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Risk Perception and Lowland Rice Farming Change in Savannakhet Province, Southern Laos

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Abstract

Lowland rice cultivation is changing in southern Laos. A formalised survey and informal interviews in the lowlands of Savannakhet Province indicate that while some farmers still raise water buffaloes, farmers now mainly use hand-held mechanised ploughs to till their fields. More chemical fertilisers are being used, and improved seed varieties have become dominant, with native varieties disappearing. Due to these changes, rice yields have increased substantially, with many more farmers selling surplus rice. The trade-offs are, however, not simple. Through applying the lens of risk perception, this article presents data about how lowland rice farming—the main occupation for rural people in Savannakhet Province—has changed over the last twenty years, critically assessing how farmers perceive and act upon risk during this time of rapid agrarian change.

Keywords

rice – lowland wet-rice agriculture – agrarian change – Laos

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1 Introduction

Wet-rice farming is the dominant smallholder family-level agricultural system in lowland parts of Savannakhet Province in southern Laos. Most rural farmers in Savannakhet have small landholdings—between two and three hectares of paddy land—and grow the main crop that their parents and grandparents grew: glutinous or sticky rice (*khao nieo* in Lao). Indeed, the amount of rice consumed per capita in Laos, including Savannakhet, is among the highest in the world (Eliste and Santos 2012). Moreover, rural people in Savannakhet still identify their occupation as being 'rice farmers' (*xao na* in Lao) above and beyond anything else, even if they are increasingly adopting multiple livelihood strategies, and more family members are leaving rural villages to work in other parts of Laos or in Thailand (Manivong and Cramb 2020; Rigg 2005). Still, rice holds a special place for rural Lao farmers, economically, culturally and socially (Manivong et al. 2014), and rice farming remains a crucially important part of the livelihood strategies of most families. According to farmers surveyed in Savannakhet (see below), rice is the main source of income for 91 per cent of rice farmers, whereas it was for 92 per cent of the farmers twenty years ago.

Lowland rice agricultural[1] practices in Savannakhet are far from static and have gone through considerable changes over the last twenty years, even though there have been fewer changes in Savannakhet as compared to neighbouring Thailand and Vietnam. Crucially, these changes have resulted in significantly higher yields and much improved levels of rice self-sufficiency and food security. Many households have gone from having to buy and even beg for rice near the end of each growing season to growing enough rice to eat—or, more commonly, to selling significant amounts of surplus rice. With some exceptions, farmers are doing economically better than ever before—at least for the time being—and it seems likely that these improvements in yield are an important part of the reason why the poverty rate in Laos has declined in recent years (Couloumbe et al. 2016). There has been a sort of revolution in rice farming quietly occurring in Laos. It is not exactly a full-scale green revolution, where all aspects of agricultural technologies and inputs have been dramatically changed (Clay 2018; Bezner Kerr 2012), since change in Savannakhet has individualised characteristics, but is rather what Manivong et al. (2014: 128) have referred to as 'the partial adoption of green revolution technologies'. Cru-

1 Lowland wet-rice is being considered here, not upland or swidden rice, which is grown in upland or hilly areas.

cially, these changes have largely been led by farmers themselves, but have also been influenced by government policy and market factors, as is elaborated on below. Some aspects have met with considerable success, but it is also true that these changes present some potentially serious risks, depending on the timeline one considers.

So, what changes have occurred regarding lowland rice cultivation in Savannakhet Province over the last twenty years, and how do farmers evaluate the risks associated with them? How do farmers' perceptions of risks and short- versus long-term benefits affect their agricultural choices? What risks are Savannakhet lowland rice farmers willing to take and what do they avoid? Why do these farmers adopt some potentially harmful practices but refuse others even if they could result in increased yields? Can the market for 'clean' food enable farmers to maintain higher incomes but avoid using the chemicals they feel are too risky for their health and the environment? These are the primary questions addressed in this article, which is based on research conducted in 2018 and 2019, focusing on four lowland rice-growing districts in Savannakhet Province: Xaybouly, Atsaphone, Outhoumphone and Song Khone.

We started, in May 2018, by conducting preliminary interviews with government officials and farmers in two–three villages per district. In June 2019, we continued by administering formalised questionnaires within three villages in each district, interviewing a total of 20 households in each of 12 villages, or 240 household representatives in total (see Figure 1). The districts were chosen somewhat arbitrarily, although with the goal of approximately sampling farmers in different lowland districts in the province, including those closer and farther from the Mekong River and Thailand. The villages within the districts chosen were selected to include communities located farther from and nearer to urban areas and the Mekong River, and we tried to include villages engaged in single and double cropping, when this was occurring. The households were chosen through simple random sampling. We did not try to stratify our sampling to differentiate farmers socially or economically. We believe that the quantitative data provided are likely to be broadly representative of small-scale rice farmers in the lowland plains of Savannakhet.

We do not want to give the impression that farmers all have the same strategies or the same access to various kinds of resources. However, in the study area the people's livelihoods are generally similar enough that we did not stratify our sampling of households, but instead randomly selected households to survey, expecting that doing this would allow different types of household to be randomly captured. Our findings reveal the overall circumstances in the communities surveyed, but were never intended to focus on individual household differences, although we agree that these can be important.

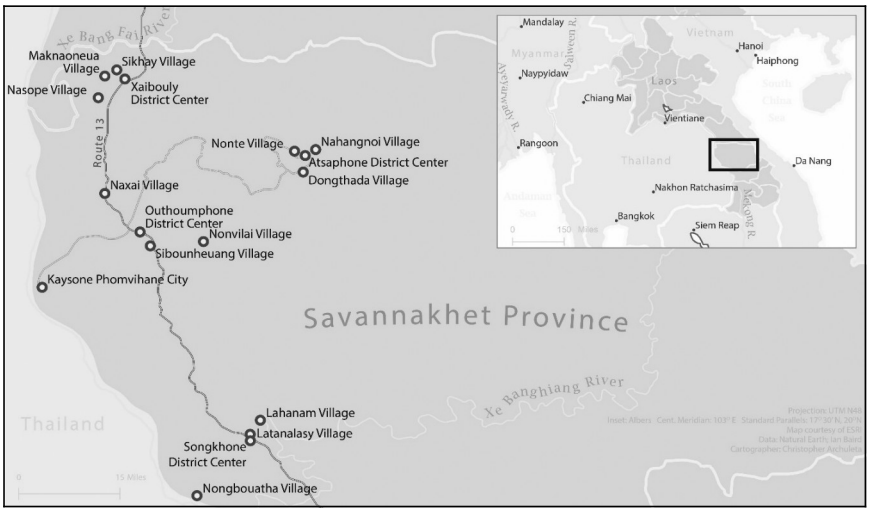

FIGURE 1 Villages where rice cultivation surveys were conducted, as well as district and provincial capitals

The main reason we chose to consider changes over the last twenty years was because there is another component of our project related to remote sensing (not presented in this article), and good quality remote sensing data exist for the last twenty years, but are not as good for thirty years ago. We could not use locally significant years for interviewing, as for comparing with other sites in Vietnam, Cambodia and Thailand we needed to use the same time periods for all locations. In addition, we were concerned that farmer memory would be less reliable the farther we went back. The surveys asked questions about present-day circumstances and about twenty years earlier. Crucially, during the surveys respondents frequently provided qualitative answers that went beyond the limited scope of the survey questions. The first author also had a number of other informal conversations with farmers during fieldwork, both in 2018 and 2019. Thus, this article presents some of these survey data, but also more qualitative information collected by the first author, who is fluent in Lao and is able to converse easily in Lao about agriculture-related issues.

