The roles of change agents and opinion leaders in the diffusion of agricultural technologies in Vietnam: a case study of ACIAR–World Vision collaborative adaptive research projects

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Diffusion of innovation in agriculture is a complex process. The success of this process is governed by the various factors—technology characteristics, socio-cultural factors, participation of stakeholders, and environment—that enable and sustain effective interaction between these stakeholders. Previous studies in technology diffusion in agriculture indicate that not all technologies that have their advantages over others and are compatible to users' setting and simple and testable are adopted by end-users. When a technology is tested, the trial process also requires effective facilitation of change agents and opinion leaders combined with sufficient timing and financial support before the technology is eventually owned and adopted by the target users. In this chapter, using the theory of diffusion of innovation, we reviewed the success of two projects implemented by World Vision International in Vietnam under an adaptive research program funded by the Australian Centre for International Agricultural Research. With the presence of a 10-year development program (namely, the Area Development Program), we argued that the likelihood for success in the diffusion of innovation is more likely for adoption when the trial of the introduced technology has sufficient time, financing, and a commitment by all stakeholders.

Keywords: diffusion of innovation, stakeholders, agricultural extension, change agent, opinion leaders

The ultimate goal of innovation diffusion in agricultural extension is to improve the well-being of farming people. Extension activities are typically done through validating and promoting the use of agricultural technologies that could potentially improve crop productivity and farmers' income. Technologies introduced, however, are put into use differently. The rate at which a new technology is adopted depends on the technology traits, the personal characteristics of farmers, and the local setting in which the technology transfer process takes place.

Given numerous achievements in agricultural research and development, new technologies are regularly becoming available for farmers' adoption. However, in some situations, farmers fail to adopt a technology because of various socioeconomic,

cultural, and technological constraints. Success in innovation diffusion is subjected to a wide range of factors—social norms, networks, attitudes, beliefs, knowledge, practices, to name a few. Bohlen argued: "The adoption of a new idea or practice is not a simple unit act, but rather a complex pattern of mental activities combined with actions before an individual fully accepts or adopts a new idea" (Bohlen 1964, p 268). For Buttel et al (1990), the more complex an idea is, the more likely the farmers have to change their attitude and belief to receive timely information before adopting the innovation. In contrast, the easier an innovation is for farmers to test, the more likely the innovation will be adopted.

Understanding the nature of the innovation diffusion process in agriculture and the factors that affect it helps predict the likelihood of adoption of an innovation. Without a good understanding of how an innovation and users interact in their own context before and during an innovation process, an attempt to transfer an innovation to the target users will likely fail. Unexpected consequences may arise as a result of that. Understanding of the process of innovation, as such, is useful for projecting whether a new technology will succeed (Sevcik 2004).

Review of literature

Rogers (2003) defined diffusion of an innovation as the "process by which an innovation is communicated through certain channels over time among the members of a social system," whereas an innovation itself is "an idea, practice, or object that is perceived as new by an individual or other unit of adoption" (Rogers 2003, p 6). According to Rogers, innovation diffusion is a type of communication in which the new idea is expected to be diffused to the target audience to achieve a desired social change in the structure and function of a social system. He argued that five critical attributes of an innovation could be used to explain and predict the rate of adoption: *relative advantages, compatibility, complexity, trialability,* and *observability*. In reality, however, other exogenous factors may affect the decision to adopt a new technology, irrespective of whether or not the technology is tested and its advantages (over an existing technology) are evident. Change agents and opinion leaders are two among those exogenous factors.

A *change agent* is "an individual who influences clients' innovation-decisions in a direction deemed desirable by a change agency" (Rogers 1995, p 27). Change agents generally encourage adoption of a new idea. However, they also may be ones who, in some cases, slow down or even hold up the adoption of an innovation that is, in their own opinion, undesirable. Change agents usually work with opinion leaders to enhance the impact of their diffusion activities in a social system. They are typically more innovative than others and their communication may pose challenges to the diffusion process.

