Adapting the Green Revolution for Laos

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INTRODUCTION

Initial efforts to introduce new agricultural practices during Asia's 'Green Revolution' were derailed in Laos for a number of reasons: the impact of the Vietnam War; unrest associated with the seizure of power by the socialist government and proclamation of independence in 1975; an unsuccessful push to collectivise agricultural production; and limited investment in agricultural research or material support to collectives (Evans 1988). Faced with ongoing food shortages across the country, the government embraced agricultural modernisation as a central policy but lacked the resources to properly implement it.

From 1990 to 2007, the International Rice Research Institute (IRRI) and the Government of Laos built the nation's capacity in rice research and developed improved varieties suitable to Lao farming conditions.

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According to Bestari et al. (2006), the introduction of modern varieties and other inputs has been one of the key factors supporting an increase in overall rice production in Laos. IRRI credits the program with bringing the Green Revolution to Laos, supporting increases in rice production to levels of national self-sufficiency, and building national research capacity (IRRI 2006).

This chapter traces the history and processes that have seen the development, use, and spread of improved rice varieties throughout Laos, particularly in the lowlands of the Central and Southern Regions. This history represents a departure from the Green Revolution narratives of other Southeast Asian countries, where the development and use of improved varieties was predicated on access to irrigation and fertiliser and favoured yield over other qualities like taste or aroma. Instead, efforts to improve rice production in Laos emphasised plant breeding based on local conditions and preferences—low input, rainfed production of sticky rice—and built the capacity of Lao institutions and researchers to continue rice breeding after formal project efforts ceased.

The chapter begins with a brief overview of key events that shaped rural development in Laos and set the scene for the partnership between IRRI and the Lao Government. It then provides a detailed account of the practical implementation of this partnership through the Lao-IRRI Rice Research and Training Program (Lao-IRRI Project), drawing on the accounts of former Lao-IRRI staff, district officials, and farmers in Outhomphone and Champhone Districts, Savannakhet Province.¹ The chapter concludes with a reflection on the characteristics of the Lao-IRRI Project that supported its success.

SETTING THE SCENE: LAOS 1975–1990

The Political Context for Rural and Economic Development

The Lao People's Democratic Republic was declared in 1975, after almost 30 years of civil war and unrest. The threads of the conflict are complex, tied to French occupation, a growing nationalist movement, and Western concerns over the spread of Communism that saw the north of Laos used effectively as an air base (and bombing ground) by the United States (Stuart-Fox 1996; Evans 1988). When the communist Lao People's Revolutionary Party came to power and abolished the monarchy, they declared three revolutions: economic production; scientific and technical;

and cultural and ideological (Evans 1988). The policies enacted in the name of these revolutions had marked impact on the processes of agricultural development in Laos.

The government introduced controls on trading between provinces, established state-run farms, and mandated the collectivisation of agriculture (Bourdet 1996). Collectivisation was seen as the best way to rapidly modernise agriculture and protect against food shortages, but also as a means to strengthen state control against civil unrest and revolt (Evans 1988). All ownership of land was transferred to the state (Ducourtieux et al. 2005).

Rules governing the cooperative system were complicated and inconsistently implemented by local officials (Stuart-Fox 1996). Weekly meetings were held to convince villagers that small plots were inefficient and collectivisation was the best way forward—many households feared the ramifications of not joining the ‘voluntary’ organisations (Evans 1988). People grew increasingly dissatisfied with the cooperative system, resenting the coercion of the district officials, the limited provision of equipment or support from government, and the uncertainty about the implications of joining, generally preferring their traditional lifestyle (Stuart-Fox 1996). Farmers began to burn crops or leave land fallow rather than be forced into collectives (Stuart-Fox 1996). Far from modernising and increasing production, collectivisation led to a drop in production and was suspended after less than a year, with officials citing a need to provide better training and improved conditions (Stuart-Fox 1996).

Collective production was not the only program that failed to bring intended benefits; hence, the Party endorsed the New Economic Mechanism (NEM) in 1986.² Under this policy, the economy has been progressively restructured, for example, re-establishing private property rights, easing restrictions on trade, and deregulating commodity prices to support economic growth (Bourdet 1996). The reforms introduced under the NEM were enthusiastically received by organisations like the World Bank, which described the ensuing economic progress of Laos as ‘unparalleled’ (Rigg 2005: 22).

While the NEM may have supported growth in industry and services, growth in agriculture remained stunted (Bourdet 1996). Rice production was not enough to keep pace with population growth and Laos was dependent on food imports (Evans 1988). Bourdet (1996) suggests slow growth in agriculture was due partly to the vulnerability of farming to drought and flood and partly to the largely subsistence nature of production, lack

of modern inputs, and poor infrastructure, exacerbated by an urban-centric political elite.

Economic reform was implemented within an unchanged political structure; the Lao People's Revolutionary Party remains the only legitimate political party. Party administration extends to all levels and areas—villages, district, province, ministries, and mass organisations (Stuart-Fox 2011). Appointment to local positions, though theoretically by election, is often through lines of patronage and controlled by the Lao People's Revolutionary Party (Stuart-Fox 2011). Opposition is not tolerated, with imprisonment or 're-education' the response to public expressions of discontent (Bourdet 1996). The second Five-Year National Socio-Economic Development Plan (1986–1990) brought decentralisation of government, with the central government providing 'guidelines' while the provinces were charged with the administration and implementation of programs (Hopkins 1995). In practice, information (and misinformation) flows up to the central government and decisions flow down (Stuart-Fox 2011).

