FARMING SYSTEMS RESEARCH NETWORKS IN SELECTED COUNTRIES OF LATIN AMERICA

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I. INTRODUCTION

Agricultural research in Latin America has been commodity or discipline oriented, reflecting educational approaches in universities and the structure of agricultural research institutes.

National resources allocated to agricultural research institutions have diminished over the last few years in several countries of the region (IDRC 1978; IDRC 1980; Trigo et al., 1982). Among other reasons, this may have been caused by the minor impact of research results on agricultural development, especially small farms.

In the last decade, considerable interest has developed in Latin America in utilizing a multidisciplinary approach in order to solve the problems existing under real farm conditions. This has been accompanied by an integration of on-station and on-farm research, and an increased recognition of the importance of mixed production systems (crops/-animals) in small farms (Borel et al., 1982; Fitzhugh et al., 1982; Martin, 1980). Various international organizations and donor agencies have supported this new approach, generally called farming systems research (FSR), as an alternative to overcome the problems of small and medium scale farms.

In Latin America several research and development activities fall within the Farming Systems Research framework, pursuing the general methodological steps of diagnosis, design and testing. Most projects emphasize the study of a specific farm enterprise, and reflect the orientation and structure of the national institutions.

The objectives of this paper are: a) to briefly review the evolution of agricultural research in some Latin American countries and show that the FSR approach is a logical next step in this evolutionary sequence; b) to describe two research networks and their role in promoting the FSR methodology as an example of the way the FSR approach can be introduced and further developed without dependence on large scale expatriate involvement; and c) to analyze on the basis of these experiences the potential and difficulties for the implementation of FSR in some Latin American countries.

II. EVOLUTION OF CROPS/ANIMALS RESEARCH IN LATIN AMERICA

In Latin America, agriculture had an impressive development in the middle and highland areas with the rise of the Maya Civilization in Mexico and Guatemala and the Inca Civilization in Peru and Bolivia. Those civilizations were among the most skillful of all plant domesticators (Harlam, 1975) and generated knowledge and capability in plant and animal production, terracing, irrigation and food conservation. Production systems presently used by small farmers in the Andean countries, Brazil, Central America and other Latin American regions apparently have not changed significantly from earlier times. These systems have been based on crops such as maize, common beans, cassava, squash, sweet potato and other crops in Central America and potatoes, canihu (*Chenopodium pallidicaule*), mashua (*Tropaeolum tuberosum*), oca (*Oxalis tuberosa*), etc. in the high Andes. Farmers growing these crops generally lack capital and land resources, while farmers having adequate resources plant introduced crops such as coffee, bananas, wheat, and sugar cane amongst others, and use technology generated both locally and in more developed regions.

Agricultural research as we know it today, supported and organized by national, regional, or international institutions is a very recent development. Limited experimentation started in the Central American countries, Colombia, Perù, Mexico and Brazil in the late nineteenth century and early twentieth century. (Sàenz, 1970; IDRC, 1978; IDRC, 1980; IDRC, 1981). In all cases research efforts coincided with the opening of a research station in order to centralize activities and attempt to extrapolate results to farmers' fields.

Waugh (1982) has recognized introductory, transfer, applied research, and client oriented phases in generating agricultural technology in developing countries. The first phase was pre-World War II and consisted principally of the establishment of some experimental stations, educational and training programs, as well as the introduction by international corporations of technology for commercial export crops. Following World War II, the second phase was implemented based upon the premise that the success of the United States in applying technology for increasing food production could be repeated in developing countries through extension systems that would inform the farmers. When this transfer strategy did not give the desired results, a third phase was initiated in which applied research, institution building and training of staff were emphasized. Research in the developing countries is now entering a fourth, client-oriented phase, characterized by its focus on the small and limited-resource farmers.

This last phase, oriented towards farmer participation, on-farm research, and consideration of biological, socio-economic and institutional limitations is very recent. The experiences and results from the Puebla Project (CIMMYT, 1979), the Càqueza Project (Zandstra et al., 1979), and research conducted by Bradfield (1969, 1970), Hildebrand

(1974), Bazàn et al (1974) and Waugh (1975) have encouraged multiple cropping and farming systems research in various Latin American countries.

