IDRC-189e

Coming Full Circle

Farmers' participation in the development of technology

Coming full circle: farmers' participation in the development of technology

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Abstract

Involving farmers in identifying the constraints to rural agriculture and in designing measures to alleviate them is the subject of this publication, which resulted from a meeting, held in Ouagadougou, Upper Volta, 20–25 September 1983. Agronomists, economists, anthropologists, and others seeking to get the most from research efforts discussed the pitfalls of assembling packages that are sound technically but have some essential flaw because the developers have overlooked some crucial constraint at the farm level. The subject is one that is receiving much attention currently as agriculture in developing countries has failed to net major increases in production despite thousands of dollars invested in research and optimistic claims that improved varieties, techniques, equipment, etc. have been developed. The gaps between results on research stations and those on farms in the Third World have prompted some researchers to view the farmers' conditions as the real laboratories. Why, how, where, and when to get farmers involved in research are the focus of this document, and the degree to which researchers and the agencies they represent have been able to listen and work with their new partners varies, as is clear from the 11 papers and the commentary that follows them.

Résumé

La participation des paysans à l'identification des problèmes agronomiques et à la recherche de leurs solutions est le sujet de cette brochure qui rapporte les états d'un séminaire tenu à Ouagadougou (Haute-Volta) du 20 au 25 septembre 1983. Afin de mieux exploiter les résultats des recherches, des agronomes, des économistes, des anthropologues et d'autres personnes intéressées ont discuté du danger de préparer des blocs agronomiques, solides sur le plan technique, mais possédant des vices fondamentaux, les développeurs n'ayant pas pris en compte certains obstacles critiques au niveau des fermes. Ce thème est largement débattu aujourd'hui alors que la production agricole stagne dans les pays moins avancés malgré l'injection de milliers de dollars dans la recherche et les espoirs mis dans la création de variétés, techniques et équipement améliorés. La différence entre les résultats obtenus dans les stations de recherche et ceux recueillis sur les fermes ont conduit des chercheurs à reconnaître que la ferme même constituait le vrai laboratoire. Le thème principal de cet ouvrage qui se dégage des onze communications présentées et des commentaires qui suivent, est donc de déterminer quand, où, comment et pourquoi les fermiers doivent participer à la recherche et aussi, jusqu'à quel point les chercheurs (et les organismes qu'ils représentent) ont su être à l'écoute des paysans et travailler avec eux.

Resumen

La participación de los agricultores en la identificación de las limitaciones a la agricultura rural y en el diseño de medidas para superarlas es el tema de esta publicación que resultó de una reunión celebrada en Ouagadougou, Alto Volta, del 20 al 25 de septiembre de 1983. Agrónomos, economistas, antropólogos y otros interesados en obtener lo mejor de los esfuerzos investigativos, discutieron los problemas de producir paquetes técnicamente válidos que no obstante presentan fallas básicas porque sus diseñadores han perdido de vista alguna limitación crucial a nivel de la finca. El tema recibe actualmente mucha atención debido a que la agricultura de los países en desarrollo no ha podido aumentar la producción pese a los miles de dólares invertidos en la investigación y a las optimistas voces que proclaman haber desarrollado variedades, técnicas, equipo y otros elementos mejorados. La brecha entre los resultados de las estaciones de investigación y aquellos de las fincas del Tercer Mundo han hecho que algunos investigadores consideren las condiciones de los agricultores como los verdaderos laboratorios. Por qué, cómo, dónde y cuándo involucrar a los agricultores en la investigación es el tema central de este documento, y el grado en que los investigadores (y los organismos que representan) han podido escuchar y trabajar con sus nuevos socios varía como lo demuestran los 11 trabajos del libro y el comentario final que los sigue.

