SOCIAL SCIENCE PERSPECTIVES ON MANAGING AGRICULTURAL TECHNOLOGY

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SOCIAL SCIENCE MONITORING AS A MANAGEMENT TOOL FOR DIRECTING THE BENEFITS OF NEW AGRICULTURAL TECHNOLOGY TO THE POOR

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Social scientists can help managers involved in the diffusion of new agricultural technologies to know more about the practical ways that benefits can reach small scale farmers This is possible whether such managers work in IARCs national programs development projects or local farmers associations Conversely managers need to analyze how their mundane decisions concerning technology design extension methods project staffing or pricing will select the farmers who will benefit from the technology

The study reported here monitored the introduction of an agroindustrial technology for processing the starchy roots of yuca (cassava, manioc tapioca, *Manihot esculenta*) for animal feed CIAT transferred the technology from Thailand to Colombia, where groups of farmers began building drying plants under the guidance of the Colombian Government s Integrated Rural Development Program (DRI) DRI is a funding and coordinating program that implements projects through existing agencies such as the national agricultural research and extension organization the land reform bureaucracy and several credit agencies

Based on data gathered by DRI agencies and the author this paper discusses management decisions at different levels of the project and how those decisions directed or could have directed the benefits of the project to particular beneficiaries The analytical approach of this paper follows a simple paradigm a variable that can be manipulated by a manager is correlated with some beneficiary characteristic A conclusion is then drawn about how the decisions did or could skew benefits to the poor This method of analysis is fairly generalizable because monitoring and evaluation units are often appended to development projects Results of this study (Romanoff 1986a, 1986b) and its monitoring approach are being used in Colombia. In Ecuador also both the project and the pilot monitoring activity have been replicated and some of the lessons from the Colombian case have been applied (Romanoff and Toro 1986 Romanoff 1987) This paper concludes with a note on the Ecuadorian experience and the limits of management and monitoring.

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BACKGROUND

Between 1981 and the start of this study in 1984 the DRI CIAT project had stimulated the organization of 20 cooperatives of yuca farmers on the North or Atlantic coast by 1987 36 cooperatives were in operation Each cooperative built, owns and operates a postharvest processing plant that consists of a yuca chipper a drying floor and a warehouse — a modest rural industry based on local production

This study on the institutional aspects of the DRI CIAT project was initiated in 1984 when the CIAT Cassava Program became interested in finding ways of lowering the cost of promoting and assisting the cooperatives The institutional costs of any rural development project run high but one that attempts to teach a new technology to a region organize farmers groups and conduct studies can become so expensive that the implementors costs eventually brake the diffusion of the technology

The first task of the study was to design a scheme to monitor costs It was time-consuming but not difficult to describe and quantify the resources that institutions had used to promote the processing plants In addition to cost data the DRI-CIAT project needed information on beneficiaries because there were issues concerning who the project s target population ought to be Gathering such data was easy once a quick but reasonably clean sampling procedure was designed based in large part on collecting the sales slips at the processing plants

The issues about the project s intended beneficiaries included the desire of some functionaries to allow DRI to benefit farmers having more than 20 hectares (ha) of land Still others felt that inclusion of the landless or near landless was a potential danger for the project because the very poor might not be able to expand their yuca cultivation and the cooperatives might become intermediary organizations They preferred that the plants be supplied by their owner members rather than buying from unaffiliated growers because they felt that 'intermediaries — even landless people organized to process yuca — are morally bad There was also an issue of feasibility with some feeling that only the more wealthy farmers were likely to enter the associations

The justification for the project s high institutional costs however is precisely that apart from those costs it is both financially viable while it benefits economi cally marginal people Indeed the plants are more feasible among farmers with problems than among the well situated For example Paul Bode a CIAT anthropologist who had been looking at the farmers associations found that farmers with marketing problems were more likely to use the processing plants because of their lack of access to traditional markets