In particular, in this article we are interested in understanding the changes in lowland rice farming that have occurred. We provide an overview of the practices and views of farmers in the study area, reflecting on their ideas and considering some of the contradictions that exist, both in government agricultural policy and with regard to the ways that farmers understand and act in relation to the changes that have occurred and are still occurring. We argue that the emergence of 'clean' rice production is providing opportunities for farmers

to improve their incomes while at the same time avoiding using the herbicides and pesticides that they perceive as risky.

In the next section, we consider the issue of risk perception. We then review agricultural policy in Laos, specifically as it relates to lowland rice cultivation. This is followed with a review of the main changes that have occurred in our study area over the last twenty years, and the results of these changes and how farmers assess them. We then reflect on a few of the key contradictions associated with changes in lowland rice farming, and government policy and market influences, before discussing rural farmer risk perceptions in relation to agrarian change in the conclusion.

2 Risk Perception

Scholars have long been interested in risk perception. Indeed, scholars of hazards have pointed out that risk perception and associated decisions are limited not only by objective uncertainty but also by various structural biases, such as the economic structure of trade or biophysical limitations, which limit how risk is perceived in relation to different options. Scholars of risk perceptions have studied people's behaviours, opinions and psychological orientations, demonstrating that sometimes people overestimate risks and sometimes they underestimate them. For example, even though the risk of flying is statistically lower per distance travelled than travelling by car, the fear of flying is much more prevalent than the fear of driving (Robbins et al. 2014: 86). Thus, scholars of risk perception have investigated the reasons for, and the biases associated with, differences between risk perception and actual risk, so that the factors that contribute to different perceptions, decisions and behaviour can be better understood (Slovic 2000). For example, Fischhoff et al. (1978) considered how the perception of risk is affected by the involuntary/voluntary nature of potential hazards, along with the chronic and catastrophic impacts of different kinds of hazards, showing that these differences are important for understanding why certain decisions are made. Douglas and Wildavsky (1983), through their cultural theory, have postulated that people perceive different types of risks based on their positionality in society. Some social or cultural groups, for example, encourage individual agency, while others are more fatalistic in their worldviews. This results in some groups being more inclined towards being cautious and risk averse, while others tend to be more willing to take certain risks. In addition, there are also sometimes significant differences among individuals within social groups with regard to how they perceive and act on particular risks.

There has been much written about farmer perceptions of risk and risk management in agriculture, including in Southeast Asia. The vast literature on risk and agriculture indicates that there are a wide range of risks associated with agriculture, and that farmers in different circumstances adopt an array of risk mitigation strategies (Duong et al. 2019). In the 1970s James Scott, who wrote *Moral Economy of the Peasant* (1976), and Samuel Popkin, the author of *The Rational Peasant* (1979), debated about whether smallholder farmers in Southeast Asia tended to be adverse to risk or not. Peres et al. (2013) have emphasised that culture and societal factors are often important for determining how farmers understand pesticide risk, and that risk aversion affects pesticide use, sometimes resulting in farmers using more pesticides on crops that they sell compared to those that they consume (Gong et al. 2016).

Annie Shattuck (2021a), in writing about increased agrichemical use and risk perception in Xieng Khouang Province, northeastern Laos, has engaged with ideas about what knowledge matters when it comes to affecting farmers' perceptions of risk. Indeed, the values of farmers are critical, since it is often difficult—especially in places like Laos where there is limited testing and assessment capabilities—to determine the exact impacts of particular agrichemicals on human health. In addition, farmer knowledge related to pesticide risk is both contextual and partial, often constituted through embodied experiences (Shattuck 2021b). In Vietnam, it has been found that most farmers who cultivate crops requiring significant amounts of agrichemicals gain knowledge about these chemicals and their risks through their own experiences, rather than from consulting with experts (Houbraken et al. 2016). Shattuck (2021b) has also pointed out that rather than interrogating the types of socio-economic circumstances that require farmers to take certain risks, farmers are often accused of individual risky behaviour in relation to pesticide use.

In this article, based on survey and interview data collected in Savannakhet Province, we consider the types of risks and aversions that lowland rice farmers appear to be generally more and less willing to subject themselves to, and some of the structural issues that are influencing farmer behaviour.

Questions related to risk perception and decisions emerge from the present trend away from simple economic analysis of changes in rural livelihood. As Jonathan Rigg (2018: 1) puts it, although in relation to rural change in northeastern Thailand, 'the development challenge is not being solved by economic growth, but reworked'. This suggests that we need to consider other ways of thinking about rural change (see, also, Nguyen et al. 2020), and emphasising risk perception moves us in that direction. Agrarian change is certainly occurring, but it should not be assumed that smallholder farming is about to end, or that the changes occurring are likely to mirror agrarian transition in the

West or in neighbouring countries. Indeed, there are a wide range of social, cultural, economic, political and geographical factors at play, ones that are contextual and require an understanding of historical context (Nguyen et al. 2020).

3 Agricultural Policy in Laos

The Lao People's Democratic Republic (Lao PDR) is a one-party state with a political system modelled on those of other communist countries, especially the Soviet Union and the Socialist Republic of Vietnam (Baird 2018). The Lao government and the Lao People's Revolutionary Party have a conventional view of agriculture development and agrarian change. They have long seen small-scale villager farming practices as inherently backward and inefficient. Initially—after taking over the country in 1975—the government hoped to modernise and transform Laos' agricultural landscape through adopting socialist forms of collective agriculture and agricultural mechanisation. However, this sort of agricultural organisation was socially and economically problematic and, by the late 1970s, the government decided to abandon collectivisation, with agricultural land tenure reverting to small-scale family-based holdings (Manivong and Cramb 2020; Evans 1990). However, the government still hoped to modernise farmers and their agricultural practices, and continued to promote mechanised farming. Crucially, Lao PDR adopted *chinthanakan mai* (the New Economic Mechanism) reforms in the second half of the 1980s (Yamada 2018), resulting in major changes in how the government managed the economy, through opening up to much more private sector involvement. Although the political system in Laos remained largely unchanged, the government moved towards encouraging farmers to produce agricultural commodities for the market rather than for subsistence purposes. This is referred to as 'producing for the market' (*phalit pen sinkha* in Lao), a major policy initiative that remains at the core of present-day efforts to commodify and liberalise the agricultural sector in Laos (Baird 2011).