During the last decade, animal and cropping systems research activities supported by national, regional and international institutions, have increased in Latin America and the Caribbean (Fitzhugh et al., 1982; Tapia, 1982; Li Pun and Zandstra, 1982). These all use a methodology which consist of: Selection of target areas, site descriptions, selection of land types and farming systems, design of alternative systems, testing of alternative systems, and technology transfer in pilot production programs (Zandstra, 1982). These efforts have been accompanied by training of national staff in the new approach and fine-tuning of research methodologies. However institutional adjustments and educational efforts have not occurred at the same pace. Commodity oriented and disciplinary programs still prevail in most countries, while the decentralization needed to support research on the farm sites is a rare occurrence.

III. EXPERIENCES WITH AGRICULTURAL RESEARCH NETWORKS IN THE REGION

Banta (1982) suggested the following definition for an agricultural research network "a voluntary association of research organizations with sufficient common objectives to be willing to adjust current research programmes and invest resources in network activities in the belief that they will meet their objectives more efficiently than conducting research alone."

Networks are a means of stimulating and developing research approaches and methodologies. They are also building a critical mass of research workers and experiences and providing a forum where research results in common areas can be discussed. This is an important contribution, since the majority of universities and research institutions in Latin America do not yet offer training in FS. The main characteristics of these networks include: a) Exchange of information and germplasm, b) Development of appropriate methodologies, c) Training, d) Appointment of advisory committees and e) Coordination.

Because the authors consider the network approach an important mechanism for implementation of FSR, two IDRC supported networks in the Region will be described: The Andean Crops Network and the Animal Production Systems Network.

A. The Andean Crops Network

This network deals with highland agriculture in Perù, Bolivia, Ecuador and Colombia. Table 1 presents project titles, the institutions involved, and specific objectives of each Andean Network project supported by IDRC.

The common denominator of the projects has been a keen interest by the participants in preserving native germplasm, understanding Andean farming systems and, through research, make improvements in those systems. The majority of projects used at first a commodity approach and are now evolving into FSR and rural development projects.

The Andean Crops Network started from individual country projects and has developed a high internal interaction among researchers in Peru and a less frequent interaction between other participating countries. The high interaction in Peru is due to the division and interrelation of research activities in three different ecological areas under the responsibility of local universities.

1. Elements of the Andean Network

a) Exchange of information:

Project staff have met formally three times (Table 2). The fourth meeting is expected to take place in Colombia in May 1984. These meetings are a good complement to other means of information exchange such as correspondence and inter-project visits by project staff and monitoring visits by the IDRC Representative in the region.

b) Exchange of Germplasm:

National and international institutions have supported the collection, evaluation, and maintenance of valuable Andean Crops. Germplasm collections of quinua (Chenopodium quinoa) are kept in Bolivia, Peru, Ecuador and Colombia; Canihua (Chenopodium pallidicaule) in Peru; and andean root crops including oca (Oxalis tuberosa), olluco (Ullucus tuberosus) and mashua (Tropaeolum tuberosum) in Peru and Ecuador. The Andean Crops Meetings and the inter-country consultancies have provided the means for the exchange of germplasm.

c) Training:

Non-formal training has been emphasized in the network, including: In-service training for countries' project staff in the other countries, short-term training at CATIE, in-country training activities for technical staff and farmers, visits to other research projects, and attendance at international meetings. In Peru six staff members have completed their M.S. degrees. Provision has been made for other project staff to pursue graduate studies in the region.

d) **Consultancies**

Consultancies from outside the region have helped to strengthen specific technical and conceptual aspects of projects. More frequent inter-regional consultancies have provided technical back-up, sharing of research experiences and generation of a sense of team work.

e) Coordination and Advisory Committees:

The role of coordinator has been played by the IDRC Regional Representative and consists of technical and administrative support as well as maintenance of a link between the various projects. Semi-annual visits have been the norm. It is expected that a formal Coordinator and an advisory group will be appointed in the near future.

2. Achievements

The exchange of results has included methodological aspects such as on-farm research, design, and testing; training of staff and farmers; site surveys, and biological results.