In a community, those who usually provide advice and information to other people and maintain a high level of credibility are usually referred to as opinion leaders. According to Rogers (1995), opinion leadership is "the degree to which an individual is able to influence other individuals' attitudes or overt behavior informally in a desired

way with relative frequency" (Rogers 1995, p 27). In a modern social system, opinion leaders are innovative. However, in traditional social systems, opinion leaders may be indicative of traditional behavior and norms—adhering to local values and practices—and are, in some cases, even strongly against changes or external influences. Opinion leaders, however, are sometimes influenced by change agents. When opinion leaders exhibit a level of change that is no longer a tradition in that social system, they may be at risk of losing credibility and influence on their former followers.

Overview

In this chapter, we argue that, when an effective, demand-driven collaboration between change agents (exogenous) and opinion leaders (endogenous) is fostered throughout an innovation diffusion process, this innovation diffusion effort is more likely to be successful when it is first tested, and is more likely to be sustained if the demand remains. To demonstrate, we reviewed the results of two adaptive research projects implemented by World Vision (WV) International in Vietnam with financial support from the Australian Centre for International Agricultural Research:

a) Rodent Control in Rice-Based Farming Systems (with technical support from the National Institute of Plant Protection, Southern Institute of Agricultural Sciences (Vietnam), Australian Commonwealth Scientific and Industrial Research Organisation (CSIRO), and the International Rice Research Institute (IRRI); and
b) Soil Fertility Improvement project (with technical support from the National Institute of Soils and Fertilizers (Vietnam) and the University of Queensland). An add-on project (namely, Soil Capability Classification) was linked to the completed soil fertility project and was conducted with technical support from the National Institute of Soils and Fertilizers, Southern Institute of Agricultural Sciences (Vietnam), and the Queensland Department of Natural Resources and Mines.

As mentioned earlier, consultation with target farming communities (as part of a technological screening process) indicates that five attributes of the technologies to be diffused under the above projects were supportive to the innovation diffusion process. With this assumption, we reviewed to see whether change agents and opinion leaders had a significant impact on the outcome of the adoption of the introduced technologies among the target communities. In the context of our projects, we categorized World Vision and participating research institutions (as mentioned above) as change agents, whereas local community leaders and innovative farmers were categorized as opinion leaders. The target groups of these projects are farming communities and local extension centers (at the provincial and district level).

In the next section, we present an overview of the two projects. We discuss the advantage of this participatory adaptive research model, highlighting the role of change agents and opinion leaders in enhancing the likelihood of project success. We then conduct a comparative review to highlight outcomes that benefit the target com-

Area Development Programs as a Model for Dissemination of Natural Resource Management in Rice-Based Agriculture

Word Vision Vietnam (WVV) is a Christian nonprofit and humanitarian organization working through transformational relief to improve the quality of life of people, especially children who are marginalized and are living in poverty. Established in 1950, the organization has projects in areas such as agriculture, micro-enterprise economic assistance, disability, capacity building, and emergency relief and mitigation. WVV encourages community participation and ownership so people become agents of their own development.

The Area Development Program

The Area Development Program (ADP) is WV's preferred manner of working throughout the world. A typical ADP duration is 10–15 years. Because poverty is multifaceted and often deeply rooted, the alleviation of poverty by people themselves takes a substantial period of time. It is also the reason why a typical ADP integrates agriculture, health, education, economic development, micro-enterprise, disaster mitigation, and capacity building. The major focus of the ADP is building capacity for local people to undertake their own development. Initial activities involve subsidies from donor and funding institutions. However, as the project goes farther, the level of subsidy decreases to a point at which WV phases out and the community takes responsibility. The major advantage of the ADP is that it can integrate sponsorship funding, grant funding, research, and type of resources. The ultimate intent of the ADP is for the community to be able to sustain activities, processes, and structures once WV leaves the community. A set of indicators is used to determine the appropriate timing and manner of exiting a community.