Early Efforts in Rice Research

The first commitment to rice research in Laos was in 1955 with the establishment of the Salakham Rice Research Station in Hatsaiphong District, near Vientiane. Despite the centrality of rice in Lao agriculture, formal research efforts prior to this had focused on fruit trees and coffee—which were of more interest to the French (Inthapanya et al. 2006). Research at the Salakham Station during the 1960s focused on evaluation of improved varieties brought from IRRI (e.g., IR8), Thailand (e.g., *Niaw Sanpatong*), and the Philippines (e.g., C4-63-1). Early releases of improved varieties from other countries and selected Lao traditional varieties were distributed through agricultural development programs funded largely by the United States (Inthapanya et al. 2006). The Lao rejected the new varieties, preferring the taste and quality of traditional sticky rice. The seed production capacity of the station was low—far below what would have been required for wide-scale use of the new varieties (Interview 6). In any case, these early experiments with improved varieties were disrupted with the establishment of the Lao PDR.

When Laos was declared an independent state in 1975, research capacity was low: a significant proportion of educated Lao had fled the country, while physical resources and infrastructure were damaged or depleted (Stuart-Fox 1996). Though it was common for officials to undertake

graduate and diploma training in Soviet-bloc countries, as one interviewee pointed out, the Russians ‘weren’t very competitive at rice’ and thus there were limited skills in rice agronomy (Interview 7).

Agricultural cooperatives were used as a basis for agricultural extension. For the most part, resources were limited and information rather than material resources was all that could be provided (Evans 1988). The process was top-down and focused on agricultural intensification (Interview 7). Recognising the preference of the majority of the population to consume glutinous rice, researchers worked to cross IRRI lines with Lao varieties to improve yields but retain eating quality (Inthapanya et al. 2006) but none was released (Schiller et al. 2006).

From 1979 to 1982, the UN Food and Agriculture Organization (FAO) sought to build on this early work supporting rice intensification research. Researchers worked with ‘farmer seed growers’ to produce certified seed to distribute to other farmers the following year (Hatsadong 2013). With close relationships between farmer seed growers and extension workers, farmers were ‘partners in the process ... [This system] helps the farmer to understand the idea of improved seed and production, distribution, and pricing for themselves’ (Interviewee 6).

From 1983 to 1988, attempts were made to build a formal seed distribution system with the establishment of Phone Ngam, Thasano, and Naphok seed multiplication centres to connect the provinces with Salakham station (Hatsadong 2013; see Fig. 6.1). Reservations have been expressed about the suitability of this kind of system compared to more locally based farmer seed production groups (Hatsadong 2013). Further support was provided through the United Nations Development Programme and FAO to strengthen linkages across the regional research stations (Hatsadong 2013). There was still no national rice research program at this time and research was relatively limited in scope and geographic reach.

With modest research and distribution capacity, the use of improved varieties was limited. Estimates vary between 2 to 5 per cent (Bestari et al. 2006) and 5 to 10 per cent (Inthapanya et al. 2006) of overall seed use. Use of improved varieties had been limited to pockets along the Mekong where the combination of access to irrigation and improved varieties enabled dry-season rice production for sale (Lao-IRRI Project 1993; Inthapanya et al. 2006). Farmers around Vientiane brought varieties (including improved varieties) over from Thailand and incorporated the new seeds alongside traditional varieties, deciding which to plant based on water availability and suitability to field conditions (Tanaka 1993).

Fig. 6.1 Rice research centres and locations of Lao-IRRI research activities. (Source: Modified from Shrestha et al. 2006: 38)

Inthapanya et al. (2006) suggest three reasons for the limited uptake of improved varieties during this time. First was the absence of an effective mechanism to distribute seeds, restricting awareness of and access to improved varieties. Where improved varieties were used, this was most likely due to cross-border, farmer-to-farmer exchange rather than formal distribution programs (Tanaka 1993). Second, even though the improved varieties outperformed local varieties in terms of yield, households preferred to maintain traditional varieties where the main purpose of the crop was home consumption (i.e., eating quality was valued over yield). Third, Lao farming systems were subsistence-oriented and used no or minimal purchased inputs (Lao-IRRI Project 1993). In low-input conditions, traditional varieties were better adapted than the early modern varieties, which performed best with fertiliser and irrigation (Inthapanya et al. 2006).

Traditional practices of seed selection and multiplication contributed to a significant diversity of rice varieties in Laos, especially glutinous varieties (Bestari et al. 2006). Farmers would trial and observe ‘new’ varieties (received from family or friends) on small areas of their field. Decisions on which seed to retain were based on the specific agronomic conditions, yield stability, taste, and other social and cultural preferences (Appa Rao et al. 2006a). Each household would plant four or five different varieties each season to spread labour requirements and pest and disease risk by staggering the stage of crop maturation (Linguist et al. 2006). In addition to fostering new traits within their own seed stock, farmers looked for plants with desirable characteristics, often observing and swapping seed with their neighbours, or when visiting family in other districts, provinces, or countries (notably Thailand and Vietnam) (Interview 1, Appa Rao et al. 2006a).

In the late 1980s and early 1990s, rice production, and agriculture in general, remained low-input and followed traditional practices. In 1995, 83 per cent of the labour force was engaged in agriculture and fisheries, mainly for subsistence (Ministry of Agriculture and Forestry 2000). Household production relied on family or shared (exchange) labour, draught animal power, and limited or no use of chemical inputs (Lao-IRRI Project 1993). Rice has traditionally played a central role in Lao social and spiritual life. As the staple food, it is also intertwined with ideas of culture and family (Bestari et al. 2006). Key activities in the crop calendar were marked by ceremonies aimed at appeasing spirits and ensuring a good harvest (Simmalavong 2011).

Yields were low compared to similar countries and far below domestic food requirements (Worner 1996). Rice crops were regularly affected by drought and flood, and food security was often precarious at both household and national levels, especially in the North. By 1990, limited progress had been made towards the government’s goal of self-sufficiency in rice (Hopkins 1995). In 1988 and 1989, severe drought cut rice production by one third and triggered emergency food aid to avert widespread food shortages and famine (Schiller et al. 2006).