Peru:

There is a high complexity in Andean agriculture enhanced by family access to different ecological sites, laws of land inheritance and diversity (Table 3). Project staff have identified the main crop rotations in each altitudinal floor and proposed relevant research accordingly. The old Inca soil classification, widely used by farmers, has been described at the project sites and will be a useful base from which to extrapolate results and recommendations to other communities. New potato, oca and faba beans cultivars introduced by the project are now widely used as part of the farmers' seed mixtures. Improvements in intercommunity organization to carry out post-production activities such as elimination of quinua and tarwi (Lupinus mutabilis) alkaloids through a washing process is well under way. This year, project staff will undertake a study of mixed systems in their research plans. Surveys have demonstrated that domestic animals take 70% of their feed from crop residues and only 30% from pastures.

Bolivia:

As stated in the objectives in Table 1 project staff initially concentrated on Quinua collection, selection and breeding. Six new varieties are ready to be released in 1983 and appear to be acceptable to farmers.

Since Quinua is normally a component of more complex production systems, project staff decided last year to study those quinua based systems (Table 4) as well as others where other crops and animals are important. They have selected 20 farmers in two ecological areas and conducted rapid surveys with help from an economist and extension staff. Each farmer participates actively in one or two research topics (for example an alternative quinua based system and/or an improved potato cultivar) and as a control in another aspect, e.g. sheep production. So far, a good response has been obtained with the introduction of new potato and quinua cultivars.

Ecuador:

This project is quite recent and has made good progress in quinua, tarwi, and root crops germplasm collection, evaluation, and selection both in Experimental Stations and in farmers' fields. Promising quinua cultivars have been identified and are being evaluated by farmers in their own cropping systems under careful monitoring of project staff.

Colombia:

The Multiple Cropping project is more diverse and includes both highland and lowland crops. Staff have been successful in the understanding and improvement of potato + sweet peas (Table 5), maize + beans, and cassava + beans systems. Their findings are part of ICA's recommendations at the national level. Good links have been established with the Rural Development Districts by means of sharing research results and conducting training courses for technical staff.

B. The Animal Production Systems Network

In contrast with the Andean Crops Network, the Animal Production Systems Network has a more formal structure. It includes present and potential recipients of IDRC funded projects whose objectives are to look for solutions to animal production problems in small farms, utilizing the FSR methodology. Participating projects cover a wide range of animal production systems, institutions, and geographical and ecological zones. (Table 6).

1. Elements of the network

a) Exchange of information:

It mostly occurs at workshops. A total of four have taken place as shown in Table 7. Usually, short presentations of recent project activities are made. Reports are prepared and published in limited quantities and a flow of correspondence among projects normally occurs.

b) Development of appropriate methodologies:

Animal production systems projects have followed the general steps of the cropping systems methodology as stated by Zandstra (1982). Problems found, especially in the evaluation of technological alternatives in small farms, include the complexity of the mixed systems, difficulties of on-farm experimentation with animals (Fitzhugh, 1982), and the scarcity of previous research experiences. Through workshop discussions several alternatives have been proposed to deal with these problems (Borel et al., 1982; Fitzhugh, 1982), such as comparison of: a) Control farms with other farms with introduced technology, b) Analysis of farms before and after the alternative technology has been introduced and c) Predicted and actual results obtained. Also, the use of more ex-ante analysis using models has been proposed.

Suggestions to carry out whole farm analysis when evaluating component technology have also been made (Li Pun and Zandstra, 1982).

During the third workshop the methodology for the design of technological alternatives from diagnostic data of farms in three tropical areas was discussed and worked on by three different groups in the region.

c) Training:

These activities include on the job training of staff members in regional institutions (e.g. CATIE) both in specific methodological steps as well as in disciplinary research fields. Workshops also serve as an informal training place for participants from present or potential projects. Inter-project visits have also occurred among researchers.

d) Consultancies:

These are where possible provided through staff of participating projects. Usually they are short-term (1 to 2 weeks) and deal with specific topics (e.g. design of experiments, data analysis, etc.) Needs are identified by project staff and the IDRC representatives, and the selection of appropriate consultants agreed between them.

e) Coordination:

At present, the network is coordinated by an IDRC Regional Representative in close contact with staff of national and regional research centers. It is expected that in the future a representative of one participating institution will take over as coordinator. Coordination should then be carried out on a rotational basis by representative network members.

f) **Advisory Committees:**

In some projects, advisory committees have been established involving project staff and network members. They usually meet once a year to program and evaluate research activities.