The Lao PDR government's ideas about agricultural development are clearly visible on state-produced posters and billboards, which frequently glorify large-scale industrial agriculture, including the use of tractors to till large farms, irrigation projects and large-scale production for the market and particularly for export. This vision is even evident on Lao banknotes, which emphasise this sort of agricultural modernisation trajectory (see Figure 2). However, this vision stands in stark contrast to the realities of rural life in Laos, where farmers tend to have small plots of land, have only partially adopted mechanised and high

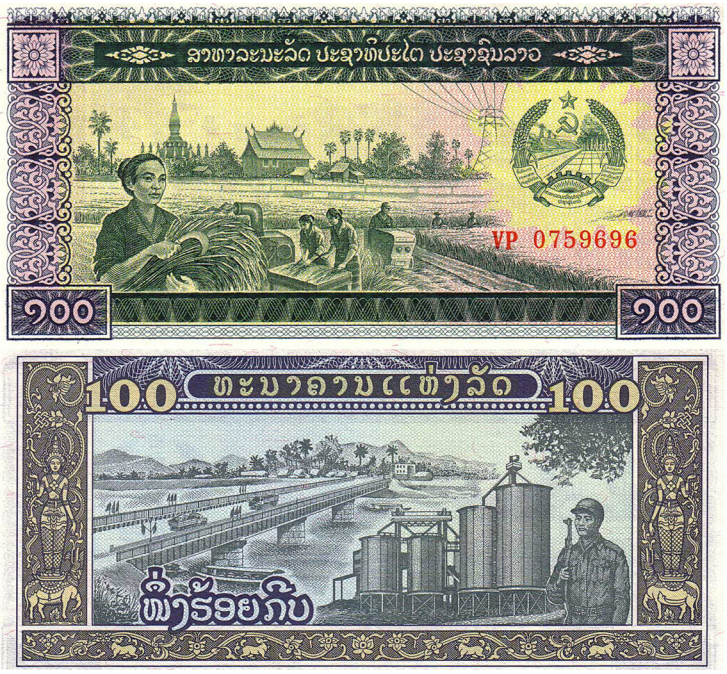

FIGURE 2 Lao 100 kip bill (1986). The front of the bill shows lowland rice cultivation, visually emphasising the need to modernise and increase agricultural production

input forms of agricultural production, and first cultivate rice for household consumption rather than for selling to the market or for export.

Small-scale lowland rice farming holds an important place when it comes to agricultural policy in Laos. In contrast, in the uplands large-scale land concessions, granted to foreign and domestic companies, began being heavily promoted in the early 2000s, despite frequently meeting with farmer dissatisfaction and various forms of resistance (Baird 2017; McAllister 2015; Kenney-Lazar et al. 2018). This led the Lao government to question the value of large-scale plantation land concessions and critically re-evaluate the 'turning land into capital' policy that was the foundation of this concession strategy more generally (*Vientiane Times* 2014; KPL 2016).

In the rural lowlands, however, the emphasis on foreign investment and agricultural land consolidation was not promoted as in the uplands. The government has not attempted to uproot rural farmers from their lowland rice paddy lands. According to the Lao government's Agricultural Development Strategy (2011–2020), the objective has been, instead, to increase lowland irrigated agriculture and market-oriented agricultural production by small-scale farmers

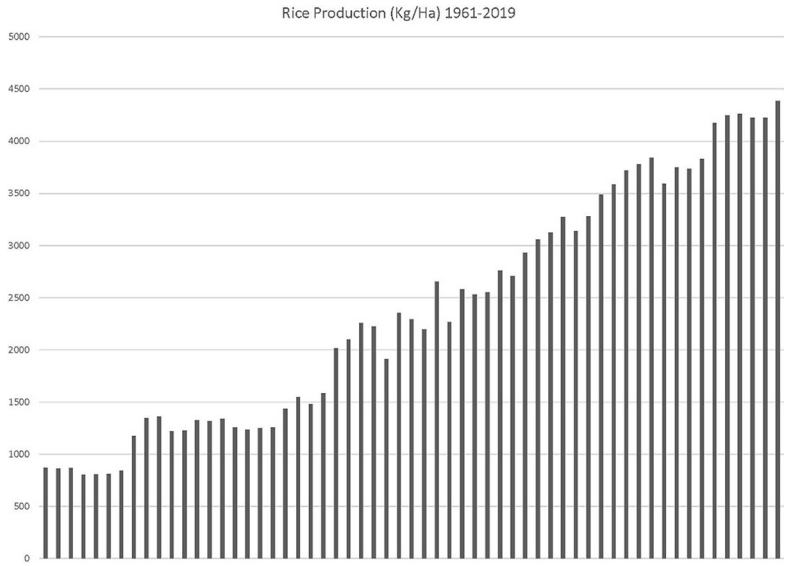

FIGURE 3 Changes in rice production in Laos
FAOSTAT

(Ministry of Agriculture and Forestry 2010). Indicative of this, the government has generally excluded lowland rice farming land from large-scale land concessions, instead encouraging smallholder farmers to keep their farmland and increase rice production, either through moving from a single crop a year to double cropping, where possible, or through generally modernising rice cultivation practices, for subsistence and food security purposes. For example, the government has become heavily involved in developing improved lowland rice seed varieties, and producing those seeds for distribution to farmers. In addition, farmers have been encouraged to sell to the market, especially international markets. Rice production increases have been achieved nationally, from just 871 kg/ha in 1961 to 4,387 kg/ha in 2019 (see Figure 3), and the Lao government hopes to achieve even greater productivity in the future (Manivong et al. 2014), particularly for export purposes (*Vientiane Times* 2018b). However, agriculture's contribution to the overall economy as a percentage of Gross Domestic Production (GDP) has declined in recent years, now contributing just 16 per cent of GDP (*Vientiane Times* 2018a). This is partially the result of the Lao government focusing more on other economic sectors, even though much of the population still relies heavily on small-scale farming for their livelihoods. These lowland farmers and their rice-growing practices are the focus of this article. How have farmers changed their farming practices, and how do they view these and other possible changes that are possible for them?

4 Changes in Wet-Rice Farming Practices in Lowland Savannakhet Province

As already mentioned, in the four districts of Xaybouly, Outhoumphone, Atsaphone and Song Khone Districts, in the lowlands of Savannakhet Province, there are extensive areas of lowland agricultural fields, where wet-rice is the primary crop cultivated, especially during the monsoon rainy season. According to our survey of 240 households, 60 per district, 48 per cent of rice farmers live in multi-generational households and another 38 per cent live in typical two-generation nuclear family households with parents and children. Although lowland rice remains the primary crop, farming households follow holistic livelihood strategies that include raising domestic livestock, such as chickens, ducks, pigs, goats, cows and water buffaloes, catching fish and other aquatic animals to eat and sometimes sell, and cultivating small vegetable gardens and a few fruit trees on their house plots. The main changes that have occurred over the last twenty years in relation to wet-rice agriculture for the households selected have been (1) the adoption of hand-held tractors for tilling their fields, (2) the application of increased amounts of chemical or inorganic fertilisers when growing rice, and (3) the increased use of improved or enriched rice seed varieties. Other significant changes include the move to mechanised threshing, increased uptake of credit, and increased labour migration and access to remittances from household members working outside the villages. A summary of some of our survey results is found in Table 1.

