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Bernard Formoso

Savoirs Environnement Sociétés (SENS)
Paul Valéry – Montpellier 3 University/IRD/CIRAD
Route de Mende, 34199 Montpellier cedex 5, FRANCE
bernard.formoso@univ-montp3.fr

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Abstract :

Smallholder farming has faced significant transformations in Thailand over the past thirty years. These socio-demographic, technical, economic and climatic changes have considerably increased its vulnerability. The sustainability of the smallholders' agricultural model which rests on cash crops and requires large quantities of chemical inputs is now threatened. Through the study in 2014 and 2019 of two rural villages he had first surveyed in 1984-1985, the author offers a detailed review of these changes, and examines the ways the farmers deal with them.

Keywords: Thai farmers, agrosystems, climatic change, agricultural sustainability, poverty.

1. Introduction

In Thailand as in other Southeast Asian countries (Myanmar, Viet Nam, Indonesia), agriculture remains dominated by smallholder farmers. The farm-size transition, i.e. the amalgation of smallholdings into larger and more efficient units of production (Hazell and Rahman, 2014), has not yet followed suit in those countries. In the case of Thailand several reasons have been put forward by Jonathan Rigg (2019: 154): the agroecologically unsuitability of wet-rice agriculture to scaling up, the Thai government subsidy policies over the past decades that preserved the small-scale sector, cultural factors, and few attractive alternatives to rice farming. In 2013, date of the most recent decennial census on agriculture,

the average size of the kingdom's 5.9 million farms was only 3.2 hectares. Among them 64,2 percent cultivated less than 3.2 hectares and 37.1 percent less than 1.6 hectares[1]. Although in the 1980s, nearly two-thirds of the labor force of the country was employed in agriculture, this rate has steadily decreased over the past thirty years, to the point that in 2017 the sector's share in employment only accounted for 28.5 percent[2]. The loss of attractiveness of agriculture results from a bundle of economic, climatic and ecological problems faced by most farmers to ensure the profitability and sustainability of their farms. The economic vulnerability of farming stems from the loss of manpower caused by the emigration of young workers (Gödecke & Waibel, 2011) (Rigg, Salamanca & Parnwell, 2012), rice yields that are among the lowest in the world (Walker, 2012: 47), fluctuating prices of cash crops in a highly competitive world market, and household over-indebtedness. In addition, global warming weighs its effects in the form of prolonged drought episodes and catastrophic floods that affect crop yields more frequently than three decades ago (Pannangpetch et al., 2009) (Khamwong & Praneetvatakul, 2011) (Attavanich, 2013). The adoption of the "agricultural revolution" in order to increase productivity in the 1970s, and in this context the intensive use over decades of chemical fertilizers and pesticides must also be invoked. It compromises the quality of fresh water and biodiversity (Tonmanee & Kanchanakool, 1999) (Tirado, Englande, Promakasikorn, Novotny, 2008).

In the following pages, through the restudy of two rural villages of Khon Kaen province (Northeast), I shall examine in details the impact of these vulnerability factors on the farmers' standard of living, the structure of their income, their social interactions, and their relationships to the biophysical environment and its resources. I shall also question the sustainability of their agrosystem based on cash crops and the alternative model of self-

[1] National Statistical Office, Advanced *Report 2013 Agricultural Census*, Bangkok, National Statistical Office, 2013, pp. 3-5.
[2] See web.nso.go.th/en/survey/data_survey/200260summary_Jan_2017.pdf (accessed February 10, 2021).

sufficiency – *sethakhit pho phiang* − promoted by the monarchy, local NGOs and the military junta currently in power.

In line with the sustainability science research program (Clark and Dickson, 2003: 8059), my approach addresses the issue of sustainability by embracing the dynamic interactions between nature and society, and by grasping the issues of social cohesion and health (both human and environmental). The study is also grounded on the belief that the knowledge thus created is coproduced through close collaboration between the scholar and the farmers. Concerning more specifically the concept of *sustainable rural livelihoods*, I endorse the definition proposed by Robert Chambers and Gordon Conway. According to them, a livelihood is sustainable "which can cope with and recover from stress and shocks, maintain or enhance its capabilities and assets, and provide sustainable livelihood opportunities for the next generation" (1991: 6).

1.1.Methodology

The two villages of the Khon Kaen province where the study took place, namely Ban Amphawan and Ban Han, were chosen according to two main considerations. First, very detailed socio-economic studies of these two villages had been carried out in 1969-1970 and 1984-1985 (CUSRI, 1976) (Formoso et al., 1997), thus offering a precious basis for a diachronic comparison. Second, they are sampling the two main types of farming systems to be met among Thai lowland rice-growers, namely irrigated versus rainfall agriculture. They also represent two levels of integration into the market economy due to their uneven distance and transport connection to Khon Kaen, the administrative capital of the northeastern region, whose metro area population was 496,000 in 2019. Ban Amphawan is a suburban village, only twelve kilometers from the city. In its case, the rural – urban divide has lost most of its relevance over the course of urban expansion. In contrast to that *desakota* pattern (McGee and Greenberg, 1992), Ban Han is located in a remote area, more than one hour's drive from

Khon Kaen. Phu Wiang, the district town on which it depends administratively and commercially, had less than 6,000 inhabitants in 2019.

In 2014, I carried out a follow-up socioeconomic study of the two villages in order to use them as a reality check of the past and present condition of the Thai peasantry, on the ground of a corpus of data covering more than forty years. On this occasion, I submitted an interview grid to the 451 household heads of the two villages. It included questions on the composition of the household (including out-migrants), the employment of its members, its agricultural activities, its income, expenses and loans. The research was aimed to substantiate or to qualify some general assumptions by specialists of Thai rural society (Rigg & Nattapoolwat, 2001) (Suphannachart & Warr, 2011) (Walker, 2012) (Keyes, 2014). Their assessment is that Thai peasantry has experienced dramatic change during the last three decade and small farmers had in the 2010s a more diversified economy than in the 1980s. They argue that farming has become a minor component of the countryside economy. Off-farm activities are now the main source of income for a great many rural households. Spatial and sectoral hybridity of the domestic economy is becoming the norm, notes Jonathan Rigg (2019: 216). To account on this process which is a pervasive feature of the global South, several expressions have been used: “pluriactivity” (Andriesse & Phommalath, 2012), “diverse and multisited livelihoods” (Preston & Ngah, 2012), or “diversification-for- survival” (Rigg, Salamanca & Parnwell, 2012). Andrew Walker (2012) contends that this occupational multiplicity, made possible by the country’s sustained economic growth, has contributed to the eradication of absolute poverty. For a large part of them, Thai peasants would be no longer poor. They would have become « middle-income peasants », even though they confront a new form of economic disparity. In comparison with the urban middle class, their relative poverty would be becoming much worse, because of uneven economic development and of low productivity in the rural economy.

While providing valuable insights, these studies nonetheless neglect three important factors of precariousness that I intend to introduce into the debate: over-indebtedness, ecological degradation and climatic change. To document these last two factors but also the negative effect on health of the villagers' massive use of pesticides, I carried out in 2019 a new survey in the two villages with a sample of one hundred farmers (50 in each of them). The aim of the enquiry was also to collect their point of view on the future of their activities and on the feasibility of alternative models such as organic farming and the economy of self-sufficiency promoted by the monarchy and the military government. As for the 2014 survey, the interviews were conducted directly in Isan, the local dialect. The compilation of data from 2014 and 2019 for this article is justified by the fact that the political, economic and ecological context of the two villages had not significantly changed between the two dates.

