ESSAYS ON VILLAGE DEVELOPMENT IN RURAL THAILAND

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ZUSAMMENFASSUNG

Die Entwicklung aufstrebender Volkswirtschaften in den Ländern Südostasiens wird von einem rasch voranschreitenden Urbanisierungsprozess begleitet. Die kontinuierliche Verlagerung von Arbeitskräften aus der Landwirtschaft in den Industrie- und Dienstleistungssektors, bedeutet gleichzeitig Migration und Abwanderung aus ländlichen Dörfern. Landwirtschaftliche Produktion in Südostasiens findet jedoch überwiegend in einem Dorfkontext statt. Dies gilt auch für Thailand. Generell, wird das ländliche Dorf als ein wenig attraktiver Ort zum Arbeiten und zum Leben angesehen. Vor allem die Jüngeren suchen Arbeit in den Städten, wo sie eine bessere Infrastruktur und mehr Freizeitmöglichkeiten vorfinden. Im Dorf bleiben dann oft nur die Alten und Minderjährigen. Politische Entscheidungsträger sehen die Entwicklung von Industriezonen und urbanen Lebensräumen als prioritär an, wohingegen die Dorfentwicklung wenig Aufmerksamkeit und daher auch wenig öffentliche Investitionen erhält.

Es ist daher nicht verwunderlich, dass in diesen Ländern, gebietsweise ländliche Armut weiterhin existiert. Das Beispiel vieler europäischer Länder, wo durch zielgerichtete Politikmaßnahmen der ländliche Raum entwickelt und modernisiert und zu einem attraktiven Lebensraum mit niedrigen Grundstückspreisen und hoher Umweltqualität wurde, findet bislang in Asien wenig Beachtung. Daher ist es sinnvoll die Rolle von Dörfern bei der wirtschaftlichen Entwicklung am Beispiel eines Schwellenlandes wie Thailand, genauer zu untersuchen. Die hier vorliegende Arbeit befasst sich deshalb mit den Mechanismen, Möglichkeiten und Grenzen, die die sozioökonomische Entwicklung ländlicher Dörfer in Thailand beeinflussen.

Die Dissertation enthält vier Essays. Jeder der vier Aufsätze befasst sich mit einem Aspekt der Dorfentwicklung. Der erste Aufsatz testet auf der Grundlage von Daten zweier Dorfzensus in 2019 und 2018 in einem typischen Dorf in Thailand, mit Hilfe zweier ökonometrischer Modelle, die Frage, in wieweit Migration für die Entwicklung der Wohlfahrt im Dorf förderlich ist und zur Armutsreduktion beiträgt? Im zweiten Papier werden dieselben Daten wie beim ersten Aufsatz verwendet. Allerdings wird hier auf der Basis des Dorfzensus von 2018, ein mathematisches Programmierungsmodell entwickelt. Damit lässt sich mit Hilfe einer Szenario Analyse die zukünftige Rolle der Landwirtschaft im Dorf untersuchen. Der dritte Artikel hat einen breiteren Ansatz, indem ein Paneldatensatz von 220 Dörfern in Nordostthailand verwendet wird. Damit lassen sich die Faktoren untersuchen, die für eine Transformation und Modernisierung der ländlichen Dörfer von Bedeutung sind und Ansätze für mögliche Politikmaßnahen bieten. Der vierte Aufsatz konzentriert sich auf Dörfer entlang des Mekong-Flusses in Thailand und Laos. Der Bericht präsentiert das Ergebnis einer Studie unter Verwendung von qualitativen Methoden über die Auswirkungen der jüngsten Covid-19-Pandemie auf Mekong-Dörfer vor dem Hintergrund der dort aufgrund der Ausbeutung des Flusses zur Wasserkraft bereits seit längerem bestehenden großen Herausforderungen.

Die Ergebnisse der Essays lassen sich wie folgt zusammenfassen. Erstens, Migration ist entgegen früherer Hypothesen der Migrationstheorie, kein signifikanter Faktor für das Einkommenswachstum der Haushalte im Dorf. Zuwanderung überstieg die Abwanderung, und die Investitionen im Dorf waren ein wichtiger Wachstumsmotor. Zweitens, während das Einkommenswachstum im Dorf, im Durchschnitt, dem Wachstum der thailändischen

Volkswirtschaft entsprach, hat sich die Einkommensungleichheit erhöht. Gleichzeitig hat sich die Armutsquote im Dorf kaum verringert und liegt weit hinter dem nationalen Durchschnitt. Darüber hinaus hat sich die Verschuldung der Haushalte im Dorf zwischen 2009 und 2018 mehr als verdoppelt. Drittens, hatten Haushalte, die stärker Lohnarbeit und selbstständige Tätigkeit aufnehmen, eine bessere Einkommensentwicklung. Gleichwohl, praktiziert die überwiegende Mehrzahl der Haushalte im Dorf Nebenerwerbslandwirtschaft und Erwerbskombinationen aus multiplen Einkommensquellen. Landwirtschaftlicher Strukturwandel, verbunden mit der Aufgabe von Kleinbetrieben und der Herausbildung von größeren Betrieben, findet nicht statt. Die Ergebnisse eines Dorfmodelles mit Hilfe der positiven mathematischen Programmierung zeigen, dass selbst drastische Preiserhöhungen bei Mais, der wichtigsten Anbaukultur im Dorfes, keine Änderung in der Betriebsstruktur erwarten lässt. Es ist unwahrscheinlich, dass viele Haushalte die Landwirtschaft in absehbarer Zeit ganz aufgeben werden. Viertens, zeigen die Ergebnisse der deskriptiven und der Modelanalyse anhand von Paneldaten in 220 Dörfern in Nordost Thailand, zwischen 2007 und 2017, die Bedeutung von Infrastrukturinvestitionen für die Dorfentwicklung. Im Durchschnitt aller Dörfer hat sich die Armut halbiert und das Haushaltseinkommen verdoppelt. Schlüsselinfrastrukturen sind bessere Straßen, die sich auf praktisch alle Wohlfahrtsparameter auswirken. Das Wachstum der landwirtschaftlichen Produktivität wird durch Verbesserungen der Bewässerungsinfrastruktur unterstützt. Eine wichtige Infrastruktur sind vor allem auch Verbesserungen in der Verfügbarkeit der Telekommunikationstechnologie, die sich allerdings in den Dörfern noch in der Anfangsphase befindet, sich aber als entscheidend für eine Modernisierung der Dorfwirtschaft erwiesen hat. Die Fortschritte in diesem Bereich hinken jedoch deutlich den Fortschritten in den städtischen Gebieten hinterher.

Das fünfte Ergebnis entspringt dem Papier über die Auswirkungen der Covid-19-Pandemie auf ausgewählte Dörfer entlang des Mekong in Nordostthailand und Laos. Es zeigt sich, dass negative wirtschaftliche Auswirkungen von Covid-19 in den Dörfern gering waren. Allerdings hat die Pandemie die strukturellen Schwächen in den Mekong Dörfern sichtbar gemacht. Die Herausforderungen, die sich aus der intensiven Nutzung des Mekong Flusses zum unbeschränkten Ausbau der Wasserkraft für die Dörfer bereits ergeben haben, sind durch die Pandemie noch einmal verstärkt worden. Die anderen weiter fortschreitenden Gefahren, wie Klimawandel und Erschöpfung natürlicher Ressourcen, stellen die Mekong Dörfer vor noch größere Herausforderungen.

Zusammenfassend lässt sich festhalten, dass die in den vier Artikeln präsentierten Studien über ländliche Dörfer in Thailand, eine neue Entwicklungsperspektive für Länder mit einer raschen Entwicklung des Industrie-und Dienstleistungssektors aufzeigen. Die Ergebnisse können für den Einstieg in eine Debatte über eine neue Politik zur Entwicklung des ländlichen Raums herangezogen werden. Eine solche Politik sollte die Möglichkeiten für integratives Wirtschaftswachstum unter Einbeziehung der ländlichen Dörfer, anerkennen und nicht wie in der Vergangenheit, das Dorf nur als Quelle billiger Arbeitskräfte für die Entwicklung in urbanen Räumen zu betrachten.

Stichworte: Ländliche Lebensgrundlagen, Dorfstudie, Paneldaten, Land-Stadt-Migration, Infrastrukturentwicklung, landwirtschaftlicher Wandel, COVID-19, Thailand

ABSTRACT

The process of development is accompanied by urbanization through shifting labor from agriculture to the industrial and service sector. Thus, rural villages in developing countries, where most agriculture takes place, are often seen as a place unattractive for work and living. Especially younger people seek employment in the cities where they find better infrastructure and more leisure possibilities. Left behind in the villages are often the elderly and minors. Most of the development investments are made in urban agglomerates while villages are given lower priority. Hence, the role of rural villages is often underrated in developing countries and therefore some villages remain pockets of poverty. Considering the experience of many European countries with well-targeted rural development policies, villages can become modernized and they can become an attractive living place with low prices for land and a better environment than in polluted cities. Hence, there is a need to study the role that rural villages can play in economic development of an emerging market country like Thailand. Therefore, this thesis takes an in-depth look at the mechanism, constraints and opportunities that govern socioeconomic development of rural villages in Thailand.

The dissertation contains four essays. Each essay deals with a different aspect of the development of rural villages. The first essay is based on panel data from a single village, and tests, by means of two econometric models, the standard assumption that out-migration is a driver for increase in welfare and reducing poverty in villages. The second paper, using the same village than in the first paper applies a mathematical programming model to investigate the future role of agriculture under two likely external economic scenarios. The third article takes a broader view, by using a sample of 220 villages in Northeast Thailand, and explores the factors that on the one hand, can facilitate transformation from backward to progressive rural villages and that on the other hand, can hinder modernization and development. The fourth essay is focused on villages along the Mekong River in both, Thailand and Laos and presents an account of the impact of the recent Covid-19 pandemic on Mekong villages.

The results of the four essays can be summarized as follows. Firstly, against the hypotheses suggested by the theory of migration, migration was not a significant factor driving income growth in the village. In-migration exceeded out-migration and business investment in the village was a major driver of income growth. Secondly, while income growth was well in line with Thailand's national rate of economic growth, inequality has risen and poverty decline was minimal, much behind the aggregate rate of poverty decline in the country. In addition, household debt on average has more doubled between 2009 and 2018.

Thirdly, households who diversified into wage and self-employment experienced better progress in terms of income growth and were less likely to be poor, compared to households whose primary occupation was farming. While all village households are engaged in farming, income from agriculture is not the only source of household income, i.e. majority of households are following a multiple income, part-time farming system. Results of a village-level, positive mathematical programming model showed that even drastic price increases in maize, which is the main agricultural commodity of the village, will not reverse the trend away from agriculture and towards

a more diversified livelihood strategy. On the other hand, households are not likely to give up farming altogether in the foreseeable future.

Fourthly, using panel data of 220 villages between 2007 and 2017, results of the descriptive and the model analysis demonstrate the importance of infrastructure investment in the development of rural villages in North East Thailand. On average of all the villages, poverty has been halved and household income has doubled. Key infrastructures are good quality roads, significantly related to basically all welfare parameters. Agricultural productivity growth is facilitated by improvements in irrigation infrastructure. A major infrastructure is improvements in telecommunication which is still emerging but was found to be crucial for a modernization of the village economy. However, progress in this area is lagging behind the advances made in urban areas.

Finally, the paper describing the implications of the Covid-19 pandemic in villages along the Mekong River in Northeast Thailand and Laos, showed that while the economic impact of Covid-19 in rural villages was minimal, the pandemic has exposed the weakness of rural economies in the Mekong villages under lockdown conditions and due to their past threats from the exploitation of the river as a source of hydropower. This makes it even harder for these villages to cope with other ongoing processes such as climate change and natural resource depletion.

In conclusion, the studies of rural villages in Thailand have opened up a new perspective of development for emerging market economies. It also provides an entry point to a policy debate for a new rural development policy. Such policy should recognize the opportunities that exist in rural villages as a means of inclusive economic growth and not, as in the past, just as a source of cheap labor for urban development.

Keywords: Rural livelihood, Village study, Panel data, Rural-urban migration, Infrastructure development, Agriculture transformation, COVID-19, Thailand

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LIST OF ABBREVIATIONS

2SLSIV	Two Stage Least Square Instrumental Variable
AB	Agriculture-based
ASEAN	Association of Southeast Asian Nations
COVID-19	Coronavirus Disease of 2019
CPI	Consumer Price Index
DFG	Deutsche Forschungsgemeinschaft
DFID	Department for International Development
DID	Difference in difference
DOAE	Department of Agricultural Extension
FGT	Foster–Greer–Thorbecke indices
GDP	Gross Domestic Product
HH	Households
ICT	Information Communications Technology
LMB	Lower Mekong Basin
LP	Linear Programming
MRC	Mekong River Commission
NAB	Non-agriculture-based
NESDB	National Economic and Social Development Board
PMP	Positive Mathematical Programming
THB	Thai baht
TVSEP	Thailand Vietnam Socio Economic Panel
UMB	Upper Mekong River Basin
UNDP	United Nations Development Programme

CHAPTER 1: Introduction

1.1 Background and motivation

Economic growth in developing countries is facilitated by transitions and structural change among the sectors in the economy. Generally, this means that resources are transferred from sectors with low productivity to sectors with higher productivity. More precisely, the agricultural sector where the marginal productivity of labor is often minimal, zero or even negative (Lewis, 1961) traditionally has supplied surplus labor to the industrial and service sector. Cheap labor has been a major driver for economic growth in the developing world. The notion of a constant institutional wage in the agricultural sector allows the industrial and service sector to expand with low costs of labor for a long period of time, i.e. until the source of cheap labor is exhausted and agriculture becomes commercialized (Fei&Ranis, 1961). Ultimately this process is accompanied by rural urban migration, and the establishment of urban agglomerates where most industries in developing countries are located. This model of industrial-led growth which was widely followed in the developing countries has created a kind of bias against agriculture. As a result, rural areas have received little attention for infrastructure investment and modernization. Thus, rural villages, where most agriculture takes place, are often seen as a place unattractive for work and living. Especially younger people seek employment in the cities, where they find better facilities and more leisure possibilities. Left behind in the villages are the elderly and the minors. This has led to sometimes dramatic changes in the socioeconomic structure and social life of villages (Rigg et al., 2012; Shirai & Rambo, 2017). For example, old customs of labor exchange and mutual help arrangements, driven by the seasonality of small scale farming, are disappearing. Increasingly, households rely less on farming and take remittances from migrant household members instead. A UNDP study has labeled this as "hollowing out village populations" (UNDP, 2007).