METHOD

The monitoring data used to evaluate management decisions were primarily derived from cooperative financial records sales receipts for yuca, lists of wages paid and membership roles. The agencies involved in DRI use these data for accounting purposes, but do not centralize them for analysis Records are usually complete because the agencies insist that the cooperatives maintain the chits and because the farmer who provides yuca is paid after he turns in the receipt to the cooperative s treasurer The slips, once ordered and "cleaned " constitute a list of all the people who sold yuca to the cooperatives, the list of beneficiaries was completed by obtaining records of wages paid and the division of yearly profits In the cases where data on the distribution of profits were lacking, estimates were made

The concern in this study was with the benefits from producing and processing yuca, some other benefits were not described For example because of high institutional costs, one could consider the functionaries as the main beneficiaries of the project The purchasers of dried yuca certainly saved money by having access to relatively cheap yuca instead of corn or sorghum The fact that cooperative members benefited from the subsidies on plant construction was also not considered

Basic data on beneficiaries were augmented by information on each member and on a sample of nonmembers selected from farmers named on the sales slips Groups of members were also asked about people present and not present. The topics included approximate age relationship to members, land tenure type of land owned and location of farm. In a separate exercise government functionaries were asked about their background and their actions in support of the associations The study also used in depth interviews that are not reported here

These methods were effective in this particular situation The sales slips constituted a ready made database that was accurate and complete In many situations it is possible to find such data, but one always has to make a judgement regarding their reliability For example to estimate the number of houses in uncensused areas I have used maps made by malaria service workers who spray every roof in an area (this required a correction factor for chicken coops) and to capture household expenditures, I have used the notebooks kept by monopolistic company stores that sold on credit.

In the Colombian case third-party questions yielded useful information because the cooperatives are part of face-to-face communities because the questions were matters of common knowledge, and because extreme accuracy was not needed In many cases it was possible to check verbal data against records (e g. if the person was a land reform beneficiary his holding was registered if a person was a cooperative member his age was documented) An independent investigator checked some of the data, and made minor corrections in 30 percent of the entries but with no substantial changes in results Data were processed using

microcomputers Hand processing was not possible because of the large number of sales slips Further it was necessary to weight the sample data to correct for biases due to overrepresenting people who sold frequently to the cooperatives

MANAGEMENT OPTIONS AND MONITORING DATA

The substantive as opposed to methodological discussion pertains to a particular type of technology In its present form, technology requires an investment that is feasible for farmers cooperatives middlemen feed manufacturers, large-scale farmers or other businesses Patterns of dissemination differ from those of for example new yuca varieties But the monitoring technique is potentially of equal use as shown by the discussion of the diffusion of new yuca varieties along the social networks of community leaders (Diaz 1986)

Decision 1 Choice of the Institutional Channel for Disseminating Technology

The major management decision that allowed the benefits of the Thai yuca dry ing technology to reach Colombian farmers was simple The CIAT Cassava Program agreed to work with a development project already in contact with small-scale farmers In the tripartite project involving CIAT DRI and CIDA, CIAT provided technology technical assistance and studies DRI provided the pathway to the small-scale farmers and CIDA promoted and funded the scheme

DRI has been committed to working with small scale farmers from its inception It has shown this commitment by having social scientists select areas to work on the basis of population concentrations of low income farmers and by placing a 20-ha limit on landownership of DRI clients However DRI had serious problems due to lack of an agricultural technology that would benefit very small scale farmers Most of the attempted land reform cooperatives had failed in part because they had no viable technology that required group cooperation. The remnants of such groups were the predecessors to some of the yuca processing associations (Bode 1986) DRI also had problems with its early attempts at delivering credit to the poor badly designed loan schemes ended in tremendously high default rates

The monitoring project found a correlation between the type of institution that disseminated processing technology and the potential recipients Demonstration at a trade fair for example resulted in inquiries from larger-scale farmers The monitor ing data verified that DRI was indeed linked to small-scale farmers and that the yuca technology provided them with benefits Processing plants had about 20 members each and purchased yuca from an additional 100 nonmember farmers The majority of benefits from the plants operations went to farmers with less than five hectares of land because so many of them joined the associations (Figure 1) The greatest *mean* benefits went to members with 7 to 13 ha (Figure 2) In terms of

