Using Farmer Participatory Research to Improve Seed and Food Grain Production in Senegal

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The On-Farm Seed Project, like any field activity, is the product of a team effort. The project would not have been possible without the efforts of Ned S. Raun, Francis C. Byrnes, and other members of Winrock International’s staff. Similarly, staff members of the Center for PVO/University Collaboration in Development, Mississippi State University Seed Laboratory, Peace Corps, many PVOs, and the USAID Bureau of Food for Peace and Voluntary Assistance/Office of Private and Voluntary cooperation played important roles in conceiving and funding the project.

The rice-seed case study was made possible by the leadership of Alan Johnston, associate Peace Corps director in Senegal, and the field work of the Peace Corps volunteers in the department of Bignona: Marilyn Hines, Mary Mackey, Robert Peplin, Mark Chenault, Donna Johnson, and Scott Thompson.

Finally, many thanks to the farmers of the department of Bignona who were willing to take a risk and reap the reward for doing so.
Using Farmer Participatory Research
to Improve Seed and Food Grain Production
in Senegal

When resource-poor farmers participate in developing agricultural technologies, those technologies are more likely to meet their needs. Thus, greater involvement of farmers has been a primary factor in farming systems research conducted by national agricultural research systems and international agricultural research centers over the past two decades. The farming systems approach has had some implementation problems; but it has been an important first step toward engaging farmers as partners in research.

In farming systems research, control of the project — choosing the focus of a study, setting priorities, and so forth — lies with the researcher. Farmer participatory research, an alternative approach for reaching resource-poor farmers, depends more heavily on the farmers’ initiative and involvement and the use of indigenous technical knowledge. Nongovernmental organizations such as World Neighbors are increasingly interested in it as a way of enhancing the effectiveness of their field activities.

Researchers have suggested that agricultural innovation comes from many sources, including the national and international research agencies, nongovernmental organizations, and farmers. Under the traditional central-source model of technology innovation, information about new farming methods moves from the researcher down to the farmer. The more recently developed multiple-source model recognizes the diversity of sources and the multitude of factors that affect the complex process of technology innovation. It includes farmer participatory research.

This paper describes, through a case study, how the On-Farm Seed Project (OFSP) in Senegal has used farmer participatory research to improve resource-poor farmers’ production of rice seed and food grain. Though the example is specific, the principles it illustrates — for conducting research and for applying that research to improve seed systems — may be useful to other types of projects and other areas of the world.
OFSP Uses an Innovative Approach
to Developing Seed Technology

Seed is the key input in agricultural development. Unlike other inputs, such as chemical fertilizers and pesticides, seed can be produced by the farmer. Traditionally, farmers produce, select, and save seed from this year's crop to produce next year's crop.

The national and international agricultural research agencies develop and test improved varieties of crops and their seed. Often, this research does not consider the needs or preferences of resource-poor farmers.

National seed systems are responsible for multiplying and distributing that improved seed. But in Africa, the government agencies that are part of the national seed systems often lack the means to multiply the seed and deliver it to the farmers.

Consequently, more than 80% of the seed planted in Africa is produced and saved by farmers. So the most direct and effective way to improve crop production in the area is to work with the traditional seed systems through which farmers can produce traditional and improved varieties.

This approach to developing technology combines disciplines, research and extension techniques, and cultural values that are not usually considered together. It involves:

- **Understanding the traditional seed system.** What system do farmers use to produce and save their own seed? What characteristics do farmers want in the crops they grow? Where do farmers get seed of the varieties they need?

- **Applying seed technology to produce high-quality seed.** What seed-technology practices are used by farmers and by the national seed system? What are the strengths and weaknesses of farmers and the national seed system in producing high-quality seed? If appropriate improved varieties are available, how do they get to the farmer?

- **Conducting research into varietal development and agronomy.** Have the national and international agricultural research agencies already developed suitable improved varieties? What agronomic innovations are available and appropriate for improving seed production and yield in this region?

OFSP's approach to developing seed technology integrates such diverse but interrelated factors, with the goal of improving the quality and increasing the quantity of seed available to small farmers.
In Senegal, Institutional Support for Agriculture Needs Improvement

As mentioned earlier, a variety of institutions are involved in national seed systems. National and international agencies conduct research; national agencies provide extension services and multiply and distribute the seed. In Senegal, nongovernmental organizations also are involved in the system.

Research institutions are making progress

Agricultural research has a long history in Senegal, which was the research headquarters of French West Africa for almost 50 years, starting in 1921. Today, Senegal, with seven agronomic research stations, has one of the most extensive agricultural research systems of any French-speaking Sahelian country.