As regards the role and the importance of rural villages, the literature has focused on rural areas as safety nets in case of crisis, i.e. such as the Asian financial crisis of 1997 (Bresciani et al., 2002 and Poapongsakorn et al., 2006), the global food and financial crisis of 2008 (Gödecke & Waibel, 2011) and the recent Covid-19 pandemic (Waibel et al., 2020). So far, very few studies have followed a rigorous, quantitative village-based approach. Therefore, in this research, several questions regarding the development of rural villages will be addressed:

1) Will the trend of out-migration and "hollowing out" of the populations in rural villages continue?
2) How important will agriculture be in the future village economy as a source of livelihood?
3) Can rural villages maintain their function as a safety net in times of crisis?
4) What are the prospects for village development, both as an attractive living and work space?

The thesis consists of 4 essays. Each essay addresses different issues regarding village history and development. The first essay is titled, "***Rural transformation and village development: a case study of a village in Thailand***". In this essay, the focus is on the role of migration for income

growth and poverty reduction in a typical rural village in Thailand. The second essay is *"**Agriculture in the village economy: a case study**"* In this essay, possible future economic scenarios are investigated as regards their effect on agriculture in a village context. The third paper is called "***Development of rural village infrastructure and its impact on household well-being in Northeast Thailand***". In this essay a larger sample of 220 villages is considered at two points in time. Finally, a paper on "***Covid-19 and Rural Development in the Mekong River Region: Case studies from Thailand and Laos***," is presented. In this paper, the impact of the Covid-19 pandemic in selected villages along the Mekong river are investigated by means of a qualitative analysis, on the basis of descriptive statistics.

In next section, the methodologies applied in the four essays are briefly described.

1.2 Methodology

Depending on the objective and the focus of the essay, different theoretical concepts, econometric models and parametric as well as non-parametric statistical methods were used.

In the ***first essay***, data of two village censes in 2009 and 2018 were used to generate descriptive statistics on income, consumption and poverty and illustrate the changes over the ten-year observation period. Based on the "New Economics Theory of Labor Migration" (e.g. Stark & Levhari, 1982; Rosenzweig & Stark, 1989), a fixed effect, two-stage least square instrumental variable (2SLSIV) model was used to investigate the effect of migration on the income of the village households. To investigate poverty dynamics (e.g. Reda et al., 2012; Roth & Tiberti, 2016; Wineman & Jayne, 2017; Cuong & Linh, 2018; Toros et al., 2017) in the village, a probit model with the change in the poverty status of village households as dependent variable, was developed. For this purpose, poverty dynamics has been defined using four categories (Hulme & McKay 2013; Chiwaula et al. 2011; Sakontawat, 2013 and Cahyadi & Waibel, 2016), namely: (i) always poor, (ii) move into poverty, (iii) move out of poverty and (iv) never poor.

In the ***second essay***, the same data set as in the first essay were used. Descriptive analysis was used to present changes in livelihoods of households in the village. To assess the impact of future scenarios regarding possible economic conditions such as the price of maize and wages on village income and livelihoods, a Positive Mathematical Programing (PMP) model (Howitt, 1995; Heckelei et al., 2012) was applied. While the PMP model has been widely used for policy analysis at sector and regional level (e.g. Hardeweg, 2008; Donati et al., 2013; Quintana-Ashwell, et al., 2021; Moulogianni & Bournaris, 2021), the model in this paper is perhaps one of the first applied to a village.

In the ***third essay***, a descriptive analysis, including parametric statistical tests were used to investigate changes in village development using long-term village and household level panel data. A difference-in-difference probit model with a fixed effects estimator was applied to identify crucial drivers of village development such as transportation, communication, irrigation infrastructure development. Income, consumption and poverty were used as outcome variables. Poverty lines were based on the Thailand National Economic and Social Development Board (NESDB, 2020).

In the ***fourth essay***, the same panel data as in essay 3 were used. However, some 50 villages in the vicinity of the Mekong River were selected. In addition, semi-structured interviews with village heads in 10 Mekong villages in Thailand and Laos respectively were applied. The data were analyzed by means of descriptive statistics and qualitative methods based on village head testimonials.

1.3 Data

There are three sources of data used in this thesis. First, the village census data collected in a typical Thai village in the province of Phetchabun. These data were used in both, the ***first and second essay***. Second, the panel data of the village and household panel data of the Thailand Vietnam Socioeconomic Panel (www.tvsep.de) with 220 villages and some 2200 households in the provinces of Nakon Phanom, Ubon Ratchathani and Buri Ram were used in the ***third essay***. The same data base was used for the ***fourth essay***. However, only villages located in the vicinity of the Mekong river from Nakon Phanom province were drawn. In addition, semi-structured interviews in 10 panel villages in Nakon Phanom, and 10 villages in Savannakhet province, Laos, both along the Mekong river we used. The map in Figure 1.1 shows the locations of the data collected.

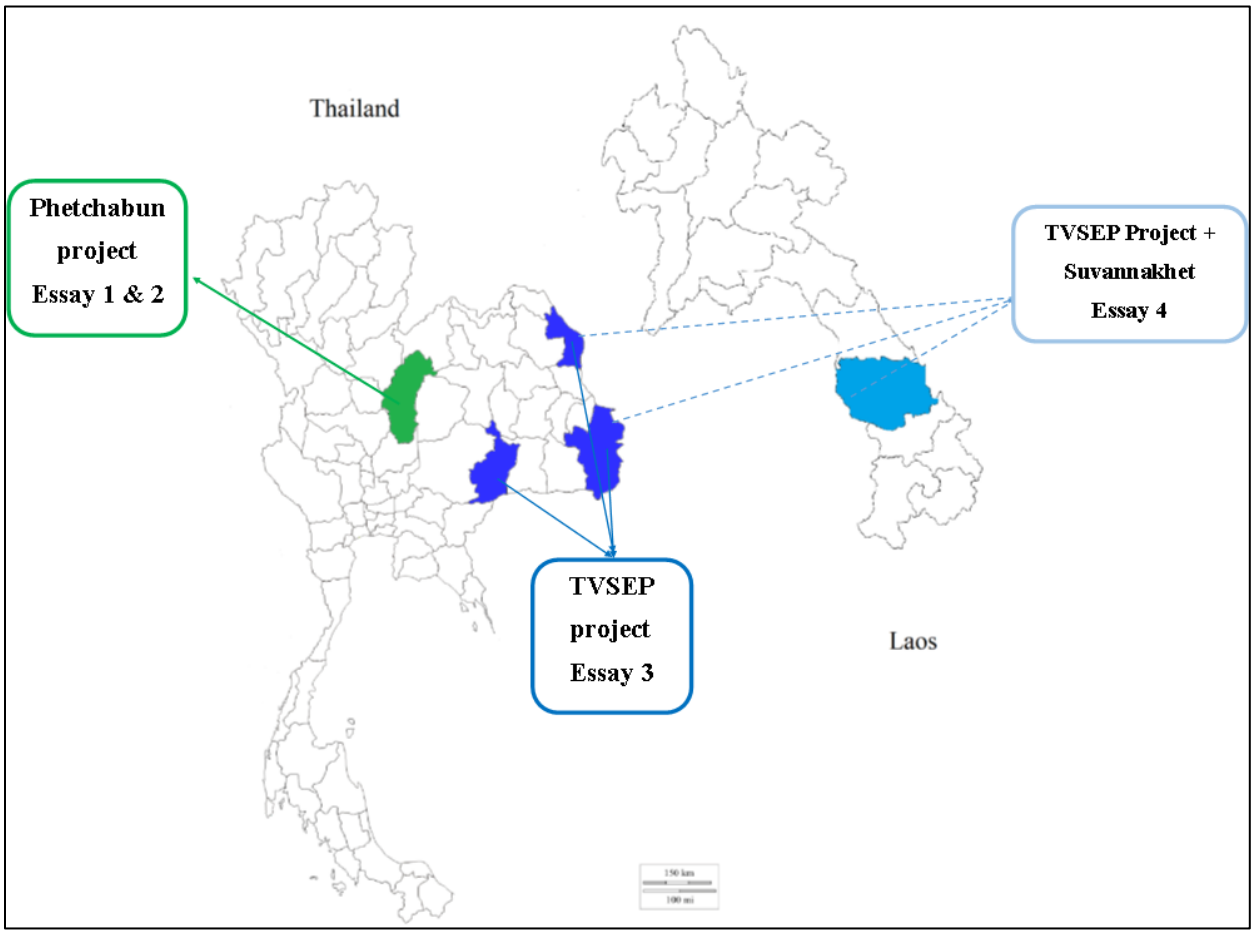

Figure 1.1 Study areas in Thailand
Source: Author's illustration.

As regards the data collected in Phetchabun province, this research has been started in 2009 with a case study of a typical village in Thailand (Gödecke, 2012). The village is located some 350 km north of Bangkok. It is characterized by mountainous terrain with small-scale agriculture under less favorable conditions. The choice of this village for conducting a research study, was based on its characteristics typical for a rural Thai village, as well as the willingness of village authorities to cooperate as facilitated by the Department of Agricultural Extension (DOAE). In 2009 all, except five of the 75 village households, were interviewed using the TVSEP survey instrument, complemented by additional modules as well as semi-structured interviews with key informants in the village. In 2018, the census was repeated, interviewing all households, whose number had meanwhile increased to 83 (Nantajit & Waibel, 2019). Basically, the same kind of data were collected as in the baseline, albeit complemented by more details on land use and details on income generating activities.

The data for third and partly also for the fourth essay, are drawn from Thailand Vietnam Socio Economic Panel (TVSEP). The panel is a unique long-term data base representative for rural areas in Northeast Thailand and Central Vietnam, Hardeweg et al. (2013). The panel has started in 2007 and by 2022, nine panel waves were completed in Thailand. Both household and village level data are collected, however the latter in less frequent intervals. For the third essay, the data of 1,770 identical households in 220 villages from the provinces of Nakhon Phanom, Ubon Ratchathani and Buri Ram in 2007 and 2016 were used. For the forth essay, the data of 54 villages, located not further than 40 km away from the Mekong River in 2007 and 2017, were selected from the TVSEP panel database. Furthermore, data from a TVSEP special Covid-19 survey, carried out in 2020 were used. The villages in Laos were drawn from a panel survey in Savannakhet province, administered in 2013 and 2014, using the same criteria as regards distance to the river. For the purpose of a country comparison, semi-structured interviews with village heads were conducted in Nakon Phanom Province and Savannakhet province in Laos. Figure 1.2 shows the location of the villages.

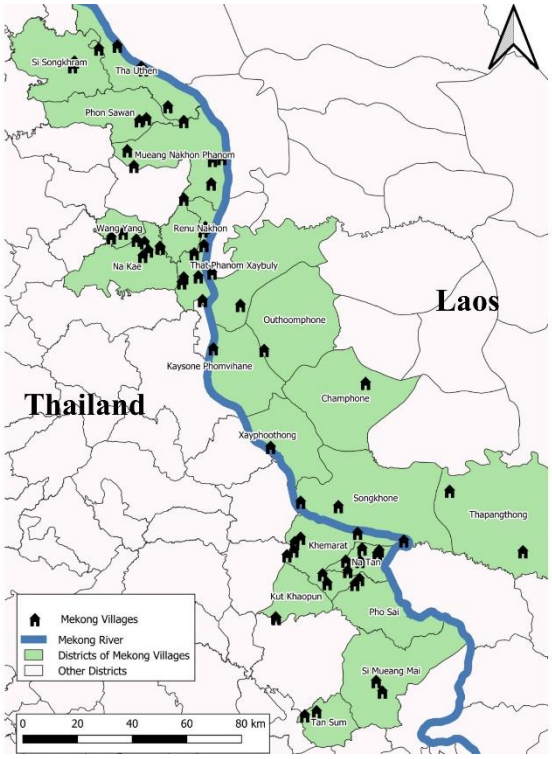

Figure 1.2 Village sample along Mekong river in forth essay
Source: Author's illustration.

1.4 Results

In the ***first essay***, the descriptive analysis illustrated the socio-economic changes which the village had undergone. Most remarkably, household income has increased within the ten-year observation period, well in line with overall income growth in the Thai economy. The drivers of growth were not out-migration as hypothesized by the theory of labor migration, but, instead, in-migration. The latter has resulted in significant village investment by the establishment of a hydroponic vegetable enterprise. The growth in village income, however, was accompanied by an increase in inequality. The GINI coefficient for income was calculated with 0.59 in 2018, up from 0.47 in 2009. Only small progress was achieved in poverty reduction. In 2018, the head count ratio was still 45 %. Furthermore, household debt has more than doubled in the ten-year-observation period. The results of the income-migration model show that migration is not significant for household income. In the poverty model, household characteristics, resource endowments as well as sources of income are significant with regards to reducing chronic and stochastic poverty. Again migration was not significant.

