The system of rice intensification as a sustainable agricultural innovation: introducing, adapting and scaling up a system of rice intensification practices in the Timbuktu region of Mali

Erika Styger[1*], Goumar Aboubacrine[2], Malick Ag Attaher[3] and Norman Uphoff[1]

[1] SRI International Network and Resources Center (SRI-Rice), Cornell University, Ithaca, NY, USA
[2] Africare Timbuktu Food Security Initiative (TFSI), Goundam, Timbuktu, Mali
[3] Agriculture Production Division of the Government's Regional Agricultural Service, Timbuktu, Mali

The system of rice intensification (SRI) originated in Madagascar in the early 1980s and has spread today to 40 countries worldwide. SRI increases rice yields significantly while reducing requirements of seeds, water and chemical inputs. SRI is a planting method based on the principles of using single, young transplants at wide spacing, the application of compost, mechanical weed control and intermittent irrigation. Over a three-year period the American NGO Africare has successfully introduced, adapted and started scaling up SRI in the Timbuktu region of Mali. The implementation processes and approaches changed with each year and depended on (i) the technical adaptation of SRI practices to the Timbuktu environment, (ii) farmers' and technicians' know-how of the SRI technical requirements, (iii) collaboration with the government extension and research agencies and (iv) the funding level. The number of SRI farmers evolved from 1 to 66 to 450 farmers from year 1 to 3. All SRI farmers were volunteers, most of them achieving highly superior yields and income compared to their current system. SRI practices have induced a dramatic shift in the perception and understanding of how to achieve sustainable and productive rice cropping systems, stimulating farmers and technicians to initiate a series of innovations inspired by the SRI system.

Keywords: adaptation of technology; adoption of technology; extension approach; farmer-centred learning; innovation development

Introduction

One of the most promising innovations to enhance agricultural productivity, with positive effects on the natural environment, is the system of rice intensification (SRI), which originated in Madagascar in the early 1980s. Unfortunately, it has been slow to spread to other African countries, while its adoption has been expanded more rapidly in Asia, where most of the world's rice is grown. In recent years, SRI has begun to take root in various African countries, a timely development because rice consumption in the region has grown rapidly. Between 1961 and 2005, annual increase in rice consumption was 4.52 per cent in sub-saharan Africa, whilst annual per capita production by only 3.23 per cent. Self-sufficiency ratio declined steadily from 112 per cent in 1961 to 61 per cent in 2006. Africa imports 40 per cent of its consumption needs. The imports represent one-third of what is available on the world market (AfricaRice, 2008). Increased production of this staple grain will both bolster food security and decrease dependence on imported food.

SRI was developed over a 20-year period of observation and experimentation by Fr. Henri de Laulanié in Madagascar: often on poor soils and working with resource-limited smallholders (Laulanié, 1993; Uphoff,

*Corresponding author. Email: eds8@cornell.edu
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2005). Rather than relying solely on improved varieties or greater use of purchased inputs like fertilizers, SRI is a management-based strategy for raising the productivity of resources already available to farmers.

SRI practices increase yields by changing how rice plants, water, soil and nutrients are managed:

- Farmers transplant single, young, widely spaced seedlings in lines, rather than closely spaced clumps of plants, greatly reducing the number of plants (and therefore seed) required. Farmers can use their own seeds, as higher output does not depend on introduction of new varieties.
- SRI replaces the traditional practice of flooding paddy field with limited, intermittent water application. This uses much less water, making rice production possible where there is insufficient water to keep fields flooded.
- To control weeds, farmers use a simple mechanical weeding tool, which removes weeds and aerates surface soil.
- Compost, manure or other organic materials are applied as the base for fertilization, improving soil structure, soil organic matter content and fertility. If necessary, chemical fertilizers may be used as a supplement.

