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Regional Analysis, Farming Systems, and Social Science: Bean/Cowpea CRSP Experiences in Manabí, Ecuador

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This chapter illustrates how basic principles of social scientific methodology were adapted to farming systems research (FSR) and utilized by a multidisciplinary team in which agronomic scientists predominated. The rationale of the research design is described, the principal results of fieldwork in the Portoviejo River valley of Manabí, Ecuador are reported, and recommendations for future research are made. This chapter reflects the collaboration of scientists at the Instituto Nacional de Investigaciones Agropecuarias (INIAP) and Cornell University on the Bean/Cowpea CRSP.

The farming systems approach to research and extension provides a user-oriented perspective on agricultural research and development. In most Third World countries, attention has focused on export commodities. Recently, however, basic foodstuffs have assumed more importance as many countries define food self-sufficiency as a desirable objective. These efforts have been supported by multilateral and bilateral programs, including the International Agricultural Research Centers (IARC's) and the Collaborative Research Support Projects (CRSPs).

National efforts to increase the domestic production of basic foodstuffs address the needs of smallholders, who are the primary producers in many DCs, and the urban poor, who are the principal consumers. In Ecuador, the decision to accord these groups higher priority had implications for the nation's major agricultural research institution, INIAP. Scientists began to adopt a more comprehensive analysis of agricultural production in order to develop technologies appropriate to smallholders.

Conventional approaches that overemphasize experiment station research at the expense of trials under actual farming conditions have often produced technological innovations that are adopted by medium- and large-scale producers but rejected as inappropriate by smallholders (Shaner et al. 1982). Accordingly, the Consultative Group on International Agricultural Research (CGIAR 1978) recommended a farming systems perspective to improve problem identification, suggest new and/or enhanced production systems, and

orient research toward potentially important innovations. These recommendations were heeded in several sites where INIAP was working with small-scale producers of basic grains. Consequently, FSR, which is actually scale-neutral, focused on the needs of smallholders for improved production practices in Ecuador.

THE DIAGNOSTIC PHASE OF FARMING SYSTEMS RESEARCH

FSR can be conceptualized as a process of technological innovation that has successive phases, beginning with problem identification and ending with technology transfer.[1] Although collaboration is essential throughout the process, social scientific methodologies are particularly important during initial phases, which rely heavily on library research and the analysis of secondary data. The analysis of some data (e.g., soils maps) requires agronomic expertise, but many sources are better analyzed by social scientists. During the problem identification phase, experimental research may also be relevant. Some kinds of on-station experimentation can be conceptualized as a way of "interviewing the plants," permitting scientists to focus subsequent interviews with farmers on problems that they suspect exist because of their prior observations of trials. The benefits of using both experimental and library research is well illustrated by the case of Manabí.

Preparation for diagnostic fieldwork includes the analysis of available agronomic and socioeconomic data and the preparation of a preliminary report. This suggests focuses for field research and provides materials for training interviewers and orienting them to the study site. The analysis of secondary data is particularly useful to those unfamiliar with a zone, because it provides a contrast to the known. Quantitative data also allow regional scientists to "true" their perceptions, potentially challenging the data and/or their assumptions.

Preliminary research means scientists can build on existing information to focus interviews. Adequate preparation for fieldwork allows the team to select informants who are broadly representative of the major ecological and socioeconomic conditions in a region. Structured interviews focus on practices common to the zone. Library research and fieldwork interact to permit rapid problem identification.

There are several outputs from diagnostic field research, including preliminary subregional reports and an integrated regional analysis. Collectively, these documents describe the principal characteristics of crop and livestock production as they vary by subregion and social group, and they identify opportunities for subsequent research and extension activities. The unit of analysis for preliminary or diagnostic research is the

subregion; this is why the Bean/Cowpea CRSP adopted the term "regional analysis."

Our thesis is that regional analysis provides valuable insights into ecological and socioeconomic variations in farming systems. Although it is important to describe existing farming systems, the fundamental purpose of diagnostic research is to identify priorities for subsequent agronomic and socioeconomic research. Structured interviewing with informants is the data-collection technique of choice. Like any methodology, however, it has inherent limitations and should be supplemented by survey research using probabilistic samples in zones where development activities will concentrate. Appropriately designed survey research permits the measurement of variation at the individual/household level. This is essential for the evaluation of certain agronomic, socioeconomic, and nutritional impacts of technological innovations (Campbell 1985; Garrett and Goldstein 1984).

THE ECUADORIAN CONTEXT

Ecuador experiences agricultural problems characteristic of many Third World countries. As in most of Latin America, productive resources are distributed unequally. Farms with fewer than 5 ha represent 67% of all units, though they occupy only 7% of the land. By contrast, large farms with more than 100 ha constitute 2% of all units, yet they occupy fully 48% of the land. Measured inequality is high. The Gini Index of Concentration, which ranges from a low of zero for perfect equality to a high of unity for perfect inequality, is 0.81 (Garrett et al. 1986).

Agriculture in Ecuador is oriented to both international and domestic markets. Historically, agricultural exports have been important; currently, they earn approximately 35% of the country's foreign exchange. Research and extension have traditionally focused on four major export crops (bananas, cocoa, coffee, and sugar), which are produced on large farms along the Pacific coast (Milford 1983).