Until 1974, research was in the hands of specialized French institutions. A tradition developed in which researchers were accountable primarily to disciplinary scientific groups within bureaucratically organized research institutes. In 1974, the Institut Sénégalais de Recherches Agricoles (Senegalese Institute of Agricultural Research, ISRA) was created to bring those institutions together under one organizational structure that was responsible for all agricultural research in the country.

The system of Unités Expérimentales (experimental units), which existed between 1968 and 1980, offered one of the first examples of farming systems research in West Africa. The system had problems because of its top-down approach, and it ended with little progress being made toward a relationship between research and extension.

In 1982, ISRA established a Production Systems Research Department with assistance from the World Bank and financing from the U.S. Agency for International Development. Michigan State University, on contract, worked with the department's interdisciplinary teams at three sites: Djiboloi, Kaolack, and St. Louis. From that work came a better understanding of Senegal's traditional farming systems and of the farmers' potential for and constraints to adopting technologies that ISRA developed. It also strengthened the ties between research and extension.

However, ISRA's effectiveness has been limited by its size and administrative structure, the effects of the structural adjustment programs, and difficult economic times. As donors' financial support has shifted, research programs have been adjusted; researchers often have not been able to pursue the work that they considered most valuable. And while ISRA's researchers, who are well trained and scientifically motivated, are interested in seeing the technologies they develop reach the farmers who need them, they must rely on the extension service to work directly with the farmers.
Overall, Senegal’s agricultural research system is highly developed compared to those of most African countries; but its top-down orientation and structure fit the central-source model. However, creating the Production Systems Research Department has been a positive step toward improving the system; and ISRA researchers are a potential source of technical innovations.

Extension efforts are uncoordinated

The traditional approach of agricultural extension includes identifying farmers’ problems, researching those problems, testing potential solutions, and extending the tested technology to the farmers.

In Senegal, agricultural extension is the responsibility of the Société Régionale de Développement Rural (Regional Society for Rural Development) and its regional agencies. The organization is supported by the government and donors; so staff numbers and activities vary according to the funding available. The regional agencies are not oriented toward working with resource-poor farmers; instead, they promote high-input agriculture that depends on credit.

To facilitate transferring technology to the farmers, ISRA’s Production Systems Research Department established relationships with some of the regional extension agencies, including one in the Senegal River basin, one in the peanut basin, and two in the Casamance region of southern Senegal. This effort was ineffective because of the institutional and funding constraints to collaboration among Senegalese government agencies.

The regional extension agencies set up their own research. For example, the agency in the peanut basin conducted trials on some varieties and on fertilizer application, with progressive farmers and on station, that duplicated ISRA’s work. It then extended the results to farmers as packages of inputs that included new varieties, fertilizer, herbicides, and insecticides, with credit usually provided by the regional extension agency. One of the agencies in the Casamance conducted rice trials with herbicides, fungicides, insecticides, and varieties from the West African Rice Development Association, rather than the varieties tested and developed by ISRA. In both instances, the agencies used a top-down approach to extend high-input agriculture that had little relevance to resource-poor farmers.

The regional extension agencies are being affected by the recent structural adjustment programs and a change in government policy to promote privatization by ending the government’s role in supplying and distributing agricultural inputs. These changes in programs and policies have substantially reduced funding, staff, and support for the agencies, demoralizing them and widening the gap in extension services to rural areas.
Institutions that multiply and distribute seed are fragmented

Senegal's national seed system comprises four related components:

- A system for acquiring new varieties from national and international institutions, which ISRA tests and selects.

- A system for multiplying seed to provide sufficient quantities for farmers. Early steps in the multiplication process are carried out by ISRA and the Direction de la Production et du Contrôle des Semences (Department of Seed Production and Control); later steps are carried out by contract growers.

- A system for quality control of seed, which is another responsibility of the seed production and control agency.

- A system for distributing seed to farmers through the regional extension agencies, the Société Nationale de Commercialisation des Oléagineux du Sénégal (National Society of Senegal for Oilseed Trade), and private dealers.

This system is changing because of the structural adjustment programs and the resulting agricultural policies. The government's role in the seed system is diminishing; the seed production and control agency is restricting its activities to quality control. Privatizing the seed industry has major implications for the seed system.

Seed production in Senegal has focused on the main cash crop, peanuts. Formerly, farmers could purchase peanut seed on credit; now they must pay for the seed at planting time or use their food supply of peanuts as seed. Work on other crops has received limited attention and funding. More than 80% of the seed used in Senegal is produced and saved by the farmers.

The greatest weakness in Senegal's seed system for food crops is in distributing seed to the farmers, an expensive task but a critical one. Peanut seed is distributed effectively, probably because of peanuts' importance as an export crop. (Historically in most African countries, export crops have been promoted since they bring in foreign exchange, which is necessary for purchasing goods from developed countries.) Seed for other crops appears not to have been tested under farm conditions to ensure that they are appropriate to the farmers' production systems. And there are no extension programs to educate the farmers about the practices that the new varieties require.