In Madagascar, uptake of SRI was slow during the first two decades, but more recently the use of SRI-recommended practices has spread to more than 200,000 farmers (Randriarimanana, 2006, personal communication). More than 70 organizations are members of the 'National SRI Group', which coordinates and supports SRI implementation (http://groupementsrimada.org/en). Evaluation of SRI practices in the Gambia and Sierra Leone in 2000–01 indicates an increase in rice yields from an average 2.5t/ha using local methods to 5–7.5t/ha using SRI management (USAID, 2004; Ceesay *et al*., 2006).

In 2006, the International Fund for Agricultural Development (IFAD) brought SRI trainers from Madagascar to Rwanda, where they trained farmers in Kibaza and Rwabutzai. After two years, 2,000 farmers in these districts raised rice yields from 4 to 6–7t/ha using SRI practices (IFAD, 2008). IFAD has now introduced SRI in Burundi (www.ifad.org/operations/pipeline/pf/bu2.htm). Trials in Benin, Burkina Faso, Guinea, Senegal and Zambia have shown substantial productivity gains using SRI methods (see specific country information in http://sri.ciifad.cornell.edu/countries/index.html).

However, the uptake and spread of SRI in these countries have been slow due to lack of both leadership and financial support. An effort to introduce SRI methods in the Gharb region of Morocco in 2008 did not achieve the expected results because of both difficulties with water management and farmers' preference for more mechanized cultivation (Antonelli and Cherkaoui, 2008).

To understand what is required to successfully introduce SRI practices in an African context, the example of Mali is most instructive. The US non-governmental organization (NGO) Africare introduced SRI to farmers in the Timbuktu region. Farmers took responsibility for both the trials and their evaluation (Africare, 2008; Styger, 2009, 2010).

The Timbuktu region covers 40 per cent of Mali. It is mostly in the Sahara desert, but the southern part is a Sahelo-Saharian climate with yearly rainfall of 100–150mm, too little to grow rainfed crops. The only permanent water source is 400km of Niger River where it flows through the region. Farming depends on the annual rise of the Niger River, which induces seasonal flooding of tributaries, ponds and lakes. Traditionally, farmers utilize this annual flooding to practise either recession agriculture as the flooding subsides or deepwater rice cultivation during the flooding itself. Yields are usually low: $<$1t/ha for both rice and sorghum. For the past 30 years, farmers have grown irrigated rice in village-based, small-scale irrigation schemes of 30–35ha, small enough to be irrigated by one diesel motor pump. The Timbuktu region, with over 20,000ha under irrigation, has become the second most important region for irrigated rice production in Mali (DRA Tombouctou, 2009).

Africare has worked for the past 12 years with vulnerable communities to implement an integrated food-security programme in the Goundam and Dire Circles of the Timbuktu region, among the most food-insecure areas in Mali. Working through village-based food security committees with support from local government and traditional authorities, Africare has focused on increasing access to food, improving health and nutrition, and building community capacity to manage risks and shocks. It has provided technical support for agricultural development and established village irrigation schemes with farmers. During the past three years, Africare, in collaboration with the government agriculture service, has worked on SRI practices with farmers to: (i) evaluate the suitability of SRI methods for the prevailing agro-ecological conditions; (ii) adapt SRI practices

to local conditions; and (iii) spread and scale up SRI practices while continuing to innovate.

Innovation process

Introducing SRI did not begin as a formal project activity, but was simply an idea that Africare project staff agreed to test, out of curiosity, with help from one volunteer farmer. Following the success of this initial trial, during the second and third years, the approach and specific activities evolved, based on both the lessons learned and the amount of funding available for each cropping season. This 'learning process' strategy (Korten, 1980) is described below for each of the three years. Africare's long-standing presence in the region and its good relationships with the farming communities provided an immeasurable advantage for engaging farmers, as collaboration was based on mutual trust and respect. Basic principles can be summarized as follows: (i) put farmers at the centre of innovation development, (ii) social capital development is the foundation for progress in innovation, and (iii) high-quality technical backstopping and good data collection are essential.