THE LAO-IRRI RICE RESEARCH AND TRAINING PROGRAM, 1990–2007

Against the backdrop of ongoing food shortages, the Government of Laos and IRRI signed a Memorandum of Understanding (MoU) in 1987. The MoU articulated a commitment to developing research capabilities in

Laos and improving rice production to achieve national rice self-sufficiency. The goals listed in the MoU were implemented through the Lao-IRRI Project. The program agreement was finalised in 1989 and the program commenced in August 1990, with Swiss Development Cooperation (SDC) committing USD 16 million to the program over several phases (Shrestha et al. 2006).

The Lao-IRRI Project represented the first long-term, coordinated effort to support rice research in Laos. The main objectives reflected national policy goals to build the capacity of the Lao rice research system and increase rice production (Shrestha et al. 2006). As the project progressed and national self-sufficiency was achieved and maintained, government priorities shifted to emphasise diversification and modernisation of the agricultural sector more broadly and included consideration of sustainability and improving livelihoods. Research priorities of the Lao-IRRI Project also adjusted to reflect revised government priorities and as skills and knowledge in rice production grew (Lao-IRRI Project 2005).

The program was structured around several broad areas: improving and building research infrastructure; providing training for Lao researchers; development of a national rice research program covering varietal improvement, crop establishment, and soil and pest management; and developing a national seed collection to record and preserve traditional rice varieties (Shrestha et al. 2006).

Government policy objectives were tailored for the different rice-growing environments in Laos, and these in turn guided the research focus and emphasis within the Lao-IRRI Project. In the rainfed lowland areas, the government's priority in the early 1990s was to increase yield per hectare and expand the total area under production. Increasing irrigation access was also a priority to reduce the impact of a variable climate on rice yield and increase dry-season rice production. In contrast, in the upland areas the focus was to stop shifting agriculture, 'stabilise' production systems, and diversify crops to reduce dependency on rice (Lao-IRRI Project 1993).

IRRI oversaw the program and placed three full-time international staff in Laos: a project leader and a lowland systems specialist, both based in Vientiane, and an upland systems specialist based in Luang Prabang in the Northern Region. Close collaboration was sought with the Lao Department of Agriculture and Extension and the Provincial and District Agricultural Offices (PAFO and DAFO).

The (Political) Will to Succeed

It is important to note the value of political and institutional support in enabling the Lao-IRRI project to operate. The project had a mandate to contribute to the development of a Lao rice research system. Hence, ties between the Government of Laos and the Lao-IRRI Project were strong by necessity. The government was tightly controlled by the Lao People's Revolutionary Party and the project required government approval for basic project activities, such as field visits to the provinces, which had to be lodged for approval a month in advance (Interview 1).

Until the National Agriculture and Forestry Research Institute (NAFRI) was established in 1999, the project sat directly under the Ministry of Agriculture and Forestry. Though having strong government support allowed the project to achieve significant change, the project was not immune from the risks or tensions of working in the country. Schiller (n.d.) speculates that the initial IRRI-appointed lowland agronomy specialist's contract was ended due to his Thai nationality and the poor relationship between Laos and Thailand at the time. The support of key high-level government officials was instrumental in allowing the project to go ahead.

[The Vice Minister for Agriculture and Forestry] would often come down for coffee just to check 'how is everything?' and [if there were] any areas where we needed support, and then he would—where appropriate—he would then make sure the support was given. Because at that time it was potentially difficult to work in Laos for a number of reasons. (Interview 1)

Schiller (quoted in Gorsuch 2002: 6) remarked that 'Lao-IRRI has been more fortunate than other projects in Laos because of political support from [the Minister]'. The Minister had studied in Russia and had strong connections to IRRI, which culminated in tenure as an IRRI board member from 1996 to 2001 (Shrestha et al. 2006; IRRI 2004). As a result, he 'was very, very conscious of the need to develop a national research capacity within Laos' (Interview 1). The Minister's background gave him a familiarity and understanding of the value of the project and what it was trying to achieve.

In addition to strong connections, the Lao-IRRI Project was directly responding to the requests of the Government of Laos, in particular the Ministry of Agriculture and Forestry, to establish a network of research

stations across Laos and to achieve national self-sufficiency in rice. With government support and involvement, the project was able to contribute to the institutional architecture and agricultural research capacity of Laos. With the establishment of NAFRI came the National Rice Research Program. The program has continued to coordinate the development of the rice sector in Laos through the network of research stations and provincial and district agriculture and forestry offices. The structures and research areas established by the Lao-IRRI Project were thus effectively institutionalised. It would seem that a careful process of building research capacity, demonstrating impacts, and ensuring that local ownership and leadership within the program was developed contributed to this outcome.

Developing Research Infrastructure and Capabilities

The first phase of the Lao-IRRI Project focused on building the capabilities within Laos to conduct rice research. One aspect of this was to expand and upgrade research facilities across the country (Fig. 6.1). The National Agricultural Research Centre (NARC) near Vientiane became the principal research centre, coordinating rice research across the regions, overseeing the germplasm bank, and crossing and evaluating varieties for lowland rainfed areas (Shrestha et al. 2006). Regional seed multiplication stations were established or upgraded to support varietal improvement and testing of varieties in specific agroecological zones. Infrastructure was built to support the operations of the research network, including roads, seed storage, drying facilities, and administration and training buildings (Shrestha et al. 2006). The network of regional centres provided a connection between the project, district agricultural offices, and farmers. These connections enabled testing of improved varieties in a range of agroecological conditions (Interview 1).