Figure 1 Total benefits by size of farm 1984 1985 members only

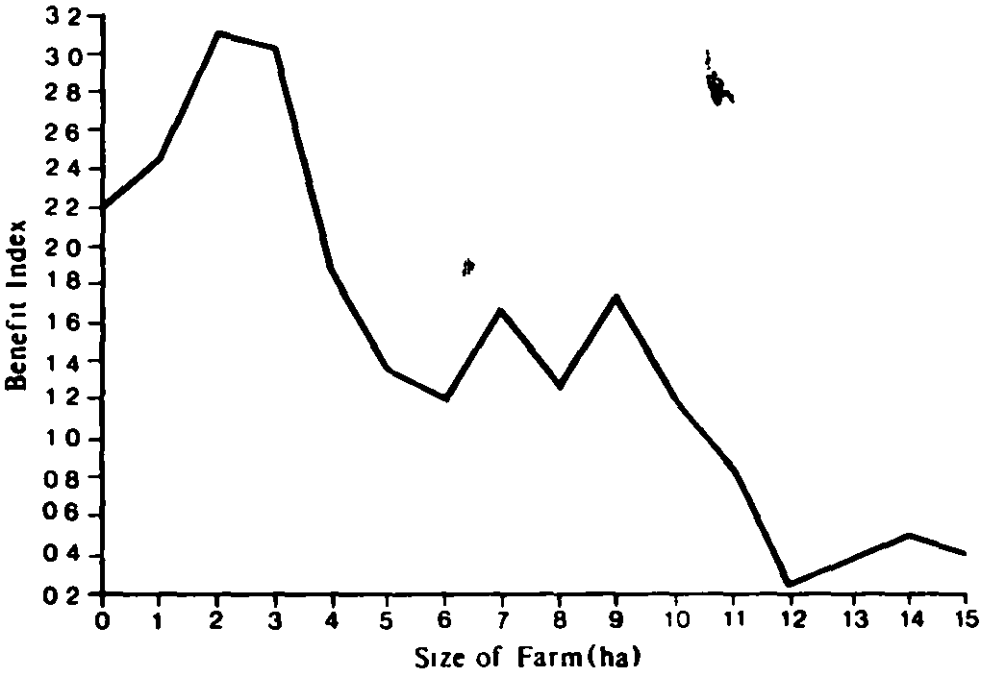
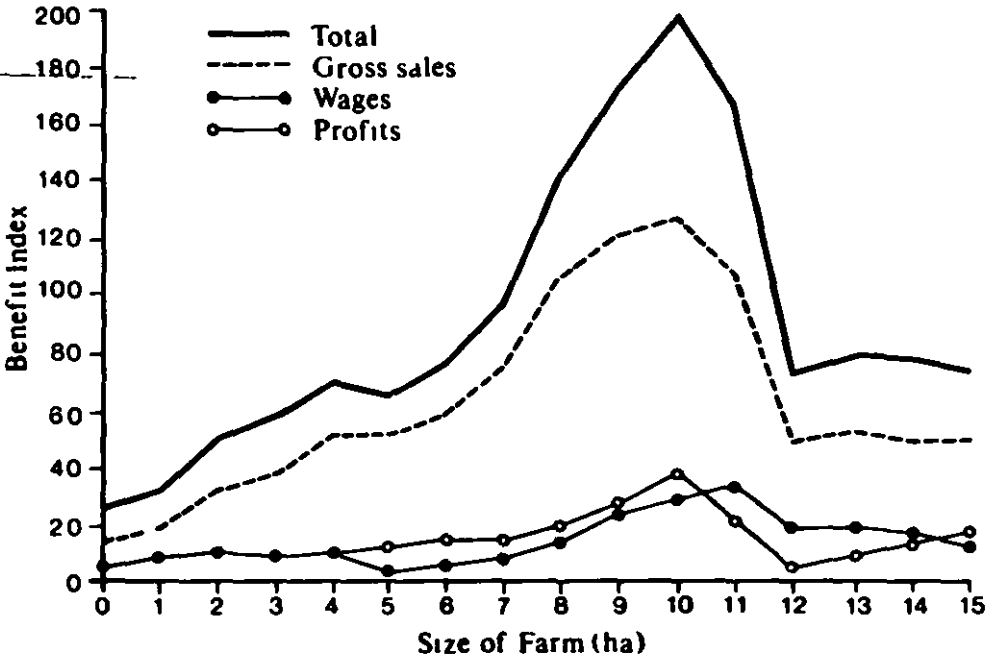