2. Spatial disaggregation and skipped generation households

Ban Amphawan had 79 households and 514 inhabitants in 1969, 123 households and a total population of 773 in 1984, and 184 households for only 711 inhabitants in 2014. For its part, Ban Han had 144 households and 927 inhabitants in 1969, and 208 households for a population of 1,137 in 1984. In 1997, the village, considered to have become too big and hardly manageable, was divided into two new administrative units: Ban Han and Ban Han Noi (« Little Ban Han »). For the need of the diachronic comparison, I decided to cover the two villages. Accordingly, in 2014, Ban Han and Ban Han Noi, put together, count 267 households (198 + 69) for a total population of 898 inhabitants (685 + 213).

The significant decrease in population observed in both villages appeals few comments. Between 1984 and 2014, Ban Amphawan has lost 8 percent of its residents and Ban Han 22.1 percent, while in the meantime the number of households increased by 50 percent in the first village and by 28 percent in Ban Han and Ban Han Noi put together. These figures offer a good illustration of what Charles Keyes (2014: 5) calls the households' *spatial disaggregation*,

partly due to increasing mobility and migration of their members, and partly due to an accelerated access of the young couples to residential autonomy. Whereas couples or individuals over 60 living in isolation did not exist in 1984, they now count for 5.4 percent and 16.5 percent of the total number of households in Ban Amphawan and Ban Han respectively. This increase of the rural elderly living alone or with their spouse is nevertheless lower than that observed at the national level, which rose from 11.7 percent in 1986 to 28.2 percent in 2014 (Knodel et al., 2015: 35). In the meantime, the rate of extended families, with married kin of different generations living together, has decreased from around 40 percent in 1984 to only 18-20 percent in 2014 in the two villages. Higher achievements in education and an easier access to off-farm employment have led a significant part of the labor force ─ mostly young or mature men and women ─ either to found precociously their own household or to desert the village and to turn to urban livelihoods.

Because of its proximity with Khon Kaen city, which is an important source of local employment, Ban Amphawan is less affected by the process of rural depopulation than Ban Han. It has maintained almost unchanged its rate of adults from 20 to 44 years old (30.1 percent in 1984, 31 percent in 2014), whereas Ban Han is facing an important loss for this category of population (from 39.4 to 23.4 percent). As a consequence of this phenomenon and of steady progress in life expectancy at birth[3], the rate of people aged of 65 and over has increased from 3.5 percent in 1984 to 12.9 percent in 2014 in Ban Amphawan, and from 4.7 to 14.6 percent in Ban Han.

The spatial disaggregation observed in the two villages has not necessarily entailed a weakening of family ties or a breakdown in the out-migrant's attachment to his/her household and native community. As Jonathan Rigg rightly puts it (2019: 76) , the fact that Thai rural households are now for most of them spatially fragmented does not mean that they are

[3] According to the UNDP's *Human Development Report 2013*, life expectancy at birth in Thailand amounted to 70.1 years in 1985 and to 74 years in 2013.

becoming socially dissociated. According to him, they should rather be conceptualized as multisited economic units transcending the classic urban-rural divide, and whose internal cohesion remains usually strong.

A new pattern that emerged in the early 21th century demonstrates the ability of family mutual help to adapt to spatial fragmentation. Some authors have called it *skipped generation households* (Yuko and Rambo, 2017: 279). It consists in migrants relying on parents left behind in the village for taking charge of their progeny. The arguments put forward to justify this delegation of authority and educational duties is that the migrants are subjected to harsh work conditions which do not let them enough time to take care of the children, and that the urban social environment is unpropitious to a good moral education. In return, the migrants regularly remit money to their elderly parents acting as substitute educators.

This new pattern of intergenerational solidarity is of particular importance in Ban Han where money remittances to old parents ─ in charge or not of grand-children ─ have become a major component of the local economy. In this village one in four households are hosting grand-children of school-age or younger and draw a major part of their net annual income from money sent by close kin working in distant urban centers or living abroad. At least two factors explain this high proportion, which is ten percent higher than the average recorded in 2014 for the entire Northeast (Knodel et al., 2015: 45). First, local income earned from farm and off-farm activities are lower in Ban Han than in Ban Amphawan, making it more dependent of external sources of cash inflow. Second, Ban Han is far less integrated into the provincial and regional labor market than the village close to Khon Kaen. As a consequence, a large part of its migrant workers move to Bangkok and to the Central plain. While in Ban Amphawan 50.6 percent of the households‘ previous members involved in off-farm activities have found a job in Khon Kaen or other cities of the Northeast, in Ban Han, 54.4 percent of them are working in Bangkok, or other places of the Central plain.

Although economic solidarity between generations has been maintained within families, mutual aid has reversed. Young men or women who were financially dependent on their parents when they helped them for free on the family farm, have now become the main source of cash inflow in support of their elders. The latter still retain the status of household head and own the land which provides a degree of security that nonfarm work cannot (Rigg, 2019: 177). However, for many of them, they now play a subordinate role as providers of resources. Alongside its effects on statutory hierarchies and family cohesion, the out-migration of young people has also caused a shortage of manpower which led the aging farmers to increase the use of machinery and chemical inputs. In the space of thirty years, the average age of those working primarily in agriculture has increased significantly, from 38 to 53 years in Ban Amphawan and from 36.5 to 55.7 years in Ban Han. National statistics confirms this "geriatrification of farming" (Rigg, 2019: 191).

3. The structure of income in the two villages

While in 1969 and 1984 farming was the main occupation of more than 80 percent of the labor force of the two villages, and the major source of income for an equal proportion of households, the imbalance between farm and off-farm activities has progressively evolved during the last three decades to the point that in 2014 only 37.5 percent of the workers of Ban Amphawan and 60 percent of Ban Han declare farming as their main activity. The suburban village is closer to the current national trend, insofar as the rate of the Thailand's labor force primarily involved in agriculture was about 31% in 2014[4]. In this community only 3.9 percent of the households derive all their income from agricultural activities (farming and/or agricultural wage labor), against 12.1 percent in Ban Han. More significantly, in 2014, 87.5 percent of the households of Ban Amphawan and 65.4 percent of those of Ban Han draw the main part of their income from off-farm activities or money sent by relatives. Trading is now

[4] According to the Thailand National Statistical Office (2014: 1), in February 2014, 31,1% of the Labor force was employed in agriculture and 68,9% in off-farm activities

the main occupation for more than 15% of the labor force in both villages, while civil servants account for 15.5 and 5.9 percent of it in Ban Amphawan and Ban Han respectively.

A majority of households in these villages still grow rice, vegetables and fruits partly for subsistence and partly for cash. However, the economic returns in the rice sector are modest, despite the substantial allocation of labor and land to its production. Questioned about maintaining a so little profitable activity when not in deficit, farmers explain that in so doing they have not to buy their rice to a higher price and that rice growing is part of their identity. As noted by Michel Bruneau about Northern Thai farmers (2012: 49), rice cultivation is conceived by these smallholder farmers as a way of life and a cultural artefact to which they remain fundamentally attached. The low benefits to draw from rice cultivation result from a constant increase in production costs combined with modest yields and low market prices, whatever the efforts by successive governments to subsidy the sector from the mid-1980s onwards (Walker, 2015: 55-65). Concerning input costs, most farmers have abandoned rice transplanting in 2002, when the Thaksin's government imposed a minimum wage per hour, which pushed up the cost of hired labor force to 200-300 baht per day. They now rely on hired four-wheel tractors and harvester-threshers for the main operations of the agricultural process. As hiring prices for tractors and harvester-threshers are around 4,410 baht per hectare in 2014 (about 134 US $), most small or middle-range farmers draw very few incomes from paddy.