Dietary staples in Ecuador have generally not benefited from agricultural research and extension. Gross agricultural production kept pace with population growth, increasing at approximately 3% per year during the 1970s. This reflects both increases in lands under cultivation and the improved productivity of a few crops, notably banana, African palm oil, soy beans, and hard corn. Nevertheless, yields of basic food crops (notably potatoes, rice, and soft corn) did not improve. Consequently, Ecuador was forced to import basic grains, and food imports increased at an annual rate of 13% (Milford 1983).

Confronting stagnant yields in basic grains and rising prices for imported food, Ecuador began to assign more importance to smallholder production.

INIAP needed to reconsider how it could achieve its basic institutional objective, the development of technological alternatives that increased agricultural production and productivity for the benefit of both producers and consumers. At this critical juncture, the institution's budget from both national and international sources was increased, thereby permitting better staffing and more on-farm research.

INIAP received substantial support from the Centro Internacional de Mejoramiento de Maíz y Trigo (CIMMYT), the Agency for International Development (USAID/EC), and the Instituto Interamericano de Cooperación para la Agricultura (IICA/OEA). With foreign assistance, INIAP's work on behalf of smallholders began seriously in 1976 and was subsequently institutionalized in the Department of Agricultural Economics, Program of Investigation in Production, or PIP (Moscardi et al. 1983). The Bean/Cowpea CRSP provided additional support during the early 1980s and was integrated into INIAP through the PIP.

A major objective of the Bean/Cowpea CRSP was to improve FSR in Ecuador. This implied building on national expertise, incorporating relevant experiences from other countries, and adapting social scientific methodologies in order to generate an economical and effective research design. The larger objective was partially achieved, as described below. This chapter focuses on methodology; more specifically, it describes the development of a research design that permits agronomic scientists to analyze smallholder agriculture in its regional and structural context.

CONCEPTUAL FRAMEWORK FOR BEAN/COWPEA CRSP RESEARCH

There is broad consensus among farming systems researchers that some sort of informal survey should be conducted by multidisciplinary teams prior to initiating agricultural R&D, but how institutions conduct preliminary or diagnostic field research varies. The Instituto de Ciencias y Tecnologías Agrícolas (ICTA) in Guatemala developed a technique called the *sondeo*. The format is open-ended, so the content of interviews varies according to what seems relevant to each region (Hildebrand 1981). A contrasting approach was developed for use in the East African Farming Systems Research Program of CIMMYT. This format is more formal, and it provides a detailed checklist to guide interviews (Collinson 1981, 1982). It is complemented by the general methodology developed at CIMMYT (Byerlee and Collinson 1980; Perrin et al. 1979). Other important approaches (Chambers 1981; Honadle 1982; Murphy and Sprey 1982; Rhoades 1982; Shaner et al. 1982) are intermediate with regard to degree of formalization. Alternatives are discussed and evaluated in Beebe (1985). The role of social scientists in these activities is

considered in Horton (1984), Rhoades (1984), and DeWalt (1985). Fresco (1984) provides a useful comparison of anglophone and francophone approaches.

The appropriate unit of analysis is a critical issue. If it is established that regional and subregional variations are important determinants of farming systems, exploratory research should focus on systematic variation across space: the appropriate unit of analysis is a geographic area with definable agroclimatic characteristics. Within regions, further variation in farming systems can occur by social group. In this case, structured interviews with informants can elicit information about agricultural practices common to specific social groups residing in identifiable subregions.

Stated more generally, ecological and socioeconomic variables determine the organization of agricultural production in the sense that they delimit the alternatives open to producers. This is reflected in group-level variations in farming practices and in generic combinations of agricultural and nonagricultural activities. Social groups are located spatially in a systematic fashion, and regularities can be ascertained through regional analysis.

Exactly how ecological and socioeconomic variables determine the organization of crop and livestock production is still under investigation. Important principles have been enunciated by agricultural ecologists (Cox and Atkins 1979), but a consistently ecological approach to farming systems is unusual (Hart 1982). Nevertheless, the concept of a "recommendation domain" is predicated on the interrelation of ecological and socioeconomic characteristics (Harrison and Tripp 1984).

There are strong intellectual traditions that emphasize the systematic variation of human interaction with the physical environment, e.g., C. Smith (1976) in anthropology and D. Smith (1982) in geography. Harwood (1979) has insisted on the importance of physical characteristics, and Shaner (1984) suggests that systematic stratification, considering such components as the agroclimatic zone, provides a potentially cost-effective approach to FSR. Hart (1982) applies ecological analysis to farming systems, and Fresco (1984) describes francophone approaches that include the village and the subregion as levels of analysis. This literature collectively reflects one emerging tendency, namely the realization that agriculture has a regional organization that must be understood in order to place farm-level decisionmaking in its structural context.