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Farmers' participation in the development of technology

Coming Full Circle

Editors: Peter Matlon, Ronald Cantrell, David King, and Michel Benoit-Cattin

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Tecnicista versus campesinista: praxis and theory of farmer involvement in agricultural research

Robert E. Rhoades, *Centro Internacional de la Papa, Lima, Peru*

The German sociologist Max Weber used a commonsense, fruitful way of analytically setting the stage for discussion of social phenomena. He proposed the notion of "ideal types," often conceptually polar extremes, from which researchers could investigate how empirical data vary from ideal forms. For example, Weber distinguished between *Gemeinschaft* and *Gesellschaft* to help clarify differences in social relations in intimate, informal groups (e.g., families, communities) versus the anonymity of large-scale, formal society (e.g., large cities, bureaucracy). This simple typology, in turn, generated a rich literature, as have other sociological ideal types, e.g., core–periphery, metropole–satellite, rural–urban, and developed–underdeveloped.

Weber's method is useful to discussions of the theoretical and practical aspects of farmer involvement in agricultural research. Contemplating the thousands of individuals who work in agricultural research and development directed toward Third-World farmers, one can distinguish two contrasting "ideal" perspectives. To identify these contrasting types, Peruvian scholars have recently coined the terms *campesinista* and *tecnicista*. A person who has a tendency to believe that farmers and *campesinos* (subsistence producers) have rationally adapted, with rural-based wisdom, solutions that cannot be measurably improved by outsiders is in the *campesinistas*' camp. According to this school, the truth is alive and well in the traditional practices of the countryside.

The *tecnicista* philosophy is followed by those who believe that scientists and formal research–extension organizations are a fountain of superior technological solutions and that answers to world hunger will come from science through controlled experimentation on research stations and direct transfer, to farmers, of the vast reserve of knowledge, technology, and basic principles that have already been discovered in advanced agroindustrial nations.

Any deserving student of Weber would argue that these ideal types do not exist, but most of us in agricultural development will agree that the Peruvians have put their fingers on a sensitive problem that penetrates many research organizations and projects. Even within interdisciplinary teams, different frameworks for defining the problems and ways of seeing the world are found. In practice, this often means that social scientists, especially the more academically oriented, tend toward the *campesinista* camp, whereas technologists and applied biological scientists naturally have a leaning toward the *tecnicista* orientation.

Farmers, of course, are rarely *campesinistas* or *tecnicistas*. These terms refer to orientations of people who study farmers or have farmers as research "clients." Farmers know through day-to-day experience that they have serious technical problems for which no local answers are available. This explains why farmers are generally eagre to talk to visiting scientists about pests, diseases, varieties, chemicals, and a thousand and one day-to-day difficulties with the practices and technologies that serve to feed and clothe their families. At least in the Andes, peasant communities are growing increasingly impatient with outsiders who come to conduct agroeconomic interviews, administer long questionnaires, study antiquated practices, or run on-farm trials, while giving nothing in return. On the other hand, the reception is equally cold to the visiting "garland speeches" from technologists who ignore local practices and push ill-adapted technologies. Agricultural scientists who believe in applied research feel under strong pressure to have ready-made solutions and answers, but farmers catch on fast to those who try to bluff their way through a dialogue. They are quick to cast a jaundiced eye on those who are — as a Peruvian colleague put it — "promoting pet technologies in search of farmers, not offering technologies sought by farmers."

Potato storage in the Andes: a tecnicista approach

The potato is the main staple food of the mountain populations of the central Andes, the cradle of the tuber's domestication. Because of the potato's importance not only in the Peruvian diet but worldwide, considerable attention has been given to this crop by technical agricultural programs. Anthropologists have studied the agriculture of many Andean communities that depend on the potato. Until the establishment of the Centro Internacional de la Papa (CIP) in 1971, however, cross-fertilization of ideas between social and biological scientists was rare. As a result, most potato projects in the Andes were developed strictly from a technical point of view. Potato storage is a good example.

Since the late 1960s, the Peruvian government and various development agencies operating in Peru have sought technical solutions to help control the flow of consumer potatoes into the Lima market. As a result, the government built storage facilities around the country. The five large storages constructed had a combined total capacity of 2.0×10^4 t.