To compensate for this downfall and to be less dependent on world rice prices, farmers have long diversified their cash crops. After having marketed fruits and vegetables for decades, Ban Amphawan has focused from 2004 onwards its cash cropping on the production of lotus and other flowers. The impetus for this production was given by the creation fifteen years ago of a nearby market for this kind of products. In connection with this cash crop, many households in the village draw incomes from the craft of prawns and garlands of flowers (*roi ma lai*). In Ban Han, sugar cane has replaced cassava and kenaf, and has been the mainstay of

the cash-cropping sector for at least fifteen years. The cultivation of sugar cane developed gradually in the Phu Wiang region from the late 1990s, when Thailand became one of the main sugar exporters in the world market, next to Brazil and Australia (Srijantr, Molle & Chompadist, 2002: 53). At that time, the Mitr Phol Group, Asia's largest sugar and bio-energy producer, opened a refinery in the nearby district of Nong Rua. Contract-farming with this sugar cane milling unit applies only for few farmers who can devote at least 45 rai (about 7 ha.) to this production. Usually the contracts specify the area to be cultivated, the nature and quantity of inputs that will be provided by the company and the amount thus advanced which will be deduced from the purchase of the crop. As the vast majority of Ban Han farmers cultivate less than two hectares of sugar cane due to the modest size of their farm holding, they have no other choice to sell their crop than to provide the production quotas the big producers negotiate with the milling company. This informal sub-contracting system is a machine to reinforce economic inequalities and patron – client relationships within the village, as official contractors charge commissions to their subcontractors on the supply of inputs and the sale of crops. Despite these practices that reduce their profits and the huge challenges they face from price fluctuations, water scarcity, soil degradation, and crop diseases, many smallholder farmers prefer sugar cane over other crops because they could get a better price. In a majority of cases, however, farming must be cross-subsidized by non-farm work. Cash crops are in both villages the main source of income for less than one in three households.

The decline of agriculture in the two villages correlates with an increasing pressure on land and a reduction in the average size of farms which is the local reflection of a national trend. Between 1978 and 2013, the proportion of holdings of less than ten rai (1.6 ha.) increased from 28.1 percent to 37.1 percent in Thailand (Rigg, 2019: 158). Between 1984 and 2014, the proportion of farms larger than 15 rai (2.4 ha.) fell from 60.1 to 34.2 percent in Ban Amphawan, and from 68.3 to 47.3 percent in Ban Han. This dramatic reduction in the size of

farms results from the combination of several factors: the absence of new land to clear, the division of ever-smaller land assets between heirs over the generations, the spatial fragmentation of farms into many small plots which hinders land consolidation, and the dizzy rise in the prices of land in the peri-urban village which makes their acquisition impossible for most farmers. In both villages landless households were a marginal phenomenon in 1984 (they accounted for 6.5 percent in Ban Amphawan and 7.2 percent in Ban Han). They now reach significant proportions. In 2014, forty households in Ban Amphawan (21.7 percent) and thirty-four in Ban Han (12.7 percent) are not involved in farming, partly because they have no more land of their own. If we add to this figure those who are landless but do farming by renting in all their holding, we reach the proportion of 28.8 percent of households in Ban Amphawan which are excluded from land ownership. Over-indebtedness and land selling to urbanites for those who have completely shifted to non-farm activities partly explain the phenomenon. More generally, a growing number of households must combine several kinds of land tenure to ensure a sufficient rice production for their household consumption. In both villages, the farms are all far below Benjavan Rekasem's estimate that 62.5 rai (10 ha.) of irrigated paddy fields are required to make a decent living from rice (2016: 111). The transfer of land ownership to heirs has become a major issue for large families with small holding in Ban Amphawan and Ban Han. Some of them circumvent the problem by giving land in free use to heirs but by postponing *sine die* the formal transfer of land rights. Others sell part or the totality of their holding to those among the potential heirs who can afford the price. The argument is that they need money to secure incomes for their old days.

4. Poverty and indebtedness

Overall poverty has continuously declined in Thailand over the past thirty years. The National Statistical Office (NSO) has set the poverty line at by 30,864 baht (1,286 US $) per person and per year for 2013. According to the National Economic and Social Development Board

(NESDB), during the last ten years the share of the kingdom population under this poverty line fell from 32.4 percent in 2003 to 10.9 percent in 2013, with nevertheless variations from regions to regions (NESDB, 2014 : 3). The same source notes that in 2013 the poverty rate was 17.8 percent for rural Northeast. It needs to be said that the NESDB's calculation does not include the costs that households face when obtaining loans from financial institutions. With regard to these figures and the NESDB's basis for calculating, the situation of the two villages is quite different. Whereas in Ban Han the poverty rate is 32.2 percent, which is about twice the figure for rural Northeast, the rate of poverty in Ban Amphawan is slightly below the national figure, with 8.15 percent (Tabs. 6 & 7). Therefore, the case study of the two villages provides evidence of sharply contrasted situations regarding poverty from one village to another, depending on location, farming system, and off-farm employment opportunities.

The data collected in the two villages tend to qualify the assertion by Andrew Walker that middle-income peasants have become the largest group in rural Thailand. According to Walker, middle-income peasants have income at least 50 percent above the poverty line. While Ban Amphawan substantiates the author's thesis with 79.8 percent of households ranging in this group, in Ban Han, the so-called middle-income peasants count for only 46.8 percent.

The concept of « middle-income peasant » should also be discussed in relation with indebtedness. A survey conducted in 2011 by the National Statistical Office of Thailand shows that 70.1% of households in the Northeastern region were indebted, with an average debt of 137,663 baht per household (NSO, 2011: 19). Both villages are above these figures. In Ban Amphawan 72.8 percent of households were indebted in 2014 and for 64.9 percent of them the debt was over 137,663 baht [5]. For 47 percent the debt exceeded 250,000 baht and 500,000 baht for about 30 percent. In Ban Han, 82.4 percent of households were indebted, and

[5] In 2014, the average exchange rate was 24 baht per US dollar.

for 38.7 percent of them the debt was over 137,663 baht. In this latter village 15.3 percent of the households had a debt over 250,000 baht. The interest rates charged by credit organizations varied from 3 to 15 percent per annum (average 7 percent), and repayments were spread over periods ranging from 5 to 30 years. In Ban Han the proportion of borrowers cumulating at the same time two or three loans was 61 percent, against 33 percent (almost twice less) in the peri-urban village. Multiple borrowing is an additional vulnerability factor. A comparative study in rural Thailand and Viet Nam suggests that it is dynamically interrelated with over-indebtedness (Chichaibelu & Waibel, 2015: 20-21).

Over-indebtedness may transform middle-income peasants in near-poor or poor, due to important mortgage repayments which put a big strain on their budgets. A comprehensive assessment of the households' economic status should involve taking debts into account. When we deduce from their annual net income per capita the mortgage repayments to be made by most households, the proportion of middle-income peasants falls from 79.8 to 64.2 percent in Ban Amphawan, and from 46.8 to 43.1 percent in Ban Han (tabs 1 & 2). If we consider that Amphawan represents the small minority of well-off villages which enjoy double cropping and the close proximity of an important employment catchment area, the fact that its middle-income peasants hardly account for two households in three suggests that, in actuality and against the Andrew Walker's claim, poor or near-poor families remains the largest group in a majority of villages of rural Northeast which, like Ban Han, are more than one hour drive from a big city and are located in rainfed areas. The harmful effects of over-indebtedness in the two villages also qualifies the argument of many authors that ensuring access to sufficient credit reduces poverty among smallholder farmers (Braverman & Guasch, 1986) (Menkhoff & Rungruxsirivorn, 2011).