4.1 *From Water Buffaloes to Iron Buffaloes*

Twenty years ago, in 2000, 87 per cent of smallholder rice farmers in our study area used single water buffaloes to pull the ploughs that tilled their fields, with another 13 per cent using hand-held mechanised push tractors. Water buffaloes had some advantages. They not only allowed for the land to be tilled, but also produced offspring and manure, and did not consume gasoline or require oil changes and repairs. They also served as an important family asset that could be easily sold for cash in the cases of emergency need, such as to pay for medical expenses, funerals or weddings. However, our survey results indicate that at present 96 per cent of farmers use hand-held mechanised tractors to plough their fields, and another 2 per cent use large tractors. Only 3 per cent reported still using water buffaloes for tilling the soil. There are important reasons why such a significant shift has occurred. In particular, hand-held tractors save considerable labour. It used to take many days to plough a one-hectare piece of lowland rice paddy in preparation for farming. Now much shorter amounts of time are required, allowing farmers to get their crops into the ground quickly. This is

TABLE 1 Survey results from rice cultivation interviews in four districts in Savannakhet Province

Practice	2000	2019
% households using buffalo to plough fields	87%	3%
% households using chemical fertilisers	26%	94%
% households adding organic fertiliser	82%	77%
% households increased amount of organic fertiliser added	44%	56%
% households purchasing rice to consume due to shortages	27%	21%
% households selling surplus rice during most years	28%	60%
% households receiving credit received from shop	8%	22%
% households receiving credit from any source	9%	27%
% households using of improved rice seed varieties	25%	93%
% households using at least one native rice seed variety	72%	10%
% households using hand sickles to harvest rice	95%	85%
% households machine rice threshing	10%	93%
% households with access to irrigation	8%	17%
% households transplanting rice seedlings	95%	84%
% households receiving remittances from relatives	4%	42%
% households partially using remittances for rice cultivation	89%	86%
% households herbicide use	0%	5%
% households insecticide use	4%	6%

important, especially during years when the annual monsoon comes late. Once the rains do arrive, quick field preparation and planting helps increase the likelihood of success. Thus, the introduction of hand-held tractors saves labour and decreases the chances of low yields due to lack of sufficient rain. Some farmers still raise water buffaloes, but very few use them to till their fields. One farmer commented, 'In the future buffaloes will become extinct since nobody uses them for farming any more.'[2] Tractors also have other purposes. In particular, they can easily be converted to transport people and goods on low-quality roads, which still exist in many rural areas.

2 Farmer, Nong Boutha Village, Song Khone District, May 2018.

4.2 *Changing Harvesting Methods*

There have been other notable labour-saving changes in rice farming in Savannakhet in recent years. For example, 85 per cent of farmers presently use hand sickles for harvesting rice, whereas 95 per cent of farmers used hand sickles twenty years ago. This is not a huge change, but the situation in Savannakhet differs considerably from neighbouring northeastern Thailand, where combines are now commonly used to harvest and destalk rice seeds, with hand harvesting declining from 97 per cent twenty years ago to 29 per cent at present. It appears that there has not been much investment in combines in Savannakhet to date. In addition, in Savannakhet machines are now usually used to thresh rice (93 per cent compared to 10 per cent twenty years ago), since it saves increasingly scarce and expensive labour. At least in theory, labour-saving innovations give farmers more time to pursue other income-generating activities.

4.3 *Changing Irrigation*

Irrigation is often a critically important factor when it comes to lowland rice cultivation, but in our study area only 17 per cent of the farmers reported having access to some form of irrigation, as compared to 8 per cent in 2000. Moreover, many of those who grow irrigated rice in the dry season still only cultivate a single crop per year, because their rice farmland is partially or very flooded in the rainy season. We also heard of cases when farmers grow two crops per year, but because of the risk of flooding they often do not use any chemical fertiliser or other inputs on their wet season crop, due to the high risk of crop losses. Therefore, irrigation is an important factor for some of the farmers we interviewed, since more fertilisers tend to be used for dry season rice, but the vast majority of farmers continue to cultivate a single crop.

4.4 *Changing Use of Organic and Chemical Fertilisers*

One of the most crucial changes regarding lowland rice cultivation has been the increased use of inorganic or chemical fertilisers. Only 26 per cent of the farmers surveyed in June 2019 claim that they used chemical fertilisers on their rice fields twenty years ago, including those who just use a small amount on rice seed beds cultivated for producing seedlings for transplanting. Now, however, 94 per cent report applying at least a small amount of chemical fertilisers on their fields, which compares to 85 per cent in Champhone District—another lowland district in Savannakhet—in 2012 (Sacklokham et al. 2020). Chemical fertiliser use is still quite limited as compared to neighbouring Thailand and Vietnam, with just two or three 45kg sacks of chemical fertiliser[3] being typi-

3 With various distributions of nitrogen, phosphorous and potassium.

cally applied to one-hectare plots. The results have been dramatic, with yields increasing significantly, turning rice-deficient farming families into farmers who sell surplus rice (see, also, Manivong et al. 2014).

Increased use of chemical fertilisers and improved seeds by small-scale farmers in Thailand have contributed to substantial increases in rice yields, especially over the last decade (Suwanmontri et al. 2021), and a similar result with rice appears to be occurring in Savannakhet Province. It is, however, unclear exactly what the long-term risks to soil quality may be. However, many farmers in Savannakhet and other parts of Laos associate chemical fertilisers with harder and less fertile soils. Still, so far the farmers in Savannakhet appear to be happy with the higher yields, and are willing to accept the long-term risks for higher production now. According to our survey, 27 per cent of households reported buying rice to consume in the household twenty years ago, because they did not grow enough to feed themselves, compared to 21 per cent in 2019. Although this change may not seem substantial, the big difference is the number of households that sold surplus rice twenty years ago compared to now. Twenty years ago, only 28 per cent sold surplus rice, but now 60 per cent claim that in most years they sell surplus rice.[4]

Based on research done in northeastern Thailand, the amount of fertiliser that they now use may not pose a serious threat to soil fertility (Yanai et al. 2020). However, if farmers produce even more rice by increasing fertiliser use, and they have better access to credit and thus are able to access chemical fertiliser more easily, the result could be soil fertility and other agro-ecological problems, although these risks are less for lowland rice fields as compared to upland agricultural areas. Still, farmers might make the classical mistake of feeding the plants rather than the soil. Will farmers be able to resist making decisions that provide great short-term benefits but more potential long-term risk? Considering what has happened in other parts of Southeast Asia, it seems unlikely that long-term risk will be adequately considered. Short-term food security and economic concerns seem likely to outweigh longer-term risks. Our discussions with farmers indicate that while there are some concerns about the potential negative impact of using large amounts of chemical fertilisers, most are not particularly concerned about using smaller amounts of chemical fertilisers.