The importance of regional variation and structural contexts has also been stressed in recent social scientific commentaries on FSR. Garrett (1984b) emphasizes how structural variables delimit the range of alternatives actually open to small-scale producers. Little (1985) argues that a focus on the individual farm needs to be supplemented by regional analysis. Maxwell (1986) demonstrates that appropriate farm-level modifications cannot be designed without attention to the economic and political aspects of a

changing structural context. Biggs (1985) and Garrett (1987) emphasize organizational and institutional issues. These interpretations are basically complementary, especially in their emphasis on the interdependence of micro- and macrolevel structures. They are also broadly consistent with insights derived from human geography (Porter 1978).

Theoretical and empirical analyses alike suggest that agricultural production has a regional organization. The activities of large- and medium-scale landowners structure those of small-scale producers. Large-scale producers often employ smallholders, and the demand for labor on- and off-farm can be competitive. Estate owners are frequently sources of credit, so interventions requiring increased cash inputs must be evaluated in the context of the local credit network. Marketing is also regionally specific. Availability of productive inputs and access to buyers of agricultural goods are critical determinants of area farming systems. Because these factors are structured at a regional level, a specifically geographic and regional approach to the field is the most appropriate way to place small-scale producers in context. If national and/or international conditions change, these also need to be considered in analysis (Maxwell 1986).

Finally, small-scale agriculture is an eminently social activity. Children learn to farm by working with their parents. Adults discuss farming practices and share solutions to problems. Communities celebrate successful harvests, and complex systems of beliefs and rituals surround many agricultural practices. Farming is learned and shared. Indeed, it is the very sociability of agriculture that makes the diffusion of innovations possible.

A viable FSR design can build on these considerations. The social and cultural aspects of farming plus the systematic variation of farming practices by ecology provide the context for informant interviewing. Interviews can be structured to discuss how people who are like the informant practice agriculture and support their families. Responses will reflect systematic influences of ecological and socioeconomic factors, and this variation will distribute itself spatially. Preliminary research can thus capture how farming systems differ by region, reflecting ecological and socioeconomic variation. Selecting informants and interpreting their commentaries are considered in detail in Garrett et al. 1987 and Uquillas et al. 1986a.

In summary, the regional analysis of farming systems derives from two basic principles: variation in farming systems is systematic by subzone and social group; this variation is known to members integrated into agricultural communities. These principles have critical implications for research design. Specifically, informant interviewing is the data-collection technique of choice during the preintervention or diagnostic phases of FSR. Individuals are asked to report not about themselves but about people like themselves, not about their personal behavior but about practices common to a region. This technique generates qualitative, descriptive data that capture regional

variation. These data have limitations, especially because they cannot be quantified and do not reflect individual differences. They can, however, provide reliable information about the farming systems in a region.

AN INTRODUCTION TO MANABÍ

Manabí is a challenge. It is a large and populous province located on the Pacific Ocean due north of Ecuador's largest city, Guayaquil. Because of its location, the province is a potential provisioner for coastal cities. Resources are limited, however, and the zone needs innovative and effective programs in agricultural research and development.

Young people leave Manabí if they can. As a counter to these migratory currents, many professionals reared or trained in the area develop regional allegiances. Consequently, provincial offices are staffed by many competent professionals committed to agricultural and rural development. Local institutions have a history of collaboration, and the Bean/Cowpea CRSP was able to mobilize interagency cooperation in ways that would probably have been more difficult in less peripheral regions.

In 1982, fully 64% of the economically active population worked in agriculture. Nevertheless, farming is problematic. Agroclimatic characteristics, topography, and limited investment in irrigation all limit production. The small size of most farms also makes exclusive reliance on agriculture difficult. Smallholders remain in farming by diversifying or intensifying. The principal alternatives are off-farm employment or intensification of on-farm production, principally through integration into the broiler industry.

When the Bean/Cowpea CRSP began work in Manabí, scientists knew little about farming systems in the region. The zone had been identified as appropriate for project activities because legumes were important in regional farming systems and in the local diet. Systematic research, however, was required to establish priorities for legume research.

PRELIMINARY EVALUATION OF LEGUME GERMPLASM

CRSP activities in Manabí began with a rapid reconnaissance of the province and the collection of germplasm during the spring of 1984. Flooding caused by El Niño in 1982–1983 had destroyed seed stocks, not only on farms, but also at the Portoviejo Experiment Station. The preservation, evaluation, and ultimate improvement of surviving legume cultivars was considered important because experimental research would require national as well as international germplasm.

A total of 155 samples of germplasm collected from 139 farmers was multiplied. Many seeds failed to germinate, and there was a high incidence of virus infestation. Plants with identical architectures were also known by different names (Chávez 1984). On-station research, therefore, identified issues that were subsequently addressed during diagnostic field research. Specifically, experimental research demonstrated that the production and storage of seed was a potentially important problem, as was loss to diseases, especially viruses. Finally, interviewers needed to pay close attention to the local names of cultivars because variation was likely to be pronounced.