Figure 2 Mean benefits per member by size of farm 1984 1985



Note Running mean of three classes Benefits gross sales + wages profits

land tenure land reform beneficiaries were the most active farmers in the project, even people with no land of their own were involved When we consider the different kinds of benefits we find that the nearly landless and the small-scale farmers provided half of the yuca processed by the plants as well as most of the labor

Decision 2 Targeting Larger Scale Farmers

The data just presented to discuss the nature of DRI s beneficiaries show that contribution to the project is *not* correlated with size of holding Rather the relationship is bell shaped Therefore deciding to bring larger scale farmers into the project would not *ceteris paribus* have the intended effect of improving the supply of yuca In fact the processing plants would not have been feasible had they not attracted large numbers of small scale farmers This is a case where a management decision on eligibility requirements incorrectly presumed a linear correlation between size of farm and production of yuca for the project

Decision 3 Size and Location of Processing Plants

The capacity of a yuca postharvest processing plant depends on the size of its concrete drying floor At the beginning of the Colombian DRI CIAT project the floors were 500 square meters (m^2) Economists demonstrated that it was profitable to increase the size of the drying floor so new plants now begin with 1 000 m^2 still small in comparison to drying floors in Thailand which reach 10 000 m^2

The current practice of building many small plants favors small scale farmers as does the practice of locating plants where there is a densely settled population where farm to-plant distances can be kept short Small scale farmers often use burros to transport the yuca and are limited to short distances On the other hand large scale farmers can transport yuca greater distances by truck Drawing on distant farms would allow entry for intermediaries and larger scale farmers

One need not be among those who claim that intermediaries are exploitative to conclude that it is more efficient to have farmers sell their raw product directly to a local plant Processing a bulky heavy raw material close to the fields where it grows reduces the cost of transportation gives the value added to local people and renders the project (given the current technology) more viable

Decision 4 Emphasis Among Types of Benefits

The members of the yuca processing associations benefit through sales of their fresh yuca wages earned in the plant and profits distributed at the end of the

year the latter being divided equally among members. One presumes that people with less land benefit relatively more from profits and wages than do people with more land who should sell more yuca. This is the case especially for the nearly landless. However the minimal size of farm for selling substantial amounts of yuca is extremely low and even the near-landless can sell something (Table 1)

Table 1 Types of benefit that accrue to nearly landless and small-scale farmers.

A. Proportion of benefits by type of benefit (members only) Colombia 1984-1985

Land holding (ha)	% of all members	% of gross sales	% of all wages	% of all profits
0-1 (nearly landless)	35	12	24	25
0-5 (nearly landless and small-scale farmers)	76	52	59	64

B. Proportional distribution of benefits by type and size of holding. Colombia 1984-1985

	Benefit (%)		
Holding size (ha)	Net gains from sales[a]	Wages	Profits
0-1	32	35	32
2 5	51	25	28
6-15	55	26	20
16 or more	50	31[b]	20

Notes: [a]Assumes that the farmer nets 50 percent from gross sales.

[b]Due to participation as managers in some of the more profitable cooperatives.