Year 1: testing SRI

One volunteer farmer, with support from Africare, agreed to test SRI. Using the only SRI manual available in French at that time, from Madagascar (Uphoff and ATS, 1998), staff designed the initial assessment to respond to the following questions:

- Can rice grown using SRI methods show improved performance compared to current rice production in the Timbuktu region, on the edge of the Sahara desert?
- If so, what are the potentials for production increase and resulting impacts on food security?
- How can SRI practices be adapted to the current farming system with respect to environmental conditions and farmer practices?
- If rice grown using SRI practices performs well in Timbuktu, could these practices work as well in other regions in Mali, other Sahelian countries, and beyond in West Africa and Africa as a whole?

Africare technicians analysed which of the principles and methods could be tested within the rice cropping system. The volunteer farmer provided land, labour and inputs for this first test, which was done without any supplementary funding, based solely on farmer and project staff interest, in addition to their other work.

The SRI plot and the control plot were installed side by side, using the same rice variety. Nurseries were started the same day. Young seedlings were transplanted, one plant per hill, with a spacing of 25cm × 25cm on a square grid, and organic matter was applied to the soil. However, other principles could not be followed: the mechanical weeder was not available, land was not optimally levelled and the irrigation schedule was the same as for the rest of the (non-SRI) irrigation scheme. An Africare technician tracked crop management data.

During the cropping season, leaders from surrounding villages and farmer cooperatives were invited to visit. They saw that plants in the SRI plot, even with incomplete use of the recommended practices, were outperforming those in the control plot. During the visit, farmers viewed a SRI video from Madagascar (with simultaneous interpretation into the local language), providing more complete information about SRI practices and how the methodology performs in another African country. Having seen the test, farmer leaders unanimously agreed to evaluate SRI practices in their own fields during the next cropping season.

Government agriculture extension staff and researchers from the nearby research station of the national agricultural research organization Institut d'Economie Rurale (IER) were invited to assist in the different activities. Some extension staff did participate but the researchers did not respond.

Results of the initial test: the SRI plot yielded 9t/ha compared to 6.7t/ha in the control plot, a 34 per cent increase for SRI (Africare, 2008).

Year 2: adapting SRI practices

For the second year, Africare was fortunate to obtain financial support from the California-based Jim Carrey's Better U Foundation to (i) design and implement a farmer-centred evaluation of SRI practices, (ii) compare SRI practices to farmer practice and (iii) adapt SRI practices to the local farming conditions.

Africare identified 12 villages with which it had collaborated effectively over previous years. For wide geographic coverage, villages were located in two different administrative circles, namely Goundam and Dire, and in four different communes, but distances between villages were close enough to facilitate supervision and to ensure good social connections between the villages. Knowing that neighbouring villages had joined the SRI evaluation

fostered a friendly competition between them. Following village meetings with Africare staff, communities decided by consensus to participate in the SRI evaluation, selecting five volunteer farmers to represent the community. Thus, a total of 60 farmers evaluated SRI on 60 plots. Villagers organized themselves without outside intervention. The selected farmers led in carrying out this innovation, and other community members contributed manual labour, learning the SRI practices at the same time. Participating farmers were fully responsible for their plots, made their own decisions, provided their own labour and received neither seeds nor fertilizer. The only material assistance supplied by Africare was two cono-weeders, a simple mechanical weeder previously unknown in the area, for each village. There were no guarantee payments to cover losses in case of failure. SRI farmers made field exchange visits among themselves, received interested outside visitors and worked with Africare staff to develop recommendations for the following cropping season.

Congruent with the first-year approach, a SRI plot and a control plot were installed side by side, using the same seed as chosen by the farmer. Both the SRI and control plot nurseries were established the same day to allow farmers to compare crop development side by side throughout the season. Farmers determined the size of the plots. Each control plot was to follow the farmer's usual practices, while technicians assisted each participating farmer to implement the new SRI practices in the other. SRI principles were thoroughly explained to farmers at the outset of the season. Technicians collected data on a weekly basis. The technical approach integrated all six SRI principles, implemented as follows: transplant single seedlings at the two-leaf stage (8–12 days old), planted on a 25cm × 25cm grid; reduced intermittent irrigation during the vegetative growth period, frequent weeding with a simple mechanical hand weeder that aerates the surface of the soil; and application of 10–15t/ha of organic matter, to be complemented by chemical fertilizer only if necessary. For irrigation, fertilization and weeding, farmers were asked to adapt the management according to their own assessment of plot conditions. This provided us with information about local adaptations of SRI practices. This stands in contrast with most researcher-driven approaches, where researchers decide on (for example) the amount of fertilizer to be applied. With the latter approach, information gained does not reflect actual conditions, results do not reflect farmers' reality and potentially beneficial impacts of the research are delayed.