However, many farmers are using the vehicles that they now have to transport organic inputs—such as manure and rice husks—to their fields, thus

4 In Choumphone District, 62 per cent of rice farmers reported selling rice in 2012 (Sacklokham et al. 2020).

resulting in increased amounts of organic inputs, to improve yields, reduce the costs of chemical fertilisers and maintain or improve the quality of soils over time. Not every farmer does this, but 56 per cent of the farmers surveyed in Savannakhet reported adding more organic fertiliser to their fields than twenty years earlier. Some claimed that it was previously labour intensive to push carts of organic inputs to their fields. Now that they have tractors, this work is much less labour intensive. The expenses associated with owning and maintaining a tractor seem not to deter farmers. The percentage of farmers who add some type of organic fertiliser to their rice fields has not changed much since 2000. At present, 77 per cent claim that they add something, whereas 82 per cent of farmers reported doing so twenty years earlier. Thus, somewhat fewer farmers are adding organic fertiliser to their fields than twenty years earlier, but those who do so are adding more, often much more. This all suggests that many farmers are aware of the potential longer-term risks associated with using more chemical fertilisers and are trying to mitigate these risks by adding more organic fertiliser.

One factor that has reduced the amount of chemical fertiliser used is a lack of public funding that farmers can access to purchase it, and then repay at a low interest rate (*Vientiane Times* 2020). This is in contrast with Thailand, where most farmers borrow from the Agriculture and Cooperatives Bank, a state-owned bank designed to support farmers. Instead, 22 per cent of farmers in Savannakhet reported receiving credit from fertiliser sellers in the communities or others, while only 8 per cent received this sort of credit twenty years ago. Chemical fertiliser is the main input that farmers obtain credit to purchase. Moreover, whereas only 9 per cent reported obtaining any credit twenty years ago, that statistic has increased to 27 per cent, although this is only about half of the proportion of farmers who obtain credit in Thailand, Vietnam and Cambodia. Nevertheless, some see increased debt in Laos as an increasing problem (Kemp 2012). We heard, in a number of communities, that standard chemical fertilisers cost 650 to 800 Thai baht[5] per bag if paid for in cash (in Savannakhet, fertiliser prices are typically quoted in Thai baht). However, if fertiliser is taken on credit, the repayment cost amounts to between 900 and 1,200 baht per bag, often amounting to 30–40 per cent interest for just a four- or five-month period. This increases the cost of inputs and causes farmers to use less. Kousonsavath and Sacklokham (2020) also found that farmers in Savannakhet were paying high interest rates when they receive fertiliser on credit. Farmers often try to reduce risk by reducing fertiliser use in order to avoid becoming indebted, indi-

5 The exchange rate is approximately 30 baht = US$1.

cating that they want to avoid the risk of becoming overly indebted. No wonder the Lao Farmer Network (2019) has called for increasing farmer-access to credit at lower interest rates.

Another factor is contributing to low levels of chemical fertiliser use in some flood-prone lowland areas of Savannakhet Province, particularly in Xaybouly and Song Khone Districts. Many farmers in flood-prone areas told us that they did not apply any chemical fertiliser to their rainy season crops, for fear that the fields would be flooded and the majority of the expensive chemical fertiliser would be lost. This represents a strategy to avoid the risk of losing expensive fertiliser. Some of these same people do, however, use larger amounts of chemical fertilisers for dry season irrigated rice cultivation, as there is no danger of flooding, and fertiliser being lost as a result, during that season.

One farmer who the first author met in another part of southern Laos in July 2019 warned that using tractors and chemical fertilisers would make the soil hard and cause fertility problems down the road. He challenged the first author to get someone to farm the soil with just a buffalo and no chemical fertiliser or other inputs and then compare it to farmland tilled by a tractor and the recipient of chemical fertilisers to increase yield. He said that the former would certainly have better soil. He did not use the word 'sustainability' (*yeun yong* in Lao), as villagers rarely articulate these sorts of understandings using newly adopted educated-Lao vocabulary, but it was clear to me that he was talking about sustainability and risk, warning about the potential for the farmland to be degraded if farming continues down the green revolution path. His comments are worth considering carefully, although it is true that the conditions for biological and structural fertility differ considerably between asphyxiated soils (water-saturated) and aerobic soils in the uplands. Still, there is no doubt that there is some risk involved.

4.5 *Changing Rice Seed Varieties*

A major change has been increased dependence on a few varieties of high-yielding improved or enriched varieties of rice (see Vanavichit et al. 2018 for information about how rice varieties are presently being enriched), something that has also been reported by others who conducted research about lowland rice cultivation in Savannakhet (Williams and Cramb 2020). The most important improved variety of rice is called Thadokkham 8 (TDK-8), a high-yielding strain developed by the National Agriculture and Forestry Development Institute (NAFRI) in Vientiane through conventional breeding of Lao glutinous varieties together with International Rice Research Institute (IRRI) Green revolution cultivars (Kousonsavath and Sacklokham 2020). Indeed, 93 per cent of farmers reported using at least one type of improved rice seed for part of their

fields, as compared to only 25 per cent twenty years ago. This coincides with a 1990 report that 95 per cent of wet-season rice farmers were using native seed varieties, whereas in 2006 only 72 per cent of farmers were cultivating at least one variety of native seed (Inthapanya et al. 2006). However, our survey found that only 10 per cent of farmers are using native varieties now. Native varieties of rice are adapted to micro-niches and have long histories. There was a particular geography to them, which is not the case for improved varieties (Williams and Cramb 2020). For example, local varieties are likely to be better suited for local conditions, including localised drought and flooding conditions. Moreover, when diverse rice varieties are cultivated, crops tend to be less vulnerable to diseases and insect damage. In addition, when local genetic material is lost, it is no longer available for future rice breeders. However, the use of native varieties has declined because the yields of improved varieties are higher, but also because some native varieties are considered to not be as good tasting as improved varieties.

Farmers also use improved glutinous rice seed varieties developed in the 1990s and early 2000s (Williams and Cramb 2020), such as RD 6 and 8, bred in Thailand through the irradiation of KDML 105 (*khao hom mali* in Thai) (Vanavichit et al. 2018). Farmers reported being able to collect the seed of these varieties of rice for planting year after year. They now largely identify these older improved varieties as 'native' (*pheun muang* in Lao), because like the truly native varieties, farmers could collect their own seeds for many years, without experiencing declines in quality. However, now that they have shifted from farm-bred cultivars to station-bred ones, they produce higher yields but report that the seeds they harvest are harder and are not as good to eat. To maintain quality, it is recommended that farmers obtain new seeds from government rice-development stations or other sources every year, but almost nobody does that. Instead, they typically trade 'hard seeds' with neighbours or relatives whose harvest includes softer seeds. Rice seed trading has a long history in Laos (Williams and Cramb 2020). As one farmer put it, 'When the rice seeds become hard, I either trade for softer seeds with relatives or neighbours, or I change the locations where I grow the seeds.'[6] Even if farmer practices like these do not fit with government technical recommendations, most farmers remain convinced that these improved varieties of rice have contributed to higher yields. Farmers did not report eating different varieties of rice from those they were selling, although we have observed that this is regularly the case in central Thailand.