In Vietnam, ADPs are focused within one administrative district of a province, providing a manageable area where activities can be effectively and efficiently implemented. Currently, WV operates 31 ADPs in Vietnam, 26 of which are located in mountainous areas where the majority of the population are ethnic minorities. One of the unique components of the ADP is that team members are based in their assigned localities, thus enabling them to work more closely with local government partners and with the community on a daily basis.

WVV's ADPs use a variety of methods to incorporate the community in their work. Some of these methods include the use of DSGs (Development Solidarity Groups), CDGs (Community Development Groups), VDBs (Village Development Boards), farmers' clubs, children's clubs, and animal-raising groups. WVV does not seek to mandate any particular structure as the only correct one. However, it makes sure that each structure ensures broad and deep participation of the most vulnerable people.

One of the most innovative elements of ADPs in Vietnam is developing and working with "hamlet facilitators." These are local people, usually farmers, who receive training from the staff of WV or partners. The hamlet facilitators then share their knowledge with the community members who live around them. Currently, WVV has mobilized a network of 2,300 hamlet facilitators to implement community development work in the absence of outside resources.

WVV acknowledges that rural development will not be sustained unless powerful community-based agricultural and food security programs support it. Since poverty and food insecurity are mostly located in rural areas, growth in the agricultural sector has been a key mission for WVV. Recently, WVV agricultural projects focus on integrated pest management (IPM), rodent control, and participatory irrigation management (PIM), among others. It is also important to note that strong links between WV's agricultural thrust and other sectors such as disaster mitigation, nutrition, and business development services (BDS) have been established.

R-E interface and multistakeholder partnerships

WVV projects are based on a strong local support system that strengthens local ownership and capacity to reinforce new techniques. They also establish a hamlet facilitator network (composed of volunteers from the community), which is structured in a way in which knowledge flows through the facilitators to their adjacent households. Hamlet facilitators receive a number of technical training skills and acquire significant teaching and facilitation skills. With access to ADP training materials, hamlet facilitators are able to keep looking for opportunities to improve the living conditions of their hamlet even if the ADP has ended.

Lessons from ADP

1. Invest in grass-roots capacity and capability
   WVV ensures that the partners in the village, commune, and district have the capacity to sustain their work after transition. Substantial funding is allocated to staff and partner capacity building. Capacity-building activities focus on "learning by doing" and participatory tools such as participatory adaptive research are used in the work with ethnic minorities.
2. Integration
   Projects will not be implemented in isolation, but designed in such a way that outcomes in one project can be measured in other projects (e.g., the effects of early childhood education on nutrition).
3. Long-term results
   WVV believes that sustainable development in communities takes time. Therefore, WVV assesses and designs ADPs that are operational for a longer period of up to 15 years. Further, reducing dole-outs has been found to increase ownership and sustainability.

Source: Dzung NV. 2008. Area Development Program as a model for the dissemination of natural resource management. Paper presented at the IRRC-ICOP Workshop. Philippine Rice Research Institute, Maligaya, Nueva Ecija, Philippines, 6 February 2008.

munes from these projects, as compared with communes with no project interventions. Finally, we draw some lessons learned for the implementation of these projects.

Rodent control in rice-based farming systems

The overall goal of the project was to assist farmers in Bac Binh District, Binh Thuan Province, to protect rice crops from damage by rodents by using environmentally friendly methods, including a community trap-barrier system (CTBS) in lieu of chemical control methods. The project lasted from 2001 to 2005.

Project objectives:

- To test and upscale the use of CTBS over Bac Binh District, and later in Binh Thuan Province.
- To develop a user-friendly, field-based toolkit and leaflets for farmers and extensionists to enable sustainable use of the CTBS for rodent control (in lieu of existing chemical control methods).
- To disseminate CTBS methods across Vietnam through World Vision's Area Development Programs in Vietnam's 14 provinces.
- To distribute the toolkit through the network of plant protection agencies through the Plant Protection Department of the Ministry of Agriculture and Rural Development.