In addition to provision of physical infrastructure, the Lao-IRRI Project developed the capabilities of Lao researchers. Training was provided in rice breeding and production, disease control, and cropping and farming systems, as well as English language and project management (Lao-IRRI Project 2005; Gorsuch 2002). Training—which included degree and non-degree programs, workshops, conferences, study tours, and other skill-building activities—was provided to staff from a broad spectrum of organisations including development planning, research, and extension agencies (Shrestha et al. 2006).

Training was provided to staff in national and regional centres, and especially to those in provinces responsible for field activities—57 per cent of trainees were staff from PAFOs and DAFOs who were in charge of local field trials (Shrestha et al. 2006: 28). In addition to formal training opportunities, IRRI publications and factsheets were developed in the Lao language to make information more accessible (Interview 1).

The Lao-IRRI Project sought to foster a sense of ownership of project activities (Shrestha et al. 2006). Annual meetings brought together representatives from all provinces to agree on work plans for the coming year, including which trials would be conducted in which provinces (Interview 1). Bringing the teams together in this way fostered collaborative links between the central and regional research stations and the provincial and district offices. While these links helped the internal functioning of the research program, external links and relationships were built between NAFRI and other international research agencies such as the University of Queensland, CSIRO, FAO, and ACIAR, providing access to additional funding and an ongoing portfolio of research for NAFRI (Shrestha et al. 2006).

When the project started, only five junior agricultural technicians were conducting field studies; by 1998, the National Rice Research Program employed 130 people and had activities in all provinces (Gorsuch 2002). Infrastructure—roads, buildings, dryers, and seed storage facilities—provided the foundations for developing the research network. Building the technical and administrative capacity of Lao researchers was central to embedding the ideas and approaches of the project in government institutions, while building an international network of collaborators has supported ongoing funding and research opportunities since the Lao-IRRI Project finished (Shrestha et al. 2006).

Many of the Lao researchers who were part of the Lao-IRRI Project went on to have senior positions within the National Rice Research Centres, the Ministry of Agriculture, and NAFRI, and continued to bring the experiences, perspectives, and networks gained through the project to these positions. The Lao-IRRI Project built on the training opportunities that had been provided to many Lao people in the Soviet Union and other Eastern Bloc countries through the 1970s and 1980s. This provided a pool of researchers with basic skills in remote provinces of the country (Interview 1). Formal evaluation of the Project concluded it had ‘clearly played a key role in building the capacity of research and related agricul-

tural organisations to develop and implement various programs effectively' (Shrestha et al. 2006: 40).

One interviewee suggested the capacity built through the Lao-IRRI Project has eroded as experienced people have moved to other organisations or retired (Interview 5b). A 2007 study highlighted the limited growth in the number of staff with master's or PhD degrees in the NARC and Multiplication Centres as an ongoing limitation to plant breeding and seed development (Thepphavong and Sipaseuth 2007).

Varietal Improvement and Management Practices

In the rainfed lowlands, the project developed a range of short- and medium-duration improved varieties for households to choose from. The primary focus was development of glutinous varieties for subsistence production, with secondary consideration of non-glutinous varieties for sale (Lao-IRRI Project 1993). In contrast to varieties released as part of the first phase of the Asian Green Revolution, the Lao-IRRI Project developed varieties that had high yield potential despite low input use and adapted to a range of agronomic conditions. Evaluation of varieties considered eating quality and duration (Lao-IRRI Project 1993). As these goals were met, varietal development shifted from breeding for crop duration and productivity to tolerance of specific conditions like drought or pests (Interview 10). Three types of varieties were released during the Lao-IRRI Project: Lao improved varieties that were developed specifically for Lao conditions by the Lao-IRRI Project; other improved varieties developed in other countries but suitable in some areas of Laos (e.g., IR66, RD23); and traditional Lao varieties that were found to be suitable for use in 'new' areas (Shrestha et al. 2006). The first of the Lao improved varieties was released in 1993 and, by 2005, 17 had been released (Table 6.1).

The Lao-IRRI Project collected and preserved over 13,000 seed samples from across the country (Appa Rao et al. 2006b). While establishing an important record of the biodiversity of rice in Laos, this also enabled the preservation of wild and traditional varieties before the introduction of new varieties (Interview 7). This collection is used to identify traditional varieties that may be suitable in 'new' areas of Laos and as part of improvement programs.

Improved varieties were part of a technical package including recommendations for planting times, plant spacing and density, and fertiliser use

Table 6.1 Release of Lao improved varieties from 1993 to 2005

<i>Year</i>	<i>Varieties released</i>	<i>Total</i>
1993	TDK1, TDK2, PNG1	3
1995	PNG2	1
1997	TDK3	1
1998	TDK4, TSN1, NTN1	3
2000	TDK5	1
2003	TDK6, TDK7	2
2004	TSN2, TSN3, TSN4	3
2005	PNG3, PNG5, PNG6	3
Total		17

Source: Inthapanya et al. (2006: 240)

Notes: Naming indicates the research station where breeding lines were developed—National Agricultural Research Centre in Thadokkham Village (TDK); Phone Ngam Rice Research and Seed Multiplication Centre (PNG); Thasano Rice Research and Seed Multiplication Centre (TSN); 30-ha Rice Research and Seed Multiplication Centre, Namthane (NTN). Not all varieties are still recommended, including PNG2 and TDK7, due to susceptibility to disease (Inthapanya et al. 2006)

(Lao-IRRI Project 1998). Additional practices in pest management and crop establishment were also explored but less broadly recommended.