The initial multiplication of germplasm also provided guidelines for subsequent agronomic research. Fifteen of the original 17 cultivars of lima bean (*Phaseolus lunatus*, climbing type) were selected for their tolerance to viruses and their pod-bearing capacity; nine of 36 cultivars of lima bean (bush type) and four with intermediary growth patterns were also selected for virus tolerance, early maturity, and productivity. Finally, 26 of the original 82 cultivars of cowpea (*Vigna unguiculata*) were selected for virus tolerance, early maturity, length of pod, and seed weight (this work is reported in detail in Linzán 1984). During the subsequent rainy season, selected lines were studied in trials with and without pesticides. Initial experiments were not conclusive, so research on this topic continued.

As a result of diagnostic field research, new trials were added during the 1985 dry season. Interviews and observations indicated that experimentation on planting distances was necessary, and this work began. Research on supports for climbing legumes was also initiated; preliminary results suggest that a good choice is horizontal wire from which a piece of plastic clothesline is suspended for each plant. Varietal research also continued, using local germplasm and lines introduced from the International Institute of Tropical Agriculture (IITA) and EMBRAPA.

The purpose of this work was to develop varieties and technologies appropriate for smallholders in Manabí. Diagnostic field research identified priority problems, and trials on smallholders' fields were initiated. Two promising lines, one of cowpea and the other of lima, earlier selected from farmers' fields, are currently being studied. Larger factorial experiments concerning planting distances and control of insects and diseases are also being conducted during both rainy and dry seasons. Collectively, this work illustrates the complementarity of socioeconomic and agronomic research, both on-station and in farmers' fields.

ANALYSIS OF SECONDARY DATA

The collection and analysis of secondary data, both agronomic and socioeconomic, began in late 1984. Ecological and soil maps were prepared

and an extensive preliminary report was written. Many sources were consulted, including theses by students at the Universidad Técnica de Manabí (UTM), census data from the Instituto Nacional de Estadísticas y Censos (INEC), and studies by the regional development agency, the Centro de Rehabilitación de Manabí (CRM).

Census data indicated that Manabí, with a population of approximately one million, had strong migratory currents that produced low rates of population increase despite high birth rates. Although urban areas were growing, rural areas experienced absolute declines in population. Consistent with high birth rates is the fact that approximately half the population was economically dependent. In 1974, for example, 44% of the age-eligible population (12 years or older) was economically active, most (68%) in the agricultural sector.

Geographically, Manabí is dominated by two river systems, the Río Portoviejo/Río Chico and the Carrizal/Chone. Soils in the valleys were formed by alluvial deposits, and the region can generally be described as very dry tropical forest. Subregions have different climates, e.g., dry tropical forest, humid premontane forest, and spiny tropical montane. Lands with these characteristics have limited productivity, especially without irrigation. Large-scale irrigation does exist in the zone, but recent flooding damaged many canals and left the system virtually inoperative. Inadequate infrastructure and insufficient water were known to be important constraints on agricultural production in the region.

The distribution of landholdings in Manabí is very unequal, as reflected in a Gini coefficient of 0.76. Agricultural census data for 1974 indicated that farms of 200 ha or more represented only 1.2% of all farms but occupied 31.4% of the land, while these figures were 67% and 10% for units smaller than 10 ha. The continual parcelization of land is demonstrated by historical data: the number of farms less than 10 ha increased from 58% of all units in 1954 to 67% in 1974 (Uquillas et al. 1985c). Although more recent agricultural census data are not available, this trend has clearly continued because there has been no major land redistribution by agrarian reform in the zone.

Agricultural production in Manabí consists principally of export crops, such as coffee, cacao, and bananas. Only 5% of the area is dedicated to crops for internal consumption, including rice, casava, cooking bananas, cowpeas, and lima beans. Production of cowpeas and limas was concentrated (70%–80% in 1974) on farms of less than 10 ha. Livestock species varied by farm size: cattle were concentrated on large farms, while pigs and goats were typical of small units. Even small farms are integrated into a market economy, and fully 85% of all farms sell some or all of their production. Family labor predominates on small holdings, while occasional hired labor characterizes farms larger than 10 ha (Uquillas et al. 1985c).

Recently, the most dramatic change in the agricultural sector has been increased production of dry corn for feed in the burgeoning broiler industry. Hard corn is grown in the coastal highlands and used in lowland chicken houses. Valley smallholders able to change over to broilers have profited. Those with limited capital, however, have been excluded from participation in this growing agroindustry.

THE UTILITY OF PREPARATORY RESEARCH

Bean/Cowpea CRSP experiences suggest that preparatory research, specifically analyzing secondary data and drafting preliminary reports, can be cost-effective. The initial payoff in Manabí was in site selection. Agricultural census data for the two principal river valleys revealed important differences between them. Land was more subdivided in Río Portoviejo/Río Chico, so there were proportionally more smallholders. Sharecropping was more common, and cash rentals less so. More farms produced for household consumption, and legumes were much more prevalent.[3]

Data reflecting these regional differences were elaborated in the extensive preliminary report prepared by a small team led by the field sociologist. This document was then reviewed by a larger team of INIAP and Cornell scientists, who recommended that the section describing the physical and ecological conditions of different subregions be revised to minimize technical terminology, and that an executive summary focusing on the Portoviejo River valley be appended. These recommendations were implemented, and another team meeting was called to study the executive summary (Uquillas et al. 1985b). On the basis of background research, the team decided to focus field research in the Río Portoviejo/Río Chico valley. This decision was taken not because it would save time and money, but because it was *appropriate* to CRSP objectives. This example illustrates how preliminary research can enhance project effectiveness—even as it reduces the costs of fieldwork.