The Soil Fertility Improvement project

The overall goal of this project was to help farmers in Bac Binh District, especially those who live in remote, mountainous areas with less-favored soil, to improve their household food security by improving their crop yield through improved soil fertility. Specifically, the project aimed to help farmers improve their understanding of their soils, be able to classify soil types, assess current soil nutrient status, participate in on-farm trials, and experiment to find ways to improve soil fertility to maintain/increase crop yield. The project lasted from 2001 to 2005.

Short-term objectives

- Help farmers improve crop yield through adoption of appropriate trial-based fertilizer formulas (recommended by the National Institute of Soils and Fertilizers, NISF).
- Introduce new high-yielding varieties suitable to local conditions to increase household food security. These are tested with fertilizer formulas recommended by NISF before scaling-out.
- Encourage the use of organic fertilizers (manure) to improve soil health and the adoption of integrated pest management techniques as an integral part of soil conservation.

- Conduct farmer-to-farmer extension to diffuse best practices gained from successful trials.
- Establish extension clubs to encourage sharing of information and experiences from these participatory adaptive research and extension activities.

Long-term objectives

- Recommend new crop patterns to maintain soil health and increase crop yield.
- Provide district Department of Agriculture staff with a knowledge base of local soil properties.
- Introduce methods of soil testing (rate trials and omission trials) currently used to identify nutrient limitations in soil for a particular type of crop.
- Introduce GIS-based land appraisal technology, used to identify potential land areas for a particular type of crop, through pilot testing of a Land Suitability Map for Hoa Thang commune.
- Build a demonstration database of soil properties for future adoption by the district Department of Agriculture and encourage local use in formulating an agricultural development master plan.

It should be noted that the above two projects were integrated into an ongoing development program implemented by World Vision in Bac Binh called the Area Development Program. The ADP is a model community-based, demand-driven development program typically comprising intervention activities focusing on agriculture, public health, education, economic development (such as micro-enterprise), and natural disaster management, done under cross-cutting issues, including gender, monitoring and evaluation, and capacity building for local people. An ADP is normally designed for 10 to 15 years' operation with funding committed from a key support office from within World Vision Partnership. Both areas of intervention and time duration for an ADP are expected to allow time and opportunities for a community to make efforts to move out of poverty. As such, the above two projects are fed into this program for this reason and to make sure that the add-on projects are an innovative addition to the overall development program in an ADP. We noted that the existence of a multiyear development program like this Bac Binh ADP is extremely vital to the success of these two projects given the leveraging of the WV's staff, commitment, and existing partnership with local partners, including governments, technical support network, and beneficiary communities.

Participatory adaptive research model—roles of change agents and opinion leaders

The traditional innovation diffusion model

Traditional research on diffusion puts farmers at the center of the diffusion process. Goss (1979) argued that traditional systems tended to hold farmers responsible for their actions in adopting an innovation. This is called person-blame causal distribution bias. This assumption caused an ignorance of the consequences as a result of the diffusion

process. Classic linear models of diffusion of innovation assumed that innovations are always good and farmers should adopt them (Fliegel 1993).

Rogers (2003) argued that this tendency is a *pro-innovation bias* and was one of the most serious assumptions that pervaded research tradition without a remedy, making these assumptions troublesome and potentially dangerous in terms of intellectual sense. This assumption resulted in diffusion researchers ignoring studying why there was an ignorance of innovation and why they underemphasized the rejection or discontinuance of innovations, and overlooked reinvention until the 1970s, when criticism of this assumption rose. Rogers (2003) pointed out two main reasons for this assumption: first, most diffusion research was funded by change agencies whose purpose was to promote the use of the innovations they wanted; second, rejected or discontinued innovation was less likely to be investigated by diffusion researchers. He suggested that pro-innovation bias could be overcome by considering the following points:

1. Investigate the diffusion of innovation while the process is underway to ensure collection of reliable data;
2. Be thoughtful in selecting an area of study—comparative analysis of both successful and unsuccessful cases of innovation diffusion is useful because such a wide range of innovations helps overcome pro-innovation bias;
3. Try to understand individuals' perceptions of innovation and their situation given that personal perception could lead to rejection, discontinuance, or reinvention of the innovation; and
4. Study the diffusion of innovation in a broader context.