Until 1997, crosses were carried out by the IRRI rice breeding division and Thai-IRRI program on behalf of the Lao-IRRI Project, using genetic material from traditional Lao varieties, varieties from Northeast Thailand, and other accessions sourced from the International Rice Germplasm Centre and IRRI. Progeny of F₂ crosses³ were transferred to the national research station for further evaluation and development in Laos (Lao-IRRI Project 1993, 1996). From 1997, the NARC had the capability to cross varieties in-house (Lao-IRRI Project 1998). Varieties that were generally adaptable, producing relatively stable yields in a range of areas, would be listed as promising lines (Lao-IRRI Project 1996).

Once evaluated, promising lines were sent to regional research centres to test for yield, adaptability, and suitability in different environments. By 1996 the project was conducting trials in every province of Laos (Lao-IRRI Project 1997).

Demonstration plots were used to conduct final assessment and evaluation of varieties with farmers, and also served as a mechanism to promote the benefits of using improved varieties (Lao-IRRI Project 1997). After harvest, farmers would be able to take seed from the demonstration plots for their own use. A number of ‘collaborator farmers’ were also involved in testing the varieties and management practices on their own farms.

They chose which varieties they would trial and were provided with seed and other inputs, especially fertiliser (Lao-IRRI Project 1997).

The Lao-IRRI project strengthened the network of research centres and created strong links with the PAFOs and DAFOs, establishing a presence across the country. Though initial steps in the varietal development process were centralised at the NARC, attention was given to developing breeding material suited to the different regions that could be tested and adapted to local conditions. One interviewee noted this was central to the success of the varietal development activities in the project, with each region receiving breeding material tailored to local conditions (Interview 5a).

Distribution and Use of Seeds by Households

The spread of varieties across the country was described as autonomous and rapid, fuelled by demonstrable and observable results. The use of seeds ‘just went boom’ after they were released (Interview 3), one informant remarking that ‘if it is a good thing, it spreads by itself’ (Interview 7). Early releases, such as TDK-1, were most suited to areas with good soil and access to irrigation, so were readily used in these areas (Interview 3). The expansion of irrigation facilities in the lowland areas along the Mekong River supported further use by enabling dry-season rice cropping (Interview 1, Interview 3). However, in rainfed and remote areas uptake was more limited.

The project used village meetings, demonstration plots, and farmer-to-farmer communication, supported by collaborating farmers, to promote the seeds and other practices. One of the biggest constraints to this process was providing an adequate supply of seed to farmers when and where it was needed (Interview 5a, Interview 1).

Formal project efforts to promote the research were complemented by a careful process of observation, trial, and seed exchange among farmers. ‘Lao farmers tend to want others to try new things so they can observe; if they see the benefits, they will consider doing it’ (Interview 2). Farmer practices of seed exchange are still prevalent in Laos. A survey of farmers in Savannakhet in 2012 found 40 per cent of farmers sourced seed from other farmers, compared to 18 per cent from the seed multiplication centres, PAFO, and DAFO, and 20 per cent from international projects (see Chap. 8). Traditional practices of seed exchange initially supported the dissemination of improved varieties, accounting for most of their use. However, it is a slow process and can take many years for seeds to be dis-

tributed over a large area, by which time seeds need to be replenished (Manivong et al. 2008).

Over successive harvests, the quality of improved seed declines and yields fall. Rather than saving seeds from each harvest for planting the next year, farmers need to replace seeds every two to three years if they are to maintain yields. As farmers began to use improved varieties, two needs emerged: to adapt traditional practices to regularly replenish seed; and to establish an effective system for seed multiplication and distribution. There had never been a formal seed distribution system in Laos, although there had been some attempts through cooperatives to establish seed producer groups. The need for a more organised national approach to seed production to ensure supply was recognised by the project (Lao-IRRI Project 2003) but was not within the project's mandate (Interview 1).

Seed had to be produced in sufficient quantities (but not excessively, to avoid waste) and distributed to farmers who were accustomed to saving seed from the harvest rather than purchasing seed. Weaknesses in the nascent extension system and low technical skills of extension staff limited the adoption of improved varieties and other practices (Lefroy-Braun and Winch 2004). In the absence of an established and well-functioning extension system, collaboration with other projects became (and remains) a key facilitator for seed production and distribution.

The Lao-IRRI Project maintained formal collaboration with many international research projects. The types of projects varied from those with their own research purpose, for which improved seeds developed under the Lao-IRRI Project were one component of research, to those whose aim was explicitly to encourage adoption of new varieties. For example, the Savannakhet Integrated Rural Development Project (Phalanxai District) and the Improving Crop Yields Project (in Phalanxai and Outhomphone Districts, Savannakhet) both aimed to increase rice production through the use of 'proven, low-input and sustainable technologies for rice-based agricultural systems' (Lefroy-Braun and Winch 2004: 2). Both projects were conduits to promote and support households to access and use improved varieties. The Improving Crop Yields Project supported production of 10 t of improved seed, which was distributed to 1659 farmers (Manivong et al. 2008: 9). These farmers further distributed the seed to other households as part of normal seed exchange practices, mostly to farmers within the same village.

ACHIEVEMENTS AND LEGACY OF THE LAO-IRRI PROJECT

Evidence of Project Impacts

From 1995 to 1998, the Lao-IRRI Project conducted household-level impact studies in two villages—one each in Vientiane and Champassak Provinces. The results highlighted the potential for rapid spread of the modern varieties, with almost 100 per cent of farms in each village incorporating at least part of the recommended package (mostly use of improved varieties) within the three-year period (Lao-IRRI Project 1999). Households that applied all recommended practices had higher yields, earned higher returns, and consumed more rice, yet consumed proportionately less of their harvest (Lao-IRRI Project 1999). Partial application of the package (using improved varieties without other recommendations) meant the full yield potential was not reached, which significantly limited the potential benefit (Lao-IRRI Project 1998: 81).