2. Achievements

a) Research Methodology

During the third workshop a methodology was agreed on for the design of technological alternatives utilizing diagnostic data (Ruiz and Li Pun, 1983) which is being followed by three different projects in Costa Rica, Panama and Peru. As a result of these experiences, suggestions and recommendations have been made for the methodology in diagnostic studies, design of technological alternatives, on-farm testing, and participation of farmers and extension agents in the various steps (Li Pun and Zandstra, 1982; Ruiz and Li Pun, 1983).

The following are examples of recommendations reached by network members:

Diagnostic studies. Three levels have been identified: regional, farm, and agroecosystem. Specific mechanisms have been suggested to obtain information at each level:

Regional: secondary information, key informants, extension agents, general surveys.

Farms: interviews with a large number of farmers. More than one visit is suggested.

Agroecosystems: interviews with selected farmers. Field measurements.

The need to restrict the collection of information to the critical amount of data to achieve the objectives has been recognized.

Design. The following steps have been suggested: analysis of the region, definition of objectives, analysis of the target system(s), definition of the adaptation domain(s), identification of technical interventions, ex-ante analysis of alternatives, confrontation with farmers and extension agents, and adjustments if needed.

Testing. The needs and conditions for on-station and on-farm testing have been established. On-station testing should be made when the alternative technologies are complex and need close control. On-farm testing should be made when ex-ante analysis of models have proven them far better than the prevalent models. They should be acceptable by farmers, be simple and carry a low risk.

Several new projects are expected to join the network such as: Dairy beef systems (CENIP, Dominican Republic and University of Costa Rica), milk production systems (UC-Chile) and goat production systems (INIA-Mexico). Possibilities also exist for other institutions to join the network. They could benefit from methodological achievements already obtained.

b) Research results:

Specific achievements of three of the network participating projects are presented below:

Costa Rica:

CATIE staff has developed a methodology for the evaluation of agricultural by-products for animal utilization. The process starts with the identification of by-products availability at the farm level, their chemical and nutritional characterization, and ends up with the design and on-farm testing of feeding sub-systems. In a static diagnostic carried out in 230 small farms in four areas of the country, it was identified that only 26% of the farms had livestock alone. Seventy-four percent were mixed farms with different combinations of livestock, and annual and/or perennial crops. While comparing the different systems, it was found that the mixed systems that included perennial crops had the highest gross return (Table 8). The use of sugar cane and banana by-products by the majority of livestock farmers was identified, thus helping to focus the research on the design of feeding sub-systems based on those products. Tests have been conducted on-station to determine the quantity and the most appropriate supplementation time according to the cows lactation phase.

The design of technological alternatives that include their confrontation with farmers and extension agents have recently been completed. On-farm testing of them will be initiated soon.

In a farm monitoring study (dynamic diagnostic) of 38 farms, the conclusions of the static diagnostic were confirmed. It was found that as the emphasis of farms moves towards producing milk in contrast to beef, farm productivity indices did improve (Table 9). The importance of the contribution of minor species (swine and poultry) towards total farm income was also determined (about 25%). The project has contributed to the development of animal production systems research methodology and provided technical cooperation to other APS projects.

Peru:

IVITA staff have conducted a survey of 80 farms in the Pucallpa region, a new colonization area. Results of the survey have allowed the determination of recommendation domains and the characterization of present agricultural production systems. Along with an analysis of research results in the area, they have served to assemble two on-station cattle production modules "pioneer" and "intensive", representing two technological levels. The first one considers very limited use of inputs in order to imitate new settlers' resources. The other one considers the use of more inputs although at a moderate level. Ex-ante analysis of these modules showed a profitability of 20-25% for the "pioneer" and 28-32% for the "intensive" modules. These are superior to the commercial beef enterprise in the region which has a rate of return of less than 4%. Modules have been operating for two years.

Results of diagnostic studies have also been used to orient and design the research on systems components. As an example, farmers use kudzu (Pueraria phaseoloides) for fallowing in shifting cultivation. They also have adopted the use of Brachiaria decumbens as an improved pasture under extensive management. These facts have been considered by researchers in designing a feeding sub-system for dairy cows that includes the use of Brachiaria decumbens in rotational grazing with kudzu in a protein bank.