Considering these factors, in Rogers' opinion, helps avoid possible pro-innovation bias. Finally, he recommended that attempts be made to understand users' motivations for adopting an innovation so as to avoid this type of bias.

The diffusion of innovation is complex and the success of diffusion could not be warranted unless the roles of stakeholders participating in this process are analyzed to ensure that stakeholders share and are committed to achieving the goal. In this review, we focus on the role of change agents and opinion leaders to see how these stakeholders interact to facilitate the success of a project. In the next section, we will outline our project collaborative research model. Then, we elaborate the roles that change agents and opinion leaders play in this model, which made the projects successful.

The project collaborative model

The commune administrative unit (rather than experimental site) is used in our review as the unit of analysis so as to assess the spillover effect of the results from project experiments. Experiments and demonstration sites were set up with the participation of selected farmers who monitor and manage the experimental sites under the supervision and support of WV's project team and research staff from research institutions. The schematic model below outlines the reciprocal relationship between stakeholders and the purposes of each relationship in this participatory adaptive research model.

A total of 42 experimental sites were set up under the rodent project and 28 sites under the soil fertility project over the course of 5 years for both experimental and

demonstration purposes. All sites were managed by farmers, supported with weekly site visits by project staff and district extension staff for data collection, technical clarification, and problem solving. The experimental design and laboratory testing were supported by staff from relevant research institutions. At key times during the cropping seasons (experimental design, fertilizer application, establishment of a community trap-barrier system (CTBS) to catch rats, harvesting…), technical staff from participating institutes came to work closely with farmers and local staff (World Vision, extension centers, farmers, local governmental leaders) and provided training to farmers using the farmers' field school training approach.

Change agents (World Vision and participating research institutions)

World Vision Vietnam was assigned the responsibility of implementing the projects. The project team coordinates all project activities and works closely with experts from collaborating institutes and farmers at the project sites to set up experimentation and to conduct capacity-building activities for district and provincial extension staff. The WV's local team also aimed to share (within World Vision Vietnam) project training materials and organize training in other provinces where applicability of project technologies was appropriate. Participating research institutions acted as the principal technical advisors to the WV's project team. They were involved in field surveys, experimental design, data analysis, and on-farm training (to farmers and local extension staff). World Vision and researchers from participating institutions worked closely with each other to maximize the strength of each party while compensating for the disadvantages inherent to each so as to maximize the concerted support to local farmers and extension agencies.

Opinion leaders (innovative farmers and community leaders)

Opinion leaders of the projects included both innovative farmers and community leaders. Both parties played different roles but complemented each other in different ways to assure maximum participation of local stakeholders, while sustaining and disseminating project outcomes to other sites (both within and outside the province).

Farmers who were selected to manage the experimental or demonstration sites were those who are known locally as innovators (those who usually try new ideas/technologies) or are collaborators of national extension programs. They had to commit time, effort, and part of their farm plot for experiments. Typically, these innovators have good communication skills and a good reputation locally.

Within the project area, communes that have ongoing support from WV and a need for appropriate technology are typically selected because there is already a commitment from the communal authority to carry out the project activities. This status is very important in making sure that experiments are overseen by local leaders and successful activities can be promoted and adopted by beneficiaries of ongoing WV projects.

Project outcomes

When commitments were made by the project team and scientists from participating research institutions, and a measurable and achievable plan of adaptive research was in place (with participation from local farmers), this generated significant leverage of limited local extension resources (typically limited human and financial resources and technical expertise) and enhanced the likelihood of experimental success.