According to a study by Solot Sirisai (1997: 86), only 38.7 percent of households in Ban Amphawan and 26.8 percent in Ban Han borrowed money from institutional sources of credit

in 1984, the resort to informal loans (parents and moneylenders) remaining dominant at that time. In 2014, the imbalance between institutional and non-formal sources of credit is reversed.

Since the second half of the 1970s, the government subsidizing policy has considerably enlarged the supply of institutional credit , and high-cost borrowing from moneylenders has become marginal (Walker, 2012: 51). In line with figures provided by the NSO[6], it now concerns around 10 percent of borrowers. Cooperatives, and the Bank for Agriculture and Agricultural Co-operatives (BAAC) now account for more than 80 percent of loans. The small-scale credit fund of one million baht for every village provided by the Thaksin government in the early 2000s only operates as a secondary source of

Table 1 Distribution of the households according to their net annual income per capita. Ban Amphawan 2014

Net annual income per capita	]0- 30,864 baht] (under poverty line)	[30,865- 46,298 baht] (less than 50 percent above the poverty line)	[46,299–61,730 baht] (from 50 to 100 percent above the poverty line	[61,731 baht – [(more than 100 percent above the poverty line)
Annual repayment of loans per capita undeducted (A)	15 (8.15)	22 (12.0)	42 (22.8)	105 (57.05)
Annual repayment of loans per capita deducted (B)	29 (15.7)	37 (20.1)	31 (16.9)	87 (47.3)
Economic category (A)	Low-income households 37 (20.15)		Middle-income households 147 (79.85)	
Economic category (B)	**Low-income households 66 (35.8)**		**Middle-income households 118 (64.2)**	

Table 2 Distribution of the households according to their net annual income per capita. Ban Han (vill. 4 + 14) 2014

Net annual income per capita	]0- 30,864 baht] (under poverty line)	[30,865- 46,298 baht] (less than 50 percent above the poverty line)	[46,299–61,730 baht] (from 50% to 100 percent above the poverty line	[61,731 baht – [(more than 100 percent above the poverty line)
Annual repayment of loans per capita undeducted (A)	86 (32.2)	56 (21.0)	33 (12.3)	92 (34.5)
Annual repayment of loans per capita				

[6] According to the NSO (2011: 16), 10.1 percent of the indebted households in the Northeastern region resorted to informal credit in 2011.

deducted (B)	123 (46.1)	29 (10.9)	36 (13.5)	79 (29.5)
Economic category (A)	Low-income households 142 (53.2)		Middle-income households 125 (46.8)	
Economic category (B)	**Low-income peasants 152 (56.9)**		**Middle-income peasants 115 (43.1)**	

rural credit in Ban Han. It is the main source of credit for 6.7 percent of the borrowers in this village. In Ban Amphawan, mismanagement of the fund has led to its collapse after only few years of operation. The prime cause of debt in the two villages is household spending, including the purchase of motorcycles and cars, and the building of new houses along the suburban style. Now every household has one motorcycle or more, while 45 percent of the households of Ban Amphawan and 31 percent of Ban Han are equipped with a car (either a pick-up or a saloon, and sometimes both). Farm and off-farm operations now represent less than 40% of households' debt.

In the 2010s, to reduce the risk of bankruptcy and land seizure, the BAAC decided to postpone *sine die* the repayment of borrowed capital for low-income rural households in the poorest districts, including Phu Wiang (Formoso, 2018: 148). More systematically, the public credit institutions postpone the repayment of capital and interests for all farmers in the event of poor harvests due to natural disasters. These protective measures have so far made it possible to limit the number of bankruptcy (only one case recorded in the two villages). On the other hand, several households in default of payment for the reimbursement of cars or trucks have had their

vehicle seized by creditors.

5. Climatic threats, water depletion and soil degradation

The difficulty faced by farmers to repay their loans, in a context of declining profitability of their crops, has worsened in recent years due to repeated weather events and the accelerated deterioration of their biophysical environment. Thailand is among ten countries in the world

most affected by climate change in the past 20 years, according to the Global Climate Risk Index 2018 compiled by GermanWatch (2018: 9). Average temperatures in Southeast Asia have risen every decade since 1960, and heat waves, severe drought, and flooding are becoming more intense and frequent in the region. According to testimonies I collected in 2019, the farmers of the two villages suffered three devastating floods and four episodes of extreme drought during the wet season in the last 10 years (Tab. 3). These weather events resulted in losses ranging from half to the entire crop. During the wet season 2019, the farmers of the two villages were faced with 45 days of drought (July-August). This forced more than half of them to pull the dried rice-seedlings up and to carry out emergency transplanting of new ones. The heavy rains that followed in early September caused flooding in the plots which damaged the seedlings. That year, farmers lost between a quarter and the entire crop. Nearly 70 percent of households were forced to buy rice for their consumption, at high prices due to the shortage. Government assistance to victims of natural disasters, in the form of lump sum of 500 baht/rai and a payments standstill of loans from public bodies, only covered part of the damage suffered.

Table 3 Disastrous weather events in the two villages (2009 – 2019)

Year	flooding	drought
2009		
2010		
2011	total loss of the rice crop	
2012		
2013		
2014	partial or total loss of the crop	
2015		total loss of the rice crop
2016		
2017	partial or total loss of the crop	
2018		total loss of the rice crop
2019	partial loss of the rice crop	

Water availability is also becoming a concern in both villages due to the uncontrolled pumping of groundwater to alleviate episodes of drought and to supply the sugar cane fields during the dry season in the case of Ban Han. A high proportion of the farmers of the 2019 sample (86 percent in Amphawan, 94 percent in Ban Han) declared to periodically face water shortage, especially during the dry season. Similar observations have been made in the Central plain where water resources are traditionally more abundant (Faysse et al., 2020). While in Ban Han drilling at 10 meters was enough in the early 2000s to reach the water table, twenty years later the depth of the drilling must exceed 25-30 meters to achieve the same result. Water pollution was a concern for 26 and 12 percent in Ban Amphawan and Ban Han respectively. If in the 1980s it was frequent for men of the two villages to fish in the rivers and natural ponds of the surroundings, this activity has since been abandoned, because fish have become scarce according to informants. Likewise, the villagers no longer consume crabs and snails from the paddy fields for fear of poisoning themselves. Farmers were unanimous in blaming chemical fertilizer and pesticide-laden runoff from rice and sugar cane fields as the main source of pollution in waterways. A hydrological survey using the SINTACs approach[7] was carried out in 2012 in the district of Nong Rua next to that of Phu Wiang (Majandang & Sarapirome 2012). It revealed a high to extremely high groundwater vulnerability to nitrate pollution. Another survey in Khon Kaen province by Supaporn Chaigarun et al., who used the biodiversity index to compare pesticide treated and untreated rice fields, shows unsurprisingly a significant degradation of the ecosystem's health in the treated fields which affects the entire food chain (2011: 79).