Panama:

IDIAP researchers conducted a survey of 78 small dairy-beef farms in three areas of Panama. Results were used to assemble three prototypes representing typical model farms in the three locations. Research results as secondary information were utilized to design improved production prototypes. Changes included the use of small plots of improved pasture for calf-feeding, rotational grazing for lactating cows, year-round mineral supplementation, and dry season-feeding with King grass (Pennisetum purpureum) silage, and a molasses - urea mixture. The improved prototypes over the three sites showed milk yields increases from 505 to 775 l/ha/y (Table 10). At present farm monitoring studies are being conducted and technological alternatives, to include changes on single and multiple components, are being tested on-farm.

IV. POTENTIAL AND LIMITATIONS FOR THE IMPLEMENTATION OF FSR IN T REGION

In the identification, development, and implementation of F projects in both Andean Crops and Animal Production Systems network progress has been limited by the following factors:

a) Institutional:

Research in Latin America is conducted mainly by three types of organizations: Universities, Research Institutes and Ministries of Agriculture. As mentioned earlier, most of them are organized and structured to conduct commodity-oriented, disciplinary research. Often times they lack participation of agricultural economists and other social scientists in their staff. Most institutions have the crops and animal sciences in separate departments or faculties.

FSR projects, on the other hand, are an important means to establish and formalize the communication and collaboration among researchers, since all participating staff relate to the same production system and are able to make specialized contributions.

b) Agricultural education and orientation:

Most researchers educated in Latin American universities get a specialized education at the undergraduate level (either crops, animal or veterinary sciences) with little contact with the small farm situation. When they pursue advanced studies in more developed countries, the trend is toward further specialization in disciplines. Upon their return they continue doing strictly disciplinary or support oriented research. Seldom is there an interest to conduct research on the problems of small farmers or a willingness to do multidisciplinary research.

The increased exposure to on-farm research (1970-75), cropping systems and animal production systems (1975-80's), and recently, mixed farming systems research has led to a greater awareness of the contribution made by small, mixed farms to food production. This and a better appreciation of the complexities of research challenges of FSR directd to the small farmer has led a few young professionals to cross institutional barriers and conduct interdisciplinary research.

c) Methodological:

Although the descriptive phase of the mixed system research is clear, there is still insufficient experience in the other methodological steps, despite efforts made by several national and international institutions. Suggestions have been made to delineate the total methodology (Zandstra, 1982), however, the relatively few experiences underway in Latin America are not sufficiently advanced to prove conclusively the advantages or success of this methodology in agricultural research.

Despite these limitations, a considerable potential for the implementation of FSR projects in L.A. exists. Small, mixed farms are the majority in many areas of the region and contribute significantly to agricultural production (Borel et al, 1982; Wharton, 1969; SIECA-GAFICA, 1974). Several groups of highly motivated researchers, such as those participating in the IDRC supported networks, are interested in studying mixed farms. This interest has been evolving from initial activities in essentially commodity-oriented projects which have gradually broadened in approach towards rural development.

V. CONCLUSIONS

1. FSR is evolving along lines developed by Latin American researchers through their experiences and expertise. Some institutions have begun to look at client-oriented research and have started to involve farmers in research activities.

2. The network approach is an effective means for spreading FSR that avoids the sensitivities, pitfalls, and losses associated with large scale expatriate based technical assistance approaches.

3. FSR should be allowed to evolve from traditional commodity programs. A close relationship between commodity and FSR approaches is essential in order to propose useful recommendations for farmers.

4. Institutional, educational and methodological aspects have limited progress of FSR networks. However, the large number of mixed farms in Latin America and the interest of a few highly motivated research teams, and the existence of promising results using this approach indicate the potential for FSR do exist.

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Table 1. IDRC Supported Projects in the Andean Network

Title	Institution	Specific Objectives
ANDEAN CROPS (Peru) Ph. II	Universities of Cusco and Puno, and IICA.[1]	To complete the ecological, technical and socio-economic analysis of traditional Andean community production systems.
		To generate appropriate technology at the community level with direct participation of farmers.
		To strengthen community organization, administration and marketing of products.
		To publish and distribute information for use by extension and development institutions.
		To train undergraduate and graduate students by means of small grants and scholarships.
QUINUA (Bolivia)	IBTA[2]	To select, multiply and distribute improved varieties of quinua.
		To improve quinua through hybridization and wide crosses.
		To advance knowledge of the genetics and cytology of quinua.
		To develop, test and disseminate improved agronomic practices of quinua.
		To train and provide learning opportunities for technical personnel, students and quinua producers.

