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Soil Recuperation In Central America:

Sustaining Innovation After Intervention

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SOIL RECUPERATION IN CENTRAL AMERICA: SUSTAINING INNOVATION AFTER INTERVENTION

Roland Bunch & Gabinò López

Introduction

Much has been said and written about the sustainability of agricultural development. Nevertheless, few indeed are the published studies that give evidence of programme impact years after the outside intervention ended. To help fill this void, this paper describes a study of three agricultural development efforts in Guatemala and Honduras and assesses impacts up to 15 years after the termination of outside intervention[1]. The study was carried out by the Honduran organisation COSECHA (The Association of Advisors for a Sustainable, Ecological, and People-Centered Agriculture).

The study assessed the impact these interventions have had over the years. The results, which show considerable increases in productivity, indicate that while specific technologies do not generally have long-term sustainability, the process of agricultural innovation does. The study points to a need for future agricultural development programmes to design their work in such a way that villagers are given strong motivation to innovate.

The Areas Studied

Although the study was carried out in four areas[2], this paper concentrates on the following three:

1. The Cantarranas Area. Between 1987 and 1993, the Cantarranas Integrated Agricultural Development Program, financed by Catholic Relief Services and managed by World Neighbours (WN), worked in some 35 villages around the central Honduran town of Cantarranas (Bunch, 1990). Using in-row tillage and intercropped green manures as its

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1. The study was commissioned by IIED as part of their collaborative research programme New Horizons: The Economic, Social and Environmental Impacts of Participatory Watershed Development. A summary of the findings of the New Horizons research programme are published in the Gatekeeper Series, as Gatekeeper 50.

2. The fourth area studied was the North Coast of Honduras, where local farmers have adopted the intercropping of velvetbean (Mucuna pruriens) with maize. The origin of this technology is not certain, but it seems to have been brought to Honduras some 70 years ago, and has since spread, with no outside encouragement, to an area 150km long. The study revealed that farmers who do not use the velvetbean system produce an average of about 800kg of maize per hectare, whereas those who have used the system for five years average 2.2T/ha, and those with 20 years or more average 2.6T/ha.

cutting edge ('limited technology'), it expanded into a general programme of agricultural development and preventive health.

Cantarranas lies at about 300m in elevation in a narrow valley about 40km long, between two parallel mountain ranges that rise to over 1,800m. The programme worked almost entirely with small farmers with two- to five-hectare landholdings. These hillsides vary in slope, with an average of about 30%. The forests have been seriously degraded. The climate of the Cantarranas area varies from hot and semi-arid, with frequent and severe droughts in the bottom of the valley, to a cool climate, with sufficient rainfall for six months each year.

2. The Guinope Area. Between 1981 and 1989, a similar WN Program worked in 41 villages, most of which are included in the townships of Guinope, San Lucas, and San Antonio de Flores in southeastern Honduras (Bunch, 1988). This programme also worked heavily in soil recuperation, basic grains, and diversification, as well as preventive health. The programme's lead technologies were drainage ditches (at 1/2% slope) with live barriers and the use of chicken manure.

The Guinope area contains the same variations in altitude and rainfall as Cantarranas, but with less severe slopes. Nevertheless, an impenetrable subsoil underlies the 15 to 50cm deep topsoil. When this thin layer of topsoil has eroded away, agriculture becomes impossible. Before 1981, emigration from the Guinope area was heavy; some residents referred to it as a *"dying town"*.

3. The San Martin Jilotepeque Area. The San Martin Integrated Development Programme was financed by Oxfam/UK and carried out by WN between the years 1972 and 1979 (Bunch, 1977). It was a highly integrated programme, working in everything from agriculture and health to road construction, functional literacy, cooperative organisation, and so on. The Programme used contour ditches and a side dressing of nitrogen on maize as the initial technologies to motivate people.

The San Martin township lies just 50km west of Guatemala City. The southern half of the township, where the Programme worked in some 45 villages, varies in altitude from about 800 to 2,000m, and has enough rainfall for a good maize crop most years. The mainly Cakchiquel Indian population is extremely land poor, owning an average of less than 1/2 hectare of seriously depleted land per family.