In ***second essay,*** it was found that households who diversified into wage and self-employment did do better in terms of income growth and were less likely to be poor, compared to households whose primary occupation was in farming. The descriptive analysis also showed that most households farming is not the only source of income. The majority of households have multiple sources of income and are part-time farmers. Results of the positive mathematical programming (PMP model

showed that even strong increases in in the price of maize, will not change the development path of the village economy. Households will move towards a more diversified livelihood strategy, also facilitated if wages increase but at the same time, they are likely to maintain farming as additional source of income and food security safety net.

The results of the descriptive statistics presented in the ***third essay*** demonstrates the progress in infrastructure such as better quality roads and irrigation, that has been made in the 220 TVSEP villages in Northeast Thailand since the first panel wave in 2007. However, the analysis also shows the variation across villages, particularly in communication technology, where in general villages are drastically being the urban areas. The DID model results show that communication technologies have a strong significant on practically all income generating activities. In agriculture-dominated villages, adoption of mechanization and improvements in irrigation infrastructure was significant. Result of the probit model on poverty confirm the role of public infrastructure investments indicates for poverty reduction.

The ***fourth essay*** has three major results. Firstly, the ongoing ecological changes in the Mekong river as a consequence of numerous hydropower project along the course of the river has caused the natural resource base of people living in villages to decline and has reduced their livelihood options and thus their resilience. Depleted fish populations in the river has causes losses that were not made up by additional irrigated land, increased agricultural productivity, and expansion of livestock and aquaculture. Secondly, in Thai villages COVID-19 did not have severe negative economic consequences partly due the Government's support schemes. Although testimonials of village heads pointed at social problems. On the other hand, Laos villages suffered more economic losses, especially due to Covid-19 related boarder restrictions causing the loss of trade with Thailand. For both countries, however, the pandemic exposed the weakness and the threats of the village economies. The unresolved cross-border water management conflicts and the continuing climate change effects reduces the resilience of Mekong villages to cope with future crises.

1.5 Conclusion and policy implications

The analysis presented in the four essays allows to draw some policy conclusions which are presented in the following.

Firstly, there is a need to rethink rural development policy in Thailand. A more pro-active rural development strategy with significant public investment especially in information and communication technology but also in sanitation, health and (adult) education can make rural villages more attractive economic units and revive the social life lost due to rural urban migration. This will lead to more shared prosperity and a reduction in the politically reducing the urban-rural divide.

Secondly, while the economy in rural villages is diversifying and will strengthen multiple sources of income, agriculture in the form of part-time farming is likely to stay. Again, this calls for a different rural development policy than what is promoted today.

Thirdly, policy makers should give more emphasis on infrastructure development in rural villages. Especially invest in the availability of IT facilities and technology and the avoidance of a widening

gap IT literacy. Finally, policy makers need to come up with better cross-country coordination and information as regards water regimes of the Mekong River. There is also a need to integrate the concept of resilience in rural development policies.

1.6 Thesis outline

The thesis is structured into five chapters including 4 essays. The overview of those chapters is shown in Table 1.1. and brief descriptions are presented below.

The first chapter provides a general introduction with background and motivation, research objectives, methodology, data, brief results, and policy conclusions and recommendations.

The second chapter presents the ***first essay*** titled as "***Rural transformation and village development: a case study of a rural village in Thailand***". An earlier version of this chapter was presented at The Annual Conference of the Scientific Research Group on Southeast Asia of German Geographical Society. The paper was also presented at the TVSEP international conference in Göttingen, Germany. The conference was held by the University of Göttingen in May 2022. In this essay, Chompunuch Nantajit collected data, conducted descriptive analysis, developed a conceptual framework and estimated the empirical models. Prof. Dr. Hermann Waibel performed the supervisory role, provided suggestions and edited the manuscript.

Chapter three contains ***second essay*** "***Agriculture in the village economy: a case study***". An earlier version was presented online at Tropentag Conference on September 2020. In this essay, Chompunuch Nantajit collected primary and secondary data, developed a PMP model and wrote the manuscript.

Chapter four presented the ***third essay*** titled as "***Development of rural village infrastructure and its impact on household well-being in Northeast Thailand***". An earlier version of the paper was presented at the UBU-TVSEP Online Conference in September 2020 and at the 10th ASAE international conference (online) in December 2021, organized by the Asian Society of Agricultural Economists (ASAE). In this paper, Chompunuch Nantajit performed the data analysis, estimated the empirical models and wrote the manuscript. Prof. Dr. Hermann Waibel performed the supervisory role and edited the paper.

The ***fourth essay*** is in chapter five with the title "***Covid-19 and Rural Development in the Mekong River Region: Case studies from Thailand and Laos***" This essay published in 2021 as a book chapter in a book titled "The Displaced: Disrupted Trade, Labour, and Politics in the Mekong River Basin." published by Konrad Adenauer Stiftung. Prof. Dr. Hermann Waibel is the first author. Chompunuch Nantajit provided contributions to selected sample and performed descriptive analysis. Phouvong Phami collected data and conducted village head interview in Laos. Dr. Somkid Naprom conducted village head interview in Thailand.

Table 1.1 Thesis overview

No.	Title	Authors	Published in/submitted to/presented at
2	Rural transformation and village development: a case study of a rural village in Thailand	Chompunuch Nantajit & Hermann Waibel	Earlier versions were presented in 1. Annual Conference of the scientific Research Group on Southeast Asia of German Geographical Society (May 2019) 2. TVSEP international conference (May 2022)
3	Agriculture in the village economy: a case study	Chompunuch Nantajit	An earlier version was presented in Tropentag Conference (September 2020)
4	Development of rural village infrastructure and its impact on household well-being in Northeast Thailand	Chompunuch Nantajit & Hermann Waibel	Earlier versions were presented in 1. UBU-TVSEP Online Conference (September 2020) 2. ASAE conference (December 2021)
5	Covid-19 and Rural Development in the Mekong River Region: Case studies from Thailand and Laos	Hermann Waibel, Chompunuch Nantajit, Phouvong Phami & Somkid Naprom	Book chapter Book title: The Displaced: Disrupted Trade, Labour, and Politics in the Mekong River Basin. Konrad Adenauer Stiftung, Tokyo.

Source: Author's illustration.

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CHAPTER 2: Rural transformation and village development: a case study of a rural village in Thailand

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Earlier versions of this paper were presented at:

1. Annual Conference of the scientific Research Group on Southeast Asia of German Geographical Society, Vienna, Austria in 3-4 May 2019.

2. TVSEP International Conference, Göttingen, Germany in 23-24 May 2022.

Abstract

In this paper, results of a socio economic study are reported, conducted in a typical rural village in the province of Phetchabun in Thailand. The research is based on two village censuses, conducted in 2009 and in 2018. The panel data allow to investigate changes in the living standard (consumption, income and assets) of village households, in poverty, out- and in- migration, infrastructure and significant events. The study finds that the village experienced positive changes, largely due to within-village investments and innovations. Contrary to expectations, labor out-migration and remittances were not a major driver of development. On the other hand, networks between migrant and village residents helped to attract outsiders to invest in the village. Overall, household income has increased in line with income growth in the Thai economy. Poverty has been reduced but is still at high levels which indicate large inequality. Major problems are increase in financial debt, low agricultural productivity and an ageing population. More studies are needed to underpin the design of a comprehensive rural development strategy that recognizes the opportunities of the rural areas beyond agriculture is recommended.

Keywords: Rural livelihoods, Migration, Village study, Panel data, Thailand

JEL Classification: I31, O15, O18, O53, R11

2.1 Introduction

In Asian emerging market economies, policy makers have given priority to the development of the secondary and tertiary sector, thus encouraging labor transfer from rural to urban areas. Hence urbanization is advancing rapidly while the development of rural areas and agriculture are often neglected. The view that sees agriculture's main contribution to economic development in providing cheap labor for the modern sector (e.g. Lewis, 1966) is still dominant among policy makers. Thus, it is often ignored that villages can also play an important role in advancing the rural economy. Out-migration of mostly younger household members has changed the socioeconomic conditions and the demographic structure of villages. For example, rural households increasingly rely on remittances from their migrant household members and therefore may reduce efforts in advancing and modernizing their own agriculture. In the past decades' labor has replaced land as the major income earner (Cherdchuchai & Otsuka, 2006, Reda et al., 2012). The demographic pattern of rural villages is dominated by older people and children. This is reflected in a gap in the age pyramid 20 to 45 between 20 and 50 ears (Hardeweg et al., 2013). While on the one hand, an urban-based development strategy has resulted in overall economic growth and poverty reduction it has also widened the gap between urban and rural areas. However, the importance of rural villages becomes visible during economic crisis. For example, during the Asian financial crisis of 1997 (Bresciani et al., 2002; Poapongsakorn, 2006) and during the global food and financial crisis of 2008 (Gödecke & Waibel, 2011) as well as during the recent Covid-19 pandemic (Waibel et al., 2020) rural villages provided an important safety net, especially for migrants with vulnerable employment conditions. While the positive role of rural villages during the time of crises has been well established, less evidence exists as regards their role as possible living environment and workspace, following the conditions of some European countries like Germany.

In this case study of a typical rural village, in the province of Phetchabun, located at the junction of the northern and north-eastern region of Thailand, we investigate the development of the village over a ten-year period. We make use of village census data, collected in 2009 and in 2018. Hence, we capture the period after the financial crisis of 2008 and the period before the start of the Covid-19 epidemic. Therefore, in this paper, we will be able to: (1) assess changes in socio economic conditions between 2009 and 2018; (2) investigate the role of migration for village development and (3) contribute to a better understanding of the structural change or village dynamics that has taken place during this decade.

The main findings of this analysis are as follows. First, we note that the role of rural villages in an emerging market economy like Thailand can be more than merely supplying surplus labor for urban development. Second, a rural village can be more than just a safety net for migrant household members in case of economic crisis. To the contrary, rural villages can be attractive for outside investors and for full or part-time residence because of lower land prices and better environmental conditions. Third, as shown by this case study, investment by outsiders to the village can drastically change the course of village development and influence migration decisions to the reverse. We submit that if advances in information technologies can be integrated into the development of a

rural village new business opportunities can emerge. An advancement of IT infrastructure in rural areas augmented by the Covid-19 experience, could further stimulate the exploitation of business prospects, for example, through home production component in a textile supply chain or online market platforms. In terms of policy conclusions, the paper points to the need to re-think rural development away from the Lewis' thinking. At the same time, there is a need to verify the findings of this case study through a larger sample of villages.

The paper proceeds as follows. In the next section the conceptual framework of the study and the hypotheses derived are presented. In section 3 the data collection procedure is described. Descriptive statistics including simple parametric and non-parametric statistical tests are presented in section 4. In section 5 an empirical model assessing the determinants of migration is introduced and the results discussed. In the last section, conclusions are drawn and policy recommendations are submitted.

2.2 Conceptual framework and methodology

The underlying framework of the study is the livelihood's concept developed by DFID (Solesbury, 2003). We adjusted this framework to capture the rural urban migration in both directions. Recent studies have shown that rural households diversify out of agriculture. Adoption of non-farm occupations, both through self- and wage employment has increased (Rigg et al., 2018; Attavanich et al., 2019) and consequently the share of agriculture in household income is declining (Rigg et al., 2012; Rigg et al., 2018; Rambo, 2017; Ramos et al., 2012). Wage employment of members of rural households is often connected with labor migration. Following the "New Economics Theory of Labor Migration" (e.g. Stark & Levhari, 1982; Rosenzweig & Stark, 1989) rural households purposively make migration decisions in order to improve overall household well-being. Most literatures demonstrated a positive effect of migration on household income growth and poverty reduction. (e.g. Reda et al., 2012; Roth & Tiberti, 2016; Wineman & Jayne, 2017). In some cases, (e.g. Cuong & Linh, 2018) no significant income effect of migration could be shown. Also, significantly negative effects for household income were found (e.g. Toros et al., 2017).

In order to investigate the effects of migration on household income in the village, we developed a fixed effect, two-stage least square, instrumental variable (2SLSIV) model, using our two-period panel data.

The income-migration model was specified as follows:

the first stage, (equation 1) models a household's migration decision:

$$M_{it} = \delta_1 + \beta_1 X_{it} + \gamma_1 Z_{it} + \mu_{it} \quad (1)$$

In the second stage and income function is estimated (equation 2):

$$Y_{it} = \delta_2 + \beta_2 X_{it} + \theta \widehat{M}_{it} + u_{it} \quad (2)$$

Where: Y = ln (income per household)

i = household (i = 1 , ... , 52)

t = year (t= 2009, 2018)

X = Vector of household characteristics

M = Dummy variable for households with migrant member

Z = Instrumental variable: Share of migrant households in a "village cluster"

δ = Intercepts

u = Error term.

Y_{it} is the log annual household income *i* at time *t*. X is a vector of household characteristics for both time periods. M_{it} is a dummy variable for migration, i.e. households who had at least one member working outside the district of the village in either of the two observation years.

To address possible endogeneity between income and migration, we employ a fixed-effects instrumental variable (IV) model with. Here, we follow Awumbila et al. (2016) used the share of households with migrants per village cluster as instrumental variable. A village cluster is a neighborhood of households where one can assume that close exchange of information exists. In Table 2.1, we have identified 5 village clusters (see also Figure 2.A – village map- in Appendix) with varying shares of migrant households. For example, in cluster 1 in 2009, half the households had at least one migrant, while this dropped to only 1 in 8 (13 %) by 2018. On the other hand, the share of migrants stayed constant in clusters 4 and 5.