QUINUA PRODUCTION (ECUADOR)	INIAP[3]	To study agronomic and socio-economic factors of existing traditional quinua production systems on small farms to identify constraints and potential demand for new production technologies and institutional services. To acquire a complete collection of quinua germplasm material from the quinua growing areas of Ecuador and to establish a quinua genetic improvement program in INIAP. To identify, develop and adapt improved quinua production practices to the local economic, social and cultural conditions. To train students and technicians in the Universities' Agricultural Sciences' Faculties capable of developing and promoting the crop in the future.
MULTIPLE CROPPING (COLOMBIA) Ph. II	ICA[4]	To complete evaluation and formulate technical recommendations for six intercropping patterns tested in Phase I. To evaluate two intercropping systems based on sugarcane and yams that were not studied in Phase I. To conduct pre-production trials on farmers' fields with one intercropped system already evaluated in Phase I. To strengthen the capability of ICA multiple cropping staff. To transfer the technology and information generated to the Ministry of Agriculture, universities, extension and development agencies, and farmers.

1 IICA - Instituto Interamericano de Cooperaciòn para la Agricultura - Lima, Perù.
2 IBTA - Instituto Boliviano de Tecnologìa Agropecuaria - La Paz, Boliva.
3 INIAP - Instituto Nacional de Investigaciòn Agropecuaria - Quito, Ecuador.
4 ICA - Instituto Colombiano Agropecuario - Bogotà, Colombia.

Table 2. List of Meetings Carried Out in the Andean Crops Network

Meetings	Place and Date	Participating Institutions	Topics Discussed
I ANDEAN CROPS SYMPOSIUM	Ayacucho, Perù October, 1977	IICA, Universities, Ministry of Agriculture, INIPA, INIAP, IBTA, ICA, IDRC	Genetics, Andean crops (emphasis on quinua), cropping systems, diagnostic studies
II ANDEAN CROPS SYMPOSIUM	Quito, Ecuador June, 1979	INIAP, Universities, IICA, Ministry of Agriculture, IBTA, ICA, IDRC	Genetics, agronomy, Andean crops, diagnostic studies
III ANDEAN CROPS SYMPOSIUM	La Paz, Bolivia February, 1982	IBTA, Universities, Ministry of Agriculture, IICA, INIAP, ICA, INIPA, FAO, IDRC	Agronomy, cropping systems, Andean crops, diagnostic studies, post-production research

Table 3. Main Crop Rotations in Three Altitudinal Floors, Cusco, Peru

Floor and Rotations	YEARS 1st yr.	2nd yr.	3rd yr.	4th yr.	Observations	Frequency %
LOW	3400-3600 m.a.s.l. "Maize Floor"					
I	M	M	M	P	I	40
II	M	M	P	R	I	25
III	P/B	F	M	M	I	20
IV	M	W	F	M	U	15
MEDIUM	3600-3800 m.a.s.l. "Potato and cereals Floor"					100
V	P	W	F	B	I	25
VI	F	W	SP	B	U	45
VII	P/Q	B	SP	R	I	10
VIII	Lu	B	F	-	U	20
HIGH	3800 m.a.s.l. "Muyuys Floor" (rotation sites)					100
IX	P	O/L	L/A	B	4 R	10
X	P	R	R	B	5 R	30
XI	P	R	R	R	6 R	40
XII	P	R	R	R	7 R	20
						100

M = maize P = potato F = faba beans W = wheat O = Oca
B = barley L = lizas A = añu Lu = lupinus Q = Quinua
I = irrigated U = upland R = rest years

Source: Tapia, M. 1982

Table 4. Partial Agro-Economic Results of Crop Rotations
Patacamaya, Boliva, 1982

Rotation	Yields Kg/ha			Net Income sb/ha	Benefit/Cost ratio
P-Q-F	POTATO	A	21,176	98,345	1.46
		B	10,661	33,851	0.68
Q-Ba-R	QUINUA	A	1,432	21,686	1.16
		B	658	2,926	0.19
F-P-Q	FABA	A	1,096	2,657	0.23
		B	614	-2,686	-0.25

P = potato Q = quinua F = faba beans Ba = barley R = rest
A = fertilizer; seed treatment; weed control
B = weed control (control)

Source: Quinoa Project, IBTA, Bolivia, 1981-82

Table 5. Yields and Net Income of Potato - Sweet Peas Intercr
Tibaitata, Colombia, 1981-82

Treatments	Yields P	mt/ha SP	Net Income/ha Pesos
P	16.9	-	48,798
P 2SP (1)	16.2	1.8	58,764
P 2SP (2)	17.9	1.4	66,078
P 3SP (1)	16.0	1.8	76,930
P 3SP (2)	15.1	1.6	59,550

P = potato SP = sweet peas (2 or 3 rows)
(1) = close spacing (2) = wider spacing

Source: Multiple Cropping Project, ICA, Colombia, 1983.