By emphasizing wages and profits, the cooperatives assist the poorest nearly landless members Changing the price paid for yuca modifies the relative importance of wages, sales, and profits in the mix of benefits. By lowering the price of yuca, one raises profits and could raise wages. This favors those members who depend on such benefits (Table 2) Thus, the monitoring system shows how to skew benefits to the very poor increase wages and profits.

Table 2. Effects of yuca price on distribution of benefits. Colombia 1983-1984

Yuca price (peso/kg)	Benefit (%)		
	Net gain from sales[a]	Wages	Profits
8	139[b]	14	(53)[b]
7	114[b]	14	(28)[b]
6	89	14	3
5	63	14	23
4	38	14	48
3	13	14	73

Notes. [a]Assumed constant.

[b]The member gains by selling yuca, but loses equity in the cooperative because the cooperative loses money

One of the notable features of CIAT Cassava Program in comparison to other IARC programs is that it emphasizes utilization technology While all farmers might benefit from research on agronomy that lowers production costs for yuca, the low income members of cooperatives benefit most from research that emphasizes utilization technology new products, higher value products and expansion of labor opportunities Emphasizing profits and wages benefits a particular type of marginal person the farmer with broken terrain Farmers with flat land which on the North coast are also likely to be better watered do not lack for agricultural opportunities Wages and profits from the processing operation are more important to the less favored Thus those with flat land obtained 73 percent of their benefits from selling cassava, but those with broken land obtained only 33 percent from sales with the rest coming from wages and profits

Decision 5 Cooperative Principles

There are many examples of how diverse factors can affect the relative importance of sales, wages and profits One is the conversion of the legally simple associations to complex cooperatives Higher level functionaries eager to enlist the assistance of the national cooperative agency promoted that change of status Ideally cooperatives are governed according to the "Rochdale principles" and a two-inch thick government volume of regulations One of the Rochdale principles is that profits or rebates are to be divided according to the degree that an individual uses the cooperative that is, either buys from it or sells to it. Another is that membership is to be open to all, with free entry

In the case of the yuca cooperatives, the distribution according to-use principle means that profits would be divided according to sales. Those who sell more yuca to the cooperative would benefit at the expense of those who sell less

Because those who sell more are also likely to have more land, they and not the very marginal are favored by a scheme of rebates in proportion to sales. The application of the open membership principle, on the other hand, would make the benefits from profits insignificant In these instances the application of cooperative principles would make the associations less able to provide significant benefits to the nearly landless members

Let us turn to another aspect of cooperatives. internal differences in benefits An ideology of egalitarianism or solidarity is insufficient guarantee that an organization or institution is capable of providing benefits to its poorer members. In the case of the yuca associations the degree of internal homogeneity is quite variable as was shown when Gini coefficients were calculated for the members benefits For exam ple wages or the number of days worked were relatively evenly distributed among members of the cooperatives except for the specialists who worked many more days than the rest of the members Recruitment to the roles of manager president and secretary is of special interest when half or more of the cooperative s wages are paid to specialists

Decision 6 Recruitment Techniques

For a local level manager a major decision is the mode of recruitment to farmers associations or simply to selling yuca. In Colombia, recruitment along the lines of friendship and kinship has been beneficial, though we shall see that it resulted in some problems in Ecuador In Colombia, propinquity is related to keeping the benefits of the plants among small holders even considering nonmember vendors The more concentrated the clientele the more they are socially integrated and the closer the social bond the more they tend to be drawn from the poor (Table 3)

Table 3 Farm size by social relation of nonmember vendors Colombia

Social relation	Mean farm size (ha)
Kin	3 12
Friend	4 17
Known person	12 82
Previously unknown person	10.23

Indeed propinquity is probably a prerequisite for member-managed processing plants unlike the installations of for example milk processing cooperatives When associations try to take members from several towns, difficulties of communication and rivalries result in one town s members becoming dominant.