The concerted action and effort of change agents and opinion leaders led to the success of the project. Table 1 summarizes the key findings of our review of the two projects.

Lessons learned and conclusions

The main lessons we draw from the two reviewed projects are different in nature. While the rodent control project aimed to maintain expected crop yields by preventing losses from rodents, the soil fertility project aimed for increased crop yields. Nevertheless, the role of the stakeholders—the change agents and the opinion leaders—were equally important and instrumental to the success of the technology diffusion process. We particularly found that the high level of technical support and the continuous commitment from researchers from national and international institutions played an important role in providing a strong platform for change for the major end-users—local government officials, farmers, and other WV staff.

Scientists from research institutions provided different pathways for bringing effective and sustainable change to famer groups. They brought a high level of expertise to the area of research in question, particularly their knowledge and research methods. Developing field trials in a farmer participatory adaptive research framework made the knowledge more accessible to farmers. Also, their regular presence in the field provided farmers and local agricultural staff with opportunities to ask questions that perhaps they would not have been prepared to ask during a formal training course. Their presence in the field, planning experiments together with farmers and training them in their own fields, provided an encouraging atmosphere for farmers to adopt new attitudes, knowledge, and practices. The adaptive research confirmed farmers' understanding of problems they faced, and most importantly provided them with a way to address the problem through an evidence-based approach to new knowledge and improvement in their crop production.

World Vision (a nongovernmental organization) played a vital role in both projects. The implementation of the projects was integrated into its ADP program, with emphasis on (1) *capacity building*, which focuses on the "learning by doing" approach; (2) *integration*, which focuses on the idea of implementing the project in relation to other projects and with respect to the other aspects of community life such as health, education, economics, consumption, and livelihood, among others; and (3) *sustainability*, which involves capacity building of all the stakeholders, understanding that sustainable development communities take a long time, and building a sense of ownership among the people.

Table 1. Overview of the activities for the two projects established in target communes compared with normal farmer practices (nontarget communes), and their associated impacts. CTBS = community trap-barrier system.

Rodent control in rice-based farming systems	
Farmers in target communes	Farmers in nontarget communes
▪ After trying the CTBS, farmers from agricultural cooperatives started using it when rodents became abundant. ▪ There was a reduced reliance on chemical control methods, which can be harmful to both humans and domestic animals, including possible contamination of water sources. ▪ There was collaboration for consensus building and community action among farmers in habitats where rodents were abundant when the crop was fallow. ▪ Community action was conducted before rodent populations reached densities that cause significant economic losses.	▪ Farmers use potentially harmful chemicals to control rodents. ▪ Farmers work individually to control rodents in their own fields. ▪ Farmers tend to apply control too late, after damage has occurred to their crops. ▪ Control actions were less targeted with regard to refuge habitats.
Project impact	
▪ CTBS technology is known now not only within the original target district (Bac Binh) but also in the whole province of Binh Thuan. ▪ The technology is now commanded by technical staff from district and provincial levels of this province. ▪ Rat abundance decreased significantly over three consecutive years following the introduction of the CTBS to the community in Bac Binh and in two other districts of the province. ▪ The technology was also replicated by the World Vision program across its 14 Area Development Programs (14 provinces) at that time. ▪ The success story and CTBS methods (built from lessons learned from Bac Binh) was documented in a toolkit that has been re-printed by World Vision and shared across Vietnam, World Vision International (as a case study), and the Plant Protection Department of the Ministry of Agriculture and Rural Development. ▪ The toolkit was also shared electronically on the Web site of mekonginfo.org and the Web site of World Vision in Vietnam. It was also shared by CARE International.	
Soil fertility in acidic uplands	
Farmers in target communes	Farmers in nontarget communes
▪ Farmers know how to improve yield through the adoption of an appropriate fertilizer formula recommended by the National Institute of Soils and Fertilizers. ▪ Farmers were willing to conduct farmer-to-farmer extension to disseminate results and methods from successful trials to similar land areas through on-farm workshops. ▪ Farmers established extension clubs to enable sharing of information and experiences from farmer-based research activities.	▪ Farmers continued with traditional soil management practices. ▪ Farmers worked individually and relied on local agricultural extension services (to which they had limited access).