6 Farmer, Dong Thada Village, Atsaphone District, June 2019.

One important factor related to the disappearance of indigenous rice seeds has been the emergence of a large rice mill owned by the Indochinese Development Partnership (IDP), which now buys much of the surplus rice produced by farmers in the study area. Having a reliable buyer to sell their rice to is seen as advantageous to farmers. Moreover, the IDP rice mill in Savannakhet Province has been able to achieve the product quality necessary to export to Thailand (*Vientiane Times* 2016) and China (Manivong and Cramb 2020). However, to do this they have insisted on consistency, thus resulting in many farmers switching to TDK-8 rice seed in order to meet the quality standards of IDP. As one farmer put it, 'We can't grow indigenous varieties of rice any more, as the seeds are big, and the mills don't want to buy them.'[7] Indeed, IDP produces some seed for farmers to cultivate. However, farmers have also received improved rice seeds from elsewhere, such as from Vietnam (*Hanoi 6*), Thailand (*Saphanthong daw*) and from the provincial government.[8] In addition, some farmers reported that they could not use native varieties of rice, as they tended to lodge[9] (fall over) when chemical fertilisers are applied.[10] This is one important reason why many farmers believe that chemical fertilisers do not go well with native rice varieties.

There is no doubt that the extensive use of TDK-8 rice seed has resulted in the vast majority of rice farmers totally abandoning native rice varieties, thus reducing agro-biodiversity significantly. Indeed, there was previously a great diversity of rice varieties in Laos (Williams and Cramb 2020). In fact, Laos has contributed over 15,000 varieties of rice to IRRI's International Rice Gene Bank, with only one other country in the world contributing more varieties of rice (IRRI 2020). In the past, farmers often used many types of rice each growing season, but now they rely on a much narrower range. This increases risk of diseases and pests, as using a single variety of rice that grows in the same way, and ripens and is harvested at the same time, may make it more efficient to cultivate and harvest but makes the crop more vulnerable to pests and diseases. Harvesting different varieties at various times can reduce efficiency for mechanised harvesting and milling, but if hand harvesting and other more labour-intensive practices are in use, this time range can actually work better if there is limited labour. Moreover, having more seeds produced by rice development centres is making farmers more dependent on improved rice seeds, an issue of impor-

7 Farmer, Dong Thada Village, Atsaphone District, June 2019.

8 Seng Maleng, Officer, Agriculture Office, Xaybouly District, Savannakhet Province, personal communication, June 2019.

9 'Lodging' is the bending over of rice stems to near ground, which makes harvesting difficult and can significantly reduce yield.

10 Farmer, Sikhai Village, Song Khone District, May 2018.

tance to those working on food sovereignty. As Williams and Cramb (2020) have pointed out, it has also shifted the development of new seed varieties from farmers to scientists. Farmers are taking more risk by relying on centre seeds, since they no longer have any native seeds left in reserve, but few farmers seem concerned about this risk.

Academics and farmers from around the world have, however, become concerned about the loss of native seed varieties and the vulnerability new varieties potentially pose for the future (Borromeo 2000; Rerkasem and Rekasem 2006; PANAP 2010). The loss of native seeds threatens the food sovereignty of small-scale farmers (Kerr 2013). Glover (2010) also reports that the positive implications of using genetically modified seeds are actually more variable and situation-dependent than has often been reported. Drawing on past local practice, when faced with this question one farmer in Savannakhet commented, 'If there were no more improved varieties of rice seed available, and we no longer had native varieties of rice to work with, we would have to move rice seed to other fields to prevent the rice from becoming hard.'[11] In other words, farmers often believe that rice seeds will become softer if hard seeds are cultivated on different fields. However, it is uncertain how effective this strategy would actually be. In any case, so far farmers seem largely unconcerned about the possibility of such a crisis emerging, albeit with some exceptions.

On the positive side, in 2019 some farmers in six village in Xaybouly District began learning how to grow rice for the rice seed market, as IDP has experienced some problems with the rice seeds produced to supply farmers.[12] This new plan should help improve local control and the reliability of seed supply. Farmers are also interested in having new seed varieties that are better suited to local conditions (see Kousonsavath and Sacklokham 2020), but it is unclear if this will happen.

4.6 *Changing Labour Issues*

As with elsewhere in mainland Southeast Asia, there are fewer people available as agricultural labourers in particular households compared to a decade ago. Based on our rice farmer survey in Savannakhet in June 2019, an average of 5.39 people live in each household and, of those, 3.12 people conduct farm work. This compares favourably to northern Thailand, where we also surveyed small-scale farmers in June 2019. There, only an average of 3.85 people live in households, and only 2.07 people in each household do some farm work. This

11 Farmer, Dong Thada Village, Atsaphone District, June 2019.

12 Seng Maleng, Officer, Agriculture Office, Xaybouly District, Savannakhet Province, personal communication, June 2019.

comparison is important, as the demographic profile of Savannakhet is now similar to what it was in northeastern Thailand a few decades ago, indicating the type of demographic and labour changes that are likely to occur in Savannakhet in the future.

In addition, in Savannakhet—as well as in other parts of Laos—many younger people are leaving their farms to study and work in other parts of Laos and especially to work in Thailand (Rigg 2005; Barney 2012; Manivong et al. 2014). Moreover, part of the way lowland rice-cultivating families work is for some young adults to go away to work, especially in neighbouring Thailand, often for extended periods (Rigg 2005). Migration for working has become increasingly common and more formalised in recent years. Some people also migrate to work in Savannakhet, Pakse, Vientiane and other parts of Laos. It is now common for one or more members of each family to send remittances back to the rest of the family on the farm. Most farmers in Savannakhet interviewed reported using at least part of remittances they received to fund lowland wet-rice cultivation on family farmland; this sort of labour strategy has become important in agriculture production in Savannakhet, although this is not always the case for other types of agriculture in mainland Southeast Asia (see Baird et al. 2019). What is the value of the family being together, and what time period should be prioritised for future generations? What spatial area of influence should be considered when it comes to lowland rice cultivation?

In Savannakhet, the average household has 2.35 members of their family working in Thailand. This high level of migration is one of the reasons why the cost of agricultural labour has increased in Savannakhet, although price increases differ depending on geography, and particularly the distance villages are from the border with Thailand. In 2018, the general cost of hiring labourers in Nong Bouatha Village, in Song Khone District, adjacent to the border with Thailand, was 70,000 kip per day. However, farther away from the border, the labour cost per day was between 50,000 and 60,000 kip a day, whereas the price in the even more remote area of Atsaphone was just 40,000 kip a day (see Figure 1). There are clearly important geographies of labour at play.