If a national seed system is to be effective, research and extension must be linked. If importing seed is a weakness in the system, seed can be multiplied locally -- farmers can multiply many varieties themselves if they are provided with initial stocks. In fact, seed production can become a small-scale rural enterprise.
Nongovernmental organizations can help fill the gap

International and indigenous nongovernmental organizations (NGOs) are emerging as an increasingly important force in the development of Africa. Several factors have contributed to this emergence:

- The drought of the 1970s and the accompanying international attention brought funding for relief activities through NGOs.
- The economic crises of African countries and the resulting structural adjustment programs have reduced all public services, including government programs for national development.
- The donor community views NGOs, both international and indigenous, as alternative vehicles for implementing rural development activities.

NGOs are working in literacy, health care, water quality and supply, natural-resource management, and agriculture. They tend to use a grassroots style of organization to respond to the needs of rural communities.

Senegal's gap in agricultural extension is being filled by NGOs. These groups have the financial support and staffs necessary to serve rural communities, but their work often is limited to small geographic areas. More than 100 international and indigenous NGOs are registered in Senegal; 64 are members of the Conseil des Organisations Non-Gouvernementales D'Appui au Développement (Consortium of Nongovernmental Organizations for Assistance in Development); 20 are international, 39 indigenous or African; at least 54 are working in agriculture.

So far, the agricultural work of NGOs has emphasized developing water supplies for gardening during the dry season; however, interest is growing in the traditional rainy-season crops. The NGOs are increasingly concerned with activities that are technically sound and sustainable. Farmer participatory research is compatible with - in fact, is an extension of -- the philosophy of the NGOs and can help relieve the seed-related problems of resource-poor farmers.
The On-Farm Seed Project: Collaboration is the Solution

The On-Farm Seed Project was conceived in 1986 during a meeting between U.S. private voluntary organizations (PVOs) and universities, all of which were members of the Center for PVO/University Collaboration in Development. This organization recognizes the strength of PVOs in grassroots activities but also their need for access to sources of appropriate technology, technical assistance, and training. The PVOs included CARE, Catholic Relief Services, Lutheran World Relief, Save the Children, and Winrock International Institute for Agricultural Development. The universities included Mississippi State University, which is world-renowned for its expertise and experience in developing seed programs in third world countries.

Those attending the meeting acknowledged that, as mentioned earlier, more than 80% of the crops in developing countries are sown from seed stocks selected and saved by farmers, despite more than 30 years of emphasis on and investment in seed-production and -supply programs. Seed-industry development has been important, and the assistance rendered was not wasted. However, it is clear that the national seed systems must work with the traditional seed system to develop improved varieties and be sure that these varieties reach small farmers. If the traditional seed systems were better understood, improved, and linked to the national seed systems, small-scale seed enterprises could develop.

The participants in the meeting agreed to develop a project that would assist PVOs with seed-related activities. OFSP was initiated in 1987 through the collaboration of the PVO/University Center, Winrock International, Mississippi State University, several PVOs, and the U.S. Peace Corps, with partial funding by the U.S. Agency for International Development. Its mission is to develop and implement innovative ways of improving the seed technology of rural farm families in Senegal and The Gambia.

OFSP's approach is unusual in two ways:

- Its interventions in the local seed systems are based on information gathered in the field.

- It is truly collaborative -- all its activities are carried out through field organizations: the PVOs and the Peace Corps.

OFSP is designed to enhance the seed programs of field organizations, not duplicate or compete with them. It provides a service to the PVOs and the Peace Corps: Its success depends on linking its interventions to the activities of the collaborators.

The project focuses on meeting farmers' demand for better seed by improving their systems of selecting, producing, storing, and distributing seed. Through training and demonstrations, OFSP helps farmers learn how to do better what they have been
doing for themselves for centuries. In the process, they learn about new varieties and technologies, share indigenous knowledge and skills, and are challenged and encouraged to review and revise, if necessary, their assumptions about and criteria for selecting, producing, and storing seed.
A Case Study: Producing Rice in the Casamance

One of the organizations that expressed an interest in collaborating with OFSP was Peace Corps Senegal, which wanted to develop a seed component for its African Food Systems Initiative. OFSP provided training to incoming Peace Corps volunteers; then, placed in villages, the volunteers worked with farmers to become familiar with their farming systems, giving particular attention to seed practices.

At the same time, OFSP contacted ISRA researchers working with major crops for information about technologies that would be relevant at the village level. The ISRA researchers were interested in finding alternative methods for interacting with farmers, particularly those planting millet, rice, and cowpeas.

Thus, a multi-institutional approach to program development took shape. The following case study examines one of the collaborative activities in which OFSP assisted.