A separate study in Champasak and Saravan Provinces found significant variation in the proportion of land planted with improved varieties between households and villages (Pandey 2001). Though 60 per cent of households surveyed used the varieties, they were planted on only 21 per cent of the land (Pandey 2001). Use of improved varieties and fertiliser was higher in villages with road access. The results are consistent with findings in other countries—larger farmers with better access to markets and fertiliser are more likely to use improved varieties as they are able to get the most yield benefits.

In 2004, a study surveyed villages in Outhoumphone and Phalanxai Districts to compare conditions in a village involved with the Lao-IRRI Project until 1999 with a village that had no prior involvement with development projects. Households surveyed in the former project village experienced a higher degree of self-sufficiency in rice, ‘disproportionately’ higher incomes, and significantly higher yields (an average of 5.4 t/ha compared to 1.4 t/ha) (Lefroy-Braun and Winch 2004).⁴ In considering these results, it is important to note that the survey was conducted as a benchmark for a research project and was deliberately targeting areas with high levels of poverty and food insecurity.

External review of the Lao-IRRI Project in 2000 found the project had been ‘highly successful’ as indicated by the increase in rice production and self-sufficiency; the rapid adoption of modern varieties; the increase in double cropping in irrigated areas; and income and food security benefits at a household level (Shrestha in Lao-IRRI Project 2003: 175).

Table 6.2 Area of paddy land planted by seed type (%)

<i>Region</i>	<i>1998/99</i>		<i>2010/11</i>	
	<i>Traditional</i>	<i>Improved</i>	<i>Traditional</i>	<i>Improved</i>
Northern	93.1	7.0	87.7	12.3
Central	58.0	42.0	46.3	53.7
Southern	69.6	30.4	35.0	65.0
National	70.9	29.1	54.5	45.5

Source: Agricultural Census Office (2000, 2012)

In 1990, an estimated 90 per cent of rice production in the lowlands was from traditional varieties (Appa Rao et al. 2006b: 123). By 1998/99 an estimated 29 per cent of land area was planted with improved varieties, just six years after the first releases from the Lao-IRRI Project (Table 6.2). The following year, Laos had produced enough rice to meet national consumption needs and has been able to maintain overall self-sufficiency since, though at regional and household levels there are still production deficits (Schiller et al. 2013). By 2010/11, the area planted with improved rice varieties had increased to 45 per cent nationally and as high as 65 per cent in the Southern Region. The difference in regions shown in Table 6.2 reflects the focus of the rice improvement program on the rainfed lowland environment and the generally more suitable conditions in the lowlands. Most varieties were not suitable for upland areas due to pests and lack of water (Interview 8a).

Nationally, rice production in Laos more than doubled from around 1.5 million t in 1990 to 3.5 million t in 2012, largely following the upward trend in yield per hectare (see Fig. 5.3 in Chap. 5). Eliste et al. (2012: 63) conclude that the increase in rice production was supported by expansion of cropped area and irrigated area, but the increased use of Lao modern varieties was the ‘single most important factor’ to achieve these increases (Eliste et al. 2012: 63). The Rice Research Program has continued under NAFRI, with a further 13 Lao modern varieties released between 2005 and 2013 (Inthapanya et al. 2013).

At the national level, the success of the Lao-IRRI Project in enabling Laos to become self-sufficient has allowed for a policy shift away from national rice self-sufficiency. Nevertheless, the government still places significant emphasis on increasing rice production. Production and yield targets for the lowlands, once linked mainly to food security, are now framed

by emphasis on the commercialisation of production (Ministry of Agriculture and Forestry 2010) and the development of rice export markets (Schiller et al. 2013).

Use of Improved Varieties in Savannakhet

A key test for any agricultural research program is whether outputs and findings are integrated and adapted into the daily life of end users over time, and particularly after formal support and funding are withdrawn. Savannakhet Province is one of the main rice-production regions of Laos and home to the Thasano Crop Research and Multiplication Centre.⁵ It provides a suitable setting in which to examine the ongoing influence of the Lao-IRRI Project. Interviews and small group discussions were held with 19 farmers in four villages in Champhone and Outhoumphone Districts during October 2014 (Fig. 6.2 and Table 6.3). Villages were within 2.5 hours' drive of the provincial capital, the city of Savannakhet. Discussions considered how and when farming practices had changed with the introduction of new technologies, including improved varieties.

Villages 1 and 2 are only 9 kilometres from Savannakhet City and located just off a major road. They were relocated from another district in the 1960s and have similar agroecological conditions. The process of rice intensification in Village 1 began just one or two years before Village 2. Village 1 has had a longer history of involvement with international research projects.

Fig. 6.2 Savannakhet Province showing Outhoumphone and Champhone districts. (Source: Modified from Manivong et al. 2008: 1)

Table 6.3 Village characteristics

<i>Village</i>	<i>District</i>	<i>Research involvement</i>	<i>Access</i>	<i>Rice system</i>
1	Outhoumphone	High exposure and participation	Sealed road access	Rainfed
2	Outhoumphone	High exposure and participation	Sealed road access	Rainfed
3	Outhoumphone	Low exposure and participation	Most remote of four villages. Dirt road access. Inaccessible during wet season	Rainfed
4	Champhone	High exposure and participation	Reasonable access (dirt road)	Irrigated

Village 1 was involved in the Lao-IRRI Project in the late 1990s and all households were said to use improved varieties. Since the Lao-IRRI Project, interviewees remembered at least four international agricultural research projects working in the village on different aspects of agricultural production such as crop establishment and climate adaptation. Projects facilitated access to fertiliser and other inputs that could otherwise be difficult for households to purchase. Though the farmers tried to maintain practices once projects finished, usually they were adapted to reflect the low levels of inputs they were able to access without project support.