Table 2.1 Share of households with in a village cluster, 2009 and 2018

		2009		2018	
Village cluster	No. of households	With migrants	%	With migrant	%
1	8	4	50	1	13
2	3	3	100	2	67
3	17	14	82	13	76
4	10	7	70	7	70
5	14	9	64	9	64

Note: calculate used panel households.
Source: Author's calculations based on 2009 and 2018 censuses.

Our second concept geared to capture village development during the ten-year observation period is a dynamic poverty model. Using the FGT poverty indicators, we aim to identify the determinants of a household's change in the poverty status, i.e. the head count ratio over time. For this purpose, we develop a probit model, where the dependent variable is the change in poverty status between 2009 and 2018. For example, households who were poor in 2009 may have moved out of poverty in 2018 and vice versa. In addition, households may also have maintained their poverty status, i.e.

they remain poor or non-poor as per their initial status. Hence, we get four groups, namely: (i) always poor, (ii) move into poverty, (iii) move out of poverty and (iv) never poor. The concept of dynamic poverty has been used in several studies, e.g. Hulme & McKay (2013); Chiwaula et al. (2011); Sakontawat, (2013) and Cahyadi & Waibel (2016). We calculate the poverty status for each household over time and identify to which group a household belongs to, in 2018. Hereby, we applied the poverty threshold of the Thailand National Economic and Social Development Board:) (NESDB, 2020), i.e. a monthly per capita consumption below 2,258 THB in 2009 and below 2,714 THB in 2018. In Figure 2.1, we illustrate the dynamics of poverty. We distinguish between poor and non-poor households, i.e. 24 and 28 respectively in 2009. By 2018, 15 of the village households were still poor which we call "chronic poor", while the remainder has moved out of poverty. On the other hand, out of the 28 non-poor households 10 had moved into poverty by 2018 while the remainder retained their status which we call "never poor" (see Figure 2.1).

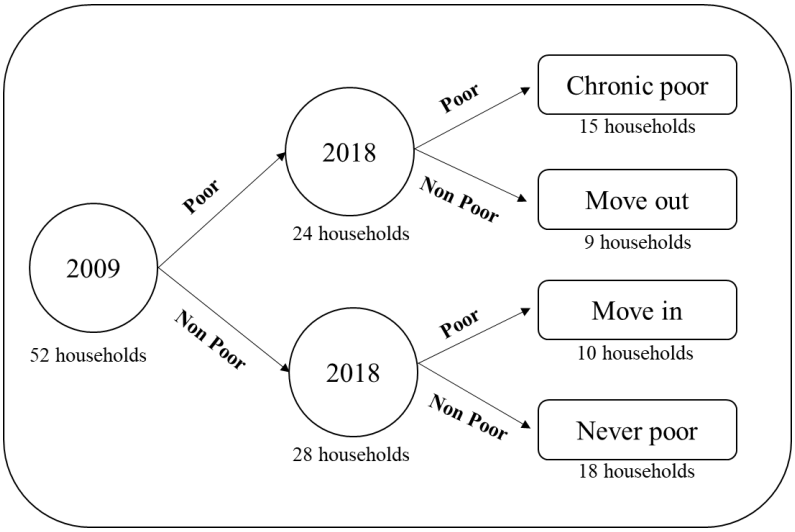

Figure 2.1 Poverty Dynamics in village
Source: Author's illustration.

The model to estimate poverty dynamics was then specified as follows:

$$Pr(D_{it} = 1|X_i) = \Phi(X_i\beta_1 + \varepsilon_i) \quad (3)$$

Where Pr(.) = Probability

D_{it} = Poverty Status (0,1)

$\Phi(.)$ = Cumulative distribution function of standard normal distribution.

X_i = Vector of Household characteristics

i = Household (i = 1, ... , 52)

t = 2009 and 2018

ε = Error term

The poverty status, *D* has a value of 1 if the household was below the poverty line, in both 2009 and in 2018 or had moved into poverty by 2018. Households who moved out of poverty by 2018 or stayed non-poor, are given the value of 0 in the model. Among the explanatory variables X_i we include, personal characteristics like age, gender and education but also employment and migration status and other control variables.

2.3 Data collection

The case study village is located in Phetchabun province some 350 km north of Bangkok. The province is located at the intersection of North and Northeast Thailand and is characterized by a mountainous terrain which formerly was dominated by forest land. The village is typical for rural Thailand with less favorable conditions for agricultural productivity growth. The choice of this village for conducting a research study was based on its natural characteristic as well as the willingness of village authorities to cooperate in a long-term intensive case study with a baseline village census in 2009 (Gödecke, 2012) and a follow-up census in 2018 (Nantajit & Waibel, 2019). The village is accessible by an asphalted road connecting its own district capital as well as the neighboring district town, with a distance of 16 and 22 km respectively. Public facilities in the village include an elementary school, a nursery, a vocational training center, a community meeting place, a sports field and a simple gasoline station. Furthermore, there are two Buddhist temples. Also, the office of the sub-district administration is located in the village (see village map in Appendix Figure 2.A)

Based on the census data, in 2009, the village had 75 households and a registered population registered of 292 inhabitants. In the 2018 census, the number of households had increased to 83 and the population increased to 347.[1] Both censuses were based on a modular formal survey instrument that comprised of household characteristics, including migrant members, income generating activities, asset and consumption, finance and behavioral aspects such as risk and other subjective assessments related to behavioral aspects of development. The questionnaire followed the concept of the Thailand-Vietnam socioeconomic household panel project (Hardeweg et al., 2013). Accordingly, the reference period used in the censuses was the Thai agricultural year, i.e. May 2008 to April 2009 and May 2017 to April 2018. The information obtained through formal interviews was complemented by a migrant tracking survey and in-depth interviews with key informants.

Table 2.2 summarizes the pattern of interviews in both census years. In 2009, only 70 of the 75 households could be interviewed while in 2018 all households were reached. Since there has been

[1] it must be noted that our census data deviated from the official village statistics which is due to delays and imperfection of the official recording system.

considerable out- and in migration, the formation of new households and the cessation of households due to death and other reasons, the number of households in the balanced panel is 52.

Table 2.2 Village Households in 2009 and 2018

Number of Households in 2009	75
Number of Households in 2018	83
Household missing in 2018:	
Out Migrants	10
Deceased	6
Other reasons	2
Households added in 2018:	
New Household Formation	15
Return migrants	10
In-Migrants	6

Source: Author's illustration based on 2009 and 2018 censuses.

2.4 Results

In this section we present the results of the study by presenting relevant descriptive statistics from our survey and then present the results of our models.

2.4.1 Descriptive statistics

Within a decade, the demographic profile of the village slightly changed. As share of village residents above the age of 50 has increased same in line with the country trend of aging society, however in this village the majority population is still younger than 50 (see Figure 2.2). Migrants are generally shared to older group. Despise of 2009, most migrants were in the age group of 20 – 30 years. While in 2018 the share of 30-40 and 40 -50 are increased.

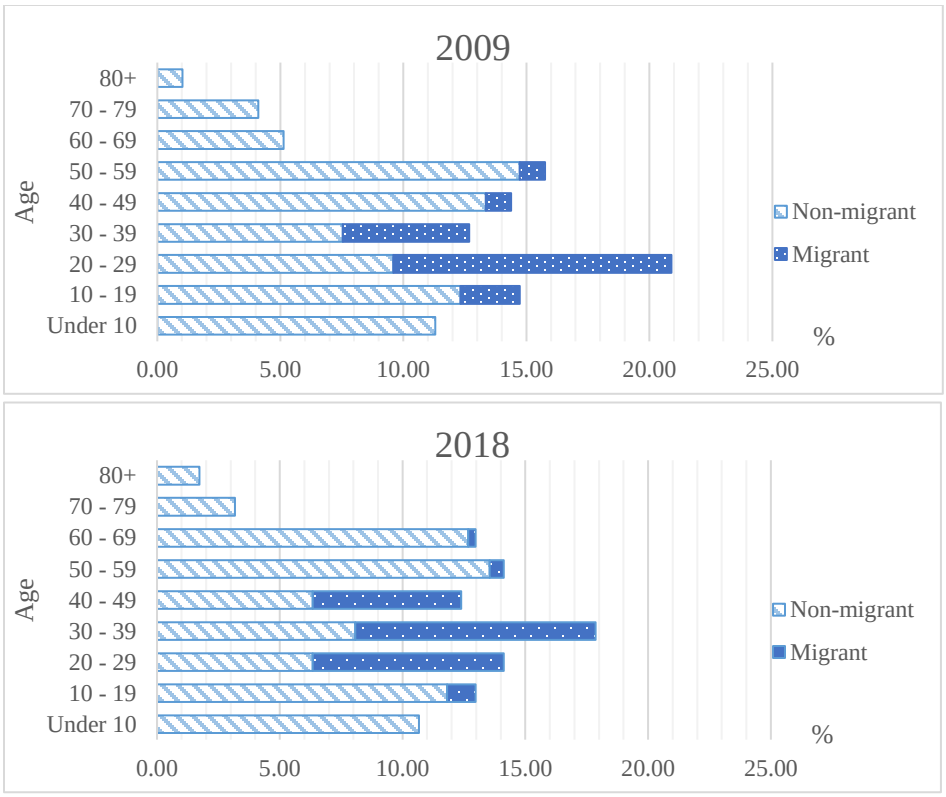

Figure 2.2 Village Demography and migrants by age group 2009 and 2018
Note: calculate include all household member of 70 in 2009 and 83 households in 2018.
Source: Author's calculations.

To assess the change in the socio economic conditions of the village households, we compare selected household and village characteristics of both census years. The comparison is made on the basis of Table 2.3. Hence not all households are identical between the two observation years. As shown in Table 2.3, in some parameters there was only a small change of less than 5 %. These include, average household size of resident household members and age of household heads. The latter reflects the new household formation and cessation between 2009 and 2018. Also the share of female headed households declined only slightly, similar to migration, although the number of migrants per household had increased by almost 20 %. Land used for any purpose, both residential or agricultural, did not change much, however own land declined by almost 15%. This indicates that a land market is emerging in the village.

The most drastic changes occurred in household income. On average it increased by 79 % in the decade observed. This is well in line with the growth rate of the Thai economy which increase 40% during the same period (World bank, 2022a). Contrary to growth in come, poverty remains high with almost 45 % in 2018, compared to a bit over 47 % ten years before. Clearly, poverty reduction in the village is lacking behind the national figure. Overall in Thailand, the poverty head count ratio has come down from 20 % in 2009 to just over 8% in 2009 (World Bank, 2022b). The

difference in urban versus rural poverty decline has contributed to the well-recognized phenomenon of the urban-rural divide for which Thailand is a particularly extreme case. However, what our data also show is that within-village inequality is rising too. The Gini coefficient in the village has gone up over 25 % during our observation period.

A similarly notable finding is the increase in financial debt of village households which significantly increased by over 150 %. This may indicate some business dynamics in the village economy. As noted by Kaboski & Townsend (2012), microcredit injection into Thai rural villages has positive effects on business development but also on consumption. Overall, the changes in household characteristics and well-being indicate that development is taking place in the village.

Table 2.3 Household characteristics and household well-being, 2009 and 2018

Parameters	**2009**	**2018**	**% change**
Resident households members (No.)	2.88	2.80	-2.6
Dependency ratio (%)	49.37	37.29	-24.5
Age of household head (Years)	53.50	56.52	5.6
Share of female headed households (%)	42.85	40.96	-4.4
Own land per household (Rai)[1]	15.97	13.58	-14.9
Total land used per household (Rai)	23.47	24.00	2.3
Share of HHs with migrant member (%)	47.14	49.40	4.8
No. of migrants per household (No.)	1.45	1.89	30.4
Income per capita per year (THB)	46,929.59	83,990.20	79.0
Consumption per capita and month (THB)	3,866.38	4,845.01	25.3
Debt per capita (THB)	27,835.69	96,727.10	247.5
Income per capita per day (THB)	128.57	230.11	79.0
Poverty head count ratio (%)[2]	47.14	44.58	-5.4
Gini coefficient of income	0.47	0.59	25.5
Number of Observations	70	83	

Note: [1] 1 Ha = 6.25 Rai

[2] based on poverty line as defined by the National Economic and Social Development Board (NESDB). The poverty line is based on monthly per capita household consumption. It was 2,258 THB in 2009 and 2,714 THB in 2018.

Source: Author's calculations based on census data 2009 and 2018.

To some extent, these changes presented in Table 2.3 also show up in the composition of household income (Figure 2.3). Agriculture, including livestock, has the highest income share with almost one third in both periods. However, in 2018, wage employment had a share of 31 % and thus exceeded agriculture. The share of remittances reduced from 24 to 17 %, now almost at par with the share of self-employment. The latter did not increase much, thus development of small-scale

enterprises was minimal. Generally, the major change in the village's labor profile is the expansion of wage employment. This is the result of the establishment of a hydroponic vegetable production enterprise in the village by an outside investor who established 13 additional jobs in the village.