Because farmers were responsible for their own crop management, the results directly reflected farmers' conditions and realities. This volunteer approach is straightforward and transparent, and only genuinely interested farmers are likely to participate. This was a novel approach in a country where government agencies and donors usually provide free inputs or subsidies as 'incentives' when conducting a trial or demonstration, which makes the innovation process an outsider-driven exercise. One can never be sure if a farmer participates for free access to inputs or out of real interest. Open, honest collaboration is necessary for innovation development to work effectively and to produce results relevant for farmers.

NGO staff provided reliable technical backstopping, working closely with farmers to implement SRI practices for the first time. This greatly increased farmers' confidence. Each week the technicians collected data on crop performance, labour, irrigation applications and other indicators. Additionally, technicians collected many qualitative observations from talking informally with farmers.

The government agriculture service is in charge of implementing national agricultural strategies and programmes and of coordinating and maintaining oversight of all agricultural activities in the region. The agriculture service of the Goundam Circle delegated one senior staff person to represent it throughout the entire evaluation, but the Dire technical service did not respond to Africare's invitation to participate. At a higher level, the director for the overall Timbuktu region established his own personal SRI plot so as to gain firsthand experience of SRI. Based on his own results and the results obtained from the 60 farmers, he concluded at the end of the season that the use of SRI practices should be scaled up across the region, and appointed an SRI coordinator for the Timbuktu region. Africare and the agriculture service both invited research staff from IER to visit the SRI plots and to participate in the season's evaluation, but IER did not respond to the invitation.

Social capital development for the technical team: The technical team was composed of four field agents, each living in a different SRI village and responsible for backstopping 15 farmers in three SRI villages, two supervisors, one from Africare and one from the government extension service, and one external technical consultant.

The consultant reviewed the various SRI manuals available on the internet – from Madagascar, Nepal and India – and summarized the practices found in them. The major milestones to be implemented on a

defined schedule were (i) soil preparation and nursery establishment, (ii) transplanting, (iii) crop management, including weeding, fertilization and irrigation, and (iv) harvesting. Before beginning work on each of these milestones, the technical team met to discuss in detail the requirements of SRI as applied in other countries and current rice cropping practices in Timbuktu. They then drew up a list of proposed modifications of SRI practices to fit local farming conditions. Next, the team discussed the proposed guidelines with the farmers in the field, making adjustments as necessary, and implemented the practices together with the farmers. Once best implementation practices were established, technicians returned to their SRI villages, carrying out the respective practices over the next few weeks with their farmers. Before beginning work on the next milestone, the team would meet again to share previous milestone field experiences and further refine the guidelines. Once the process was complete, the technical guideline development for the next milestone was begun as described above.

This approach allowed periodic and systematic collection of field experience. It benefits from the deep knowledge of field technicians who are also aware of the many social factors that influence the agricultural system. Such an approach is seldom used in current agricultural research, where most often a project agronomist will make decisions and provide analysis on purely technical grounds with little or no consideration of social factors. In addition to being relatively simple and inexpensive, this approach also encourages and motivates technicians as fully acknowledged and appreciated team members.

At the end of the season, Africare published a field manual for using SRI techniques in the arid Timbuktu environment, the second SRI manual to be written in the French language (Africare Mali and SAC Goundam, 2009).