Table 1 continued.

DARD of Bac Binh District	Nontarget districts of Binh Thuan Province
▪ District Department of Agriculture and other subdepartments had a better understanding of soil properties. ▪ Understand methods of soil testing (rate trials and omission trials) that could be used to identify nutrient limitations in soil for a particular type of crop. ▪ Have a better understanding of GIS-based land appraisal technology, which helps identify areas suitable for particular types of crops. ▪ Have access to a "crop suitability" map (piloted for Hoa Thang commune), which is helpful for planning crop cultivation.	▪ Continuing to rely on soil maps that are not suitable to planning crop cultivation. ▪ Lack of knowledge on soil properties limited the effectiveness of agricultural extension activities and annual crop planning.
Project impact	
▪ Farmers are now aware of the important role of organic fertilizers. Therefore, cow manure, which is available in great quantity in the community, was retained for local use rather than being sold to farmers in other areas in the Mekong Delta. ▪ Farmers appreciated the role of on-farm experiments for their own learning process and considered this an important part of their effort toward improving the quality of soil health and crop yield. ▪ Staff at agricultural extension stations at the district and provincial level are more aware of the role of experiments in raising the awareness of farmers in improving soil quality. ▪ The World Vision project team was able to continue experiments after the project closed. This experimental mind-set created a learning community in the project area covered by World Vision. ▪ Relationships established with a national research institution (National Institute for Soils and Fertilizers) were continued in other aspects of agricultural research and extension under other World Vision programs. ▪ Knowledge gained from the project was extended to other World Vision teams as part of knowledge sharing in the area of soil amelioration.	

WV (the local team) maintained effective communication among stakeholders and provided an effective link between farmers and researchers, and the funding agency (Australian Centre for International Agricultural Research). WV staff ensured that local staff maintained a focus on project goals and that they became achievable within the project time frame. While scientists are not always at the site, WV acted in the role of clarifying technical issues and ensured effective communication between stakeholders, and that experiments were conducted properly (failure of one experiment in some cases is equivalent to the loss of one year since the failed experiment needs to be repeated in the same cropping season the next year). Their job was also to ensure that experiments were co-managed by farmers and extension technicians to ensure satisfactory completion of field trials and demonstrations.

Local governmental leaders were pivotal in both projects. Continuous support and monitoring of experimental activities and support for replication of experiments and request for concerted coordination between relevant local agencies (DARD, plant protection stations, agricultural extension station, farmers' association, women's association) were important to ensure that successful activities were shared across the project area. This was then fed back to the regular agricultural extension program of the government, indicating local government co-ownership of the projects.

Farmers are the end-users and they provided a clear measurement of whether the projects could add value to their current practices. They decide whether they adopt the technology as they validate it by evaluating its value in contributing to increasing their crop quality and yield. Despite the wealth of their indigenous knowledge, they know that their knowledge needs to be updated to cope with continuously changing conditions (soil, water, air, farming systems, market conditions, etc.) to maintain and increase their crop yield. In addition, given the context of climate change, an increasing need for improved crop quality, and the pressures of regional food security, effective cooperation between farmers, scientists, local government, and the business sector needs to be maintained. This collaborative model using adaptive research provided a good framework of partnership and an active learning alliance between these partners. Such success stories need to be scaled out, not only to leverage the limited financial and human resources on the part of the government but also to avoid possible traps in the innovation diffusion process. The two projects mentioned above are actually a dialogue between development organization, technical support institutions, and the beneficiary communities. When the commitment of these parties is sustained, this achieves the goal of innovation diffusion in agricultural extension.

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