Decision 7 Recruitment of Functionaries

We now return to the issue of institutional links to farmers, turning the focus from the farmer beneficiaries to the functionaries This is an important and understudied issue CIAT has already published a report on the cost of the project (Romanoff 1986b) It was shown that the cost of institutional support to start a farmers association and processing plant was US$30 000 in 1981 the first year of the project and US$10 000 in 1984 and that it took between half and one person-year of direct effort

Here we shall examine the social structure of the DRI bureaucracy as it pertains to successfully channeling new agricultural technology DRI works with small-scale farmers The social nature of the contact between low level DRI workers and farmer "leaders" is also of interest Equally important is the fact that DRI works at the upper levels of society where it can capture resources

DRI links the classes and regions of Colombia the presidency and peasants, the capital and the provinces and the source of technology and small-scale farmers The DRI bureaucracy itself replicates these linkages in miniature people of higher social class (as measured by land ownership) staff its upper levels (as measured by salary) and lower class people staff the lower echelons

At the upper end the success of the project as a conduit for technological change depends on the capacity of the bureaucrats to use the unusual freedom that a DRI project allows Throughout Latin America such projects have been situated in the offices of presidents and ministers and given external funding so that they can bypass entrenched political structures The success of the Colombian DRI agency depends on mobilizing functionaries to unusual effort overcoming the usual constraints and using social and official position on behalf of clients

At the other extreme of the DRI social universe is a constellation of low level functionaries farmers and local leaders The former are not of farmer origin but rather of poorer town or city origin They have established links to recognized community leaders who are not part of the bureaucracy and thence to farmers Some of the leaders in Colombia have gained their position through organizing land reform actions a few are village notables such as petty merchants others were brokers who were known for their willingness to seek benefits for the village from outside agents The link between leader and functionary often predates the formation of the yuca cooperative having been established to organize land invasions conduct on farm trials etc In turn the leaders had pre-existing enduring ties with other farmers because they were in the same land reform unit or because the cooperatives are units of kinship and propinquity as will be discussed below

A manager staffing a development project with the goal of diffusing new technology to farmers would do well to examine the social reality of the extensionist-leader

farmers complex at the working end of the bureaucracy including the social characteristics of the people recruited into these roles. The peculiar constellation that characterizes the DRI project in Colombia (nonfarm lower class functionaries allied with leaders from the land reform movement) is probably not replicable in other situations, but every research extension complex has functional alternatives

The social analysis of bureaucracies is pertinent to topics widely discussed Excessive turnover in agricultural research and development agencies is common In the DRI project the upper-level functionaries come from more prestigious jobs and expect to leave within five years for such jobs or for their own farms Lower level officials from less-prestigious positions have been in their agencies longer and expect to stay longer finding them to be attractive in comparison to alternatives hoping to advance by in-service training.

REPLICATION IN ECUADOR

In October 1985 CIAT introduced the yuca-drying technology to Manabi Province Ecuador The methods used are similar to those of Colombia, and many lessons learned on the North coast have been applied in Ecuador with the goal of replicating the technology without incurring the high institutional costs of the initial experience Some of the patterns among beneficiaries that are emerging from the first Ecuadorian experience are like those of Colombia because in both countries the project works in areas with substantial numbers of small scale farmers The mix of benefits is similar small scale farmers prevail among beneficiaries and the correlation between distance and social relations is the same in both countries The Colombian associations have let in more marginal people while the Ecuadorian farmers have chosen owner farmers for the most part (Table 4)

The equivalent of DRI's capacity to form associations among lower income farmers was found in the Ministry of Agriculture's communal development projects Working with an existing agency was mutually beneficial in 1986 in Ecuador for the same reason that it worked in Colombia agencies are able to form groups but once the groups are formed their persistence requires economically viable activities better performed by groups than individuals The yuca technology filled that need The upper level bureaucrats of the Ministry of Agriculture provided valuable links to funders buyers and other institutions as did the DRI bureaucrats in Colombia However an important contrast was the lack of Ecuadorian bureaucrats of lower class origin

In Ecuador lessons from the North coast monitoring exercise were modified and applied While some prove true and useful the limits of "management are becoming clear Sometimes the only thing that monitoring does is allow one to see clearly how things are not working out as well as they might For example the trade-off between yuca price wages and profits is the same in both countries but in Ecuador