Salinity has been a long-standing issue in northeastern Thailand whose light sandy-clay soils have a low p.H. and a low organic matter content which make them not really suitable for rice

[7] The acronym SYNTACs originates from the Italian names of the variables that are used. Soggicenza (depth to groundwater), Infiltrazione (effective infiltration), Non saturo (unsaturated zone attenuation capacity), Tipologia della copertura (soil/overburden attenuation capacity), Acquifero (saturated zone characteristics), Conducibilità (hydraulic conductivity), and Superficie topografica (topographic surface slope).

cultivation (CUSRI 1976: 204). According to Somphob Wongsomsak (1986: 133), every year the acreage of saline soil is increasing and causing major problems for Isan farmers in managing their land. This is particularly the case for the Khon Kaen area where dominates the rock salt formation which is a potential source of surface salt. It is therefore not surprising that most farmers in the sample (80 and 92 percent in Ban Amphawan and Ban Han respectively) complained about an increasing salinization which affected the quality of their rice plants and their yields. Despite the use of "improved" varieties, the rice panicles appeared to them less "prosperous" (*sombun*) than twenty years earlier. Some also noted that it was more difficult for trees to grow than before, and that some fruit trees die prematurely. However, in their view, the main indicator of soil impoverishment was the increasing amount of chemical fertilizer that now has to be used to maintain yields of their rice fields between 2.5 and 4 tons per hectare. Between 1970 and 2014, the average quantity of chemical fertilizer spread in the rice fields has increased from 30 kgs per hectare to 150 kgs, i.e. a five-fold increase, without yields significantly improving (Thongdi, 1997: 336). Such data confirm at micro-scale the conclusions of several authors about the vicious circle of underproductivity and stagnation in which are trapped most Thai smallholdings (Walker, 2012: 47) (Rigg, 2019: 284).

Farmers are aware of the disastrous effects of intensive agriculture and chemical inputs on the environment. While asserting that they need these inputs to maintain yields and stay afloat, they recognize direct responsibility for environmental degradation. A majority of survey respondents interpreted climate change not as an effect of global human activity, but as the result of deforestation that they had pursued for generations on their land. In their view, nature was taking revenge for the ill-treatment they had inflicted on her.

Because of pesticide pollution, villagers came to establish a new distinction between "safe" and “unsafe” food (*plôtphai* / *mai plôtphai*). To adapt their agricultural space accordingly, they differentiate between "clean" plots (*sahat*) for self-consumption, and polluted areas

(*sokaprok*) for cash crops. In this new spatial structuring, rice for self-consumption or sale occupies a special position because its young plants are systematically treated with selective herbicides. When asked on the subject, some farmers replied that the risk of poisoning is reduced in this case, because the spreading of herbicide is carried out long before the formation of panicles and that rice husking eliminates the herbicide residues.

6. The pesticides' trap

The sustainability of Thai small farming must be assessed in my view by crossing economic, ecological, but also health. In 2016, Thailand was ranked 48th in the world for its cultivated area[8], but 4th in terms of the quantity of the 35 most hazardous pesticides covered by the Rotterdam Convention of 1998. In a matter of twenty years, the country has tripled the quantity of imported pesticides, reaching 198,317 tons in 2017 (Office of Agricultural Economics, 2018). In the 2010s, the five largest import tonnage herbicides were in order of glyphosate, paraquat dichloride, 2.4 dimethyl sodium, ametryn and atrazine. The five most commonly used insecticides were in order of chlorpyrifos, cartap hydrochlorid, carbaryl, cypermethrin and carbosulfan. All except cypermethrin have been banned from use by the European Union. Pesticides are available locally in more than 20,000 formulas manufactured under license. Several of them are of proven ecotoxicity because of their carcinogenicity (glyphosate), or because of their effects in terms of renal insufficiency and endocrine disturbances (paraquat, atrazine, amethryn, chlorpyrifos). Their massive use by the kingdom's farmers logically has a negative impact on their health. Between 2007 and 2013, 49,000 to 61,000 cases of pesticide poisoning were recorded each year in the country, with a morbidity rate of 76.4 to 96.6 per 100,000 (Tawatsin, Thavara, Siriyasatien, 2015: 5).

Faced with this situation, the Thai government has enacted in 1992 the Hazardous Substance Act BE 2535, amended in 2001, then in 2008. The text establishes a Hazardous Substances

[8] According to the Noema Atlas: https://knoema.fr/atlas/ranks/terre-agricole-km-carrés

Committee in charge of initiating regulations relating to the production, marketing and use of hazardous chemicals. The mission of this committee is also to control the composition and packaging of products through specialized sub-committees, to inform the public of the dangers associated to their handling and to initiate investigations in the event of user complaints (Chanyuwat, 2005). However, the law largely relies on the industry for toxicological testing and has never resulted in effective control of products and brands.

Acting more radically from the 2000s onwards, the Thai Ministry of Public Health (TMPH) banned an increasing number of pesticides to arrive at a list of 98 prohibited products (Panuwet et al., 2012: 72-81). In 2019, recognizing the proven health dangers of paraquat, chlopyrifos and glyphosate, the TMPH obtained a ban on the first two products, and a use of glyphosate restricted to certain cash crops (sugar cane, corn, palm tree, cassava). These measures took effect on June 1, 2020.

The results of the survey carried out in 2019 reveal that a high proportion of farmers in the two villages used herbicides belonging to the list of toxic products now banned (paraquat) or restricted (glyphosate). 56 percent of the sample farmers in Ban Amphawan and 38 percent in Ban Han had used glyphosate in their paddy fields, a majority of them for more than fifteen years; 46 percent in Ban Amphawan and 80 percent in Ban Han used paraquat, especially for the cultivation of sugar cane in the latter case. This cash crop compels the farmers of Ban Han to use a wider range of herbicides and in larger quantities than their counterparts in Ban Amphawan. While 55.5 percent of farmers in Ban Amphawan use only one type of herbicide, 62 percent use four or more varieties in Ban Han, in quantities of up to 16 kilograms of basic product per hectare. As a result, they are more exposed to the toxicity of these products.

Because they only produce fruits and vegetables for home consumption, the two villages are low users of insecticides. The study reveals that only 38-40% used them within the sample and mostly in small amounts. The main molecules used are nevertheless among the most

dangerous. Chlopyrifos, which 10 percent of them use, is known to scientists to be a formidable endocrine disruptor causing changes in mammary gland and hormonal balance (Ventura et al., 2016), while cypermethrin, used by 17.9 percent, may reduce the body's immune defenses, disrupts the hormonal system and is a possible carcinogen.

For the last ten years, the Thai Ministry of Public Health has periodically organized nationwide blood testing campaigns on volunteers through district health offices. Such health assessments, known as GPO[9] rapid tests, are carried out by applying drops of blood on reagent papers. They measure the average activity of acetylcholinesterase, an enzyme which plays an essential role in the cholinergic regulation of the central nervous system. The GPO rapid test reveals the excitotoxicity of insecticides on human organisms for which they inhibit acetylcholinesterase, but they are ineffective at detecting the toxicological impact of herbicides which require different, more extensive and expensive tests. In 2011, according to personal information provided by the TMPH, GPO tests carried out on 533,524 people across the kingdom revealed that 32.47 percent of them were intoxicated in proportions deemed “at risk” or “unsafe”. According to the same source, in 2018, 419,093 people underwent the test. 28.18 percent of them fell into one of these two categories. The latest campaign, in 2019, show that of 155,766 people tested in the Northeast, 32.1 percent were at risk or unsafe.