Methodology

The methodology used in the study varied somewhat from area to area. The most participatory work occurred in Guinope and Cantarranas. In these cases, COSECHA personnel knew the areas well (having worked in the programmes being studied) and were able to dedicate plenty of time to the study. The four COSECHA personnel involved in the San Martin study were all Cakchiquel Indian farmers originally from the area, who had been trained in the programme and gradually worked from programme participant to extensionist to programme director. Thus COSECHA had a unique knowledge of, and perspective on, the area.

The methodology consisted of a combination of:

- observation of the plots in the study villages, including visual productivity estimates and the use of a checklist of questions about easily observed factors in the fields (the existence of contour live barriers, contour ditches, fruit trees, etc.)
- individual open-ended interviews based on a list of questions memorised by the interviewer
- open-ended informal conversations held with people known to the study team
- participatory rural appraisal (PRA) techniques with groups of villagers which included men, women, and children. These methods included mapping exercises, priority exercises, and participatory economic analyses of specific crops.
- a review of programme documents, including evaluations made of programme impact.

This approach allowed the study team to triangulate between data collected through direct observation and gained from the various kinds of interviews and reading of background documentation.

Choice of Study Villages

COSECHA personnel made a list of all the villages worked in by the respective programmes, then divided the villages into three approximately equal categories:

1) those in which they judged the impact to have been best,
2) those in which the impact was moderate, and
3) those in which the impact was relatively poor.

A composite list was then made, averaging the ratings in the three separate lists. One village was then selected from the best category, two from the middle category, and one from the poorer impact category. These villages were selected so as to get an even geographic spread within the programme area, afford fairly good access during the wet season (when the study was carried out), and avoid contamination of the findings by subsequent work of other development agencies.

The names of the villages, and the total number of farmers in each village are as follows. Also shown are the village abbreviations:

San Antonio Cornejo (S, 65), Las Venturas (LV, 96), Xesuj (X,), Pacoj (PJ, 90), Pacayas (PY, 30), Manzaragua (M, 85), Lavanderos (LD, 74), Tapahuasca (T, 50), Guacamayas (GM, 80), Joyas del Carballo (J, 180), Guanacaste (GN, 65), and Cerro Grande (C, 74).

Results

Sustained Use of Introduced Technologies

Different technologies had been given different emphases by each programme, and in different villages within each programme. Nevertheless, the figures displayed in the tables opposite give us some idea of the relative sustainability of the technologies. For each technology, the number of farmers using the technology is shown at the time of programme initiation, programme termination, and at the time of the study (1994), the dates of which are as follows:

Programme	Year Initiated	Year Terminated
San Martin	1972	1979
Guinope	1981	1989
Cantarrenas	1987	1991

The villages studied in Guinope and Cantarranas are presented in decreasing order of previously judged quality of impact. That is, the first village listed is that chosen from the one third of the villages with best impact, the next two from the group of average impact villages, and the fourth from the group of least impact.

These results show that the overall level of continuing innovation, despite programme termination, is remarkable.

Sustained Increase in Productivity

In Central America, maize is the basic staple. Being very sensitive to soil fertility, maize productivity is a good indication of overall soil fertility, and of productivity in general. Table 5 shows that major increases in productivity have been achieved after the programmes ended.

All averages of harvest data are rounded off to the nearest 100 kg/Ha in the tables. Most of the harvest data comes from farmers, based on the number of bags they carry home during the harvest of the mature grain. Thus, their calculations exclude grain lost to thievery, eating ears harvested early, and occasional ears given to labourers as partial recompense for their work. The figures are especially dramatic in San Martin, where the time since programme termination is longest. Thus these figures are probably the most important in the entire study, clearly demonstrating that productivity has continued to improve after the programmes' termination. Although the increase in yields is not as dramatic as during the

Table 1. Numbers of farmers using at project initiation, termination and at the time of the study.*

