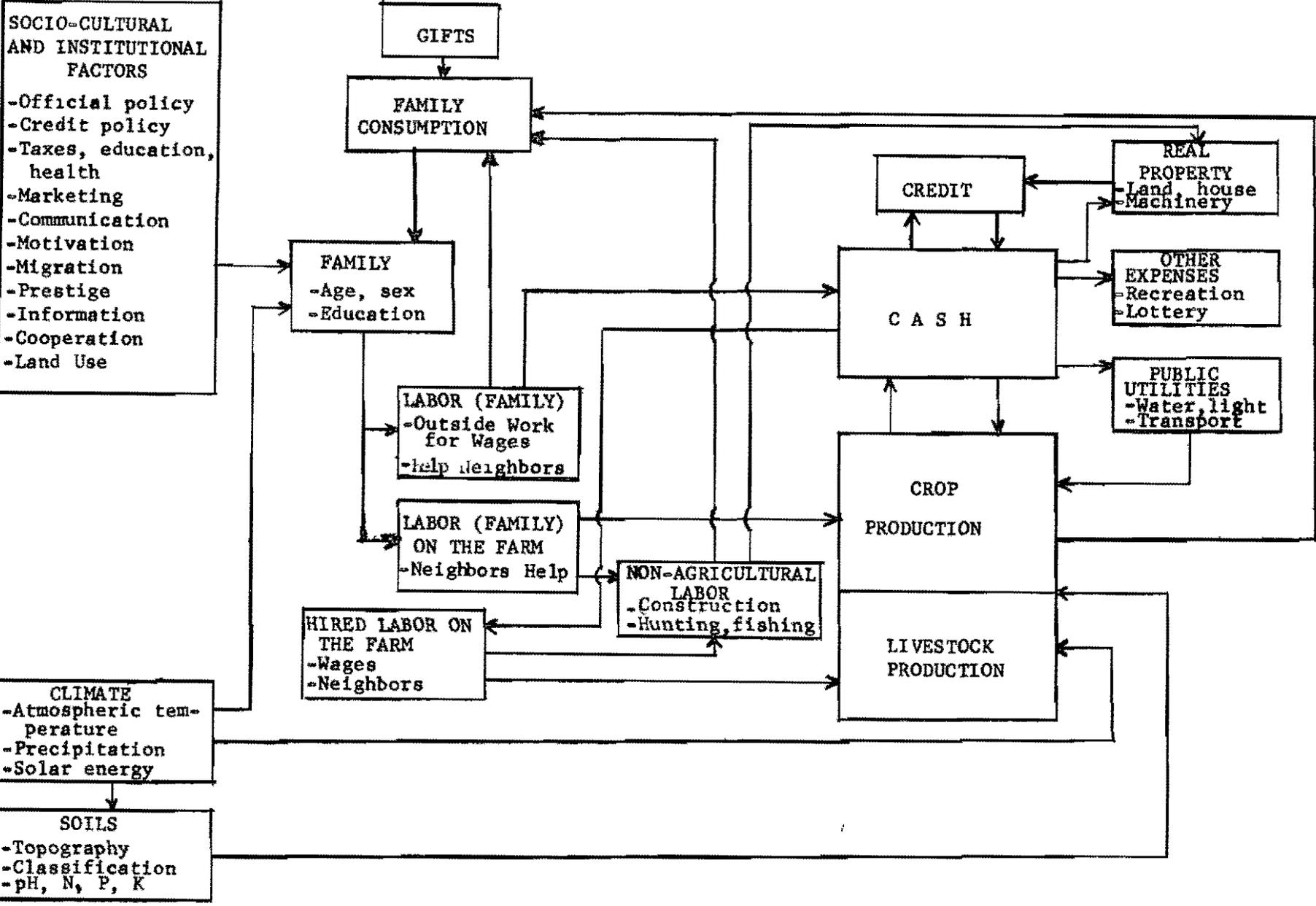
REAL PROPERTY  
-Land, house  
-Machinery