Likewise, in Village 2, all households were said to be using improved varieties. They were first introduced in the mid-2000s by staff from Thasano, though farmers also received some improved seed from neighbouring villages. Traditional varieties were still used by some farmers interviewed. Three large international agricultural research projects had worked in this village in the last 15 years (one was ongoing at the time of the interview), each aiming to improve rice production in some way. However, as with Village 1, villagers here noted they found it difficult to continue using the practices after projects had finished because they could not afford or easily access the required inputs.

Of the four villages visited, Village 3 was the most remote (though only two to three hours from Savannakhet), connected by a narrow, bumpy, dirt road. Village 3 had the least connection to Thasano and the least exposure to international research projects. Households were still using traditional varieties but had started using improved varieties around 2010, after they were introduced by an international research project concerned

with improving food production and marketing systems. Some of those interviewed stated that they wanted to maintain diversity and continue to use both traditional and improved seed.

Village 4 had irrigation access and had been involved with several international agricultural research projects. One was ongoing at the time of the visit, trialling strategies to support adaptation to climate variability, such as use of a mechanised drill-seeder. Regular field schools were held to discuss progress and challenges in the farming season and the farmers received detailed weather information to guide timing of activities and crop choices. As part of the project activity, DAFO officers visited twice each month and a PAFO officer visited once a month. Researchers from Thasano visited as part of trialling transplanting machines and other new techniques. Some farmers had started using improved varieties from Thailand in the early 1990s, while others had started to use them only in 2009.

There had been widespread use of improved varieties in each village but, as was the case during the Lao-IRRI Project, the adoption of the other practices to support yield improvement, particularly fertiliser use, remained low. Households spoke about the benefits of improved varieties in conjunction with other changes, such as mechanised land preparation. Improved varieties gave higher yields, for some farmers up to 50 per cent higher, while mechanisation helped save labour. Increased yields supported improved livelihoods but there were increased costs in terms of inputs (seed, fertiliser, machine maintenance) and pest and disease problems. Households interviewed appreciated the yield increases, but their aim was to increase the efficiency of production to meet household needs and to free labour and other resources for other (often non-farm) activities. This is consistent with other studies (Newby et al. 2013; Manivong et al. 2014) which show low returns for rice discourage farmers from investing in inputs to the ‘recommended’ levels (see Chap. 10).

Farmers in each village were using Lao improved varieties, Thai varieties, and traditional varieties. The diversity of varieties may have declined, but households still selected for traits that were appropriate for household needs, labour, risk, and local conditions. Some households noted that they found it difficult to know which of the suite of available improved varieties were most suitable for their land.

The persistent role of traditional practices for seed saving across seasons and farmer-to-farmer seed exchange was common across villages. However, the use of improved seed had resulted in some changes to this practice. Households expressed annoyance at having to pay for a resource they had

previously been able to manage and reuse for free. However, it was clear that the benefits of increased yields outweighed the costs, as farmers continued to use improved varieties and replenish seeds when required. The dissatisfaction reflects a process of adjustment in household expectations.

International research projects continued to play a significant role in the supply of Lao improved varieties. Most, if not all, projects, source seed stock from Thasano. Once projects finish, farmers access seed from Thasano directly or from other farmers. Thasano was at the centre of farmer networks to replenish seed. It should be noted that all the villages visited had reasonably good access to Thasano relative to the rest of Savannakhet Province.

Thasano is 40 minutes' drive from Savannakhet City and multiplies seed for sale to research or development projects and to farmers. Systems for seed multiplication and distribution were still not well established. Limited farmer demand means seed stocks are kept relatively low to avoid oversupply and spoiling (Interview 2). At the same time, international research projects—which have played an essential role in distribution of seed and supported their use by farmers—have ‘sudden and significant’ demands which can strain under-resourced centres (Schröder 2003).

The role of the Thasano Director was crucial in building a strong profile and reputation for the Centre with farmers, across the different levels of government, and with international researchers. An evaluation of seed production activities in 2003 concluded, ‘seed rice production activities are mainly left to the personal initiative of the research station manager and the Thasano Research Station in Savannakhet can be regarded as an outstanding success story’ (Schröder 2003: 177). The Director's efforts extended to helping farmers in seed selection when they came to the station for seed. The Director did not leave the station during the month the farmers came because she wanted to talk to them and ask them about their fields and cropping history so she could recommend a variety and teach them how to use it (Interview 2).

Efforts to address the limitations in the seed multiplication and distribution networks are ongoing. Supported by the World Bank's Rice Productivity Improvement Project (RPIP), Thasano has collaborated with farmer groups to produce registered and certified seeds—in effect supporting the development of a decentralised seed production system (Interview 2). RPIP has funded equipment, initial seed stock, training, and technical support to farmers (World Bank 2012). Farmers multiplied seed in compliance with strict guidelines to preserve purity and quality,

and either sold the seed back to PAFO or Thasano for a premium price or sold to other farmers (see Chap. 8).

A key constraint for the seed multiplication centres like Thasano has been a lack of operational funds—salaries for staff are funded by the government but centres are encouraged to cover operational costs through commercial seed production—which forces a reliance on commercial arrangements with international projects (World Bank 2012). At the household level, an absence of commercial seed markets limited the ability of households in a seed-producing farmer group to sell high-quality seeds above the price of paddy rice (World Bank 2014).

REFLECTIONS ON THE SUCCESS OF THE LAO-IRRI PROJECT

The conditions in Laos at the commencement of the project were dire: a country trying to rebuild after decades of war and revolution; a failed restructuring for collective production; significant and successive crop losses due to drought and flood, leading to severe food shortages. Interviews with key project staff conveyed the sense that this project had to succeed. Prior to the Lao-IRRI Project, there was no specific or coordinating research entity in Laos, no national rice research program, and a relatively empty landscape in terms of international research projects (Interview 1). The open space into which the Lao-IRRI Project stepped helped assure the necessary political support and gave the room to develop a national network of rice research centres. By design (and direct instruction from the government), the project was able to put in place the architecture and connections to implement project activities at a national scale, with links across the provinces and down into the districts.