In the Nong Krung Thanassan sub-district from which Ban Han depends, the most recent campaign took place in 2019 and involved 275 volunteers. Almost 70 percent of them had worrying levels of insecticide residues in the blood. Concerning more specifically Ban Han, they were 60% in this case. In the sub-district of Samran from which Ban Amphawan depends, the GPO test campaign took place in 2018 and involved 257 volunteers. According to its results, 33.8% of the volunteers had intoxication rates higher than those considered acceptable.

[9] GPO stands for Government Pharmaceutical Organization. The test is based on the Ache indicator (Average of Acetylcholinesterase Activity) which indicates the degree of exposure to organophosphates and carbamates measured from the threshold 6.416 / inline / pm 1.443 µg L-1.

The rate even fell to 21 percent in the case of Ban Amphawan, perhaps due to his specialization in flower crops which require less insecticides and fungicides than fruits and vegetables grown in neighboring villages.

Villagers who take the GPO test are notified of its result when they have risky or unsafe levels of intoxication. The health officials give them protective advice such as wearing coveralls, masks and gloves when spreading pesticides, washing immediately their clothes and showering completely. In addition, there are dietary recommendations, including the systematic washing of fruits and vegetables. Pesticide dealers also have an obligation to inform their customers of the precautions to be taken in their use. Since the 2010s, the district agricultural office hold public meetings in the villages two to three times a year. During these meetings, officials detail the new regulatory provisions relating to the purchase and use of pesticides, and provide recommendations on dosage and spreading according to the types of products. In recent years, the Thai Ministry of Agriculture committed to promote organic farming. Its local representatives provide farmers with information on alternative cultivation methods, along with free distribution of samples of organic fertilizers and pesticides.

Two-thirds of the hundred farmers interviewed had attended these meetings in the past two years. Among them a majority had experimented the use of natural fertilizers and other samples provided by state agents in their home garden. However, only two of those surveyed in Ban Amphawan and one in Ban Han had converted to organic farming on their entire farm. These few “converts” had a good academic level: one was a retired teacher, another had completed technical training at the Khon Kaen Faculty of agriculture and a third was a retired soil scientist. The other sample farmers were, for most of them, convinced of the ecological and health benefits of organic farming. However, they were reluctant to engage in this farm-wide process. Several arguments were put forward to justify such a reluctance. First, they explained that the use of organic fertilizers gave results too delayed in time and that natural

pesticides were less effective than their chemical counterparts. Indebted and facing low-paying cash crops, they could not shift to the new agrosystem without endangering the economy of their household. Second, they lacked the necessary labor force to make up for the non-use of chemical inputs. Moreover in their view, conversion to organic farming should be a community process to have any chance of success. As things stand at present, it would be misguided to adopt virtuous practices, while neighboring fields continue to be treated with pesticides. In Ban Han, some saw their rice crops partially destroyed by the spraying of herbicides on contiguous sugar cane fields.

7. The sustainability of self-sufficiency and organic farms in question

The arguments of local farmers has also to be set in the broader context of the domestic demand for organic food and of the government's agricultural policy. Organic is a concept that remains underdeveloped in Thailand. As things stand at present, consumers for this product line are mainly expatriates and cosmopolitan urbanites of the middle and upper classes. In 2017, the organic market in Thailand amounted to 81.8 million US $, of which 24.2 million only for the domestic market and 57.6 million for export (Phisuntsinthop, 2017: 23). Although organic farming re-emerged in the country in the late 1980s (Ratanawaraha et al., 2007: 40), only 9,281 farmers were certified organic producers in 2012, for a total area of 55,000 ha, or 0.21 percent of the kingdom's cultivated land (Kongsom and Panyakul, 2016: 2725). Most of them are organized in producer groups and networks. A study in the northeastern province of Surin, which is with Yasothon the stronghold of the organic rice production in Thailand, shows that many smallholders have successfully converted to this type of agriculture, thanks to the support of the governor of the province who interacted dynamically with the local civil society to help micro-developmental initiatives (Moore & Donaldson 2016: 6-10). This type of support uniting in the same momentum networked

community NGOs and local policy makers does not exist in Khon Kaen where, according to the same source only 19 farmers cultivated 25 hectares in 2013.

Despite some local successes, the low level of development of organic farming in the kingdom is all the more surprising as the late king Bhumibol Adulyadej (1946 – 2016) encouraged it from 1993 through his "new theory" of agricultural sustainability. In this theory, the farm land is divided into four parts with the ratio of 30-30-30-10, for fish pond, rice farming, organic crops, and house with adjoining vegetable gardens, respectively (Subhadrabandhu, 1998: 1238). The model was designed for farms with an average area of 10-15 rai (1.6 – 2.5 ha), thus excluding the poorest farmers who do not have their own land or have less than 10 rai. In the two villages studied in 2014, they represented between 41 and 51 percent of farmers. In the 1990s this concept of sustainable development was mainly applied to pilot projects sponsored by the royal family. Farms restructured according to this model only occupied a total area of 36,666 ha in 1999 (NESDB, 2004: 15-18).

When economic crisis hit Thailand in 1997, King Bhumibol advised his people to break with their liberal orientation in order to cope with present economic adversity and prevent the recurrence of an economic crisis in the future. The message was aimed in particular at farmers. It invited them to subscribe massively to the royal philosophy of "self-sufficiency economy" (*setthakit pho phiang*) (Hirokawa, 2010: 356). Implicitly, the royal utopia, tinged with nostalgia and rooted in the localist discourse of the 1970s (Hewison, 2000), advocated a return to the premodern situation of a self-reliance economy where farmers, steeped in the Buddhist ideology of renunciation, would be satisfied with little and would submit reverently to the governance of enlightened elites. The philosophy of "self-sufficiency" has been used as the guiding principle of the successive national economic and social development plans from 2002 onwards. In 2007, it was included in the Thailand's new constitution. Despite the support of the government and of the Thai NGOs which adhered massively to its anti-

capitalist and conservative ideology (Phatharathananunth, 2020: 345-47), the sufficiency economy was not endorsed by the kingdom's small farmers. Andrew Walker (2012: 222) explained this lack of enthusiasm by the stark contrast existing between its moralizing tone and the pragmatism of his respondents. According to Jonathan Rigg (2019: 103), the lack of connection between such a policy and the real difficulties and aspirations of many villagers explain this failure. For their part, my respondents considered that the sufficiency economy did not match their financial needs and the land constraints. Against what they saw as a return to the past, they manifested nostalgia for the measures in favor of rural entrepreneurship taken by the government of Thaksin Shinawatra (2001-2006).

The practical failure of the sufficiency economy did not prevent its continuation. In 2017, the ruling military junta launched a National scheme (2017-2021) to foster the transition to organic agriculture. According to this scheme, farmers who initiated the process received subsidies of 2,000 baht per rai cultivated in organic rice for the first year, 3,000 baht for the second, and 4,000 baht for the third. The program, aimed at converting 160,000 hectares to the production of certified organic rice, provided training to farmers, and application for certification that was free of charge. Its focus on rice production made it consistent with the paradigm of "self-sufficiency". In terms of areas covered, the program quickly achieved its objectives. However, it used the certification standard of the Ministry of Agriculture − *Organic Thailand* − that was not widely recognized abroad and consequently the rice premium received by farmers was lower than expected. As noted by Oceane Herique and Nicolas Faysse (2020: 1): « Farmers who considered profitability was important received no support in getting certificates from other organic standards that could help them obtain higher premium prices ». The authors concluded that « whether these farmers will continue to practice organic farming once the programme ends is thus questionable ».