The largest of the storage complexes (7.0×10^3 t) is near the mining town of La Oroya, more than 3500 m above sea level. These naturally ventilated, forced-air stores were built to take advantage of the low temperatures and high humidities found at high altitudes between 1800 h and 0600 h (Fernandez 1976). The Oroya stores are located roughly halfway between the major potato-producing areas of the Department of Junin and the Lima market. On initial impression, the idea behind the stores makes good sense. Potatoes could be held at La Oroya with minimum losses until prices improved in July or August in the Lima market. Theoretically, everyone gained. Farmers could get higher prices than they would if forced to sell immediately at harvest in May. Consumers gained as well by having to pay lower prices during the "critical months" for potatoes.

Any traveler along Peru's central highway running from Lima to Huancayo, the capital of Junin department, can visit the impressive Oroya storage complex. However, it, and the others in highland Peru built during the same period and later, today stand empty, just as they have virtually every day since they were built. These stores are existing monuments to mistargeted development projects, although, according to storage specialists, they are technically sound and extremely well-designed. The failure resulted because the designers did not understand the postharvest system of potato agriculture as it functions in the central Andes. Such mistakes are not unique to Peru. Similar potato stores, technically sound but equally empty, can be found throughout the developing world.

Potato storage in the Andes: a campesinista approach

Outsiders entering an Andean house have the impression of total disorder. Across the main living area hangs a string of ears of corn; against the wall next to the bed are farm tools; below the bed are piled small, shriveled potatoes; and Guinea pigs scamper about the room, hiding behind the worn straw mat that holds the potatoes. It is easy to conclude, as does a recent FAO (Food and Agriculture Organization of the United Nations) proposal calling for more storage research in the Andes, that farmers' storage practices are inadequate.

Unlike in developed countries, potatoes in the Andes are rarely stored in separate, specialized buildings. In the early 1960s, an ethnographer (Stein 1961) noted:

> the main economic function of the house is storage of agricultural products and tools and it serves to shelter at least some of the animals as well. Its functions in sheltering people are almost secondary to the basic purposes.

The house offers security against thieves, and the darkened rooms hide one's wealth against the prying eyes of neighbours and employees of the agrarian bank. Virtually all the technical potato-storage programs, however, emphasized the need for specialized structures. Anthropologist Robert Werge (1980) wrote:

> Concentration on specialized constructions derives from use of a model based on the contemporary European and North American practice of keeping domestic and farm activities separate in specific houses, sheds or barns. Potato farmers in developed countries have highly sophisticated storage buildings with large scale capacities, often constructed with special financing. This model is not appropriate to the Andes. There farmers regard the storage of food, seed and tools as a domestic activity. The flexibility of space within the household residence and the security of the house is not compensated for by technical advantages which a specialized storage facility can provide.

A farmer from the community of Palca, within the area projected to use the stores, summed up his complaints, emphasizing labour costs for, and damage caused by, the extra stop enroute to Lima:

> *Ingeniero*, whose idea was it anyway to build those stores in Oroya? Once I start to Lima with my potatoes, why do I want to stop in Oroya, unload them, wait a month or so, and load them again? That is a lot of

> trouble, causes a lot of damage. Besides, the loss of weight will not compensate for the rise in price. If you want to build a store, build it where I live, not up there.

Along with market risk, farmers mentioned the risk associated with dealing with government bureaucracy. The few times the government did store in the Oroya silos, the potatoes spoiled and had to be thrown into the nearby Mantaro River.

Most Andean farmers, especially small-scale ones, do not store potatoes for market speculation. A catch-22 in the government storage scheme is that the agrarian credit bank demands repayment of production loans at harvest. Farmers, thus, sell off all except for what they wish to keep for home consumption or seed. In addition, farmers often must purchase inputs for the next planting or pay off other debts.

Finally, consumers prefer fresh potatoes, not potatoes that have been in store for 2–3 months. Also, some farmers argue that the improved varieties sold in the Lima market do not store sufficiently well to play a speculation game.

The simple facts make it easy to believe in the *campesinista* position, just as the *tecnicista*'s construction of the stores had its own logic. It is tempting to throw up one's hands and conclude all is futile. However, I believe that the trick is to combine elements from both perceptions: so that farmers can use science to its best advantage.