Rice yields needed to be improved

Agricultural development activities have had little success in achieving sustained rice-yield increases in West Africa. The hindrances have included lack of appropriate rice varieties, poor water control, shortages of fertilizer and other inputs, poor weed control, shortages of labor, inadequate rainfall, and failure to consider traditional production practices and ethnic factors.

Senegal's extension process has not taken into account that the rice-farming systems differ greatly between geographical areas and even within some small areas. Further, there has been too little understanding and appreciation of indigenous technical knowledge; farmers' beliefs and expertise must be considered if the interventions are to be compatible with local production practices. The approach of delivering a package of an improved variety, fertilizer, and fixed production practices has not benefited West African rice farmers for the long term.

Therefore, to attempt to improve rice yields, OFSP and the Peace Corps collaborated with Alphonse Faye, a Senegalese rice agronomist and plant breeder, to develop a small-scale pilot program for extending rice-seed technology in the Casamance. The goal was to achieve sustained increases in yields by using a process approach to gaining knowledge and understanding of the seed-related problems of the farmers. The project combined the technical expertise of ISRA with on-site monitoring by Peace Corps volunteers in the villages, coordinated by OFSP and Peace Corps staff — a multi-institutional, comprehensive, technically sound team.
The study focused on

- the variety of ecologies in which rice is grown — upland, phreatic (sometimes submerged), paddy (always submerged), mangrove, and riverain (deep flooded)
- the variety of planting methods — broadcasting, planting in rows, and transplanting
- the number of rice varieties planted — more than 200 varieties have been identified in the Casamance region alone
- the influence of labor constraints, rainfall, ecology, and cultural factors on the timing of production practices

The basic steps included

- gathering information — developing knowledge and understanding of the production practices and seed-related problems of the farmers
- designing and implementing — conducting trials to demonstrate how changes in the rice-production system could relieve the seed-related problems that were identified
- discussing the results of the trials with the farmers
- following up — conducting further trials and extension activities with the farmers in the pilot group
- disseminating the results — extending the activity to more farmers and organizations

The pilot project was meant to test the methodology of the multi-institutional approach for developing and testing technologies for improving the production of rice seed and food grain and extending those technologies to the farmers.

Farmers were using two types of rice-production systems

Farmers began producing rice in the Casamance over 10 centuries ago. The region is the center of origin of Oryza glaberrima, a lesser-known species of rice. In the fifteenth and sixteenth centuries, Oryza sativa, the species grown in Asia, was introduced to the Casamance by the Portuguese. Rice is the staple food of the area; it is grown mainly for home consumption, not for sale.
Rainfall levels in some areas of the Casamance have declined 27% in the past 20 years. This has had several effects:

- The flow of the Casamance River has been reduced, so saltwater has intruded into the mangrove and paddy rice ecologies near the river, threatening the rice plants, which cannot tolerate salt.

- Insufficient moisture has been available during the grain-fill stage of growth, so traditional varieties of rice have not been able to mature, which has reduced yields.

- Some of the traditional varieties bloom in October, when moisture is limited. Although they are adapted to predrought conditions, moisture is now so scarce in October that their yields have declined.

To determine how yields might be increased to previous levels or beyond, information was gathered from farmers and from secondary sources. The Peace Corps volunteers identified small groups of farmers, mostly women, in five villages who were willing to discuss their rice-production practices. Group interviews, conducted in January 1989, concerned the production practices used, timing of field operations, varieties used, and problems encountered. These early meetings were formal because they included village leaders.

A month later, the rice fields were visited to gather more information about soil types and salinity and water levels. Peace Corps volunteers and OFSP staff interviewed the farmers individually during and after the growing season. Discussion and feedback, primarily from the women, was an essential ongoing information-gathering component of the study.

Secondary information about rice production in the Casamance also was reviewed. A wealth of such information is available as a result of surveys conducted earlier by ISRA’s rice team and Production Systems Research Department.

The research revealed that two basic systems of rice production were being used in the Casamance: the Diola and the Mandink. These are the names of the two dominant ethnic groups in the area; however, both systems are used by members of each group, with some variation in practices between groups and individuals.

The following summaries of the characteristics of the two systems are based on information gathered from more than 60 farmers from January 1989 to April 1990 in the villages of Dioloulou, Karong, Mangoulene, Tendouk, and Tiobon in the Casamance region of Senegal.
The Diola system

The Diola system is found in 45% of the total rice-production area in the Casamance. Its characteristics are

Labor. Both men and women participate in rice production. Men plow; women prepare nursery beds, plant, weed, and harvest. During the interviews, women provided information about transplanting and harvesting dates and brought seed samples to be examined and identified, while men were more knowledgeable about the timing of field preparation.