Background research also improves fieldwork by focusing inquiry on relevant issues and preparing interviewers to learn from the field. The Bean/Cowpea CRSP developed an interview guide that was originally applied in Imbabura (Garrett et al. 1982); it was modified and adapted to Manabí by the field sociologist, and a draft was discussed by the INIAP/Cornell team. Recommendations, especially those concerning details of legume cultivation during rainy and dry seasons, were incorporated into the schedule that multidisciplinary teams employed during field research in Manabí (Uquillas 1985).

Two CRSP documents were used to train interviewers. The executive summary was sufficiently short so that it was actually read and studied by

team members. Also, authors of the longer paper were on hand to provide additional information upon request. The executive summary, however, furnished the ecological and socioeconomic information critical to effective field research; agronomic scientists found it informative and useful. The interview guide gave guidance for first-time interviewers and some uniformity of coverage across teams. Both documents provided concrete topics for discussions and a basis for cross-disciplinary dialogue. They enabled a multidisciplinary team, composed disproportionately of agronomic scientists, to begin field research with greater knowledge, confidence, and sophistication.

THE ORGANIZATION OF FIELDWORK

Informal interviews, such as the sondeo, are intended to identify common agrosocioeconomic characteristics of farmers so as to orient subsequent agronomic and socioeconomic research (Hildebrand 1981:426). With this objective in mind, a training session for the entire field team was organized. Training themes included the history of the INIAP/Cornell project, activities in Manabí, and techniques for field research. Particular emphasis was accorded the preliminary analyses of Manabí and the methodology for regional analysis that the CRSP was developing.

Training exercises were organized in which scientists divided into two teams and interviewed farmers near the Portoviejo Experiment Station. Subsequent discussions focused on the researchers' experiences in this pilot study and the utility of the interview guide. Thereafter, the logistics of fieldwork were considered, and issues concerning staffing, transportation, and finances were resolved. Earlier experiences in Imbabura had demonstrated that logistical problems needed to be anticipated and resolved before they arose. Planning facilitated fieldwork.

Field research was conducted by a rather large and diverse team. The 17 members represented four institutions: eight from INIAP, four from the regional development agency (CRM), three from the Manabí Technical University (UTM), and two from Cornell University. The team consisted of 13 agronomic scientists and four social scientists (one sociologist, one economist, and two agricultural economists). There were 15 males and two females, both agronomists.

Four teams were constituted, each with a social scientist and a representative of CRM. The social scientists were there to guarantee the collection of both agronomic and socioeconomic data, and the personnel of CRM were to enrich interviews with their years of extension experience. Each team was assigned one subregion of the Río Portoviejo/Río Chico basin. These subregions were delimited with agroclimatic data interpreted by knowledgeable scientists from CRM and INIAP. Once in the field, each team

worked separately, but occasional general meetings permitted the exchange of ideas and evaluation of work in progress.

Diagnostic field research took place from 23 April to 3 May 1985. The four teams conducted more than 110 interviews, some of them group discussions. All teams had been instructed to seek out informants with a broad knowledge of the area and to focus discussions on phenomena typical of the region rather than peculiar to the respondent. These interviews, plus field observations, constituted the basis for preliminary team reports (Carrillo et al. 1985; Hinostroza et al. 1985; Maldonado et al. 1985; Uquillas et al. 1985d). Collectively, these reports identify similarities and differences across four areas of the river valley. Reports were written within a few days after fieldwork ended, a rapidity possible because structured interviewing using the CRSP interview guide elicits information that virtually writes itself.

These preliminary reports were used to design follow-up agronomic and socioeconomic research. Subsequently, the results of library and field research were synthesized and published (Uquillas et al. 1986b) in a document that focused on agricultural production, marketing, labor force, and consumption patterns among farmers in the Portoviejo River valley.

OVERVIEW OF PRINCIPAL FINDINGS

Together, the five reports mentioned above extensively document the organization of agricultural production in the Río Portoviejo/Río Chico valley. The richness of this information cannot be captured in a summary. However, a few of the principal socioeconomic findings from one subregion are highlighted here, followed by a discussion of the utility of fieldwork.

Throughout the study site, agricultural production is typified by intermediary levels of technology and unpaid family labor. Males and females, adults and children, all work, performing different tasks. Women manage farms when males migrate to engage in seasonal wage labor. These results echo other research (Balarezo et al. 1984; Safa 1987).

Despite these uniformities, the Portoviejo River valley divided itself into two zones. The lower valley is of greater interest to the Bean/Cowpea CRSP. Fieldwork there revealed three important changes in production during the last decade: Large-scale irrigation was constructed; high-value crops, including vegetables, coconut oil, soy beans, and marigolds, were introduced; and improved seeds were adopted for such traditional crops as maize, peanuts, cotton, and rice. Agriculture had changed rapidly.