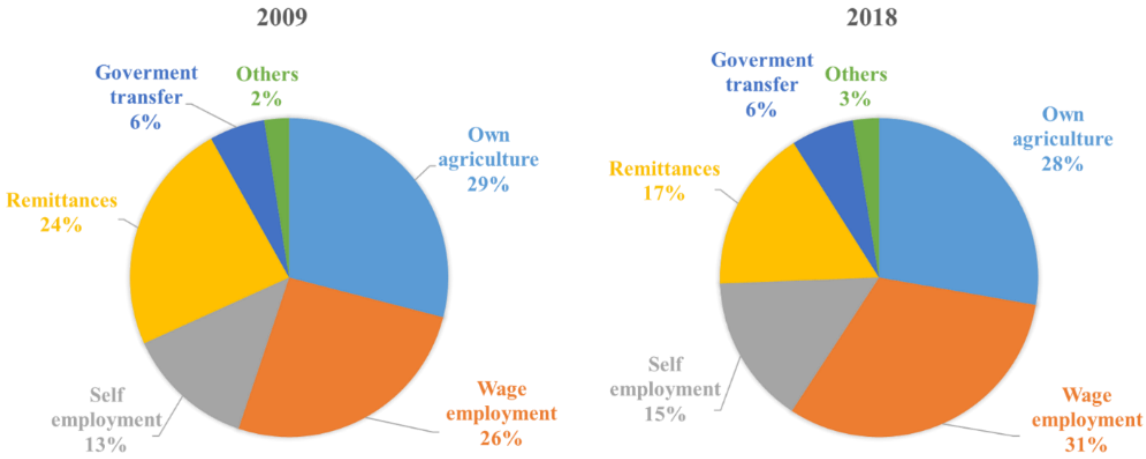

Figure 2.3 Composition of household income in 2009 and 2018

Note:1 Household income is defined as income from all household members' resident in the village plus remittances from migrants and others.

2 Number households (n) was 70 in 2009 and 83 in 2018.

Source: Author's calculations based on census data in 2009 and 2018.

2.4.2 Model results: Income-migration model

The description of variables and their mean values for 2009 and 2018 are presented in Table 2.4. The values are based on the balanced panel of 52 households and therefore mean values differ from those of Table 2.3. Following our two stage model, as described in the methodology section, we regress migration on the set of explanatory variables using the pooled sample as listed in Table 2.4. The income equation used the same variables plus the estimated coefficient of the migration equation. As explanatory variables different household characteristics such as age and educational status, level of household debt are used. Furthermore, resource endowments such as land, productive assets, such as machinery and transportation vehicles, occupation, as well as shock experience are included.

Table 2.4 Description of variables and basic statistics of the income – migration model

Variable	Variable Description	2009	2018
Income	Annual income per household in THB	89,767.29	148,927.82
Migration	Share of households with migrant members	0.54	0.52
Dependency Ratio	Per cent	37.03	30.21
Education Members	Average years of schooling of household members (except minors)	5.57	5.78
Education Head	Years of schooling household head	3.40	3.69
Age	Average age of household head in years	53.19	60.10
Land	Land owned and rented in per household in rai	24.14	24.27
Mechanization	Households who own pick-up or 4 wheel tractor	0.17	0.35
Shock	Shocks experienced (Y/N)	0.39	0.40
Debt	Amount of Debt per household in THB	77,468.72	186,877.00
Wage Employment	Number of Household Members engaged in wage employment	0.19	0.12
Self-Employment	Number of Household Members engaged in self - employment	0.23	0.25

Note: Number households (n) was 52 in both periods (balanced panel).
Source: Author's calculations.

In Table 2.5, the results of the two stage income migration model are presented. Most coefficients are significant and have the expected sign. For example, households with higher land endowments have higher income. Households who own a pick up or tractor or both, tend to earn more, as such assets can lower timeliness costs in agriculture and lower the transaction costs for access to input and output markets. Engagement in wage or self- employment is positively and significantly correlated with household income as this facilitates more efficient use of surplus labor. However, Age of household head effect might be ambiguous eg. Tuyen (2014). Younger household head while gaining more year of experience might lead to higher earing. However old household head may be retired and grain less income. The dependency ratio is significantly negatively correlated. This is plausible, as a lower share of working age members will constrain the possibilities of households to earn income. Many of literature find education have significant positive effect on household income eg. Van Vu (2020) and Mukaila et al. (2021) tough it not significant in this model as well as household debt.

Most important in our model is the coefficient for migration which is the predicted value of the migration model (stage 1, see Appendix for results) fitted into the income model (stage 2). This coefficient is not significant which suggests that migration does not significantly increase to income and that the observed income growth was driven by within-village development. In this regards, our result thus supports Cuong & Linh (2018) who also find that migration was not a major factor of rural income growth in Vietnam and Marta et al. (2020) who find that migration

based on risk motive cannot provide a real impact on the improvement of migrant household welfare.

In summary, the model suggests that in our case study village, within-village factors rather than external drivers are the cause of growth in household income. Based on our model we cannot support the notion that migration is the main driver for rural development.

Table 2.5 Result of two stage, fixed effects, IV income - migration model

Variable	Type	ln(income per household)	
		Coef.	Robust Std. Err.
Migration	Dummy	-1.171	0.909
Dependency Ratio	Continuous	-0.004*	0.002
Education members	Continuous	0.13	0.081
Education head	Continuous	0.180**	0.086
Age	Continuous	0.052***	0.017
Land	Continuous	0.020**	0.009
Mechanization	Dummy	0.420**	0.226
Shock	Dummy	-0.143	0.32
Debt[1]	Continuous	0.002	0.006
Wage employment	Continuous	0.456***	0.171
Self-employment	Continuous	0.599***	0.168
R-squared		0.4332	
F(11, 36)		11.73	
Prob > F		0	
Observations (n)		94	

Notes: ***, ** and * denote significance at the 1%, 5% and 10% level, respectively; result of 1st stage estimation in Appendix Table 2.A; result of instrument test is in Appendix Table 2.B

[1] This variable used unit of 10,000 THB.

Source: Author's calculations.

2.4.3 Poverty dynamics: Descriptive analysis

To assess changes in poverty in the village, in Table 2.6, we present the composition of household income by poverty group. The changes reveal something about possible reasons for poverty dynamics. For example, we can see that households who were poor in 2009 and still poor in 2018 reduced their share of income from agriculture, from wage employment and from self-employment. They seem to depend on government transfers and remittances. The situation is similar for those households who were non-poor in 2009 but were poor by 2018. They increased their share in agricultural wage employment, i.e. working on other farms in the village, mostly in

seasonal employment for planting or harvesting. On the other hand, households who were poor in 2009 but who moved out of poverty by 2018, increased their income share from livestock, perhaps by undertaking respective investments. They also engaged in small scale enterprises as show by the increased income share of self-employment from 1.3 to 14.2 %. At the same time, households moving out of poverty decreased income share from working on other village farms. Finally, permanently non-poor household increased their income share from agriculture (crops and livestock) to 45 % while the share of remittances from household members dropped to one third of the 2009 value.

In summary, the poverty dynamics in the village showed that the chronic and stochastic poor show a different pattern of household income composition from the non- or never poor. Hence the factors that drive the poverty dynamics will be explored in our probit model.

Table 2.6 Share of household's income composition by poverty group

Source of HH net income	Poor 2018				Non-poor 2018			
	Chronic poor		Move in		Move out		Never poor	
	2009	2018	2009	2018	2009	2018	2009	2018
Crop activities	23.0	17.7	45.1	27.7	38.6	11.4	27.9	39.5
Livestock & product	0.1	-4.6	0.1	3.8	2.1	27.0	-3.8	5.2
Natural resource extraction	3.3	2.4	0.9	1.8	1.2	0.8	3.4	0.7
Wage in agriculture	17.1	11.9	6.0	24.4	18.4	2.5	24.2	15.3
Wage in non-agriculture	16.1	16.0	2.2	5.6	16.9	27.2	4.0	3.9
Self-employment	2.4	-0.1	10.8	0.0	1.3	14.2	5.4	4.8
Remittances from migrants	22.1	13.7	27.0	19.8	15.7	5.9	31.3	12.2
Remittances from friends & relatives	2.8	20.5	0.0	3.6	0.8	2.8	1.1	10.7
Government subsidy	11.5	20.9	6.9	8.5	2.8	4.8	5.9	5.3
Rent out land	1.6	1.7	1.1	4.8	2.2	3.4	0.7	2.5

Source: Author's calculations based on census data 2009 and 2018.

Table 2.7 shows the demographic features, land use and labor profile of households in different poverty groups. It becomes obvious that poor households, both chronic and stochastic poor tend to be those with older household heads and a higher dependency ratio as compared to households who either were non-poor in both observation periods or had moved out of poverty. Further differences between these two groups are in the years of schooling and the area planted to field crops like maize, cassava and vegetables. Furthermore, the labor pattern shows differences in number of household who involve on their self-employment. Once again, our descriptive analysis points to the need for further analysis by means of our model as formulated in the methodology section of the paper.

Table 2.7 Household characteristics by poverty group as used in the model

Household characteristics	Poor 2018				Non-poor 2018			
	Chronic poor		Move in		Move out		Never poor	
	(2009)	2018	(2009)	2018	(2009)	2018	(2009)	2018
Demography								
Age of household head (year)	59.67	67.47	53.1	61.9	50.78	53.33	49.06	56.33
Dependency ratio (%)	62.05	54.86	19.83	30.42	52.22	18.89	25.03	24.37
Education of household head (years)	2.93	2.67	3.1	3.6	3.44	4.67	3.94	4.11
Education of household members (year)	3.93	4.28	5.61	6.02	5.78	5.49	6.82	7.03
Migrant (no.)	0.73	0.86	1.7	1.5	0.67	1.11	1.05	1.27
Land								
Field crops (rai)	8.87	6.82	19.3	14.83	22.47	15.17	25.22	27.28
Perennial crops (rai)	0.47	0.33	0	2.4	0	0.78	1.33	3.71
Labor								
Self-employment (no.)	0.00	0.07	0.40	0.00	0.11	0.22	0.28	0.17
Wage employment in Agriculture (no.)	0.40	0.20	0.20	0.30	0.33	0.11	0.50	0.50
Wage employment in Non-Agriculture (no.)	0.20	0.07	0.30	0.10	0.33	0.44	0.28	0.06
Total worker (no.)	1.20	1.00	1.90	1.40	2.33	1.67	1.78	1.33
Shocks (no.)	0.53	0.60	0.20	0.80	0.33	1.11	0.39	1.38
Obs.	15		10		9		18	

Source: Author's calculations based on 2009 and 2018 census data.

2.4.4 Model results of poverty dynamics

The poverty model basically uses the same explanatory variable as in the income model with a few additions. These include average age of household members, membership in village institutions as well as annual and perennial crop area. These variables are representative of human capital and land capital that relevant for poverty transition later than income. Description and basic statistic of poverty dynamic model are showed in Table 2.8.

Table 2.8 Description of variables and basic statistics of poverty dynamic model

Variable	Variable Description	Move out & Never poor	Move in & Chronic poor
Age household head	Age of Household Head in years	52.48	61.14
Age household members	Average age of household members in years	37.28	43.47
Education Members	Average years of schooling of household members (except minors) in years	6.50	4.79
Membership	Household is member of village community group (Y/N)	0.63	0.48
Annual crop area	Number of land use for annual crops activities in rai	23.77	11.53
Perennial crops area	Number of land use for perennial crops activities in rai	1.81	0.72
Migration	Household with migrant members	0.54	0.52
Self-employment share	Share of household members engaged in self - employment	11.27	7.00
Wage employment-Agri	Share of household members engaged in agriculture wage employment	23.15	19.33
Wage employment-Non-Agri	Share of household members engaged in non-agriculture wage employment	10.03	6.67
Shock	Shocks experienced in in either observation year (Y/N)	0.41	0.38

Source: Author's calculations based on 2009 and 2018 census data.

The model to capture the poverty dynamics in the village uses the poverty status of village households as the dependent variable. More precisely, for a household who was poor in 2009 and is still poor in 2018 the variable code is 1. Likewise, a household who was not poor in 2009 but has moved into poverty in 2018 falls into the same category. Conversely, a household who was poor on 2009 but had moved out of poverty by 2018 is labelled with zero; the same applies to a household who was non poor in both observation years.

As shown in Table 2.9, most coefficients are significant and negative. For example, the average age of household member is negatively correlated with poverty while it is the opposite for age of household head. This is not unreasonable as advanced age household members may have better opportunities to earn while old household heads tend to be old and out of the labor market or own agriculture. This is supported by the fact that all occupation variables are negatively correlated with poverty. The variable negatively correlated with poverty is age of household heads. This is

plausible as social protection for the aged is limited and savings are seldom in rural Thailand. On the other hand, households where the average age of members is higher, tend to have a lower chance of stochastic or chronic poverty. Likewise, better education and membership in village committees and organizations also helps to reduce poverty. The same is true for membership in village institutions and resource endowments in agriculture. Households with more land can plant more maize, cassava, and vegetables or fruit trees and natural rubber. This reduced the probability for a household being in stochastic or chronic poverty. Surprisingly shocks are not significant which may be against expectations. However, since shocks is a subjective variable it depends on people's perception of the severity of shocks. Oftentimes, people who are frequently exposed to all kinds of shocks may not perceive them as such. Also, the migration variable is not significant. This confirms the result of the income model (see Table 2.5) and suggests that having a migrant does not prevent poverty.

Generally, the model suggests that the households in our case study village do have a number of tools to escape from or stay out of poverty. This depends on resource endowment and employment opportunities. Those in chronic poverty tend to be the elderly, those with low education, less land and fewer business and job opportunities. Hence, our results give some indications how poverty reduction can become more inclusive and how rural development policies should be modified in order to better exploit the opportunities that rural villages have to offer for sustainable development.