Table 4 Comparison of Ecuador and Colombian experiences

	Benefits	Ecuador 1985 (%)	Colombia 1984-1985 (%)
A	Size of farm (ha) members		
	00-09	5	21
	10-49	65	53
	50-199	25	25
	20 or more	1	5
B	Land tenure		
	Permanent use owner land reform land reform II communal assigned	80	59
	Kin s land	5	17
	Renter loan sharecrop for improvement	10	24
	Landless	5	1
	Total	100	101
	(n)	20	394

perhaps because the project is new strong factions in the associations seek to raise the price of yuca beyond the limits that allow profits

Further both the reality of local stratification and members perceptions of inter nal stratification are problems in Ecuador factions form about this issue and the effectiveness of leaders is diminished Knowing that internal st atification was occurring did not result in functionaries taking effective action

In the Ecuador project few lower-class people have been brought into the bureaucracy and the nature of local stratification and hence of farmer "leaders" is different In Colombia very large scale farmers compete with small scale farmers for land trying to avoid all contact with them in Ecuador merchants and small scale landlords still live and associ ate with small scale farmers Therefore the equi valent of the Colombian functionary leader farmer complex is functionaries of middle-class origin in contact with local notables who in turn have clients This social constellation is less effective than the Colombian for mounting a farmer owned company To cite an example of a problem a leader who was a coffee merchant convinced his association not to process coffee on the drying floor in the off season his interests diverging from the members prevailed

In order to have a farmer functionary within the project expert farmers were brought from Colombia to teach drying techniques This *campesino-to-campesino* (peasant-to-peasant) technical assistance model was efficient especially in its second stage when the experts were Ecuadorian farmers who taught in a second province To cite another example of the limits of monitoring, the Colombian data show that members resident in the town where the processing plant is located receive more than 10 times the benefits received by out-of town members Therefore during the formative stage of the Ecuadorian groups it was suggested that only nearby farmers should be allowed to join Some groups deviated from this suggestion some of the more distant farmers are dropping out and there are problems of communication among members One could see the problem coming, but members made decisions based on such local factors as prior membership in project groups

SUMMARY AND CONCLUSIONS

The kind of monitoring system that worked in Colombia also works in Ecuador and the patterns revealed are similar Monitoring data and social analysis were useful in setting up the Ecuadorian replication of the technology but there are limits to the use of such data.

- Methodology By slightly augmenting project monitoring activities it is possible to show who benefits from a project introducing new agro-industrial technology how they benefit, and the basic social factors that are correlated with their partic ipation

- Benefiting the poor and project feasibility The monitoring data show that the participation of the landless and near landless in the DRI-CIAT project was much greater than had been expected The members with five hectares or less supplied half the yuca provided by all members and more than half of the labor These data support the position that the small-scale farmers made the plants more feasible rather than less

- IARC collaboration with development projects The principal reason that the new technology reached small scale farmers was the collaboration between the CIAT Cassava Program and the Colombian DRI program the latter (with the land reform) being a bridge between the centers of Colombian society and its marginal farmers CIAT had technology appropriate to small scale farmers that was not diffusing very quickly DRI had contact with farmers and resources but insufficient technology Both institutions and their respective functionaries benefited from the collaboration

- Agency social structure Social analysis of research and extension organizations is pertinent to problems that have been approached from different perspectives The social nature of the extensionist leader farmer complex at the lower end of the bureaucracy has been identified as an important institutional variable

- Replicability The monitoring data techniques presented here were replicated in Ecuador and similar patterns were found The central aspects of the project were repeated with some success in Ecuador — and with enough difficulties to make for a realistic assessment of the efficiency of monitoring and management

The general conclusions of this study are that new technology can reach small scale farmers in an expeditious and preferential way by developing and refining appropriate institutional means This process can be described replicated and made more efficient by monitoring the results and using those results to make informed decisions.

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