The lower valley is typified by level fields, an incipient tendency toward monoculture, and crop rotation to maintain soil fertility. Smallholdings of less than two hectares predominate, and land is intensively exploited. Principal crops are short-cycle annuals—vegetables, maize, rice, peanuts,

casava, and legumes, for example. The production and consumption of legumes are generalized. The zone is quite dry, so water availability is critical.

A large-scale irrigation system, the Poza Honda, was constructed to irrigate the entire valley, but flooding in 1983 destroyed the principal canals in a large sector, and they have not yet been repaired. People who live near water construct small dams to flood adjacent fields, but other farmers can grow crops only during the rainy season.

Historically, the Poza Honda permitted innovations in cropping systems, intensification of the agricultural calendar, and expansion of commercial production — all factors accelerating class formation and differentiation. Some farmers who began with better resources were able to intensify production. By increasing marketable surpluses and cash income, they positioned themselves to buy more land and expand their enterprises. Over time, both small- and medium-scale petty commodities producers have arisen, and these strata now employ wage labor.

Landless strata have also emerged. They engage in wage labor in the countryside and in nearby towns, working in fishing, fish processing, artisan production, and construction. These industries employ both males and females, but males uniformly command higher wages. This is consistent with CRSP findings in Imbabura (INIAP/Cornell Team 1982; Urquillas et al. 1985a). Jobs in the region are generally limited, so males frequently migrate to other coastal provinces for the harvests of coffee, cacao, and cotton. During their 2-to-4 month absence, their wives manage the farms. This adaptation, common throughout the world, has profound consequences for the organization of semiproletarian production (Chaney and Lewis 1980; Garrett 1986).

Marketing in the region centers on the city of Portoviejo. Only there can a wide variety of agrochemicals be purchased. The city's merchants serve a substantially larger market than do their counterparts in other towns. Producers deal principally with intermediaries rather than with customers, although transportation is adequate and distances short.

Despite the commercial orientation of smallholdings, production for home consumption remains important. Most of what people consume is produced locally. Legumes, a desirable foodstuff, are consumed throughout the year. They are eaten daily when available in the garden, and two to three times a week when they must be purchased. Most legumes are consumed green in soups and salads. Mature, dry legumes are also prepared as a savory called *manestra*. Animal protein is usually purchased. Beef and fish can be bought in markets and from itinerant vendors. Potatoes, a highland crop, and noodles, a processed food, are also purchased, along with toiletries, clothing, and the omnipresent Coca Cola, plus its national relative, Inca Cola.

Informants in the lower valley felt that families could live from their

farms if they had two to three hectares of irrigated land, or at least six hectares of hillside lands. Hillside lands were seen as problematic, and families would require at least twice as much land as in the flats. Interestingly, informants' evaluations of what was necessary for subsistence were routinely and dramatically below professionals' calculations of minimal farm size.

THE UTILITY OF DESCRIPTIVE REGIONAL ANALYSIS

The Bean/Cowpea CRSP's adoption of a macro perspective on regional farming systems in Manabí resulted in the identification of marketing as a central socioeconomic issue requiring further research. Diagnostic research identified several problems with marketing channels. Farmers have limited liquidity and inadequate facilities for on-farm storage. Consequently, they must sell at harvest time when prices are lowest; price controls are not enforced. Farmers report limited access to official sources of credit, relying instead on informal systems. Professional moneylenders charge high interest rates. All these factors make it difficult for producers to prosper (Barril 1983).

These findings raised two fundamental questions: first, would producers and consumers, as well as merchants, benefit substantially from increased production? Second, could consumer demand absorb increased production if it were spaced more evenly throughout the year? Answers to these questions would determine whether scarce project resources should be devoted to legume research in the region.

A marketing study was designed that combined structured interviewing with participant observation. A total of 29 merchants, broadly representative of known marketing centers and channels, were interviewed. In addition market dynamics were observed during both wholesaling and retailing hours (detailed results are reported in Chávez et al. 1986).

As diagnostic research had suggested, the principal marketing chain is producer to large-scale wholesaler to intermediary to retailer to consumer. Producers bring legumes to the wholesale market in Portoviejo, where large-scale wholesalers purchase goods and resell them to medium-scale wholesalers. These intermediaries usually sell to retailers or to other medium-scale wholesalers from other large cities within the province or along the coast. Other marketing channels exist but handle little volume.

The difference between producer and consumer prices can be conceptualized as the surplus appropriated by merchants. An earlier study of marketing in the region (CRM 1978) found that profit margins varied by season, ranging from a high of 52% in March to a low of 28% in June. CRSP research, conducted in November, estimated an average profit margin of 50%. Seasonal variability in prices is marked, with lows immediately after

harvest and highs at triple these levels during shortfalls. Merchants explain that demand for legumes is relatively stable throughout the year though supply is highly seasonal.

The CRSP marketing study suggested that increasing legume production and stabilizing availability would be a viable commercial strategy since the demand for legumes seems relatively inelastic. Under these circumstances, agronomic research could appropriately focus on modifications in planting dates and/or varieties to stabilize market availability. Since legumes are currently exported to other provinces, the potential market for Manabita production is substantial.