Table 2.9 Result of Probit model, poverty dynamics

Variable	Unit	Coef.	Robust Std. Err.
Age household head	Years	0.1095***	0.0416
Age household members	Years	-0.0647**	0.0327
Education Members	Years	-0.2319*	0.1284
Membership	0-1	-0.3392	0.3894
Annual crop area	Rai	-0.0291**	0.0145
Perennial crops area	Rai	-0.0896**	0.0414
Migration	0-1	0.2580	0.4706
Self-employment share	Share household members	-0.0127*	0.0066
Wage employment-Agri	Share household members	-0.0129**	0.0061
Wage employment-Non-Agri	Share household members	-0.0226***	0.0086
Shock	0-1	0.6137	0.4268
Wald chi2(11)		29.09	
Prob > chi2		0.0022	
Log pseudo likelihood		-10.5738	
Pseudo R2		0.6945	
Obs		104	

Note: ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.

2.5 Summary and conclusions

In this paper, we present results of a village case study for a typical rural village in the province of Phetchabun, some 350 km northeast of Bangkok. We conducted two village censuses, i.e. in 2009 and in 2018. With these panel data we can provide first-hand evidence of the socioeconomic changes in the village, including demography, land, labor as well as income and poverty. We find that the village experienced positive changes, which was primarily to a within-village investment by an in-migrant. Out migration, however, did not change much between 2009 and 2018. To the contrary, more people moved into the village than out. The common paradigm that labor out-migration determines the welfare of households in rural villages cannot be verified by our case study. The increase in average income was remarkable and well in line with Thailand's overall income growth during this period. However, the picture is very different when looking at poverty which was still at 45 % head count ratio, over four times higher than Thailand's overall poverty rate. Similarly, inequality has increased with a Gini coefficient at 0.59 in 2018, up from 0.47 in 2009. Hence, in addition to the rural-urban divide, another one seems to emerge within the rural sector. Another alarming signal is household debt. The latter has more than doubled during the ten-year-observation period and it is not clear how much of the borrowing was dedicated to investment.

We developed two models, firstly to assess the determinants of income of village households and simultaneously assess the role of migration for household income and secondly to investigate the poverty dynamics in the village. The first model is a two stage, fixed effects log-linear IV model. In the first stage, out migration was estimated was while in the second stage household income was regressed on household characteristics, land and labor variables as well as the predicted value from the migration equation. The major finding is that migration is insignificant for rural household income which is against the findings in many literatures but also confirmed by others.

In the poverty model, we find that household characteristics, resource endowments as well as sources of income tend to reduce chronic and stochastic poverty. Once again, migration was not found to be significant for poverty reduction.

The paper provides a good basis for drawing policy conclusions and policy formulation. Firstly, a rural village is more than a source of labor for industrial and urban development. It is also more than a retirement place of aged return migrants who cannot afford to remain in the city after being out of work. Secondly, the vast majority in the village remain engaged in agriculture. However agricultural income is no longer the main income source. So, in effect the farming system in the village basically is part-time farming. Households keep their agriculture as a base, while engaging in wage- and to a lesser extend in self-employment. Clearly, the expectation by some policy makers that structural change in agriculture will generate a few large, full-time farms as time goes on is not happening. This is not only a phenomenon for Thailand. All over Asia, farm size during the past 30 years did not significantly change. Farms remain small, mostly just around one ha (Yamauchi et al., 2021). The Thailand Vietnam panel data base (www.tvsep.de) has detailed records of the development of farm sizes among 4400 rural households in Thailand and Vietnam.

Again these data show that the majority of farms in Thailand are below 3 ha and in Vietnam below 1 ha. It is unlikely that this situation will change rapidly. Considering past and expected future crisis will make rural household to their safety nets and food security bases.

On the other hand, the overcrowding of cities with often exorbitant land prices and the improvement of fast internet coverage in rural areas offers new possibilities for village development. Advances in information technology, with fast internet more and more available in rural areas, offers new opportunities for work and living space in the village where land is cheaper and the environment is less polluted as in urban areas. Attracting outside investment for small and medium size enterprises can be a stimulus for village development as this case study has shown. While there is definitely a need for more village-based analysis and more case studies in different regions, our case study provide an entry point for re-thinking rural development policy change.

Undoubtedly, a case study has its limitations and a larger sample of villages is need to verify the results of this case study. Therefore, in a future study, we will make use of the panel data from 220 villages of TVSEP data base as a broader empirical basis for studying actual and potential development paths of rural villages.

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2.7 Appendix

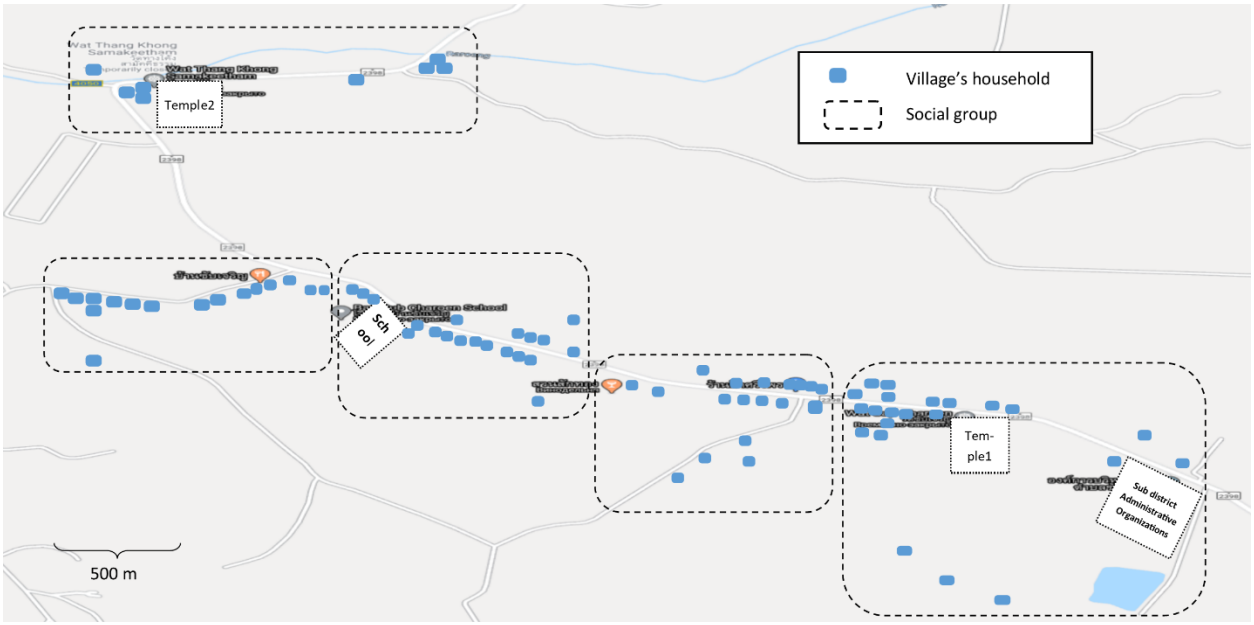

Figure 2.A Sub Jaroen village map and cluster of household

Source: Author's illustration.

Table 2.A First stage result of income – migration model

Variable	Type	Coef.	Robust Std. Err.
Migration	Dummy	1.280**	0.583
Dependency Ratio	Continuous	-0.001	0.001
Education members	Continuous	0.029	0.030
Education head	Continuous	0.088***	0.025
Age	Continuous	0.010	0.009
Land	Continuous	0.004	0.003
Mechanization	Dummy	-0.140	0.143
Shock	Dummy	-0.113	0.153
Debt	Continuous	0.003	0.003
Wage employment	Continuous	-0.176	0.124
Self-employment	Continuous	0.206**	0.088

Notes: Note: ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.
Source: Author's calculations.

Table 2.B Instrumental test for income - migration model

Test	Value
Underidentification test	
(Kleibergen-Paap rk LM statistic)	5.757
Chi-sq(1) P-val:	0.0164
Weak identification test	
(Cragg-Donald Wald F statistic)	4.435
(Kleibergen-Paap rk Wald F statistic)	4.812

Source: Author's calculations.

CHAPTER 3: Agriculture in the village economy: a case study.

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Abstract

This paper analyses the long-term changes in the livelihoods of households in a rural village in Phetchabun province, Thailand. Two village censuses have been collected in 2009 and 2018 which form the basis for a Positive Mathematical Programming (PMP) model. The model results are being complemented by descriptive results of the survey data. In the latter a comparison is undertaken between households whose primary occupation is in own agriculture versus households whose main occupation is in non-agriculture although they are also engaged in farming. The data show that the former group had less income growth and have a higher poverty rate than the latter. In order to assess the development prospects of the village a PMP village model was developed. In the model, two likely scenarios calculations are undertaken. First, a drastic price increase in maize, the main crop in the village. Second, an increase in wages are explored. Results show that both scenarios will not reverse the trend in socioeconomic conditions in the village. Farming will remain the base income of farmers with part-time farming as the dominant farming model.

Keywords: Role of agriculture, Rural livelihood, Panel data, Positive Mathematical Programming, Thailand

JEL Classification: O13, O18, Q12, Q15, R11, R14

3.1 Introduction

The agricultural sector remains important for the Thai economy in spite of the decline of agriculture's share in GDP. While by 1960, the share was 36.4, it was only 8.1 % in 2019 (The World Bank, 2022). Most of agriculture is in rural areas and takes place in a village context.

During the past decades, rural villages in Thailand have undergone profound changes. Very often younger household members have been migrating as wage laborers to the urban centers, while the elderly and children are left behind to continue practice farming (Rigg et al., 2012; Shirai & Rambo, 2017). Hence, the importance of land for household income is reduced and labor is now the main income generating factor in rural areas (Cherdchuchai & Otsuka, 2006; Reda et al. 2012) In some areas, i.e. in the central plains and in peri-urban areas, land is rented out to larger, full-time farmers (Rambo, 2017). However, in north and northeast Thailand, households are holding on to their land as a safety net in case of economic crisis. In such situations, for example, as it happened during the global economic crisis in 2008 or the recent COVID-19 pandemic, rural households have the possibility to engage more in subsistence farming or collect food from natural resources such as mushrooms, or go hunting or fishing (Bresciani et al., 2002; Poapongsakorn, 2006; Gödecke & Waibel, 2011; Waibel et al., 2020). For return migrants and elderly, the rural village can be a convenient and cost-effective retirement place. On a longer term horizon, people in rural villages change their perception towards job perspectives outside agriculture (Rigg et al., 2012; Shirai & Rambo, 2017; Rigg et.al, 2018) Hence it is not so clear who will be Thailand's farmers in the future and how this will affect overall agricultural output and productivity?

Taking the case of a typical rural Thai village in the province of Phetchabun, located at the junction of North and Northeast Thailand, this paper investigate likely development paths by means of a positive mathematical programming (PMP) model. In this village, of some 80 households, with a population of some 300 people, the data collected from two village censuses conducted in 2009 and 2018. The data included detailed accounts of the household's income generating activities including technical data on crop and livestock farming.

The paper has two objectives:

(1) To describe changes in socioeconomic conditions of the village over the ten-year observation period.

(2) to investigate the impact of likely future scenarios in external economic conditions on village welfare.

The paper proceeds as follows. In the next section, the conceptual framework and methodology of the study is presented. Section 3 describes the data and presents the methodology. In section 4 descriptive statistics using parametric and non-parametric statistical tests are submitted. In section 5, the result of the PMP model are discussed. Section 6, summarizes and concludes.

3.2 Conceptual framework and methodology

3.2.1 Conceptual framework

The first objective is to investigate the changes of the livelihood of households in the village, almost all of households are agricultural households. Generally, agricultural households are defined as households with at least one member engaged in own farming (Handbook of Household Surveys, 1984). However, this definition is insufficient for the purpose of our analysis. Rural households now have multiple sources of income beyond farming, such as wage employment, self-employment as well as remittances from migrant household members.

Therefore, this paper distinguishes between households whose main occupation is in agriculture as agriculture-based (AB) households. The counterfactual are those households whose main occupation is outside own agriculture but who nevertheless are engaged in own farming are called "non-agriculture-based" (NAB) households. The distinction is based on a question in the survey instrument which asks for household members' main occupation. Households with at least one member who reports own agriculture as her first occupation are "AB" while households without such member are called "NAB". Nevertheless, such households may have members who report own agriculture as their second occupation since basically all village households practice some sort of farming. Likewise, AB households may have members who are engaged in wage or self-employment. So in effect, all households are, what can be called part-time farming systems. Households without members engaged in either agriculture or non-agriculture and who rely on government transfers or remittances such as elderly people, are included in the NAB group.

To measure structural changes in village livelihoods over the ten-year observation period, the village is taken into account as the observation unit, i.e. all income generating activities of all village residents are accounted for. Income generating activities of household members residing outside the village are not reported. However, remittances send by household and non-household members are included in village income. The latter includes income from agriculture, natural resource extraction and non-agriculture, i.e. wage- and self-employment (see Figure 3.1) Income from agriculture and livestock is defined as gross income less variable costs of production. The same applies to income from logging, hunting, fishing and collecting. Home consumption is valued at opportunity costs. For wage employment, both cash and in-kind is counted and for self-employment net revenues are calculated.