	San Martin				Guinope				Cantarranas				Total
	S	LV	X	PJ	PY	M	LD	T	GM	J	GN	C	
contour grass barriers													
IN	0	0	0	1	0	0	0	0	0	0	0	0	1
TN	12	<30	36	<22	13	5	14	12	14	12	6	16	<192
TS	18	92	71	22	13	5	10	5	14	12	4	14	280
contour or drainage ditches													
IN	0	0	0	1	0	0	0	0	0	0	0	0	1
TN	12	45	79	?	19	8	17	12	2	12	11	14	c253
TS	9	13	118	22	19	8	6	10	2	12	8	12	239
Green manures													
IN	0	0	0	-	0	-	-	-	0	0	0	-	0
TN	0	1	20	-	0	-	-	-	0	4	10	-	35
TS	2	0	36	-	2	-	-	-	4		4	4	52
Crop Rotation													
IN	-	-	0	-	12	0	0	0	0	0	0	-	
TN	-	-	6	-	18	?	21	17	<36	36	25	-	<209
TS	-	-	10	-	33	50	27	15	58	36	25	-	254
No longer burn fields													
IN	-	-	-	-	0	0	2	0	0	0	0	-	2
TN	-	-	-	-	20	24	22	17	41	14	22	-	160
TS	-	-	-	-	22	32	55	18	58	20	30	-	235
Fertilisation with organic matter													
IN	0	<10	-	-	2	2	0	0	30	-	0	-	<44
TN	12	<30	-	-	20	50	18	12	53	-	0	-	<195
TS	>28	96	-	-	33	100	75	5	60	-	0	-	>397

** Note: IN = initiation; TM = Termination; TS = Time of Study* programmes' existence, these figures leave no doubt that even though some practices have been abandoned, the productivity of the better villages (and all the villages in San Martin), has continued to increase after the programmes ended. That is, soil conservation and soil improvement have, in fact, been sustainable activities.

The lack of maize production in Guacamayas is due to the fact that farmers there make a good deal more money from vegetables, and prefer to buy maize. Thus, the lack of maize is precisely because of the dramatic increases in yields and value of production achieved in this village since programme termination.

Table 2. Productivity of maize (in 100kg/Ha), at project initiation, termination and at the time of the study.

	San Martin				Guinope			Cantarranas		
	S	LV	X	PJ	PY	M	LD	GM	J	GN
Initiation	4	4	3	5	6	6	6	8	4	8
Termination	<24	<28	<20	<28	32	20	20	?	20	19
Time of study 94	48	52	32	48	42	20	20	none	22	19

Table 3. Productivity of edible beans (Phaseolus vulgaris) in 100kg/ha at project initiation, termination and at the time of the study.

	San Martin			Guinope	Cantarranas		
	S	LV	X	LD	GM	J	GN
Initiation	2	1	2	1	none	5	5
Termination	12	2	12	8	9	15	9
Time of study 94	18	8	20	8	15	15	9

Other Impacts

Other positive impacts in the project areas were noted as follows (space does not allow us to report these in detail[3]):

- Increased wage rates
- Increased land value

3. A fuller report, containing details of these results, is shortly to be published by IIED.

- Decreasing or reversed emigration from the project areas
- Decreases in resource degradation
- Increases in numbers of trees planted
- Almost total elimination of the use of herbicides through hand weeding or green manures
- Significant reduction in the use of chemical fertilisers with a variety of organic fertilisers used instead
- Increased crop diversity and practice of intercropping
- An increase in local savings, leading to a decreasing dependence on formal credit and increased investment in education, land improvement, purchasing animals etc.
- Marked improvements in diets, including the consumption of more vegetables, native herbs, milk and cheese
- Improved resilience and resistance to drought and climatic variability
- Increased involvement in local groups, such as producers' associations, agricultural study groups, community betterment committees, or groups formed by whole villages to protect communal forests from loggers or corrupt municipal officials

Less success has been achieved in reducing dependence on the use of insecticides and fungicides. Central America in general has been slow to find feasible alternatives for these chemicals. The programmes taught people the dangers of pesticides, the importance of Integrated Pest Management, and encouraged them to try any others they could. But few effective alternatives have been found. The programmes have successfully encouraged the safer use of these chemicals, but the overall impact of the programmes, with their crop diversification efforts, has probably been to increase insecticide use. Finding alternatives to insecticides is a major area for additional work.

The most disappointing finding is the lack of spontaneous technological spread *between* villages. Whereas spontaneous spread within villages does occur (though slower than we had hoped), spread between villages is negligible. This might be attributable to the Guatemalan counterinsurgency campaign of the 1980s, which purposely turned villages against each other, and the Honduran villagers' aversion to walking from one village to another (there being no major village markets in the programme areas). Nevertheless, we have no evidence that the technology would have spread in the absence of these factors.

Local Innovation

Local innovation is one factor that COSECHA sees as absolutely critical to the villagers' becoming the 'subjects' of their own development. Within the study sites the overall level of continuing innovation, despite programme termination, has been remarkable.