While marketing research was under way, INIAP's legume program proceeded on the assumption that CRSP research would continue in Manabí. The findings of diagnostic field research were interpreted, and priorities for INIAP's legume research were established.[3]

The relationship between diagnostic fieldwork and experimentation can be conceptualized in many ways. One approach is to emphasize problem definition through a process of elimination. Legumes are known to have a finite set of problems that agricultural R&D can address. The CRSP objective was to eliminate from the research agenda those problems that appeared unimportant to smallholders in the region and then to establish priorities among remaining topics. Field research is not designed to discover problems that scientists have never identified. Rather, its purpose is to select from among commonly recognized problems those whose solution would make a difference to specific groups of producers. FSR is applied, not basic, research.

Problem elimination is important to the design of experimental research. Legume storage in the Portoviejo River valley provides a useful illustration: legumes are stored exclusively for seed; consequently, there is no reason to study technologies for long-term, on-farm storage for human consumption. In another zone, however, this might be an appropriate theme.

Scientists found two principal on-farm techniques to store seed: legumes were either left on the vine and hung near the fireplace; or they were shelled, mixed with sand, and placed in a closed container. These are both fairly common postharvest technologies, but they are not completely effective. Informants reported insect infestations (*polilla*, *Callosobruchus* sp.). Scientists confirmed these reports and also observed that farmers were using certain chemicals in ways dangerous to human health. Finally, the germplasm trials that had been conducted on-station suggested that poor quality seed, infected with seed-borne diseases, was a common problem.

Collectively, these insights identified as a research priority the development of a technology to produce and store clean seed under smallholder conditions. This provided a framework for organizing supportive and related research and defined the context for work on improved varieties,

planting distances, and infestations, including nematodes, insects, and diseases. The development of procedures for clean seed production and storage defined the parameters of associated research. Consequently, the research design had a rationale and logic frequently lacking in experimentation designed without intensive exploration of the site to be served.

The research agenda that emerged after fieldwork consisted of studies that are individually quite traditional. It is noteworthy, however, that several traditional topics are absent—for example, fertilization levels. Critics who fail to consider complementary aspects of research design (i.e., what is excluded as well as what is included) trivialize the contribution that a holistic analysis can make to R&D design.

IMPLICATIONS FOR MULTIDISCIPLINARY RESEARCH

Preliminary research, both on-station and in libraries, prepared CRSP researchers for much of what they observed during fieldwork. Indeed, there was little from a socioeconomic perspective that had not been anticipated on the basis of the general theoretical literature or the empirical analysis of Manabí. Certainly, a team composed solely of social scientists could have produced a more penetrating analysis of the organization of agricultural production in the province. In the context of this project, however, much of what is conceptually interesting in sociological terms could not be adequately explored. The Ecuador project differed from other CRSPs because social scientists enjoyed less disciplinary autonomy and more multidisciplinary collaboration (Garrett 1984c). There are both costs and benefits to this organization.

Our objective in Manabí was to adapt standard social scientific methodologies to provide a framework within which agronomists could conduct fieldwork successfully. Professionals with and without field experience improved their interviewing skills in both eliciting and interpreting commentaries. CRSP collaborators learned how hard smallholders work to maintain farms and support families under the disadvantageous conditions of Manabí. Interviewers focused on the details of agricultural production because they were of interest to both scientists and farmers. This focus allowed agronomic scientists to appreciate how production practices were influenced by factors other than knowledge of technological alternatives and professional recommendations.

In this way, agronomists developed some ownership of social scientific concepts. They saw firsthand how seasonal male migration affects the allocation of labor by task and how the availability of family labor conditions the organization of farming systems. It is possible to develop such understandings theoretically, but agronomists drew on what they saw and sought to interpret it. Because these insights were their own, CRSP

agronomists expressed satisfaction with what they had learned. They had enjoyed fieldwork and thought it enhanced their understanding of agriculture in the region. Nevertheless, they found it difficult to specify exactly how fieldwork influenced experimentation decisions.

This observation can be interpreted in several ways: one could adopt the traditional position and argue that multidisciplinary fieldwork is marginal to the design and conduct of agronomic research; alternatively, one can ask how research priorities are actually established.

The provenance of existing strategies for agricultural development in Third World countries is not intuitively obvious. Conventional wisdom holds that research agendas in the natural sciences reflect consensus on puzzles important to the "scientific community." In many countries, however, critical contemporary literature is inaccessible because libraries cannot afford expensive journals. Contact with international peers is hard to establish and maintain because communication is difficult and travel expensive (Lacy et al. this volume.) Under these circumstances, national commodity programs find it difficult to reach the cutting edge of research.[5] National institutions also feel pressure to conform to an international division of labor. The IARC's facilitate research, but they also influence the direction of national programs. Finally, national programs have their own dynamics, which generally discourage innovation. All these factors mean that scientists cannot control their research agendas in an assertive, pro-active fashion. They can exercise control at the margin, but many parameters of their research are defined by outsiders.

Exactly how disciplinary, commodity, and national factors interact to determine research agendas is poorly understood. Consequently, it is not clear how much autonomy national commodity programs actually have. To the extent that the definition of a research strategy is mechanical rather than deliberate and judicious, programs are inherently unable to redefine agendas based on the regional analysis of farming systems.