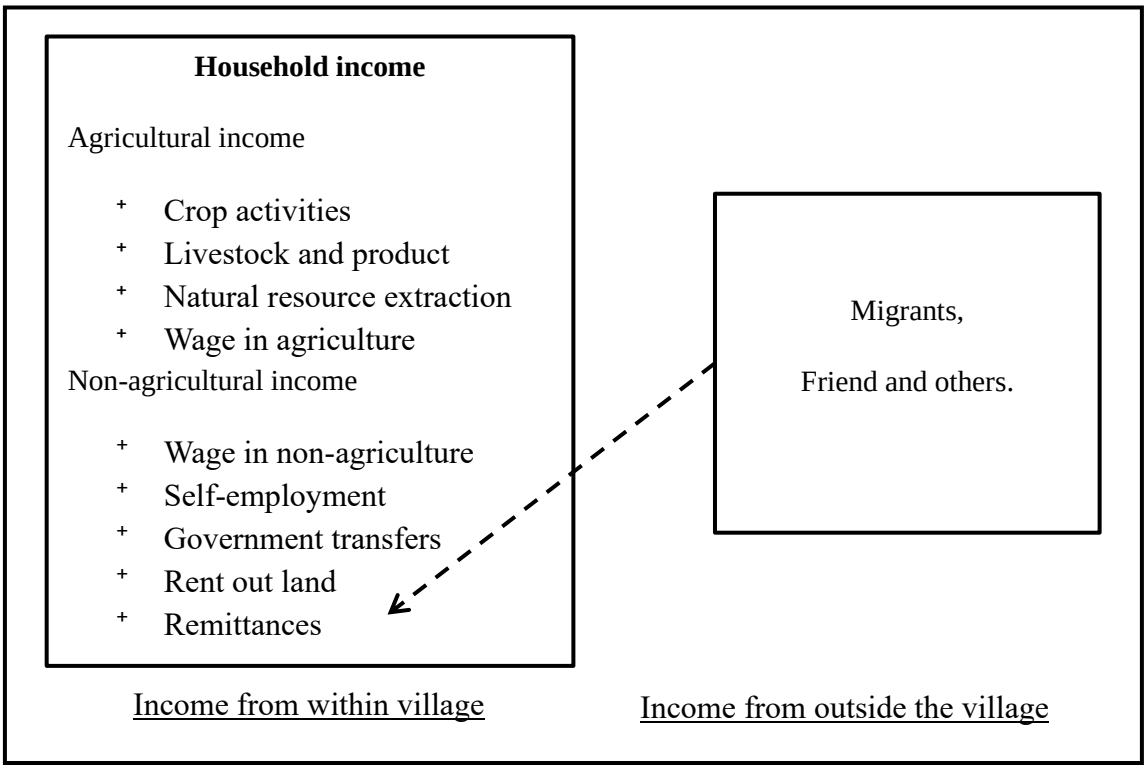

Figure 3.1 Village income conceptual framework

Source: Author's illustration.

3.2.2 Methodology

To meet the first objective, descriptive analysis is used to capture changes in socioeconomic conditions of the village, by comparing the 2009 with the 2018 data set using the household definition from above. Socioeconomic conditions such as income, income inequality, poverty, land use, labor use and migration are main focused.

In order assess the impact of likely future scenarios in the price of agricultural commodities as well as labor wages on village development, and to better understand its underlying factors, positive mathematical programming (PMP) model is employed. PMP (Howitt, 1995) is deemed to be a suitable approach for this problem because it is more behavioral than standard linear programming (LP) models which are normative and therefore often yield unrealistic results. "Observed behavior actors provide the basis for model calibration consistent with microeconomic theory. Hence, the distinction between normative and positive (econometric) models will be minimized" (Howitt, 1995, p.331). Furthermore, since the data set is restricted to only one village, the use of advanced econometric models is ruled out and hence PMP is a good substitute. The model calibrates production and resource use of the linear models by applying nonlinear yield or cost functions to reflect actual decision-making. Like most economic models, it assumes profit maximizing behavior.

This methodology has been widely used to model policy interventions on sectoral (Hardeweg, 2008) or on regional level (Umstätter, 1999; Heckelei et al., 2012). More recent applications include impact assessment of sustainability policies (Moulogianni & Bournaris, 2021), the introduction of energy crops (Donati et al., 2013), water management technologies (Quintana-Ashwell, et al., 2021) risk management (Arribas et al., 2017; Liu, et al., 2020). The approach taken in this paper falls into the category of regional policy models whereby "region" in our case, refers to a village. In this study, a PMP model is applied to conduct a scenario analysis, i.e. investigating the ex-ante impact of changes in external economic factors such as crop prices and labor costs on village resource allocation and welfare outcomes. Model coefficients are based on the 2018 census data.

Model development

PMP comprises of three steps. In the first step, an initial LP with the usual Leontief type of production function, underlying the cropping activities and other non-negative income generating activities, all being subject to fixed resource and other constraints, is formulated. An equation representing the calibration constraint with the (n x 1) vector of observed base-year activity levels is added. The objective function maximizes the total gross margin at village level. The PMP procedure calibrates the model in terms of output, input use, objective function values and dual values (shadow prices) on model constraints. The main activity variables are crops, wage- and self-employment as well as outmigration of labor, subject to an urban wage activity. However, livestock, minor crops, natural resource extraction are excluded due to their small share in village income. Land rental income is also excluded because it is a within-village transfer payment. Remittances from friends and relative are as well excluded as these incomes are external, i.e. unrelated to village resource allocation. Majority of technical coefficients are from cropping activities, taking account of the seasonality of crop production following a crop calendar (Table 3.A in the Appendix). Data from the 2018 village census are used for objective function values, technical coefficients and resource capacity constraints. For perennial crops, the annuity is calculated using dynamic investment analysis. Details of the data used in the model are presented later in the model results section in Table 3.7.

The first stage is to create the LP model with the activities observed. The mathematical structure of the LP model with actual activity level constraints is shown in equations (1) to (9) as follows:

Objective:

$$\text{Max} \quad TGM = \sum_j \left(P_j Y_j - C_j\right) X_j + \sum_w \left(R_w - C_w\right) X_w - I * O \tag{1}$$

Subject to

$$\sum_{jm} a_{jm} X_j \le Land_m \tag{2}$$

$$\sum_{jwm} b_{jwm} X_{jw} \le Labor_m \tag{3}$$

$$\sum_{jwm} d_{jwm} X_{jw} - Sell_{jm} - \text{Re}v_{wm} + \sum_m \left(T_m - T_{m-1}\right) - O_{m1} + (1+I) O_{m12} = Capital_m \tag{4}$$

$$O \le Loan \tag{5}$$

$$\sum_j (P_j Y_j) X_j = Sell_j \tag{6}$$

$$\sum_w R_w X_w = \text{Re}v_w \tag{7}$$

$$X_{jw}, O \ge 0 \tag{8}$$

$$X_{jw} = X_{jw}^{Actual} \qquad [\lambda_{jw}] \qquad \text{(calibration constraint)} \tag{9}$$

Where the indices are:

TGM = total gross margin

P_j = price of crop j — Y_j = yield of crop j

C_j = variable cost of crop j — X_j = crop j activity level

j = crop activities including maize, bean, rice, cassava, tamarind and mango

R_w = revenue of work w — C_w = variable cost of work w

X_w = work w activity level

w = work activities including wage employment, self-employment and migrant.

I = interest rate for loan — O = level of loan activity

a_{jm} = technical coefficient of use land for crop j in month m

b_{jwm} = technical coefficient of use labor crop j or work w in month m

$Land_m$ = Land resource endowments in month m

$Labor_m$ = Labor resource endowments in month m

$Sell_j$ = balance equation for revenue of crop j

Rev_w = balance equation for revenue of work w

$T_m - T_{m-1}$ = technical equation for money transfer of month m from previous month

Capital = Capital of village

Loan = Available loan for village

X_{jw}^{Actual} = actual activity level (observe activity) in village in 2018

The vector of shadow prices associated with calibration constraint is denoted by $[\lambda_{jw}]$. From stage 1 the coefficient needed for model calibration including variable cost of activity $[C_{jw}]$, observed activity $[X_{jw}^{Actual}]$ and dual value $[\lambda_{jw}]$ are generated, to be used for creating the calibration coefficients in stage 2.

In stage 2, model calibration is undertaken. In principle, there are several versions to do this. For example, Umstätter (1999), based on a review of literature, presents three alternative ways to calibrate the objective equation from linear to non-linear. Firstly, by increasing the marginal costs (Howitt, 1995). The second possibility is to introduce a decrease in marginal yields as suggested by Howitt (1995). The third possibility is the method proposed by Paris & Howitt (1988) for increasing the marginal costs.

Since, the way to decrease in marginal yields is not a suitable method because of activities such as wage employment, self-employment and migration. The version of increasing the marginal costs is chosen. Due to the disadvantage of Paris & Howitt (1988) version which is marginal cost are implicitly assumed to be zero at an activity level of zero plus the necessary data for Howitt's version are available. Therefore, the method of increasing the marginal costs by Howitt (1995) is selected for this study. Hence, the slope coefficients and intersection of marginal cost are calculated following the procedure as shown in Table 3.1.

Table 3.1 Calculation of calibration coefficients

Coefficients	**Calculation method**
Slope coefficient marginal activity	$\gamma_m = \frac{c_m}{\eta_{s(m)} X_m}$
Intersection marginal activity	$\alpha_m = c_m - 0.5\gamma_m X_m$
Adjustment term	$adj = 0.5\gamma_m \hat{X}_m$
Slope coefficient non-marginal activity	$\gamma_n = \frac{2\left(\lambda_{cal(n)} + adj\right)}{\hat{X}_n}$
Intersection non-marginal activity	$\alpha_n = c_n - \left(\lambda_{cal(n)} + adj\right)$

Source: (Umstätter, 1999).

In stage 3, the PMP model is created by adjusting the objective function of the LP model. Hereby, the normative variable costs are replaced by the variable cost functions that the increase activity level will increase its marginal cost. Therefore, the $[C_{jw}]$ in equation (1) is replaced with $[\alpha_j + 0.5\gamma_j X_j]$. After replacement, the objective function of PMP model is then shown in

equation (10). Equation (2) to (8) remain the same as in the initial LP model without the calibration constraint (equation (9)). The adjusted model is as follows:

$$\text{Max} \quad TGM = \sum_j \left(P_j Y_j - (\alpha_j + 0.5\gamma_j X_j)\right)X_j + \sum_w \left(R_w - (\alpha_w + 0.5\gamma_w X_w)\right)X_w - I * O \qquad (10)$$

Subject to equations: (2) – (8)

Next, two scenarios are assumed to reflect possible future economic conditions relevant for the development of the village.

The first scenario is the change in the price of maize, the main crop in the village. A change in the maize price is expected to affect land allocation and output of maize depending on the supply elasticity. In first scenario, the standard deviation of maize prices is extracted from secondary data from Office of Agriculture Economics (2019). Between 2009 to 2018, the variation of the farm gate price for maize in Thailand was 14.61%. Therefore, in the model, the price of maize has been increased by one standard deviation, i.e. from 5.28 to 6.05 Baht per kg and decreased by one standard deviation, equivalent to a lower bound price of maize of 4.51 THB/kg. In addition, a scenario with a maximum maize price between 2009 and 2018 is investigated. The maize price was 7.78 THB/kg or 47.34 % higher than the current price.

In the second scenario, the impact of wage increase is investigated. The change of minimum wage is applied to all unskilled labor in the village, including wage labor in agriculture and non-agriculture, self-employment as well as migrant wage, i.e. outside the village. The rationale for wage increase is derived from the announcements of the wage committee of the Ministry of Labor. Accordingly, the minimum wage in Phetchabun province was 305 THB/day and 315 THB/day in 2018. Hence, as a first step in this scenario, a wage of 325 THB/day is applied. In a second step we increase the wage to 350 THB/day. The rationale for this assumption is the trend in minimum wages in ASEAN countries during the period of 2017-2019 (Trading Economics, 2019). An average growth in minimum wage is found to increase 7.16 % equivalent to a daily wage of 350 THB in our village.

3.3 Data collection

The village used for this case study is located in the district of Chon Daeng in Phetchabun province, some 350 km north of Bangkok. Phetchabun is located at the junction of the Lower Northern and Northeastern Region of Thailand. It is characterized by a mountainous terrain which until a couple of decades ago, mainly was occupied with forest.

The village was chosen for a case study already in 2008 and a baseline village census was administered in 2009 (Gödecke, 2012), using a comprehensive socioeconomic questionnaire. In 2018, a follow-up census was implemented, re-interviewing all households in the village (Nantajit & Waibel, 2019). The village is typical for rural Thailand and for agriculture in low potential areas. Village infrastructure is limited to an elementary school, a nursery, a vocational training center, a community meeting place, a simple gasoline station and two Buddhist temples. Most of the village population are engaged in small-scale farming and natural resource extractions. Conditions for agriculture are unfavorable, i.e. soils are poor and access to artificial irrigation is almost absent. However, there is easy access to markets through an asphalted road with a distance to its own district of 16 km and 22 km to the capital of the neighboring district. Most of the houses of the village are located near the road, somewhat organized in neighborhood clusters (see village map in Appendix Figure 3.A).

As regards village inhabitants in 2009, the village had 75 households and the population registered in the village was 292 persons. In the 2018 census, it was found that the number of households had increased to 83 and population of the village had grown to 347.[2] In Table 3.2, the dynamics of households between the two survey waves are reported. It is shown that 15 new households were created as a results of e.g. marriage, separation or divorce. There were 10 household formed by return migrants, the same number as out-migrants, while six households were in-migrants.