Ecology. The plots are in either phreatic or paddy ecologies near the river's mangrove area. Because salinity, iron toxicity, and acidity are problems, farmers depend on rains to flush the soil before planting. They determine whether the salinity has been reduced to acceptable levels by tasting the water.

Land preparation. Although several farmers use animal traction for plowing, most use the traditional long-handled shovel, the kajango, to make ridges in the soil. In areas where salinity is high, initial ridging is done in February and March to inhibit the capillary action that brings salt to the surface. Plots also are plowed after the initial rains, when the weeds have emerged. This plowing system buries weeds and manure, comports them, creates furrows that retain more water in the plots, and keeps salt away from the plants.

Plot size. Plots are small, 200 sq m or less, because landholdings are fragmented. Traditionally, family plots are scattered randomly among the large rice fields of the village.

Water control. Water comes from rainfall and is seldom drained from the plots. However, when the water is deep enough to inhibit seedling growth, it is drained during transplanting.

Seeding. The nursery beds are in upland areas and are prepared at the beginning of the rainy season. Seedlings are transplanted after the plots contain sufficient water and the salt content has been reduced, usually in mid-August. Spacing after transplanting is dense: about 10 cm x 10 cm. No particular attention is given to the age of seedlings when they are transplanted; that is, the age varies from 30 days to 60 days.

Fertility management. Cattle graze the rice stubble during the dry season. Ash, leaves, household waste, and manure are added to the plots before plowing. Because the plots are plowed after the first weeds emerge, these weeds also are composted. Chemical fertilizer is seldom used; no fertilizer was used in 69% of the Diola plots and seed beds included in the study. Almost all of the farmers interviewed used manure as fertilizer; 22% used ash; 3% used household waste; and 4% used chemical fertilizer.
Weeding. Minimal weeding is needed. Because of the plowing method, weed infestation is low, and transplanting after the plots contain water inhibits weed growth. Plots are not weeded after transplanting.

Varieties. Farmers use two to five varieties of rice, according to the water conditions. Traditional varieties that flower in October were used by 91% of the farmers interviewed. Yield from these varieties is reduced because water is limited when the plants are in the grain-fill stage. Varieties can be identified only by examination because the names used for them are local, based on where they came from or who brought them to the village. All of the farmers surveyed saved their own seed. Field observations showed that the varietal purity of the seed was high, which illustrates the care that farmers take with their seed.

Harvesting and drying. Rice is well dried before harvest. Groups of women harvest the crop, picking only the panicles and tying them into bundles, which are stacked together for storage. Average rice yields range from 800 kg/ha to 1,000 kg/ha.

Storage. Rice seed is kept in a storage room or the attic in the family compound, separate from the store of rice that is kept for the family's food. This system's advantage is that it lets the rice dry properly; its disadvantage is that it leaves the seed vulnerable to attack from insects and rodents.

The Mandink system

The Mandink system was used in 42% of the rice-production area of the Casamance. Of the villages included in the study, one used the Mandink system and one used a modified Mandink system. The system's characteristics are

Labor. Only women work with rice; men work with the upland crops of peanuts, corn, and millet. Even though women do most of the work in producing rice, in initial interviews the men insisted on answering most of the questions.

Ecology. Rice is planted in inland valley swamps, where salinity is not a problem.

Land preparation. Women work the soil surface with small hoes, after the first rains and just before planting, to loosen the soil and remove weeds.

Plot size. Plots are larger than those of the Diola system; the average plot is 2,000 sq m.

Water control. Water control is minimal.

Seeding. In 83% of the plots, seed is broadcast when moisture in the plots is sufficient. (Plots can be seeded as soon as 100 mm of rain has fallen, but they usually are seeded later.) In the remainder, rice is planted in rows or transplanted.
Fertility management. Women work manure, the main source of fertilizer, into the soil while plowing.

Weeding. Plots are weeded from 30 to 60 days after planting. Earlier weeding is not possible because, when seed is broadcast, young weeds cannot be distinguished from rice seedlings.

Varieties. Rice seed used in the Mandink system comprises 90% traditional varieties.

Harvesting and drying. The Mandink system uses the same practices as the Diola system for harvesting and drying rice. Yields average from 800 kg/ha to 1,000 kg/ha.

Similarities and differences in the two systems

The Diola rice-production system uses more labor than the Mandink system. Labor is a major constraint in the Mandink system because only women farm rice. The inland valley swamps cultivated under the Mandink system do not have the salinity problems of the lands where the Diola system is used. Projects to develop rice production have favored the Mandink areas because the plots are larger and, thus, tractors can be used to plow the land before the rice is planted.