In San Martin, over 30 innovations have been adopted successfully (not just tried) since programme termination, spread among all the villages about equally. This figure only includes the important innovations, such as the introduction of new crops (cauliflower, broccoli, and herbs), adoption of new green manures (velvetbean and *Tephrosia*), planting improved pastures (such as Kikuyu grass), and building stables for animals.

Probably most important, each village has developed at least one whole new system of production. In one village, a whole system of intensified cattle raising has been developed, in which improved pastures are planted to supplement the Napier grass barriers, legumes are being tried to increase protein, animals are stabled, pastures rotated, and cheese is made to increase the value of the milk before it is marketed. In other villages, a large percentage of the villagers' land has gone into technically grown coffee or fruit production. In Las Venturas, a system of sustainable forest management has become a major economic factor. Here, in areas from one half to two hectares per farmer, villagers are planting out volunteer seedlings to fill clearings, and are cutting a certain number of the largest trees each year, thereby creating a sustainable source of income.

In Honduras, new innovations have occurred in virtually all the villages, though in some much more than others. In Guacamayas, for example, totally new crops include avocados, lemons, potatoes, tomatoes, green beans, and cauliflower, while people are also experimenting with new green manures (*Mucuna pruriens* and *Phaseolus coccineus*), and organic vegetable production. Furthermore, they have developed a very simple way of processing coffee pulp, by which individual farmers produce as much as 3.5 tons each of organic matter each year for their vegetables. In Guanacaste, people had planted *Ciruela corona* fruit and cassava on a commercial scale for the first time, in both cases because of their observed resistance to drought. In Lavanderos, chile peppers, cabbage, carrots, beets, and strawberries were all common crops which did not exist in the village at programme termination. In Manzaragua, a community from the group of least impact, chile peppers, carrots, and onions are all grown commercially by a good number of farmers, all of these being new since programme termination.

In Pacayas alone, people counted 16 innovations adopted since programme termination. These consist of four new crops (chile peppers, beets, onions, and carrots); two green manures; two new species of short grass for use as contour barriers in vegetable fields; a zero-cash-cost chicken pen made entirely of kinggrass planted on a rectangle; marigolds used to control nematodes; the feeding of both lablab bean (*Dolichos lablab*) and velvetbean to cattle and foul; numerous cases of nutrient recycling from fish ponds and animals to vegetables and field crops and back; the use of human waste through composting latrines; a home-made sprinkler; and the use of Napier grass on cliff edges to stop further caving in.

The incorporation of traditional components into external technology were virtually universal. People became tired of thinking of examples before they finished their lists. Most commonly, soil conservation techniques are used to grow traditional beans and maize; innovative organic fertilisers are used to fertilise them; and new methods of insect control (grain silos, cooking fire ashes, and ground chile peppers) are used to control pests in traditionally stored grain.

Discussion

Sustainability of Specific Technologies

Of the dozens of technologies promoted by the various programmes, the technologies that have proven themselves sustainable over a 15-year period in San Martin Jilotepeque without significant abandonment are contour grass barriers, fertilisation with organic matter and crop rotation. In fact, all three technologies have experienced significant spontaneous adoption in San Martin over the years since programme closure. In central Honduras, however, the grass barriers seem to be losing popularity after only five years, and the local green manure systems have not fared too well (largely because they still need some improving). The termination of agricultural burning has also continued to spread, and should continue to do so.

However, fertilisation with organic matter is really not a single technology, but rather a range of quite varied technologies. Farmers in San Martin are using methods of organic fertilisation that are quite different from those originally introduced. The ending of burning is not really a technology either, but rather the absence of a previous technology, which has been superseded by the use of alternative sources of organic nutrients. Therefore, only one technology, crop rotation, has really survived in its original form for at least 15 years.

One might assume that this lack of technological sustainability is caused by poor selection of the technologies. Nevertheless, these same technologies have spread to literally hundreds of programmes on four continents. If they were poorly chosen, the same mistake has been made amazingly often by programmes with a healthy degree of farmer participation. It is much more likely that most of the technologies have fallen by the wayside because changing circumstances, such as emerging markets, disease and insect pests, land tenure, soil fertility and microtopography, labour availability and costs, and the adoption of new technologies, have reduced or eliminated their usefulness. Wheat growing, a major programme technology in San Martin (adopted by over 600 farmers), was lost completely because cauliflower and broccoli, also cash crops, paid much better. Broccoli and cauliflower, in turn, disappeared when farmers nearer the processing plant took over San Martin's market.