Season results: Average SRI yields of the 60 farmers reached 9.1t/ha, with the lowest yield being 5.4t/ha and the highest 12.4t/ha. On average, SRI yields were 66 per cent higher compared to the control plots with 5.49t/ha, and 87 per cent higher than from surrounding rice fields with 4.86t/ha average yield. All yield parameters were superior with SRI compared to the control plots. Although SRI plots contained 3.5–5 times fewer plants per square metre at the time of transplanting, at harvest the number of panicles per m^2 was 31 per cent higher than in the control plots. Also, the one-plant SRI hills produced on average 50 per cent more tillers than the three plants per hill in the control plots.

Although production costs per hectare were slightly higher for SRI – 15 per cent and 25 per cent compared to the control and farmer-practice plots, respectively – SRI revenues were 2.1 and 2.4 times higher. Net revenue for SRI farmers were more than 1 million CFA/ha, compared to 490,000 CFA/ha for the control plots and 426,000 CFA/ha for the farmer-practice plots. The calculated cost of producing 1 kg of paddy was 76 CFA and 77 CFA for the control and farmer-practice plots, respectively, 50 per cent higher than the 52 CFA/kg for SRI.

Using SRI practice, only 6kg of seeds were used per hectare compared to 40–60kg under farmers' practice, a reduction of 85–90 per cent. With application of organic matter, chemical fertilizer inputs were reduced by 30 per cent. Use of irrigation water was reduced by only 10 per cent, much less than attained elsewhere in the world under SRI practice, which usually attains reductions of 25–50 per cent. This was due to farmers' initial hesitation to reduce water application in this hot and dry climate, and the limited control of irrigation at the field level (Styger, 2009).

Year 3: scaling up and continued innovation development

Based on year 2 results, the Regional Director's own SRI experience and availability of locally adapted technical guidelines, Africare and the Direction Regionale d'Agriculture (DRA) developed a three-year programme to systematically scale up SRI across the entire Timbuktu region. Unfortunately, no donors could be found to fund the full project. With two small grants – from Jim Carrey's Better U Foundation and the US Agency for International Development (USAID) – SRI fieldwork continued in the third year, although on a smaller scale than desired. Given limited resources, Africare decided to scale up within the area already practising SRI, to introduce SRI into a few adjacent locations and to continue innovative development in relation to SRI practices.

The objective for this third year was to make SRI techniques available to all interested farmers in the four communes where SRI had been introduced the year before. Of the total 31 rice-growing villages in the four communes, the project was able to provide field support to 20 villages. Two-day farmer exchange visits were organized for the remaining 11 villages, so that by the end of year 3, all rice-growing villages were able to either practise or to learn about SRI practices. Africare also introduced SRI to seven new

villages in neighbouring communes, planned to become new centres for future expansion.

The implementation approach changed from intense technical supervision – as done in year 2 – to one where communities and farmers take primary responsibility. The communities themselves decided on how many farmers would participate and how big the plots would be. There was no outside influence on the extent of participation. This provided an unbiased indication of how much SRI as an innovation is appreciated by the rice farmers of Timbuktu. In the 12 villages from year 2, the number of farmers increased from 60 to 200 in year 3. In the 15 new villages, a total of 70 farmers tested SRI, adding up to a total of 270 farmers in 27 villages.

Africare and DRA technicians were present for the beginning of each major technical task, and once a common understanding was established, both experienced and new SRI farmers continued on their own. Thus, each technician could service about 40 farmers, compared to 15 in year 2. High investment in social capital in year 2 paid off, as new knowledge was built on a solid foundation. Many village communities decided to locate the SRI plots together, which both allowed farmers to more easily work together and facilitated irrigation management, because the SRI irrigation cycle uses a wetting and drying cycle that differs from conventional irrigation.

The government extension services of the Dire and Goundam Circles followed third-year activities with more interest and greater field presence than before, participating more actively in technical backstopping of the 20 villages. IER researchers at the local and regional levels, as in year 2, were invited but did not participate. However, at the national level, an IER rice breeder provided five new varieties for testing under SRI, and the head of IER mechanization helped identify a direct-seeding machine for a system of wheat intensification (SWI) trial (see Table 1 below).