The traditional method of hand plowing, using the kajango in the Diola system, makes it possible for rice to be produced in areas where the soil has salinity, iron toxicity, or acidity problems. The kajango is also used to maintain soil fertility, control weeds, and manage water; therefore, it is an essential, appropriate indigenous tool. Projects to develop rice production have bypassed farmers who use the kajango because modern agricultural methods have not yielded better results than traditional methods that use this tool.

Because of the differences between the Diola and Mandink systems, different strategies are needed for dealing with the seed-related and production problems of each group. The traditional approach to seed production of both systems is basically sound. As rice is highly self-pollinated, maintaining varietal purity is not a problem. Field observations during the growing season did not reveal rice plants of different heights within the same plot; thus it did not appear that varieties had been mixed. The farmers are knowledgeable about the characteristics of the varieties of rice they grow.

Rice seed is not mixed with food rice; they are store separately. Harvesting and storing rice seed in bundles of panies results in some mold on the stems in the center of the bundles; but, otherwise, the quality of the seed is acceptable. Rice seed stores well, especially in the low-humidity conditions of Senegal during the storage season.
Losses of seed quality or quantity (to insects and rodents) during storage are minor. Simple tests of seed before planting indicate that the germination rate is 80% to 95%.

All farmers mentioned salinity in the Diola area and reduced rainfall in both areas as causes of production problems. Addressing these problems was within OPSP's mission and capabilities.

**Trials were developed and implemented**

Many projects have tried to increase rice production in the Casamance by promoting the use of new varieties, fertilizer, herbicides, insecticides, credit, and tractors. When these projects ended, the farmers returned to their old varieties and production practices; thus, the lasting effects of these projects on increasing rice yields have been negligible. Furthermore, as a result of these activities, farmers now believe that rice production cannot be increased without the inputs the projects supplied.

In contrast to the approach of previous projects, OPSP's strategy is to understand the traditional production system and suggest changes that are compatible with it. This is a step-by-step, long-term approach in which the project works with farmers to seek sustainable improvements that can increase yields dramatically and immediately. Initially, the changes focus on using an improved variety and modifying a few practices to help that variety produce more than the traditional variety. As farmers implement a change, they provide feedback to the project, which then initiates further changes based on that information. Farmers apply only the changes they understand and see as beneficial; as partners in the change process, they determine its direction and pace.

**A plan of action was developed**

The farmers who participated in the survey were asked to plant demonstration plots on their land. Because all of a village's rice plots are in the same area, using the farmers' plots for the demonstrations would make the work highly visible.

The project provided up to 2 kg of seed but gave no credit or free inputs. Farmers paid the equivalent of US $50 for the seed. Work started with two improved, adapted varieties that could perform better than the traditional variety under low-input conditions, provided the farmers modified a few production practices.

Four women's groups and 15 families each grew plots of approximately 200 sq m of the new variety; Peace Corps volunteers monitored the activity. The farmers were to use the rice produced from these plots as seed the following year; and, after the trials, the seed was to be introduced into the traditional system.
Improved varieties were selected

ISRA developed several improved varieties of rice that were well adapted to the area, tested them under farm conditions, and released them to farmers. These varieties produced more rice than the traditional varieties and had several characteristics that were important to the farmers:

- They did not require a certain day length for flowering and they matured earlier than the traditional varieties: in 105 to 120 days compared to 150 days. This growing period lets the rice mature with sufficient moisture during the grain-fill stage of growth, which is essential for high yield.

- They used the available level of fertility more efficiently to produce grain rather than using it to produce taller or larger plants, as do the traditional varieties. If moisture levels are high enough to promote rapid growth, plants produced from traditional varieties of seed tend to fall over, making harvesting difficult and lowering yield.

- Their tillering capacity was higher than that of traditional varieties: 5 to 25 tillers per plant, depending on fertility and spacing, compared to 2 to 5 tillers per plant. Since each tiller produces a panicle of grain, this translates into higher yields for improved varieties.

- Their grain size, milling characteristics, and taste were compatible with local preferences. These factors strongly influence farmers' decisions about adopting a new variety, particularly when the rice is for family consumption.

- They were resistant to rice blast, a major rice disease in West Africa.

Modified production practices were introduced

The improved varieties could produce more than the traditional varieties only if several production practices were modified. In both the Diola and the Mandink rice-production systems, changes were needed in planting practices.

In the Diola system, those changes involved

- Nursery practices. During nursery-bed preparation, sufficient manure was incorporated into the soil (15 kg for 10 sq m) to improve consistency and fertility, thus ensuring the production of healthy, vigorous seedlings. The seed was treated with an insecticide and fungicide to improve emergence and deter bird
and insect attack. Nursery beds were planted later than normal so the seedlings would be younger at the traditional planting time.