The villagers of Ban Amphawan and Ban Han, like most of the kingdom's farmers, did not get involved in these government programs intended to foreshadow the sustainable agriculture of tomorrow. The fact that the government scheme is limited to rice provides little incentive. Rice cultivation is very vulnerable to climatic hazards, it pays little for the work provided and part of its production is reserved for domestic consumption. On its own, this crop cannot meet the significant cash needs of Thai farmers.

8. Conclusion

Sustainable development theories generally aim at the social, political and psychological empowerment of small farmers. According to John Friedmann (1992: 33), social empowerment rests upon social organization, financial resources and knowledge. Its political counterpart depends on collective action and the capacity for farmers to make their voice heard. For its part, psychological empowerment takes the form of a sense of individual potency. To these criteria I have added the ability to implement a farming system which does not compromise the peasants' health and that of their ecosystem.

As it stands, the farmers of the two villages do not meet any of these conditions. Although they have developed in recent years an acute awareness of their precariousness, and have been informed of the long-term benefits of organic farming, several factors hinder their conversion to non-chemical agriculture. The aging of the agricultural workforce, the lack of succession among young people, a high debt ratio, the lack of funding to adjust, and the uncertainty caused by climate change combine their effects to reduce their ability to change. The small size of a large number of farms is another obstacle, as it does not offer room for trying new experiments. At the provincial level, the absence of financial and logistic support from external agents (local government, NGOs, organic farmers' cooperatives) is another impediment to be considered. It does not create locally the necessary incentive to engage in alternative farming methods less harmful to health and more respectful of nature.

Trapped in their sub-livelihood farming system, the villagers have developed a pessimistic view of the future. Only 22% of respondents in Ban Amphawan and 38% in Ban Han thought that some of their children or grandchildren would continue farming. A majority of them deplored that their descendants from an early age turned away from work in the fields. The intergenerational transmission of agricultural skills is consequently threatened.

Family farming increasingly needs the support of off-farm activities to persist as a way of life in the Northeast of Thailand, a poor region unfavorable to agriculture. Although the persistence of sub-livelihood holding is puzzling (Rigg, 2019), it covers a hidden process of "deagrarianization without depeasantization" (Bruneau, 2012), which transforms Thai countryside into a "post-productivist" space where agricultural production per se is no more the main objective driving the decisions of most farmers (Mather, Hill, Nijnik, 2006). At the micro-scale of the two villages such a process is reflected by a significant number of households which have already squeezed out farming of their livelihood. In the specific case of Ban Amphawan, the proximity of the city of Khon Kaen has led to an accelerated conversion of rice fields into land dedicated to suburban residential housing or to small agribusiness (sausage and chicken factories). The dizzy rise in the cost of urban land is encouraging the urban middle class to colonize the space formerly devoted to rice cultivation. This urban colonization process is likely to affect the social cohesion of this rural community, because of conflicting values and lifestyles (Tubtim, 2012). The extension of industrial activity to the countryside also increases the pollution of water and soil. Located in a remote area, Ban Han remains protected from these threats.

In the conclusion of *More than Rural*, Jonathan Rigg maps out two transitional and not mutually exclusive scenarios marking out the range of possible rural futures in Thailand. The first scenario anticipates that land consolidation will go hand-in-hand with growing opportunities in the non-farm sector, thus offering job opportunities to the young educated

peasants. Those remaining in farming will accumulate land to develop modern industrial farming methods. Assuming that the national economy, which has underperformed for ten years (Samphantharak, 2020), takes off again, this scenario could only apply to the few landholders of Ban Han who have enough land to derive substantial profits from sugar cane. According to the second scenario, which corresponds to the experience of most farmers in the two villages, land consolidation is limited, smallholders remain dominant, livelihoods remain multiple and spatially dispersed, and engagement with off-farm work and urban living is partial. In this perspective, a low-income farming system, detrimental to biodiversity, dangerous for health, and ultimately unsustainable would remain the dominant farming mode in Thai rural areas.

References

Andriesse, E., Phommalath, A., 2012. Provincial poverty dynamics in Lao PDR: a case study of Savannakhet. Journal of Current Southeast Asian Affairs 31 (3), 3-27.

Attanavich, W., 2013, The effect of Climate Change on Thailand's Agriculture. MPRA Paper n° 84005, available on https://mpra.ub.uni-muenchen.de/84005/1/MPRA_paper_84005.pdf

Braverman, A., Guasch, J. L., 1986. Rural credit markets and institutions in developing countries: lessons for policy analysis from practice and modern Theory. World Development 14 (10-11), 1253-1267.

Bruneau, M., 2012. Agrarian transitions in northern Thailand: from periurban to mountain margins 1966-2006. in J. D. Rigg and P. Vandergeest eds. Revisiting Rural Places: Pathways to Poverty and Prosperity in Southeast Asia. University of Hawai'i Press, Honomulu, 38-51.

Chaigarun, S., Kessomboon, N., Kessomboon, P., Singwarl, S., Perayos, K., Heong, Kong Luen, H., 2011. Comparison of biodiversity index in pesticide treated and untreated rice field in northeast Thailand. Chiang Mai Journal of Natural Science 10 (1), 71-79.

Chambers, R., Conway, G., 1991. Sustainable rural livelihoods: practical concepts for the 21st century. IDS Discussion Paper 296. Institute of Development Studies, Brighton, UK.

Chanyuwat, P., 2005. Country Report. in Proceedings Asia Regional Report. Implementation, Monitoring, Observance. International Conduct on the Distribution and Use of Pesticides. Bangkok. Available on http://www.fao.org/3/af340e/af340e0l.htm#TopOfPage, accessed November 17, 2020.

Chichaibelu, B., Waibel, H., 2015. The interrelated dynamics of multiple borrowing and over-indebtedness among rural households in Thailand and Vietnam. Milano, 29th International Conference of Agricultural Economists, August 8-14, Milano 2015, 1-28.

Clark, W. C., Dickson, N. M., 2003. Sustainability science: the emerging research program. Proceedings of the National Academy of Sciences of the United States of America, Vol. 100-14, 8059-61.

CUSRI, 1976. Village Khon Kaen. Social and Economic Conditions of a Rural Population in Northeastern Thailand. Chulalongkorn University Social Research Institute, Bangkok.

Faysse, N., Aguilhon L., Phiboon, K., Purotaganon, M., 2020. Mainly farming… But what's next? The future of irrigated farms in Thailand ». Journal of Rural Studies 73, 68-76.

Formoso, B. (ed.), 1997. Ban Amphawan et Ban Han. Le devenir de deux villages rizicoles du Nord-Est thaïlandais. ERC/CNRS, Paris.

Formoso, B., 2018. La dette des agriculteurs passée au crible. Le cas de deux villages du nord-est de la Thaïlande. Etudes rurales 202, 140-157.

Friedmann, J., 1992. Empowerment : The Politics of Alternative Development. Basil Blackwell, Cambridge.

Germanwatch, 2017. Global Climate Risks Index 2018. Germanwatch, Bonn. Can be retrieved on https://germanwatch.org/sites/germanwatch.org/files/publication/20432.pdf

Gödecke, T., Waibel, H., 2011. Rural-urban transformation and village economy in emerging market economies during economic crisis: empirical evidence from Thailand. Cambridge Journal of Regions, Economy and Society 4 (2), 205-219.

Hazell, P. B. R., Rahman, A. (eds.), 2014. New Directions for Smallholder Agriculture. Oxford University Press, Oxford.

Hérique, O., Faysse, N., 2020. A large-scale public programme to promote organic rice-farming in Thailand: building solid foundation to enable farmers to engage », *Organic Agriculture* 12, 27-40.