During the first two years, innovation development focused on establishing good guidelines for adapting SRI principles and practices to local conditions. In the third year, focus shifted towards associated practices, with the aim of increasing productivity, reducing production costs and improving environmental sustainability. Trials included compost production, a simple irrigation test to measure reduction in use of water, introduction of a hand tractor to facilitate soil preparation and comparative testing of 15 varieties including seven indigenous *Oryza glaberrima* varieties. Based on an idea from the SRI farmers, SRI principles were adapted to the irrigated wheat crop for a test of the SWI (Styger and Ibrahim, 2009). A prototype seeding machine for wheat was tested in collaboration with a private firm and the IER.

Two additional projects started working on SRI. The Initiatives Intégrées de la Croissance Economique au Mali (IICEM) project funded by USAID introduced SRI into the Gao and Mopti regions and into locations in Timbuktu not covered by Africare, working with 30–40 farmers in each region. It also ran trials on rainfed SRI in the Sikasso region in southern Mali. IICEM applied a similar approach at farmer and

Table 1 | **SRI development in Mali, 2007–2010**

	Number of farmers	Number of villages/sites	Regions	Lead agency	Collaboration with
2007/2008	1	1	Timbuktu	Africare	
2008/2009	60	12	Timbuktu	Africare	DRA
	6	6	Timbuktu	DRA	
Total	**66**	**18**	**1**		
2009/2010	270	27	Timbuktu	Africare	DRA, IER, Cafon
	120	23	Gao, Timbuktu, Mopti, Sikasso	IICEM	DRA, IER
	60	5	Segou, Mopti	Fondation Syngenta, IER	Office du Niger
Total	**450**	**55**	**5**		

village levels as developed by Africare. It worked through local NGOs, the agriculture service and IER. In addition, the Swiss Syngenta Foundation for Sustainable Agriculture contracted IER to introduce SRI into the Office du Niger zone in the Segou region and to one location in the Mopti region. This on-farm work with 25–30 farmers per region was accompanied by a large, multi-year, on-station SRI experiment to evaluate variations in fertilization and spacing.

Over three years, the number of farmers working with SRI practices increased from 1 to 66 to 450, and SRI was introduced into five of Mali's eight regions.

Outcomes and predicted trends

Paradigm shift for agricultural development

SRI introduces a paradigm shift for agriculture, a shift from emphasizing plant breeding and external inputs to better utilization of local resources and better skills. In Mali, the idea of SRI encountered resistance at the beginning. IER rice researchers assured us that SRI would not work in Mali, although they had never tested it. It was the farmers themselves who were most open to these new ideas, as they have the most to gain from any improvement. Testing of the SRI methodology found its initial support from farmers, an NGO and a few open-minded individuals in the government extension service. The solid results created demand for SRI from the bottom up.

One of the most important outcomes from the three-year SRI work is the impact on farmers' and technicians' thinking about how things are done in agriculture. Many SRI technical guidelines contradict those from research institutes and the agriculture service, and often also clash with what farmers think works best. To cite some examples: (1) farmers in Mali believe that using more water to flood their rice fields will give higher yields; (2) similarly, it is currently recommended, and believed, that a higher plant density will increase yields; (3) researchers, extension personnel and farmers are convinced that larger applications of chemical fertilizer will give better results; and (4) many farmers focus on the perceived desirability of new varieties and complain that their seeds are old and less productive, despite the fact that they already possess the best varieties available on the market. Experience shows that many of these assumptions are not true.

In Mali, the SRI results surprised nearly every technician and every farmer, not only as regards yields but also in the challenges to conventional wisdom about how farming is currently done. We observed that once exposed to SRI ideas and results, farmers and technicians become more open to new ideas, more venturesome and creative in their thinking.

The SRI experience encouraged people to look at the larger picture, and to rethink agricultural principles and practices, and to explore new ideas. To cite one example: the idea of testing SRI principles on the winter wheat crop was initiated by farmers, who undertook the first test with support from a dedicated Africare technician. This inclination is a powerful force for innovation development and may be the most powerful and long-lasting outcome of our SRI work in Mali. How can this be encouraged and nurtured?