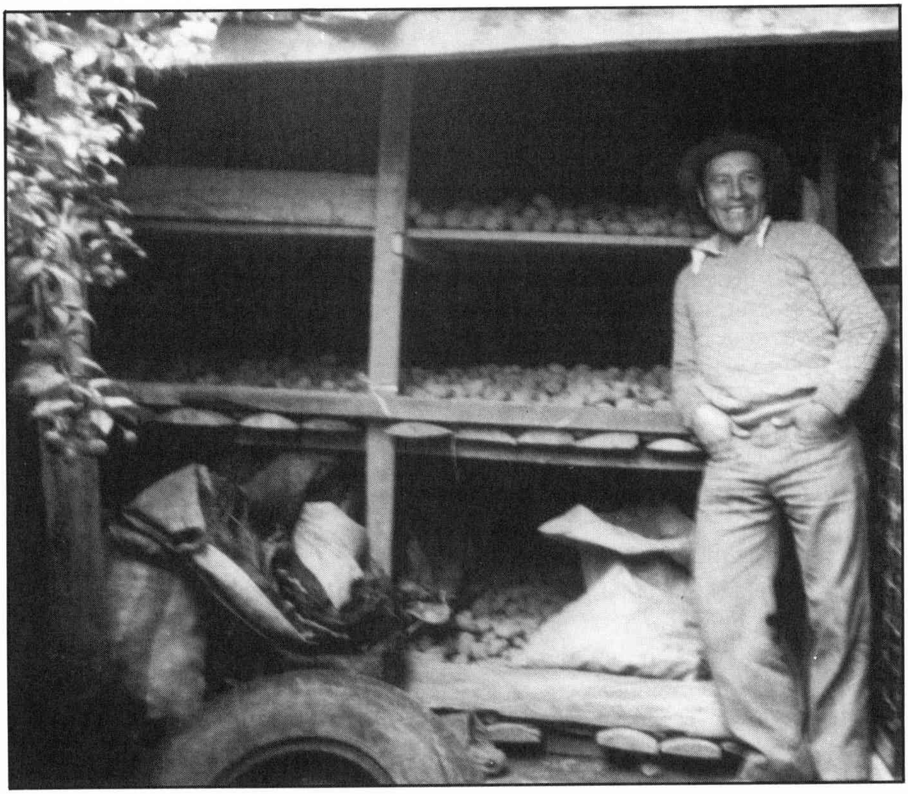
A new approach

In 1975, CIP took a new approach to solving Peruvian postharvest problems. The initial setting of this effort was the Mantaro valley where CIP's Andean research station is located. The empty stores of previous projects are scattered throughout the valley and 3 hours by car is the Oroya project.

In the early years of CIP, most postharvest research was carried out on the experiment station, without farmer or social-science input. Excellent technical research was under way, but the question was not asked whether the research addressed the farmers' problems as opposed to scientific questions. For example, one postharvest project dealt with solar drying of processed potatoes in a black box as a means to speed dehydration. The individuals who had decided to work on solar energy had not bothered to research whether speed of drying potatoes was important to Andean farmers. This is what the postharvest team now calls "designing technology at a distance" (Rhoades et al. 1982).

This lack of focus began to change with the formation of a truly interdisciplinary team composed of two postharvest technologists and anthropologists. This team set about to integrate the countryside with the experiment station in an effort to avoid previous failures. However, then, as now, combining views from farmers, biological scientists, and social scientists is not easy.

Initially, anthropologist Robert Werge conducted a socioeconomic survey of postharvest activities and problems facing highland potato farmers in the Mantaro valley (Werge 1977). The biological scientists still restricted their activities to conducting research trials on the experiment station nearby.



Peruvian farmer beside a 1-t store utilizing diffused light.

It was not clear how team members would relate to each other or the scientific team to farmers.

Werge's survey soon called into question some research directions that had been taken by biological scientists on the experiment station where controlled conditions are possible. A debate, or "constructive conflict," within the team then surfaced over the sacred concept of "storage losses," perhaps the central concern of many postharvest technologists and the basis of earlier Andean storage projects. The potato, a tuber, is highly perishable. Biological scientists were logically concerned with how to design a storage system to reduce pathological and physiological "losses." Werge, however, argued that Andean farmers did not necessarily perceive small or shriveled and spoiled potatoes as "losses" or "waste." All potatoes were used in some form. Potatoes that could not be sold, used for seed, or immediately consumed at home were fed to animals, mainly pigs, or processed into dehydrated potatoes, which could be stored for long periods. Women even claimed that shriveled, partially spoiled potatoes tasted sweeter and were sometimes more desired. (This information is based on personal communication from R. Werge. Still today, some CIP scientists have a slightly different version of the story. I suspect this is inevitable in interdisciplinary research. Farmers, no doubt, have yet another version.)