- **Transplanting.** Seedlings were transplanted younger, at 20 days instead of the traditional 30 to 60 days. When seedlings are transplanted at more than 35 days old, the plant has no time in the vegetative stage to produce tillers before it goes into the reproductive stage that produces the grain. Thus, this early transplanting was essential for the improved varieties to produce more tillers and, therefore, greater yield. This modification represented a dramatic change from tradition, but it was a change only in timing; it required no more labor.

In the Mandink system, the changes involved

- **Row planting.** Rice was planted in rows so the plants could be weeded early, a critical factor in increasing yields. Rice plants cannot be distinguished from weeds in the early growth stages. With traditional broadcast planting, rice plants and weeds are mixed together, so early weeding is impossible. When rice is planted in rows, all plants between the rows can be removed.

Optimum row spacing of 20 cm was achieved easily with the use of a locally constructed rake. Planting rows by hand required more labor than the broadcast method, which may have inhibited adoption of this practice, even though the increase in yield could compensate for the increase in labor required.

- **Weeding.** Row-planted plots were weeded at 20 and 40 days. Small weeds were removed early with a small hoe, rather than by hand. Two weedings of a row-planted plot required less time than one weeding of a broadcast-planted plot. Nevertheless, this change to traditional practices was difficult for farmers to accept.

*The farmers' activities were monitored*

In February, project workers and farmers examined the sites of the trials together to determine which varieties to use. The project team visited the sites monthly, and the Peace Corps volunteers in the villages provided on-site monitoring. The volunteers encouraged farmers to carry out the practices on time and record their activities. The volunteers also measured field size, plant height and density, tillers per plant, and yield.

The timing of traditional practices and the resulting yields were observed. It was not expected that all farmers would apply the modified practices as advised; but because the information was recorded, the effects of the recommended practices could be compared to those of the traditional practices. The information collected provided sufficient basis for concluding that the modifications to the traditional system improved yields.
As expected, the results varied greatly because of individual differences in farming practices such as water control, fertility management, and degree of adoption of the modified practices. Any analysis of the results must consider:

- This was the first year of an activity in which methods and technology were being tested.
- Farmers could not see the variety and modified practices demonstrated before using them.
- Change to traditional practices is a slow process; farmers must see and understand the benefits.
- The trials were conducted under low-input conditions — except for the seed treatment at planting — to emphasize, initially, the improved rice varieties and modified practices.
- Results were not equally successful in both systems. Several factors contributed to this inequality, but farmers' attitudes were the greatest influence.

Despite the variations, the results were encouraging. As mentioned earlier, rice yields average 800 kg/ha to 1,000 kg/ha in both Diola and Mandink systems. ISRA data showed that, for years with rainfall amounts comparable to that of the study year, average yields were 1,040 kg/ha. But in the trials, the average yield for the rice variety Dj684D was 1,960 kg/ha (88% higher than the expected average yield for traditional varieties), and the average yield for the rice variety Dj12-519 was 1,491 kg/ha (43% higher). Two farmers included in the study had yields of about 3,400 kg/ha.

These results delighted the farmers and were sufficient to confirm that achieving incremental, sustainable increases in rice yield requires a step-by-step approach to change.

The project directly involved 80 women and 20 men. The small size of the trial plots and their concentration in small areas made them highly visible. The Peace Corps volunteers estimated that the demonstrations were observed by most of the women who grew rice in each village.

No formal field days were held at harvest time. Instead, groups of women harvesting the crops were able, informally, to observe the yields of the demonstration plots and compare them with the yields from their own plots. This approach generated considerable interest and was more appropriate to the culture than a formal field day.

Word of the demonstrations is spreading by itself, indicating that farmers are understanding and accepting the innovations. The farmers involved in the
demonstration, in particular, expressed acceptance and appreciation of the technology and interest in participating in future activities.

Follow-up work continues

The program will continue to work with the farmers and villages that participated in the first season's trials; now that the farmers have seen some results, they are eager to continue with the demonstrations. In the next series of trials, the farmer in each village who had the highest yield, following the recommended practices, will be chosen for the demonstration, and the participants will be brought together before each field activity for instruction and discussion.

In the Diola system, the demonstration will focus on the following critical production practices:

- Preparing the nursery bed, including applying fertilizer, at the optimum time.
- Reducing the seeding density from that used in traditional practices.
- Treating the seed with insecticide and fungicide.
- Planting the nursery bed in stages so seedlings are about 21 days old at transplanting.
- Reducing the transplanting density from that used in traditional practices to allow more space for tillering; this will also reduce the number of seedlings and amount of planting time needed for the plot.
- Counting the tillers with the farmers so the farmers can observe that tiller numbers are higher.
- Recording water availability and date of harvest and comparing this data to the data for nondemonstration plots.

In the Mandink system, the demonstration will focus on

- Recruiting individuals, rather than groups, to participate so the incentive for higher yields is greater.
- Applying manure.
- Plowing at the optimum time.
- Planting in rows after 100 mm of rain has fallen.
• Using the locally constructed rake to mark rows.
• Encouraging weeding with a hoe at 20 and 40 days after planting.