Table 6. IDRC Supported Projects in the Animal Production Systems Network

TITLE	INSTITUTION	BRIEF DESCRIPTION
AMAZONIAN PRODUCTION SYSTEMS (PERU)	IVITA[1]	The main objective is to develop economically and ecologically stable dual purpose cattle production systems in the Amazon basin of Peru. Two production prototypes representing different technological levels ("intermediate" and "intensive") have been designed and implemented. A diagnostic study was conducted to characterize prevalent production systems. Component research is being conducted with emphasis on pasture improvement. Also limited research is being conducted on animal health and management. Farm monitoring studies are being started.
NATIVE SWINE (EL SALVADOR)	Centro de Desarrollo Ganadero CEGA-IZALCO[2]	The general objective of this project is to develop swine production systems utilizing locally available resources. The project staff has conducted a survey of over 1000 swine production units in El Salvador. Production systems have been characterized and research priorities have been identified. Besides research on swine feeding on-farm and on-station, technological alternatives that also include health and management practices will be evaluated on-farm. Some basic research on nutrition characteristics of native swine is also conducted.
DAIRY BEEF FEEDING SYSTEMS (PANAMA) Ph. II	IDIAP[3]	The project objective is to develop dairy-beef production systems for three areas of Panama. Farm surveys and monitoring studies have been conducted. On-farm evaluation of technological alternatives that emphasize feeding subsystems is being performed.
ANIMAL PRODUCTION SYSTEMS (CATIE) Ph. II	CATIE[4]	The main objective of this project is to develop improved dairy-beef production systems for small farmers in some Central America regions. Static and dynamic diagnoses of small farms have been conducted. The project has proposed a methodology for the evaluation of crops that include the following steps: availability, seasonality, chemical and nutritive characteristics, and their present and potential utilization by animals within

		the small farm situation. Also, the project is contributing intensively towards the development of the animal production systems research methodology. Several crops and residues have been evaluated up to the point of being included in feeding systems for dual purpose cattle for the dry season. The methodology developed by this project has served as a model for other APS projects in Latin America.
SOUTH AMERICAN CAMELOIDS (PERU)	IVITA[1]	The objective of the project is to develop improved alpaca production systems and to augment the potential area of utilization of high altitude rangelands through better management. Project activities include characterization of alpaca production systems in peasant communities of the high Andes of Peru. Basic research is also conducted on nutrition, health and management of alpacas. Project staff intends to design and evaluate improved production systems on-station and on-farm.
MILK PRODUCTION SYSTEMS (GUYANA)	CARDI[5]	The project intends to develop specialized milk production systems for the intermediate savannas of Guyana. Component research emphasizes the introduction and evaluation of new species of grasses and legumes for year round feeding. Project started last year.
GOAT PRODUCTION SYSTEMS (PERU)	INIPA[6]	This project is just starting. Its main objective is to develop semi-extensive goat production systems for two areas in the Northern desertic areas in Peru. A survey of small goat herds has been conducted. Farm monitoring studies are going to be started this year. Emphasis of component research will be on designing better feeding systems that will utilize existing feeding resources: agricultural by-products, bushes and trees.

1, 2, 3, 4, 5, 6 See Table 7 for explanations of acronyms.
2 Ministerio de Agriculture y Ganaderia. Sonsonate, El Salvador.