Werge, wearing his *campesinista* hat, questioned technologists' accusation that farmers' practices were "poor." He asked in what respect they were "poor": in relation to the USA, the experiment station, the coast of Peru, or where? According to Werge, the farmers claimed they had "problems," but different ones than scientists had imagined. The problem as perceived by farmers was not with their traditional storage technology per se but with "improved varieties" that were replacing native varieties in the region. Farmers claimed that, with new varieties, they were having difficulty keeping seed tubers from harvest to the next planting (Werge 1980:15–16). They complained that the improved varieties produced long sprouts that had to be pulled off before the tubers could be planted. This, to farmers, was labour and time costly. As a result of this research, the team focused its attention on the idea that a new method of storing seed potatoes of hybrid varieties would improve production. Although on-station, basic research on potatoes for consumption continued, no clear technological problem for local on-farm testing was defined.

As early as 1972, CIP had been experimenting with a technique already known to farmers in some developing countries: natural, diffuse light reduces sprout elongation (Dinkel 1963; Tupac Yupanqui 1978). However, whether the principle could be widely used in storing seed tubers under farm conditions was not clear.

On the experiment station, research verified that indirect light reduced sprout elongation and improved overall seed quality under Andean conditions. The design of experiment station stores, however, was still based on the technologists' point of view. The question remained whether the storage design was relevant to farm conditions and acceptable to farmers. This question could only be answered through continued ethnographic research and on-farm trials with farmers' acting as advisers. The an-

Potatoes stored in diffused light had much shorter sprouts than did those stored in the dark.

thropologist, interested in the cultural uses of farmhouses and buildings, was concerned with how the new diffused-light principle might fit. A storage facility separate from the house did not seem realistic because of the lack of security and convenience. Nor did it seem possible to introduce diffused light into the dark rooms traditionally used as storage areas.

Diffused light produces greening in potatoes and renders them unsatisfactory for food. Many small Andean farmers prefer to store potatoes in the dark, even those to be used later for seed, in case they need to consume the potatoes or to market them. How to convince farmers to store seed potatoes in diffused light, given their risk-averting strategy of storing all potatoes in darkness, had not yet been resolved.