Constraints and barriers to innovation development

In Mali, innovation development in farmers' fields as undertaken by extension agencies is not perceived as serious, bona fide research. 'Research', in the minds of most, seems restricted to a limited range of concepts and must be carried out in controlled, often unrepresentative research settings, monopolized by the national agricultural research system. Research and development are most often two separate processes operating in different 'worlds', co-existing but not mixing, each side ignorant of what the other is doing.

The old paradigm – developing technology on research stations and then attempting a 'transfer' of technology – still prevails in Mali. Development organizations, such as local NGOs, international NGOs and contractors, have little incentive to undertake research, although it would not be difficult to more systematically collect and analyse data from their own ongoing fieldwork.

Currently, development organizations are funded to collect data about the project indicators imposed by their donors. Data are less often collected to document field progress and orient recommendations for further programme development. Development projects may undertake innovative and exciting work at the farmer level, but do not report on it. Their great work remains relevant only to the farmers directly concerned; the outside world has no way of accessing this information and learning from it. It is also an unfortunate reality that government project outcomes or research results are seldom available to the public in Mali, unless it is a condition of funding. Even when contacted directly, government development and research

organizations will most often decline to share documentation with the interested inquirer.

Why? It is expected that donor-assisted projects and NGOs who wish to establish a partnership with the government technical services, either agriculture extension or research, have to pay for any services. Those unable or unwilling to pay will receive little or no cooperation. This was our experience with IER and the Dire agriculture service, who would not make simple field visits without receiving per diem payments. Only a few volunteer government staff participated in field visits and meetings, and they greatly enriched the team effort and contributed to achieving good-quality work.

Paying for government involvement has both pros and cons. On the positive side, it exposes staff to the innovation and encourages them to take ownership of its testing and evaluation. At the national level, government institutions should be aware of an innovation, which can ultimately lead to official acknowledgment. On the other hand, there is hardly a guarantee of good work, as there is seldom much real quality control within these services. For research, the expectation that collaboration and even exchange of ideas must always be compensated for leaves all the initiative with deep-pocketed outsiders. Innovations and ideas from the field will not drive research agendas. Rather, priorities will be set by the willingness of donors to fund research according to their own preferences. Paid or unpaid, there are constraints on innovation development inherent in both options.

Partnerships between development projects are tricky. Although partnership is encouraged in all official project documents, in reality it can be very difficult to establish genuine, effective partnerships. There are many conflicting interests, and given the perpetual scramble for available funding, competition for donor funding and prestige takes priority. Achieving beneficial impacts for farmers becomes important only to the extent that good results will attract donor resources.

Funding constraints have been a major restriction to the expansion of SRI in Timbuktu and in Mali, as in the situation for year 3 described above. Most bilateral or multi-lateral donors have little flexibility to respond to opportunities that arise from the field, but must follow a planned, multi-year approach with predetermined programmes, funding cycles, targets and expected results. Most donors are reluctant or unable to invest in innovations that emerge from the field. Donor agencies and development professionals may well demand new and better solutions, but both bureaucratic constraints and a reluctance to take risks bring resistance to investing in alternative programmes, even if there is a high demand from the field.

In our three-year experience, it became clear that success was due to the performance of many individuals who went beyond their daily duties, investing the time and energy to make this initiative succeed. It is clear that successful innovation development needs to be institutionalized, but there seems no recipe for it, given that success depends in so many respects on the initiative, persistence and dedication of individuals.

Outlook for the future

Options for spreading SRI are many, but they are dependent on adequate financial underwriting from donors, on political commitment from decision makers, and on reliable, high-quality technical backstopping from field agents and researchers at the farmer level. The commitment and willingness of stakeholders, including farmers, to continue to innovate with SRI practices within the agricultural system should result in its adaptation to the many environments. In Mali, farmers have been quick to understand the importance of SRI for their livelihoods. If the technical assistance provided is collaborative and well conceived, we expect that Malian farmers will pick up SRI quickly and will spread it among themselves, as seen in the Timbuktu region already by the third year of SRI introduction.

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