Similarly, when the grass barriers trap eroding soil and build up a natural terrace (some four to six years after adoption), farmers stop cleaning out their contour ditches. As many villagers have explained, *"If my ditches never fill up with water any more, why should I keep cleaning them out?"* Both in-row tillage and cover crops can make contour barriers irrelevant. This study, plus observation of the experience of over 100 other programmes, has led us to believe that the half-life of even very well chosen technologies for villager farmers is probably about six years.

Sustainability of the Development Process

The results clearly indicate that even though the vast majority of specific technologies disappeared, farmers' productivity continued to climb. In some of the best villages, yields are continuing to increase at rates not much lower than those achieved during the programmes' presence. Thus, the sustainability of specific technologies may well be largely irrelevant, if not counter-productive. Much more relevant to farmers' well-being and productivity is the sustainability of increasing yields or, more generally, the sustainability of the development process. That this process is not only sustainable, but can lead to significant increases in villager well-being and can be carried on by the villagers themselves, is probably the most important single finding of this study.

Thus, Paulo Freire's belief that village people should become the 'subjects' rather than the 'objects' of their own development, is not just wishful thinking (Freire, 1972). The evidence from this study shows that in measurable, concrete terms, villagers can continue to improve their situations significantly without any continuing outside involvement.

Some readers might wonder if this continuing improvement was not the result of other outside programmes' work in the area. But no other programmes worked for any significant period of time in these villages on soil conservation or crop production during the ensuing years, except in minor ways in the cases of Pacayas and Pacoj. Another possibility would be that agricultural productivity was increasing during these years in any case, and the villages studied merely shared in a more general improvement. Nevertheless, in villages near the studied villages, yields presently average less than 1.6t/ha (compared to Las Venturas' 5.2t/ha), and most of the last two decades' relatively small increase in yields is directly attributable to heavier use of expensive chemical fertilisers.

What has happened is that the process of agricultural innovation, always occurring among villagers (Richards, 1985), was greatly sped up by the programmes to the point that it is capable of improving yields over the medium and long term. This increase in the intensity of the innovation process requires that villagers:

- learn the rudiments of simple scientific experimentation
- learn a minimum of very basic theoretical ideas about soils and agriculture, in order to orient their experiments in useful directions
- learn to share the results of their experiments with each other
- become motivated to do all of the above sustainably.

The key to designing a sustainable soil conservation or agricultural programme does not consist, therefore, of choosing a group of technologies that will be sustainable. Rather, the key is choosing a very few technologies that will motivate farmers to become involved in a process of innovation, to search for new ideas, experiment with them, adopt those that prove useful, and share the experimental results with others.

Farmers, like all human beings, are best motivated by what psychologists call 'positive reinforcement'. They tend to continue doing that which brings them satisfaction. In agriculture, one generally finds satisfaction in either increased yields, decreased costs, decreased risk, or some combination of these. Therefore, we should carefully choose technologies for their ability, in a relatively short time, to bring significant increases in yields and/or decreases in costs without increasing risks.

One of the striking features of soil conservation technologies is that they rarely accomplish any of the above. We have heard farmers say, dozens of times, *"But I can't eat a grass barrier".* For farmers to accept soil conservation technologies and become involved in a sustainable process, the technologies must be combined with a technology that enhances yields: in-row tillage combined with the use of animal manure, or grass barriers with the application of dried coffee pulp. It is the increase in yields that convinces the farmers of the value of soil conservation. More important, the increase in yields will convince farmers to continue to experiment - to continue to become involved in a development process of, by, and for themselves.

Through such a process, subsidies, food-for-work, and other artificial incentives become irrelevant. If the yields have increased or costs decreased, artificial incentives are not needed. If the yields have not increased, no artificial incentive will make the technology's adoption sustainable.

Which Farmers Were Helped

It is commonly believed that the wealthier farmers inevitably adopt new technologies faster, and therefore profit more from agricultural development efforts than poorer farmers. Yet in these study areas, small farmers have adopted the technologies faster, and profited more, than the wealthier farmers. Why?