Labour availability is a crucial driver of changes in rice cultivation, but so are the remittances received by household members who do not contribute labour for farming, but do provide funding via remittances. In Savannakhet, 42 per cent of households surveyed reported regularly receiving remittances from family members; especially from across the border in Thailand, and 86 per cent of those who did receive remittances reported spending at least part on rice cultivation expenses. This compares to just 4 per cent of households receiving remittances twenty years ago, although 89 per cent of the households that

received remittances twenty years ago used them to pay for expenses associated with rice cultivation.

4.7 *Changing Use of Chemical Herbicide and Insecticides*

Herbicides and insecticides are a crucial issue, but only 5 per cent of farmers in Savannakhet reported using any herbicide at all, which compares to none of the farmers we interviewed reporting using herbicides for rice cultivation in 2000. Herbicide use for rice cultivation is exceptionally low in Savannakhet, as compared to 24 per cent of farmers in neighbouring Thailand using them, along with 90 per cent in the Red River Delta of Vietnam, 92 per cent in northwestern Cambodia, 98 per cent in the Mekong Delta in Vietnam, and 100 per cent in central Thailand. In some cases, farmers told us that they had switched to broadcasting recently, but that yields had been low because they did not use herbicides. Therefore, they decided to revert to transplanting rice seedlings, as they had done in the past.

One of the biggest changes in rice cultivation in mainland Southeast Asia, including in Thailand and elsewhere in the region, has been the adoption of 'broadcasting', or the tossing out of seed on to fields, as a labour-saving innovation, instead of hand transplanting. There are farmers in our study area who have adopted rice broadcasting for many years and have been successful in so doing. However, the vast majority of farmers in Savannakhet (84 per cent now as opposed to 95 per cent twenty years ago) still hand transplant rice seedlings. One key challenge that often results in increased herbicide use when broadcasting relates to water management. If one's field is not totally level, it is hard to manage water levels so that seeds are not either drowned under water or exposed on dry land, leading to significant weed growth. This is why those broadcasting often choose to keep water out of their fields and use herbicides to suppress weeds.

Farmers in Savannakhet frequently report that broadcasting results in low yields unless they apply herbicides, and that farmers do not want to use herbicides, because of concerns about the direct risks of doing so on human health, and also because they are worried about the possibility of aquatic animals that they harvest to eat and sell becoming contaminated and unhealthy to consume. Some farmers reportedly adopted broadcasting for one or more years and then reverted to hand transplanting, largely due to a belief that broadcasting results in decreased yields. This is even true in Nong Bouatha Village, near the border with Thailand, where labour costs are particularly high. This suggests that farmers are very concerned about the risks of herbicide use.

The statistics for insecticide use are similarly lopsided, with only 6 per cent of farmers reporting using insecticides on their rice fields, as compared to 4 per

cent in 2000. Again, insecticide use is exceptionally low in Savannakhet, compared to 17 per cent of farmers in northeastern Thailand reported using them, 73 per cent in northwestern Cambodia, 98 per cent in central Thailand, 99 per cent in the Red River Delta of Vietnam, and 100 per cent in the Mekong Delta in southern Vietnam. Indicative of the attitude that prevails in southern Laos, one farmer said, 'I don't use insecticides [in my rice fields] because people downstream from me drink the water.'[13] The farmers who do apply chemical insecticides tend to use only small amounts to control non-native Golden Apple snails (*hoi deng* in Lao), as well as crabs (*kapou* in Lao) and stinkbugs (*meng kheng* in Lao). Our interviews in June 2019 indicate that the above pests tend to become a problem in places where double cropping occurs. As with herbicides, farmers are concerned about the direct impacts of insecticides on human health, but also with negatively affecting aquatic life in their rice fields. Finally, they are concerned that using insecticides will make aquatic animals dangerous to consume. As one farmer put it, 'If we use insecticides, the Golden Apple snails and crabs decline, but people still eat them, which is dangerous for one's health. It is also bad for livestock.'[14] During a June 2019 interview, a farmer reported that another farmer used insecticides in his fields and then, as a risk mitigation strategy, collected shellfish and crabs to eat from someone else's field, because he did not want to consume contaminated aquatic animals.[15] Overall, many farmers expressed concern about using dangerous agriculture chemicals, and those who did not use insecticides expressed pride in not doing so.

5 Lowland Rice Agriculture Production and Risk Perception

Smallholder family rice farmers are certainly happy to be reaping greater yields. However, there has been a lot of negative media coverage in relation to the adverse impacts of insecticide and herbicide use in cultivating bananas in Laos (Radio Free Asia 2020; Xayxana 2019; Finney 2018). This has contributed to farmers becoming increasingly hesitant to adopt some green revolution methods, especially in relation to applying herbicides and insecticides. Although only some farmers occasionally use these inputs, almost all now apply at least a small amount of chemical or inorganic fertilisers, and farmers are using increasing amounts of organic fertiliser as well. However, as mentioned earlier, many farmers reported that it is now easier to transport manure and rice

13 Farmer, Lathanalasy Village, Song Khone District, June 2019.
14 Farmer, Dong Thada Village, Atsaphone District, June 2019.
15 Farmer, Nong Bouatha Village, Song Khone District, June 2019.

husks on to fields because they have hand-held tractors.[16] Therefore, in many cases there is an increased use of both chemical fertiliser and organic fertiliser. While the main motivation to using less chemical fertiliser is cost, some farmers also mentioned being concerned about the long-term risk of reduced soil fertility due to a high level of chemical fertiliser use.

On the one hand, increased production—and the wealth that comes with it—is certainly contributing to improved livelihoods, in particular better short-term economic security. However, the long-term implications of abandoning buffaloes for ploughing, adding increased amounts of chemical fertilisers, and using new seed varieties that make it difficult for farmers to control their own seeds, are more uncertain. Risk perception, as outlined earlier, depends on values and ethics, both of groups of people but also of individuals. On the one hand, farmers want higher yields, but on the other hand, they express pride in using no or less chemical fertiliser and no herbicides or insecticides. As the ideas of farmers gradually change, it is hard to know how best to reconcile the contradictions associated with considering the short-term gains in relation to potential long-term risks.

An issue that warrants consideration is that early adopters of new agricultural inputs, such as increased chemical fertilisers or insecticides, often experience considerable success early on, while those who follow are more likely to have trouble. Sometimes it takes time for problems such as those related to soil fertility to emerge. For example, it may take generations for resistant strains of particular pests to out-compete other strains and become dominant. Problems can accumulate over time, as more and more farmers adopt the same or similar chemicals. Agro-ecological systems can also be damaged by the use of chemical inputs of various types, thus negatively influencing certain natural control agents, and making crops more vulnerable to pests as they become more resistant. The pesticide treadmill is a well-known problem that farmers around the world face as they inadvertently wipe out natural predators for pest species and increase pest resistance to chemicals, thus necessitating increased use of pesticides, or the use of more toxic or dangerous chemicals. This can lead to even more resistance and bring on other problems related to the costs of these inputs, and the environmental and human health impacts of the increased use of these inputs (Benbrook 1996).