Hirokawa, S., 2010. Promoting sustainable agriculture development and farmer empowerment: a case of northeast Thailand. Asian Rural Sociology IV, Vol. 2, College of Agriculture, los Baños, 354-363.

Keyes, C., 2014. Finding their Voice. Northeastern Villagers and the Thai State. Silkworm Books, Chiang Mai.

Khamwon, C., Praneetvatakul, S., 2011. Impact of climate change on agricultural revenue and adaptation strategies of farmers in northeastern Thailand. Kasetsart Journal (Social Science) 32, 214-228.

Knodel, J., Teerawichitchainan, B., Prachuabmoh, K., Pothsiri, W., 2015. The Situation of Thailand's Older Population: An Update Based on the 2014 Survey of Older Persons in Thailand. University of Michigan Press, Population Studies Center Research Report, Ann Arbor

Kongsom, C., Panyakul, V., 2016. Production and market of certified organic products in Thailand. International Journal of Economics and Management Engineering vol. 10 (8), 2723-2727.

Mather, A., Hill, G., Nijnik, M., 2006. Post-productivism and rural land use: cul de sac or challenge for theorization? Journal of Rural Studies 22 (4), 441-455.

McGee, T. G., Greenberg, C., 1992. The Emergence of extended metropolitan regions in ASEAN towards the year 2000. ASEAN Economic Bulletin 9(1), 22-44.

Mjandang, J., Sarapirome, S., 2012. Ground water vulnerability assessment and sensivity analysis in Nong Rua, Khon Kaen, Thailand. A GIS-based SINTACs model. Environmental Earth Sciences 68 (7), 2025-2039.

Menkhoff, L., Rungruxsirivorn, O., 2011. Do village funds improve access to finance? Evidence from Thailand. World Development 39 (1), 110-122.

Moore, J.D., Donaldson, J.A., 2016. Human-scale economics: economic growth and poverty reduction in northeastern Thailand. World Development 85, 1-15.

National Statistical Office of Thailand, 2011. Household Socio-Economic Survey 2011, Northeastern Region. National Statistical Office, Bangkok.

National Statistical Office of Thailand, 2013. Advanced Report 2013 Agricultural Census. National Statistical Office, Bangkok.

National Statitical Office of Thailand, 2014. Summary of the Labor Force Survey in Thailand, Feb. 2014. National Statistical Office, Bangkok. Can be viewed on: http://www.nso.go.th/en/survey/data_survey/250414_sumFeb56.pdf (retrieved November 14, 2015).

NESDB, 2004. The Evaluation of the Capacity development and Life Quality of Sustainable Agriculture. NESDB, Bangkok.

NESDB, 2014. Poverty and Inequality in Thailand. NESDB, Bangkok.

Office of Agricultural Economics, Department of Agriculture, Thailand, 2018. Imported volume and value of agricultural hazardous chemicals 2011-2017, 2018. See http://oldweb.oae.go.th/economicdata/pesticides.html, accessed February 14, 2021.

Pannangpetch, K. et al., 2009. Impact of Global Warming on Rice, Sugarcane, Cassava, and Maize Production in Thailand. Project code RDG 5130007. The Thailand Research Fund.

Panuwet, P. et al., 2012. Agricultural pesticide management in Thailand. Situation and population health risk. Environment Science Policy, March 17, 72-81.

Phatarathananunth, S., 2020. Dances with dictators: NGOs and military regime in Thailand », *in* Pavin Chachavalpongpun ed., Coup, King, Crisis. A Critical Interregnum in Thailand, New Haven, Yale Southeast Asia Studies, Monograph 68, 339-361.

Phisutsinthop, K. M., 2017. Organic Market in Thailand, Central Group, Bangkok.

Preston, D., Ngah, I., 2012. Interpreting rural change in Malaysia. Singapore Journal of Tropical Geography 33 (3), 351-364.

Ratanawaraha, A., 2007. Measuring the geography of innovation: a literature review », in Karen R. Polenske ed., The Economic Geography of Innovation. Cambridge University Press, Cambridge, 30-59.

Rerkasem, B., 2016. Thai Rice: A Crop that Shapes the Lives and Land of a People, Feeds the World, and Has in Turn Been Moulded by Them. Chiang Mai University Press, Chiang Mai.

Rigg, J., 2019. More than Rural. Textures of Thailand's Agrarian Transformation. University of Hawai'i Press, Honolulu.

Rigg, Jonathan, Nattapoolwat, S., 2001. Embracing the global in Thailand: activism and pragmatism in an era of deagrarianization. World Development 29 (6), 945-960.

Rigg, J., Salamanca, A., Parnwell, J.G, 2012. Joining the dots of agrarian change in Asia: a 25 year view from Thailand. World Development 40 (7), 1469-1481.

Samphantharak, K., 2020. The Thai economy: a lost decade? In P. Chachavalpongpun (ed.), Coup, King, Crisis. A Critical Interregnum in Thailand. Yale Southeast Asia Studies, Monograph 68, Yale University, New Haven, 249-269.

Srijantr, T., Molle, F., Chompadist, C., 2002. Profitability and yield gap of sugar cane cultivation in the Maeklong region. Thai Agricultural Economic Journal 18 (1), 53-69.

Subhadrabandhu, S., 1998. Horticultural production for sustainability of small scale farms in Thailand. Journal of the Japanese Society for Horticultural Science 67 (6), 1236-1241.

Suphannachart, W., Warr, P., 2011. Research productivity in Thai agriculture. Australian Journal of Agriculture and Resource Economics 55 (1), 35-52.

Tawatsin, A., Thavara, U., Siriyasatien, P., 2015. Pesticides used in Thailand and toxic effects to human health. Medical Research Archives (3): 1-10.

Thongdi, Iam, 1997. Les pratiques rizicoles et leur transformation, in B. Formoso éd., Ban Amphawan et Ban Han. Le devenir de deux villages rizicoles du Nord-Est thaïlandais, ERC/CNRS, Paris, 313-342.

Tirado, R., Englande, A.J., Promasikorn, L., Novotny, V., 2008. Use of Agrochemicals in Thailand and its Consequences for the Environment. Greenpeace Research Laboratories Technical Note 03/2008 – Feb. 2008.

Tonmanee, N., Kanchanakool, N., 1999. Agricultural diffuse pollution in Thailand. Water Science and Technology 39 (3), 61-66.

Tubtim, T., 2012. Migration to te countryside : class encounters in periurban Chiang Mai, Thailand. Critical Asian Studies 44 (1), 113-130.

UNDP, 2013. Human Development report 2013, Thailand, New York: United Nations Development Programme.

Ventura, C., Nieto, M., Bourguignon, N., Lux-Santos, V., Rodriguez, H., Cao, G., Randi, A., Cocca, C., Nuñez, J., 2016. Pesticide chlorpyrifos acts as an endocrine disruptor in adult rats causing changes in mammary gland and hormonal balance. Journal Steroid Biochem Mol Biol 156, 1-9. doi: 10.1016/j.jsbmb.2015.10.010. Epub 2015 Oct 27.

Walker, A., 2012. Thailand's Political Peasants. Power in the Modern Rural Economy. The University of Wisconsin Press, Madison.

Walker, A., 2015. From legibility to eligibility: politics, subsidy and productivity in rural Asia. TRaNS 3 (1), 45-71.

Wongsomsak, S., 1986. Salinization in northeast Thailand. Southeast Asian Studies, 24, 133-153.