OTHER EXPENSES  
-Recreation  
-Lottery

PUBLIC UTILITIES  
-Water, light  
-Transport

CLIMATE  
-Atmospheric temperature  
-Precipitation  
-Solar energy

SOILS  
-Topography  
-Classification  
-pH, N, P, K



participation in these courses is an efficient route to supplement national program efforts to develop a core of well oriented and highly motivated personnel in project zones. The current crop production training course in CIAT includes five Guatemalan agronomists who will be returning to work in ICTA's intensive production campaigns. They will be located in La Maquina, the Oriente, and Quetzaltenango - three zones where the AID Small Farm Income Generation Program also is collaborating with ICTA in directed projects to increase income and improve nutrition. In La Maquina, one of these ICTA agronomists will work in collaboration with our Systems Team. One of the agronomists may be designated to establish a national training center for preparation of development and production-oriented personnel in Guatemala. With continued CIAT support from the Training and Systems Programs, this training center could multiply the numbers of trained extension agents, practical agronomists, credit supervisors, technical assistance personnel, and others to more quickly assure an impact on national production.

Direct involvement of the Systems Team in training in CIAT allows us to develop with the trainees an understanding of the process of problem identification and application of technology which is central to our approach. The later dedication to follow-through activities with specific trainees in specific zones back in their countries is a supplement to the training program's present activity, and this increases the number of visits from CIAT staff which a former trainee can expect in the field in his work zone. For future Program Activity Zones, we will plan ahead far enough to select agronomists or animal production specialists for training in CIAT's production specialist programs, so that they will be back in their respective work zones by the time we are ready to collaborate with national agencies in an in-depth development activity.

Training of research interns in the Systems Program will be valuable when specific people are needed for specific jobs - to include those who would receive

more appropriate training from an internship with one of the scientists on the Systems Team than in the production specialist courses. These may include individuals who will be working in national planning, credit policies, land development or other phase of engineering, plant protection as related to production, multiple cropping, or socio-cultural research related to development. A part of this training could be in conjunction with on-going production specialist courses, and a part in one of the Program Activity Zones, depending on the specialist and the job he will do when he returns.

Our involvement in training will receive priority, and the integration of any training activities with the current crop and animal production specialist courses insofar as possible is the most efficient route for achieving common goals. Systems Team involvement in selection of trainees and in follow-through activities will be beneficial to both programs, and help in achieving CIAT's objectives.

#### VIII SUMMARY

This progress report of the CIAT Small Farm Systems Program includes a brief description of the activities and results of the first six months of integrated research and field involvement. The major sections of the report and conclusions are

- A Background and philosophy of the program are summarized from the original program document, and the systems procedure is outlined for problem identification and definition of most relevant alternatives.
- B Specific Program Objectives which have evolved through experience in the field and interaction with farmers and specialists from national agencies include the following

1. Assemble appropriate technology to provide alternatives for the small farm family in the lowland humid tropics to increase production, improve income and nutrition, and reduce risks
  2. Explore the credit, marketing, extension and land reform activities which operate in a region and directly affect the farmer's decisions and his implementation of technology on the small farm
  3. Develop an efficient process for identification and analysis of small farm systems, to facilitate the rapid application of technology in rural development.
- C Field Activities have included preliminary survey visits to three zones - Agrovilas on the Transamazonica highway in Brazil, the Yurimaguas region of Peru, and the eastern plains (llanos) of Colombia. Two Program Activity Zones were identified for more detailed study and intensive involvement by the team - North Coast area near Monteria, Colombia, and La Maquina on the Pacific Coast of Guatemala.
- D Official Agencies involved in small farm - related interventions are being surveyed in Colombia, to assemble data resources and other references, and to understand how each agency defines and reaches the small farmer.
- E Criteria for Zone Selection are used to determine which zones are most appropriate for in-depth team involvement in cooperative projects with national agencies.
- F Development of a General Model as a result of experience in specific zones leads to generalizations about the small farmer's production limitations on the farm and the external factors which influence his decisions and success in improving income and nutrition
- G Training of Personnel is critical if the experience from our team's involvement in specific zones is to be extended and multiplied into other regions and additional projects

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