The results will be disseminated

To increase the number of farmers participating in project activities in the coming years, efforts will be made to include

• Farmers in the initial villages who have received seed from those who participated previously.
• Farmers in six neighboring villages. In most cases, a participating farmer from the previous year will help Peace Corps volunteers initiate the program in new villages.

Essential data will be gathered on factors such as timing of production practices, yields of the demonstration plots, and yields of the traditional plots of participating farmers. Data also will be gathered on the spread of the improved rice varieties: number of farmers growing them, timing of those farmers’ production practices, area under cultivation, and farmers’ levels of satisfaction.

The results will be shared with other organizations involved in extension in the area. Through training activities, the approach and technology will be introduced to

• the government extension service
• NGOs with extension activities in the area
• farmer groups involved in producing rice
• other interested groups

Key to the project has been the process approach to identifying problems with the farmers, which allows feedback and information sharing. Farmers are now communicating with the project about problems they have identified, and the project has worked with them to solve these problems. It is hoped that the trust and confidence established between the project’s staff and the farmers will result in continued feedback, which is important in selecting further activities that can alleviate the farmers’ seed problems.
Conclusions:  
Benefits, Opportunities, and Lessons

The benefits of the collaborative project described in this paper have been shared by all the participants.

- The farmers have benefited by increasing their rice production, as evidenced by their willingness to participate in the next season's program.
- The Peace Corps has benefited by having a program that provides a useful service to farmers and viable and satisfying roles for the volunteers.
- ISRA has benefited by having its technology extended to farmers and by obtaining feedback from the farmers that can be used to develop future technologies.

OFSP has facilitated the development of this beneficial program. Particularly important has been the support OFSP has provided to NGOs. The managers of NGOs have a variety of responsibilities, including personnel, budget, planning, logistical support, and communication with their headquarters. Thus, it is often difficult for them to find the time and encompass all the fields of expertise needed to handle all the technical aspects, liaison, and training necessary for their programs. OFSP can provide these services in the field of seed technology, enhancing NGO agricultural programs and, in turn, benefiting the farmers.

Links must be developed carefully

Before direct links can be established between a national agricultural research system and NGOs, the following questions must be answered.

- Do the researchers and the NGO staff members speak the same technical language?
- Do the researchers and the NGO staff members have the same view of farmers, their indigenous technical knowledge, and their problems?
- Are the researchers oriented to high-input agriculture and research or to viable modifications to traditional agriculture and extension?
- Does each party have the time to establish and support links?
- Although the potential benefits for the NGO are clear, what benefits accrue to the researcher, who already may have a full work load?
• Does the national agricultural research system view the interaction between researchers and NGO personnel as a positive influence on the researcher's job performance and ability to publish research?

• If the national system lacks a mandate for or direct link to extension activities, can it work directly with NGOs?

The answers will vary in each situation, but NGOs must be aware that these issues exist. The multiple-source model of agricultural innovation involves many institutional issues that affect technology development because the objectives of the organizations involved often differ.

OFSP (and projects like it) can be the link between the national systems and NGOs because it speaks the technical language of the researchers, uses the researchers' time judiciously, and is able to communicate the NGOs' interests to the researchers. OFSP has expertise in seed issues among its full-time staff and its supporting organizations, the Mississippi State University Seed Technology Laboratory and Winrock International. It also can call on other sources of expertise -- such as staff members of international agricultural research centers, university researchers, and consultants -- for technical assistance as needed.

The lessons learned must be heeded

Farmer participatory research means entering the world of farmers and accepting them as partners. This approach can frustrate researchers and extension workers because the farmer determines the pace and scope of the activities. Nevertheless, for the approach to be successful, the following conditions must apply:

• The researchers must develop personal relationships with the farmers. In Africa, each party must be known and respected personally before technical subjects can be discussed.

• Communication must conform to the cultural norms of the area. Researchers must listen to farmers -- on the farmers' terms in their villages, fields, and homes -- because important information and feedback often come in subtle ways. Researchers must be willing to participate in many meetings that have little technical merit but great cultural meaning. Detailed knowledge of the local language is essential.

• Researchers must be clear and consistent in communicating what the activity requires. Even with clear explanations, misunderstandings will arise that must be worked out over time. Researchers must be patient: After many broken promises from projects, extension workers, and the government, farmers are wary of outsiders and skeptical of their proposals.
- Researchers must build credibility with the farmers by using solid technical knowledge and experience and by appreciating the farmers' indigenous technical knowledge.

- Researchers must be willing to work step by step toward a long-term goal.

- Researchers must involve the farmers in extension work as soon as possible.
Sources


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