Further complicating the problem of research strategy is a markedly divergent approach to the field in the social and biological sciences. Social scientists conduct research in the field, collecting data and exploring alternative interpretations. By contrast, biological scientists tend to equate research with controlled experimentation in laboratories and test plots; they therefore have difficulty incorporating insights from fieldwork into "real" (i.e., experimental) research. Fundamentally different conceptions of research, and consequently of fieldwork, inhibit communication in ways that need to be better understood if multidisciplinary collaboration is to be effective.

The farming systems approach allows scientists rationally and self-consciously to design a research program. This potential calls attention to some relatively unexamined influences that currently set the agenda for Third World commodity programs. Dependency is a complex phenomenon, and

although national programs conduct research, they do not control basic aspects of their scientific agendas. A farming systems approach encourages nationals to take control of programming in ways that meet the needs of specific constituencies. Reflection on these issues may allow national scientists to make more deliberate and appropriate choices about research design in the future.

NOTES

Research was conducted under the Bean/Cowpea Collaborative Research Support Program (AID/DSAN/XHG-0261). The authors have tried to reflect the stimulating contributions of those who worked intensively with the project in Manabí and who produced many of the papers cited in this chapter. Nevertheless, we accept responsibility for the interpretations presented here.

1. A model depicting phases of farming systems research and synthesizing diverse experiences was developed by collaborating scientists during a project workshop in Quito in August 1985. The following participants were included: INIAP/Ecuador—José Acuña, Diana Barba, Victor Hugo Cardozo, Rómulo Carrillo, Edmundo Cevallos, Napoleón Chávez, Francisco Muñoz, Arturo Villafuerte, Cristóbal Villasís, and Ely Zambrano; ICTA/Guatemala—Selvín Arriaga, José Manuel Díaz, and Porfirio Masaya; Cornell/USA—Patricia Garrett, Judith Hall, Wesley Kline, and Jorge Uquillas. The model was also employed in Espinosa and Garrett (1987) to illustrate how gender is a relevant consideration during all phases of FSR.

2. Research based on structured interviews must be carefully designed because the quality of information depends directly on the care with which informants are selected and interviewed. Knowledge of regional ecological and socioeconomic characteristics allows the team to identify appropriate informants. Preparatory research, specifically the analysis of existing agronomic and socioeconomic data, is essential to ensure coverage of all major ecological regions and social groups. Individual informants are selected so that they collectively represent the *range* of ecological and social situations manifested in the study site.

If researchers understand that experiences vary systematically by social position, they can identify respondents who are knowledgeable about specific themes. Preparation for field research is particularly helpful in anticipating the probable range of variation in the study site. In the field, social scientists (notably anthropologists and sociologists) are trained to analyze social, cultural, and economic differences within small regions, and their participation is critical on teams using structured interview techniques. A detailed interview guide that illustrates how structured interviewing can be adapted to farming systems research is available in English (Garrett et al. 1987) and Spanish (Uquillas et al. 1986a).

3. Agricultural census data are available in Ecuador down to the county (*parroquia*) level, and our original intention was to analyze the parroquia data for Manabí, following the outline in Palacios and Garrett 1983. This was not possible. Team members did not have sufficient time to hand-copy the data on multiple variables for 90 parroquias. Moreover, adequate software for statistical analysis on the Apple II did not exist. Consequently, it was not feasible to

conduct a comprehensive statistical analysis for Manabí, paralleling that for Imbabura (Palacios and Garrett 1984). However, technology has changed dramatically in the short time since research began in Manabí. Lap-top computers now permit direct data entry in libraries and offices, and powerful statistical packages (such as SPSS and SAS) run on computers with hard disks. These innovations make it realistic to tally and analyze secondary data, at least under the favorable conditions that obtain in a country such as Ecuador. The application of microcomputers to agricultural development is discussed in Duff and Webster 1984 and Garrett et al. 1986. Obtaining USAID authorization to purchase microcomputers, however, remains an obstacle.

4. The CRSP had the freedom to decide whether to continue legume research in Portoviejo. By contrast, INIAP's Legume Program was administratively required to conduct research so long as the commodity program was assigned to the zone. It was necessary, therefore, that the Legume Program proceed as it did, using diagnostic research to define its work plan. The FSR approach to problem definition presumes the autonomy that the CRSP enjoyed; but it is also frequently employed by national programs that cannot elect to abandon regions or commodities. Thus, the commodity organization of national programs, based on the U.S. land grant university model, can conflict with a farming systems approach. FSR must, therefore, be creatively adapted to different institutional environments.

5. One notable exception is the bean program of ICTA/Guatemala directed by Porfirio Masaya, a host country PI on the Bean/Cowpea CRSP. The collaborative research support mode is intended to keep well-trained directors of national research programs in close communication both the such international centers as the Centro Internacional de Agricultura Tropical (CIAT) in Colombia and with peers such as Donald Wallace at Cornell University so that their programs can work on the cutting edge. The importance of CRSP support for good science conducted with and through national commodity programs needs to be highlighted.

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