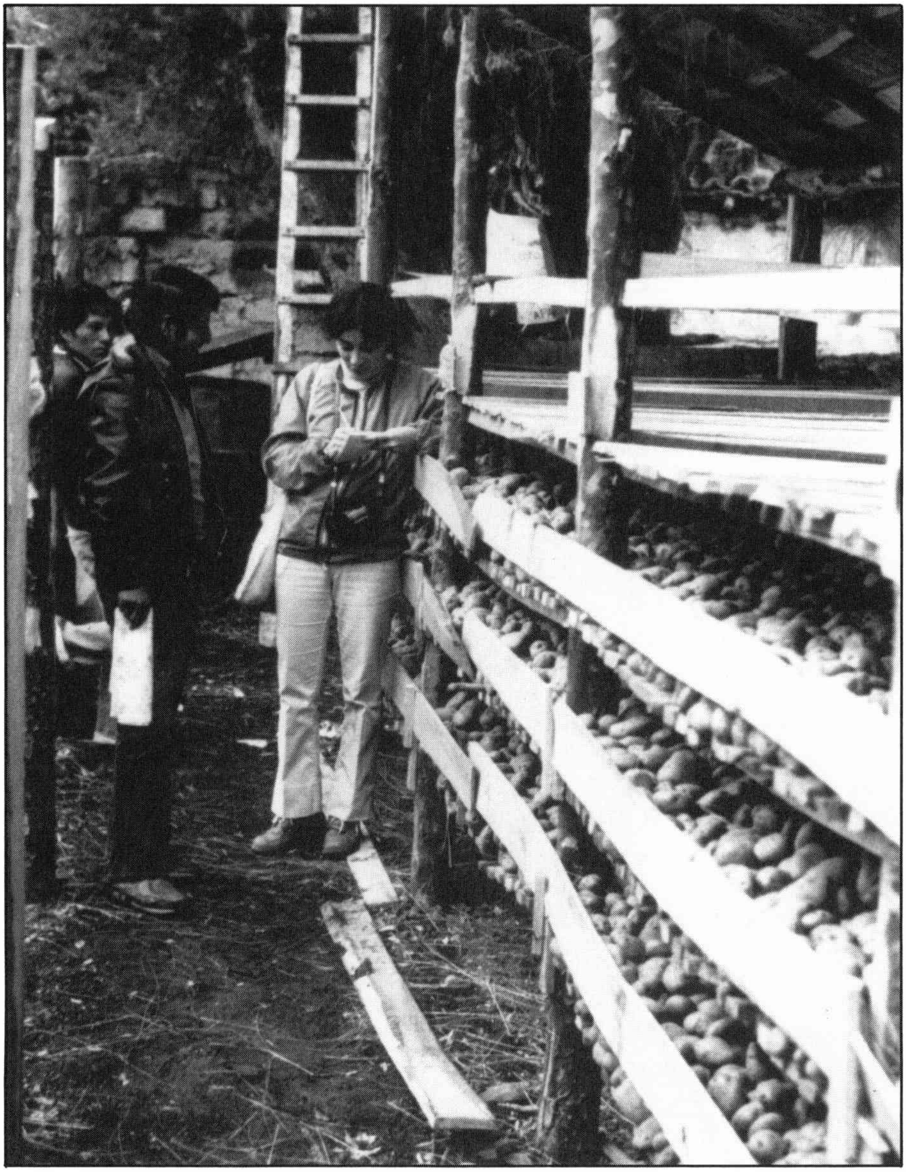
With the socioeconomic considerations in mind, CIP staff inspected farmhouses and talked over the problem with farmer cooperators. Many Andean houses have a veranda with a roof that lets in indirect light. The team decided to set up seed trays (similar to open vegetables crates) used on the experiment station in the houses of cooperating farmers. The trays were stacked up in the corridor area where diffused light, as opposed to direct sunlight, enters.

These on-farm experiments yielded the same scientific results as on the experiment station. Upon seeing that diffused-light storage reduces sprout elongation, farmers expressed interest but were still concerned about the cost of seed trays. In response to this, the team built simple collapsible shelves from local timber and used them in a second series of on-farm trials. The results were again positive, and, this time, farmers were able to relate more closely to the rustic design of the stores. Throughout, scientists were learning more and more about both the technical and the socioeconomic aspects of storage and the proposed new technology.

Still, by 1979, 3 years after the interdisciplinary team began research, no evidence was available that farmers would accept the technology. The validity of the team's research approach still depended on whether farmers were willing to use the diffused-light principle at their own expense and time. By this point, however, the principle of using diffused light in rustic stores had been introduced through CIP training courses to potato workers in 21 countries of Asia, Africa, and Latin America.

The first tangible payoff of the team's efforts did not come in Peru, but in the Philippines (Rhoades et al. 1983). As a result of a visit by Dr Robert Booth of the postharvest team, farmers in the main potato-producing region decided to finance a demonstration of diffused-light storage. This store was followed by five more demonstration stores built by the Philippine National Potato Program and backstopped by the local extension service.

In the Philippine case, farmers were clearly not "adopting" the demonstration model but rather *adapting the principle of diffused light to their cultural circumstances and needs.* Regional-development workers expected that farmers would copy the demonstration stores and had difficulty believing that the farmers would use ingenious methods to adapt the idea to their conditions. Follow-up in the adoption areas, however, demonstrated clearly that a "technology" as a unique, physical "package" was not being accepted. What, in fact, was being accepted was the principle of diffused light.



Large diffused-light store under a veranda in the Andes.