The main factor seems to be the nature of the technology. Most technologies presently promoted in developing nations require capital, literacy, access to markets, etc. which favours the wealthy. However, the technologies which work best on poorer soils, require no capital, deal with traditional crops, and are difficult to mechanise, favour the poor (Lappé, 1977). Programmes that use the second group of technologies will often find the poorer farmers innovating fastest. In fact, an independent mid-programme evaluation in San Martin found only two farmers with more than 1.5ha who had adopted contour ditches, while over 3,000 smaller-scale farmers had. The literature appears to confirm this phenomenon. Studies that support the thesis of wealthier farmers innovating more are based on capital-intensive inputs, while most studies that used neutral technologies conclude that all socioeconomic groups are equally innovative.

The one group left out, however, by most soil conservation programmes is the totally landless. We have often found that those few landless farmers who do try to improve rented land only make it more attractive for the landowner to farm it himself.

Recommendations

Recommendations For Technologies

1. *Combine soil conservation or recuperation technologies with technologies that raise yields or lower costs.* Farmers adopt those technologies that bring rapid, recognisable success. Most soil conservation technologies are incapable of bringing rapid yield increases. Therefore, for villagers to become motivated to maintain and/or improve soil conservation technologies, they must achieve such increases while adopting soil conservation measures. Technologies capable of bringing such increases should therefore be taught together with the soil conservation technologies that make the former possible.

2. *Use intercropped green manures (or other green manures that can be produced on land with no opportunity cost) wherever possible.* Most small farmers in developing countries already use virtually all the organic matter they produce, and can seldom afford to buy more. Therefore, we must find ways that they can drastically increase the high-nitrogen biomass they produce on their farms. One of the best-known ways to do this is to produce green manures or cover crops, which can usually be produced without spending cash and in ways that involve no opportunity cost (intercropped, on wasteland, under trees, during periods of frost, or during the dry season). The best of these crops are not green manures (they are seldom turned under at all, much less when they are green) or cover crops, but are multi-purpose crops. They can fix nitrogen, prevent soil erosion, dramatically increase soil fertility, control weeds, control nematodes, and/or provide both highly nutritious animal fodder and human food (Bunch, 1993; and Flores, 1991-94)

3. *Use simple, appropriate technologies.* For example, COSECHA uses a list of some 18 criteria for appropriate technologies. Among these criteria we include simplicity, low cost, positive ecological impact, rapid recognisable results, and the possibility that the technology can serve as a basis for many other technological innovations (Bunch, 1982). Reduce as much as possible the labour required for soil conservation technologies. Bench terraces are seldom appropriate anywhere, except as formed naturally by contour grass barriers.

4. *Maintain flexibility in technological recommendations.* Giving exact specifications and making only one recommendation for solving a problem reduces the space for villagers to experiment and make the technology theirs.

Recommendations For Methodology

1. *Use the "Farmer First" Approach (Chambers et al., 1989; Scoones and Thompson, 1994).* This study provides strong evidence that the *"farmer first"* approach (using villager extensionists and participatory technology development) is conducive to the sort of villager self-sufficiency that makes sustainable agricultural development possible.

2. *Achieve Rapid, Recognisable Success (Bunch, 1982).* Begin agricultural programmes with a limited number of technologies chosen, above all, to achieve significant success in the shortest time possible (within three months, if at all possible). Supervise the farmers' experiments with these technologies closely, so that 90% of these experiments, if at all possible, achieve success.

3. *Initiate the process with the smallest number of technologies consistent with achieving significant success.* Since the objective of the initial technologies is not to introduce permanent innovations, but rather get people involved in a process of self-generated innovation, there is no reason to introduce a large number of technologies, or even a 'technology package'. The fewer technologies we can introduce and still achieve success, the better.

Fewer technologies can be understood better by the farmers, can be supervised more closely by extensionists, will allow the programme to reach more people, and will be easier for the poorer farmers. Other more human factors such as social justice, respect for local people's culture, a more ecologically sensitive agriculture, reaching a critical mass of farmers sooner, and allowing the process of farmer-sustained development to run its course, are also served by the use of a limited number of technological innovations (Bunch, 1982). Of course, in time, as occurred in the villages studied, the programme and the farmers themselves will expand the array of technological innovations being used. But the best way to achieve that is for the programme to begin with a limited number of innovations.

4. *Make the main goal of programme planning a system whereby farmers learn to, and become motivated to, continue developing their own agriculture.* The UN Food and Agriculture Organization's book *Rural Development, From Farmer Dependency to Farmer Protagonism* (FAO, 1993) expresses the idea well: avoid all dependency. Make sure that each programme role is gradually taken over by the farmers.

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