Table 7. List of Workshops Carried Out in the Animal Production Systems Network

	PLACE AND DATE	PARTICIPATING INSTITUTIONS	TOPICS DISCUSSED
WORKSHOP I	David, Panama May 19 - 22, 1981	CATIE[1], IDIAP[2] IVITA[3]	General APS methodology
WORKSHOP II	Pucallpa, Peru January 21 - 25, 1982	IVITA, IDIAP, CATIE, WINROCK[4], CENIP[5], CARDI[6], IDRC[7], INIPA[8]	Methodology for the design and test of technological alternatives for animal production in small farms. On-farm evaluation of alternatives. The linkage between research and transfer of technology.
WORKSHOP III	Turrialba, Costa Rica February 22 - 25, 1983	CATIE, IDIAP, IVITA WINROCK, CENIP, INIA[9] UCR[10], EMBRAPA[11], INIPA, IDRC	Design of technological alternatives based on diagnostic data.
WORKSHOP IV	Chiclayo, Peru October 24 - 28, 1983	INIPA SR, CATIE, IDIAP, IICA[12], CENIP, INIA, IVITA, WINROCK, UC-CHILE[13], IDRC	Evaluation of alternatives in small farms. Biological and socioeconomical aspects. Definition of farmers objectives. Confrontation of designed technological alternatives with farmers and extension agents.

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1 CATIE - Centro Agronòmico Tropical de Investigaciòn y Enseñanza. Turrialba, Costa Rica.
2 IDIAP - Instituto de Investigaciòn Agropecuaria de Panamà. David, Panama.
3 IVITA - Instituto Veterinario de Investigaciones Tropicales y de Altura. Pucallpa, Perù.
4 WINROCK - Winrock International Livestock Center. Arkansas, USA.
5 CENIP - Centro de Investigaciones Pecuarias. Santo Domingo, Repùblica Dominicana.
6 CARDI - Caribbean Agricultural Research and Development Institute. Port of Spain, Trinidad.
7 IDRC - International Development Research Centre. Bogotà, Colombia.
8 INIPA - Instituto Nacional de Investigaciòn y Promociòn Agropecuaria. Laymbayeque, Peru.
9 INIA - Instituto Nacional de Investigaciones Agricolas. Torreòn, Mexico.
10 UCR - Universidad de Costa Rica. San Josè, Costa Rica.
11 EMPRAPA - Empresa Brasileira de Pesquisa Agropecuaria. Santa Catarina, Brasil.
12 IICA - Instituto Interamericano de Cooperaciòn para la Agricultura. San Josè, Costa Rica.
13 UC - Universidad Catòlica de Chile. Santiago, Chile.

Table 8. Comparison of Economic Efficiency Indices Among Different Farming Systems in 230 Farms in Costa Rica.

	SYSTEMS			
	LIVESTOCK N = 60	LIVESTOCK + ANNUAL CROPS N = 31	LIVESTOCK + PERENNIAL CROPS N = 80	LIVESTOCK + ANNUAL CROPS + PERENNIAL CROPS N = 59
TOTAL FARM MARKET VALUE US$	2184	1984	6691	5451
PROPORTION OF MARKETED PRODUCTS, %	59	55	88	82
GROSS RETURN, US				
LAND, Ha	136	100	432	345
LABOUR, DAY	3.62	2.57	7.72	5.15

Source: Adapted from CATIE, 1982

Table 9. Comparison of Performance of Different Livestock Production Systems in 38 Farms of Costa Rica

	SYSTEMS		
	DUAL PURPOSE		
	BEEF	MILK	SPECIALIZED MILK
BIRTH RATE, %	39	52	67
CALF MORTALITY, %	2	10	8.4
MILK PRODUCTION, 1/Ha/y	182	652	1567
BEEF, Kg/Ha/y	153	192	86
TOTAL FARM INCOME, US$/Ha	130	270	539
NET FAMILY INCOME, US$/Ha	109	155	377

Source: Adapted from CATIE, 1982

Table 10. Comparisons of Improved and Control Dual Purpose Cattle Modules in Panama.

INDEX	AREAS					
	GUALACA		SONA		LOS SANTOS	
	C[1]	I[2]	C	I	C	I
BIRTH RATE, %	62	79	69.9	71.4	70.8	76.2
MILK PRODUCTION, 1/Ha/y	491	764	538	735	437	725
BEEF PRODUCTION, Kg/Ha/y	106	136	49	123	105	187
NET FAMILY INCOME, US$/Ha[3]	153	184.9	122	182	170	160

[1] C : Control
[2] I : Improved
[3] Net Family Income : Total Farm Income-Cash Expenditures

Source: Adapted from IDIAP, 1982