Worldwide, this principle has been translated into an amazing array of farmers' versions of potato stores, each with a particular cultural flavour. Wherever the idea was introduced through demonstration models, farmers quickly began to experiment on their own. Later, as adoption spread in Peru, farmers simply placed a few potatoes under the veranda, an experiment that involved virtually no inputs. Others, either as a first stage adoption or elaboration of the spreading trial, constructed a raised platform, under the veranda, a modification that allowed for better ventilation. Other farmers built simple structures, but few were exact copies of demonstration stores. In some cases, associations or farmers' cooperatives built stores with capacities up to 100 t, many times larger than the rustic demonstration models. To date, a documented 1500 stores have been built by farmers in developing countries.

As a result of farmer evaluations, the postharvest team encouraged national programs to establish demonstration stores illustrating different ways that the principle might be adapted. Farmers did not automatically accept the relevance of the principle, especially if the national program had constructed a relatively costly demonstration model. Sometimes, extension workers became frustrated when farmers did not precisely copy their design.

Thus, much was to be gleaned from monitoring — not only what farmers do and need but also how to improve the technology and avoid production contexts where it might be inappropriate. For example, in areas where farmers want to break dormancy rapidly to meet a planting date, the diffused-light principle offers few advantages. Understanding the decision-making behind adoption or rejection requires continued interdisciplinary research with farmers as the primary advisers.

Farmer-back-to-farmer: a model

The CIP team developed an action-, problem-, and client-oriented model that we at the centre have used in training courses (Rhoades and Booth 1982). Called by us the farmer-back-to-farmer approach, it offers some relief from what we feel are the fruitless dialogues between *campesinistas* and *tecnicistas*.

The CIP postharvest team openly admits that adaptive research potentially involves at least three distinct perceptions of reality and three sets of motivations: social scientists', technologists', and farmers'. Extensionists might be added as a fourth. These separate views of reality can be considered true in and of themselves and are based on the individual's relationship to the situation at hand. Technologists are under strong pressure by donors, administrators, and colleagues to produce a better technology that works and is adopted by farmers or consumers. Social scientists are faced with a marginal human or cultural brokers' role: articulating their understanding of the farmers' situation to colleagues from the biological sciences. Then, to complete the triangle is the farmer, the one facing the problem but who does not receive a guaranteed monthly salary to "solve farmers' problems." The farm family must live by the consequences of its decisions, not scientists'. Farmers live in both a technical and a social world based on agriculture; researchers simply study the worlds. And all this boils down to an undeniable fact: the researcher and farmer see the world differently.

Briefly, the basic philosophy upon which the model rests is that successful, adaptive, interdisciplinary research must begin and end with the farmer, farm household, and community. It does not posit that decisions as to what are important problems can be formulated on an experimental station or with a planning committee removed from the rural context and out of touch with farm conditions. The model subsequently involves a series of targets or goals that are logically linked by a circular and potentially recycling pattern of four basic activities — diagnosing problems, identifying solutions, testing and adapting the technologies, incorporating farmers' evaluations

(Hildebrand 1978; Harwood 1979:38–40). Research must come full circle from problem identification to farmer acceptance or rejection. Research, thus, is client- and problem-oriented. Research, extension, and transfer are seen as parallel and ongoing, not sequential, disjointed activities.

Diagnosing problems

The first activity in the farmer-back-to-farmer model is an understanding and learning stage. It is similar to the diagnosis stage outlined in farming-systems research, although relatively more emphasis is placed on what anthropologists call the "emic" perspective — that is, putting oneself as much as possible into the farmers' shoes to understand how they view the problem in both technical and sociocultural terms. Thus, this stage does not simply involve administering a questionnaire wherein scientists decide the relevant questions and farmers struggle to fill in the blanks. According to the farmer-back-to-farmer approach, informal surveys or formal questionnaires are not the only early diagnostic tools. Other techniques include on-farm experiments, farmer field days, farmer-advisory boards, participant observation, scientists' working hand to hand with farmers in their fields in exchange for information. The method used will vary, depending on local transportation, time, size of region, and the scientists' knowledge of local conditions and populations.