Such direct access to high-level government officials and scope to build up a research program starting from the basics is rare and mostly seen in post-conflict states, where physical infrastructure, formal and informal institutions, and skills and capacity have been weakened or completely destroyed (Erskine and Nesbitt 2009). IRRI established a similar program in Cambodia in 1986 as that country struggled to rebuild after the destruction brought about by the Khmer Rouge (Nesbitt 2003). Similarly, the Seeds of Life Program in Timor-Leste supported the development of a national policy and research capability for a range of seed crops after independence from Indonesia, fostered by close relationships with the emerging Government of Timor-Leste (Borges et al. 2009).

According to one of the former Lao-IRRI Project leaders, the basis of success for these kinds of programs is ‘the political will of the countries to make the programs work’ (Schiller, quoted in Gorsuch 2002: 5). In this case, the combination of history and circumstance aligned the goals of the Government of Laos with the goals of IRRI. However, it is more than just an alignment of intent that supports successful project outcomes. In ‘adapting the Green Revolution for Laos,’ IRRI responded to criticism that its first releases in Asia were developed without consideration of farmers’ circumstances or needs; hence, it shifted to more participatory modes of research, such as involving farmers in varietal selection (Douthwaite et al. 2001).

The task of the Lao-IRRI Project began with a focus on developing the capacity of the institutions and individuals within Laos to establish and take ownership of a rice research program. Horton (2002) highlights the importance of mentoring, beyond one-off training events, to effectively build capacity. This was a feature of the Lao-IRRI Project. The extent of impacts on the ground, in terms of the number of varietal releases suitable to different environments and their use across the country, would not have been possible without the scale of capacity-building that occurred. While the national program has continued and releases of improved varieties are ongoing, since the Lao-IRRI Project finished concerns have been raised about whether the research capacity has been or can be sustained (Thepphavong and Sipaseuth 2007; Clarke et al. 2015). This study does not directly affirm this concern, though it does suggest that current research capacity is dependent on key individuals. One interviewee suggested that a combination of lack of specialist agricultural skills at the district level, a lack of connection between extension and research, and government pressure to release new varieties was transferring higher risk to farmers as varieties are released without adequate testing (Interview 3).

In the absence of government operational support for breeding and with a still-nascent extension system, the Lao-IRRI Project depended on promotion of the varieties in project sites and subsequent farmer exchange to spread the varieties. Farmer observation of new practices in other farmers’ fields is a long-used way for innovations to spread (Appa Rao et al. 2006a). However, the capacity of the project to provide and distribute seed also depended heavily on other international research projects that brought seeds to additional areas and supported farmers with information on their use. International projects have played an important role in expanding the use of new varieties, with many villages first gaining access

to the varieties with the arrival of a project. This has led to a government preference for projects to fund seed multiplication, rather than itself ensuring basic availability as a public good (Schröder 2003). Recent efforts to encourage commercial production have been limited by a lack of households willing to pay premiums for good-quality seed (World Bank 2012).

One of the key constraints to a commercial market for seed in Laos is the long-held practices of selecting, multiplying, and exchanging seeds at the household and village levels. As a result, farmers typically had a range of varieties highly suited to their conditions and preferences. The introduction of improved varieties has shifted this knowledge from farming households to research and extension services. New varieties are developed by scientists, albeit with the involvement of some farmers, whether through participatory varietal selection or other studies that aim to understand what traits farmers value. These participatory approaches were strong themes within the Lao-IRRI Project and remain good practice in rice varietal development. However, in contrast to past farmer practices, where each farmer would be connected to seed selection and varietal development through their own processes of exchange and experimentation, most farmers are removed from the process of developing improved varieties. Participatory varietal selection directly involves only a sample of farmers.

Farmers in the village discussions reflected that they were now less certain about selecting varieties suitable for their land and soil types. Kousonsavath and Sacklokham (see Chap. 8) likewise found farmers wanted more varieties for specific environments and better information regarding suitability of varieties in different conditions. Disconnecting varietal development from farmers has undermined their familiarity with the suitability of seeds for different areas. This is observable in other aspects of production, with ritual and ceremonies traditionally used to inform key decisions such as the timing of planting now replaced by scientific knowledge and recommendations (Hatsadong et al. 2006; Simmalavong 2011). Efforts by seed centres to collaborate with farmer groups to multiply seed could be one mechanism to build farmer understanding of the range of improved varieties.

Impacts that emerge over time are more profound than an increase in rice yield at the farm level and point to fundamental transitions in production and markets. Varietal improvement does not stop with the release of a variety but is a continuous process of adaptation. The release of a relatively simple technology such as improved seed into the system likewise

triggers a series of social and institutional adjustments—as households re-interpret recommendations to suit their resources; as new and old practices of resource management are adjusted to accommodate each other; or as knowledge and understanding of varieties are re-housed to sit with breeders rather than farmers.

NOTES

1. The research involved 28 individual interviews and 2 small group discussions in 2013–2014. For a full account of research methods, see Williams (2018).
2. Reforms in Laos followed those implemented by Vietnam and China, which de-collectivised agricultural production and encouraged foreign investment but retained strong protections for state-owned industry (Stuart-Fox 2011).
3. Filial generations indicate the number of generations after making a cross; F2 is the second filial generation.
4. In 2009, average yield for lowland irrigated rice was under 5 t/ha, compared to under 4 t/ha for lowland rainfed rice (see Chap. 7).
5. The Centre was formerly called the Thasano Research Station and is referred to here simply as Thasano.

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