If one takes northeastern Thailand as an example of how lowland rice farming is likely to develop in southern Laos, we might expect chemical fertiliser usage to increase substantially in the coming years. Broadcasting also seems

16 Farmers, Xaybouly, Outhoumphone, Atsaphone and Song Khone Districts, June 2019.

likely to increase along with herbicide use. It can also be expected that hand-held tractors will be exchanged for larger tractors, and that hand-held harvesting will be replaced by the use of combine harvesters, something that is already occurring in northeastern Thailand but which has still not happened in Savannakhet Province. Once large tractors and combines are in use, we can expect to see the levelling of fields and the removal of bunds—the mounds that separate different plots and are built to manage water—to facilitate the use of larger machinery. Although Manivong and Cramb (2020) reported that small combines are beginning to appear in the lowland plains of southern Laos, so far they are not being widely used in Savannakhet and most farmers have not altered their rice field bunds. For example, in Savannakhet only 24 per cent of farmers reported removing bunds to make fields larger in recent years. Notably, only 15 per cent of farmers reported doing any kind of mechanised harvesting, and only 2 per cent reported using combines to harvest. This differs from northeastern Thailand, where 64 per cent of families report having removed rice bunds, and 68 per cent now use combines to harvest their rice.

There have been some recent efforts to promote less chemically intensive agriculture in Laos. At the policy level, for example, on 31 January 2019, the government released Declaration #20, in which it committed to what the declaration refers to as 'green development' (Bounsong InsideLaos 2019), economic growth with 'sustainability', without providing a precise definition regarding what 'green development' means in practice, or particularly mentioning agriculture chemical use.

At a more practical level, 'clean' rice production is being increasingly promoted, including in Savannakhet Province. 'Clean' rice production is a level below 'organic', where no chemical substances at all are permitted, but is rice grown with a small amount of chemical fertiliser, or none at all, and no herbicides or insecticides. Thus, 'clean rice' is not exactly organic, but it is close to it. Our research indicates that most rice grown in Savannakhet meets the criteria for 'clean rice' (DAWN 2013). Moreover, 77 per cent of the farmers we surveyed reported that part of their rice fields are grown without the use of any chemicals, including chemical fertilisers, which compares to 80 per cent twenty years ago.

In that IDP has been promoting 'clean' rice production (DAWN 2013; *Vientiane Times* 2016), the Director of the Savannakhet Province Commerce Office described the rice produced in the area we worked in as 'clean and chemical-free' (DAWN 2013), even though small amounts of chemical fertilisers are used. Still, it is true that other chemicals are rarely applied, and that chemical fertiliser use is low. This is providing a particular niche market reputation that complies with farmers' preference to avoid the health risks of using chemical

pesticides and herbicides and may allow them to benefit from growing market demand for 'organic' or 'clean' foods such as rice. Small-scale farmers in other parts of Southeast Asia have also taken advantage of niche markets for heirloom varieties of rice, which has resulted in increased interest in cultivating traditional rice varieties (Glover and Stone 2018), but there is no sign of this occurring in southern Laos. However, since 2015 Laos has been exporting organic rice to China (Manivong and Cramb 2020). This niche rice market is allowing farmers to increase incomes, which is important, while not overly sacrificing their desire to limit the use of chemical fertilisers and chemical pesticides.

Sugar cane production in Laos is also increasingly becoming organic due to problems with meeting European Union quality standards when sugar was initially being cultivated using non-organic processes, and the importance of the European market for Lao sugar. In Savannakhet Province, in Xaybouly District, Mitr Phol Sugar, a Thai company, has made this switch because of problems meeting EU standards[17] (see, also, *Bangkok Post* 2015). This same sort of transition has also occurred in Attapeu Province, where the Vietnamese Hoang Anh Gia Lai (HAGL) also made some serious mistakes in the processing of sugar at its processing factory there, thus leading to the sugar quality not meeting European health standards (Baird 2020). Partially due to this marketing problem, HAGL sold its state-of-the-art $100 million sugar processing plant and 6,000 hectares of land for cultivating sugar to Thanh Thanh Cong (TTC), in October 2016 (VietNamNet Bridge 2016), and since then TTC, like Mitr Phol, has converted to organic sugar production.[18]

There are also other indications that organic agriculture is likely to be increasingly promoted in other parts of Laos. For example, Vinamilk, Vietnam's largest dairy company, has recently teamed up with Lao and Japanese companies to build an organic dairy farm and tourism resort in Xieng Khouang Province, in northern Laos (*Vientiane Times* 2019). Indicative of this trend, a senior agriculture officer who has been working in Xaybouly District, Savannakhet Province, told the first author that he believes that the trend is to more organic and 'clean' agricultural production.[19] Although it is uncertain how these market influences will affect rice cultivation changes in Savannakhet, it seems reasonable to expect that they will have an impact.

17 Seng Maleng, Officer, Agriculture Office, Xaybouly District, Savannakhet Province, personal communication, June 2019.

18 HAGL employee, Phou Vong District, Attapeu Province, May 2019.

19 Seng Maleng, personal communication, June 2019.

6 Conclusion

A recent article written by Jonathan Rigg (2018: 1) makes the case—relying on longitudinal research done in northeastern Thailand—that 'the social adjustments and perturbations engendered by development have created second-order, often more intractable problems and challenges'. This suggests that we need to adjust our understandings of changes in lowland rice cultivation and associated risks in southern Laos over time. Indeed, the developments that have led to increasing rice yields represent real advances, at least in the short run. However, what about the 'second-order, often more intractable problems and challenges' that potentially lie ahead? The problems and challenges associated with green revolution approaches to lowland rice cultivation in southern Laos are likely to emerge, although at a level of severity that remains unclear. There are many associated factors, both environmental and social, and this makes many risks uncertain. What kind of life do farmers in Savannakhet want, and what is possible in this increasingly capitalist and pro-business landscape? We are not certain about either.

Yet old and new ideas associated with sustainability and environmental and social protection are being challenged by new economic, social, environmental and political circumstances. That is, following Karl Polanyi (2001 [1944]), there is a sort of 'double movement' in play, with agrarian change associated with capitalist development leading to potentially serious social and environmental impacts, followed by increased concern about the impacts of chemical usage and modern forms of agriculture, and also an increased market for organic or 'clean' agricultural products. There is no doubt that these changes are influencing both risk perception and also the behaviour of farmers. Indeed, consumer demand for low-chemical agriculture is providing opportunities for smallholder rice farmers who perceive the risk of high levels of agro-chemical use as problematic. Although farmers have adopted many of the green revolution technologies, they have not adopted them all and have only adopted some to a certain extent, and this middle ground appears to be opening up opportunities for farmers to take advantage of new niche markets related to clean and organic rice. However, it remains difficult to predict how this trend might affect farming practices in the future, especially if there is less labour available for transplanting rice.

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