The diagnostic, or understanding, stage should include farmers, social scientists, and biological scientists, each using their own skills to interpret a problem area. The farmer-back-to-farmer approach does not encompass specific methods for determining a ranking of constraints to, or priorities for, agricultural policy at local or national levels but illustrates guidelines for effective design, generation, and spread of appropriate technology. Building upon, rather than replacing, traditional practices is the route to successful problem-solving.

In the model, farmers, because of their long-term practical experience with their land, mix of crops, climate and local socioeconomic conditions, assume the status of experts in their own right and are equal members of the problem-solving team. In this beginning stage, biological scientists will naturally focus largely on technical problems. Social scientists, bound by their own selective perception, will focus on another set of phenomena: ecology, marketing, price conditions, credit restraints, or their interpretation of what farmers believe. The challenge is to weld these different perceptions into a common framework for action.

Seeking solutions

Once the problem is generally identified and the team shares some common ground, the search for solutions is the next, but perhaps most difficult, stage. Despite public pronouncements by *tecnicistas* that a vast pool of technology is ready to be transferred to farmers, the process is not so simple. In the search for solutions, a constant on-the-spot exchange is necessary between farmers and those who test hypotheses about potential technologies on the research station. This interchange should continue throughout the selection stage. Compromises, changes, reversal of direction, or even termination of projects may be appropriate (but difficult) at this stage.

The purpose of linking on-station and farm-level team research is to arrive at a definition of potential solutions, and a portion of the farmers' problems always remains undefined. Proposed technologies are rarely solutions at this early stage because farm problems are immensely complex, interrelated, and constantly changing.

Testing and adapting the technologies

Once a potential solution or set of solutions is defined, the team — including extension workers if possible — should proceed to a testing and adapting activity. The objective now is to fit, with the farmer acting as adviser, the technology to local conditions. Generally, testing and adaptation occurs first on the experiment station followed by on-farm trials. Nevertheless, in the farmer-back-to-farmer organization of research, even during the transfer stage, the flow of information is circular between the field and the experiment station. The technology should pass through an agronomic or technical test, an economic test, and sociocultural suitability tests. The tests result in constant modification of the testing methods and the technology. CIP's storage team, for example, began by building costly seed stores on the experiment station, but data from farmers oriented the team progressively toward less-expensive designs.

During on-farm testing, the potential solution or solutions should be compared with traditional methods. This comparison can still be considered as part of the understanding stage, for there are often factors in the farming system yet unrealized by scientists and even farmers. The testing and adaptation stage may need to be recycled several times before a technology emerges that is worthy of demonstration and independent evaluation by farmers. Also, sometimes, one will find that the traditional method cannot be improved.

On-farm research is not much value if farmers do not consider themselves part of it and make straightforward suggestions on the technology being tested. Involving farmers to this extent is not easy in parts of the world where farmers are outwardly submissive to urban-based research scientists. Building rapport is the best way to gain farmer cooperation, and this requires that scientists spend much time in the field.

Farmer evaluation: the crucial stage

In the agricultural-development business, technologies are typically released and forgotten. Storages are built, irrigation canals constructed, livestock or crop varieties introduced and are rarely seen again by the innovators who, by then, have terminated their contracts and gone on to other assignments. Follow-up is rare, perhaps because the innovators assume the job is accomplished — that it is the responsibility now of a national program — or they fear that the real results won't be palatable. In contrast, follow-up is the crucial final link in the farmer-back-to-farmer model. Data must be collected on the reception of the technology by farmers, the ultimate judges as to the appropriateness of a technology. Until this stage, all scientific evaluations remain at the level of hypothesis. Unless the circle is completed, unless research results reach the farmer, prior efforts can be considered fruitless and research findings will be shelved to gather dust. And, if the technology is rejected by farmers, research should be repeated to determine reasons and seek ways to overcome the problems. One may only have to return to the adapting stage, but, if the technology is totally rejected, a new slice of the "farmer problem" needs to be taken.

The final stage involves the independent evaluation and use by farmers of the technology under their conditions, resources, and management. At this stage, scientists must not only determine acceptability but understand how farmers continue to adapt and modify the technology. Likewise, researchers must monitor the impact of accepted technology to ensure that it does not produce detrimental side effects.