The data collected in the two census waves included household characteristics, household living standard measurements, income generating activities, asset and consumption, finance and some behavioral aspects of development such as risk and other subjective assessments of well-being. The questionnaire followed the concept of the Thailand-Vietnam socioeconomic household panel (TVSEP) project (Hardeweg et al., 2013, www.tvsep.de). During the 2018 census, more details on land use, labor use, costs of production, yields and prices of major crops as well as crop rotation patterns were asked. All items for income, consumption and assets were asked for the agricultural year in Thailand, i.e. from May to April the following year. The village census was complemented by in-depth interviews with key informants such as village head, village committee members and head of school. Furthermore, a migrant tracking survey was conducted among household migrant members residing in Greater Bangkok area.

The village census was complemented by in-depth interviews with key informants such as village head, village committee members and the head of school. Furthermore, a migrant tracking survey was conducted among household migrant members, residing in Greater Bangkok area.

Table 3.2 Household Dynamics between 2009 and 2018

Number of Households in 2009	75
Number of Households in 2018	83
Household missing in 2018	
Out Migrants	10
Deceased	6
Other reasons	2
Households added in 2018	
New Household Formation	15
Return migrants	10
In-Migrants	6

Source: Author's illustration.

3.4 Descriptive statistics

3.4.1 Household income and other parameters

To assist the description of socioeconomic changes in the village, the distinction between two group is defined. The first group is households whose main occupation is in agriculture called agriculture-based (AB). The second group is called non-agriculture-based" (NAB) households

[2] it must be noted that census data deviated from the official village statistics which is due to delays and imperfection of the official recording system.

i.e. those whose main occupations is not in agriculture but who nevertheless are engaged in farming.

Table 3.3 compares AB with NAB households. Income has grown much faster in NAB households, roughly 13 % p.a., well above aggregate income growth in the Thai economy. This is mainly due to the growth in non-agricultural income with an approximate 20 % growth rate p.a. AB households experienced a growth rate of 5 %, which is clearly below the national average. Nevertheless, there are also income-poor households among the NBA group but poverty head count ratio has declined while it has increased in the AB group. On the other hand, household debt in the NBA has grown three times as much as in the AB group. Presumably, much of the borrowing in NBA households was used for income-related activities and for investment.

Table 3.3 Socioeconomic parameters of agriculture and non-agriculture-based households in 2009 and 2018

	Agriculture-based households			**Non agriculture-based households**		
Parameter	**2009**	**2018**	**(% change)**	**2009**	**2018**	**(% change)**
Total household income (THB)	128,914	196,095	52	95,591	221,918	132
Agricultural income (THB)	69,554	130,452	88	41,798	60,035	44
Non-agricultural income (THB)	59,360	65,643	11	53,793	161,883	201
Consumption per capita (THB/Month)	4,657	3,552	(24)	3,161	5,656	79
Household debt (THB)	116,024	281,158	142	28,778	184,268	540
Poverty head count ratio (%)*	48.48	53.13	10	43.24	39.22	(9)
Number of household (No.)	33	32	(3)	37	51	38

Source: Author's calculations.
Notes: * based on poverty line as defined by National Economic and Social Development Board (2020). The poverty line is based on monthly per capita household consumption. It was 2,258 THB in 2009 and 2,714 THB in 2018.

3.4.2 Changes in the village labor profile

Changes in the labor profile in the village have been less profound than those in economic conditions. The share of the village population whose main occupations is either in agriculture or in non-agriculture and those not in the labor force in 2009 was roughly 40:40:20. This has changed only slightly in favor of non-agriculture (see Table 3.4). Within non-agriculture, the most visible change has been in permanent employment in the village which almost doubled between the two observation years. On the other hand, wage employment in non-agriculture was reduced to one half of the share in 2009, while self-employment increased only slightly.

Table 3.4 Occupation of Household members in 2009 and 2018

Main occupation	2009		2018	
	Persons	**%**	**Persons**	**%**
Agriculture				
Own agriculture	64	27	61	21.1
Wage labor	33	13.9	45	15.6
Total agricultural labor	***97***	***40.9***	***106***	***36.7***
Non-Agriculture				
Self-employment	17	7.2	29	10
Wage labor	43	18.1	26	9
Permanently employed	33	13.9	70	24.2
Total non-agricultural labor	***93***	***39.2***	***125***	***43.2***
Not in Labor Force*	47	19.8	58	20.1
Total labor	**237**	**100**	**289**	**100**

Source: Author's calculations.
Note: only household members above 14 year olds.
* includes students, house wives, unemployed people and those unable to work

One component of structural change can be observed in demography. In Table 3.5, the age structure of workers in agriculture and non-agriculture is shown. Clearly, agriculture laborers tend to be older. For example, in 2018, almost one fourth of workers were above 60 while this share was just 6 % ten years before. The majority of people working in non-agriculture, almost 60%, is below 40 years old (see Table 3.5).

Table 3.5 Agricultural and non-agricultural workers by age group

Age group	Agricultural labor				Non- agricultural labor			
	2009		2018		2009		2018	
	Persons	%	Persons	%	Persons	%	Persons	%
<20	3	3.09	3	2.83	9	9.68	6	4.8
20 - 29	12	12.37	11	10.38	42	45.16	31	24.8
30 - 39	14	14.43	19	17.92	22	23.66	40	32
40 - 49	30	30.93	17	16.04	9	9.68	24	19.2
50 - 59	32	32.99	30	28.30	11	11.83	13	10.4
>=60	6	6.19	26	24.53	0	0.00	11	8.8
total	97	100.00	106	100.00	93	100.00	125	100

Source: Author's calculations.
Note: only household members above 14 year of age are included.

3.4.3 Land use

Another element of structural change is land use. In Table 3.6, the ownership and use of land in absolute and relative numbers by the two type of households are compared. As expected AB households own more land and cultivate larger crop areas. However, land ownership has almost doubled for NAB households between 2009 and 2018 while it has declined by over one third for AB households. This indicates a certain dynamic in the village' land market. However, the land rental market shows little dynamics. In terms of land use there is some shift away from field crops to perennial crops in AB households which is small in absolute terms but almost 3 times in relative terms. Also vacant land, although a minor share of total village land has increased considerably in relative terms.

Table 3.6 Land use by type of use for agriculture and non-agriculture-based households in 2009 and 2018

Parameter	Agriculture-based households		Non agriculture-based households	
	2009	**2018**	**2009**	**2018**
Own land per household (Rai)	27.64	17.63	5.27	11.04
Total land use per household (Rai)	40.43	37.47	7.93	15.55
Land use type (Rai)				
Residential	3.31	1.70	0.98	1.02
Field crops	32.16	29.35	5.26	6.67
Perennial crops	1.33	3.57	0.65	1.80
Rent out	3.36	1.70	0.72	3.49
Vacant	0.27	1.16	0.11	2.57
Land use type (%)				
Resident	8.18	4.54	12.76	6.57
Field crops	79.54	78.33	68.11	42.89
Perennial crops	3.30	9.53	8.40	11.58
Rent out	8.32	4.52	9.28	22.44
Vacant	0.66	3.09	1.44	16.51
Gini of own land 2009		0.65		
Gini of own land 2018		0.69		
Gini of land use 2009		0.58		
Gini of land use 2018		0.66		

Source: Author's calculations.

3.5 Model results

The model is calibrated to reproduce the income generating activities in the village during the May 2017 to April 2018 reference period. The main purpose to develop a PMP village model was to assess the development of the village economy, given likely changes in external conditions. Two basic scenarios are explored with a total of five sub-scenarios. The first basic scenario is the change in the prize of maize, the major crop in the village. The second is the change in wages, since wage labor is the main income generating factor.

This section reports the results in two steps. First, the calibration procedure to establish the PMP model including the calculation of coefficients for variable costs, revenues, land and labor use, for the base scenario are shown. The procedure follows step 3 as described in the methodology section. Second, results of the scenario analysis are presented in and discussed against the background of the possible future economic conditions, assumed to be relevant for the socioeconomic development of the village.

3.5.1 Calibration of PMP model

Table 3.7 shows the LP model coefficients and calibration constraints. The table is separated to 4 sections from 4 types of income generating activities including crops, wage and employment, self-employment and migration. Column (1) presents the actual activity in the village during the reference period. Column (2) presents labor use of each activity (Labor use in the model is family labor inside village. Hired labor is included as variable cost). Column (3) represents the revenue from each activity. For crop activities, the value of production is calculated by price of

crop multiplied by its yield. While, migration generates revenues to the village as remittances. The last column shows cash cost of activities.

Table 3.8 shows the calibration coefficients from stage 2 in the methodology. Lamda (λ) shows the shadow prices of activities. Alpha (α) and Gamma (γ) show intersection and slope coefficient of the marginal cost function of activities. For example, one rai of maize1 activity has a shadow price of 2,882.84 Baht. The cost function starts from 239.90 baht at zero rai of maize1 and increasing maize1 will increase the marginal costs to 6.60 Baht per rai.

In stage 3, after the calibration coefficients are fit into the objective function of the PMP model, the calibration constraints are omitted. Thus the PMP objective function becomes a nonlinear function. The optimum solution of the PMP model yields the baseline scenario. Results show that the model almost perfectly displays the observed situation in the village economy. However, the total gross margin calculated by the model does not fully match the observed village income since some activities such as government transfer and remittances from non-household members are not captured.

Table 3.7 Details of income generating activities

Activities	**(1)**	**(2)**	**(3)**	**(4)**
Crops	Land use (Rai)	*Labor use (Man-day/Rai)	Value of Production(Baht/Rai)	Variable Costs (Baht/Rai)
Maize1 (June-September)	874	1.4	6,006	3,123
Maize2 (April-July)	171.25	1.4	6,006	3,123
Beans	171.25	5.09	2,791	2,040
Rice	45	6.79	4,684	2,315
Cassava	41	2.8	8,029	2,716
Tamarind**	70.63	24.21	16,395	8,449
Mango**	91.5	3.01	28,424	18,208
Wage employments	No. of workers (Person)	Labor use (Person days/Year)	Revenue (Baht /Year)	Variable Cost (Baht/Year)
Agricultural Wage	33	45	12,092	654
Permanent employed in agriculture	25	234	69,491	1,020
Non-Agricultural Wage	6	240	70,509	972
Driver	4	282	140,569	6,492
Village health volunteer	7	24	7,200	191
Teacher in Village School	2	252	300,213	756
Government officer	3	24	123,520	160
Administrative	6	312	169,294	4,346
Self-employment	No. of business (Business)	Labor use Person days /Year)	Revenue (Baht/ Year)	Variable Cost (Baht/ Year)
Grocery store	7	504	755,657	692,329
Restaurant	3	444	412,800	156,235
Tailor	3	176	134,163	65,789
Student transport service	4	108	93,000	44,799
Agriculture machine service	2	90	219,312	124,893
Street food stall	2	132	115,200	41,764
Construction service	1	80	53,340	25,825
Handicraft	2	216	14,502	8,769
Middleman for labor	1	76	13,500	6,606
Migration	No. of Migrant (Person)	Labor use (Person days /Year)	Revenue (Baht /Year)	Variable Cost (Baht/Year)
self-employment	3	360	1,667	28,800
wage in agriculture	2	360	0	24,250
wage in non-agriculture	12	324	167	17,200
permanent work in agriculture	5	348	196	2,800
permanent work in non-agriculture	40	348	2,715	22,488

Source: Author's calculations.

Note: *Count only household labor use. Hire labor is included as variable cost.
**For perennial crops the annuity is calculated s)

Table 3.8 Dual values, Alpha and Gamma Parameters of each activity

Crops and work activities	λ	α	γ
Maize1 in June-September (Rai)	2,882.84	239.90	6.60
Maize2 in April-July (Rai)	2,882.84	239.90	33.67
Bean (Rai)	2,370.13	-55.25	27.68
Rice (Rai)	751.03	1,289.20	33.38
Cassava (Rai)	5,301.31	-2,585.24	258.60
Tamarind (Rai)	7,945.28	504.07	224.98
Mango (Rai)	10,215.83	7,992.31	223.30
Ag-Wage in July (Persons)	2,541.80	-2,396.50	154.05
Ag-Wage in Aug (Persons)	3,812.70	-3,594.75	231.07
Ag-Wage in Sep (Persons)	5,083.60	-4,793.00	308.10
Non-Ag Wage in Jan-Dec (Persons)	5,794.82	-5,713.85	1,931.61
Ag-Permanent employed (Persons)	68,470.74	-67,450.50	5,477.66
Driver (Persons)	134,076.90	-127,585.26	67,038.45
Public health volunteer (Persons)	7,009.20	-6,818.40	2,002.63
Teacher (Persons)	299,456.64	-298,700.64	299,456.64
Provincial government officer (Persons)	123,360.00	-123,199.92	82,240.00
Administrator (Persons)	164,948.16	-160,602.00	54,982.72
Grocery store (Business)	63,328.08	629,001.00	18,093.74
Small restaurant (Business)	256,565.40	-100,330.80	171,043.60
Tailor shop (Business)	68,374.46	-2,585.55	45,582.97
Student transport service (Business)	48,200.76	-3,401.55	24,100.38
Agriculture machine service (Business)	94,419.42	30,473.56	94,419.42
Street food stall (Business)	73,436.16	-31,672.32	73,436.16
Construction service (Business)	27,514.68	-1,689.36	55,029.36
Handicraft (Business)	5,732.52	3,036.96	5,732.52
Middleman for labor (Business)	6,893.54	-287.08	13,787.08
Migrant do self-employment (Persons)	27,133.33	-25,466.66	18,088.89
Migrant do ag-wage (Persons)	24,250.00	-24,250.00	24,250.00
Migrant do non-ag wage (Persons)	17,033.33	-16,866.66	2,838.89
Migrant do ag-permanent (Persons)	2,604.00	-2,408.00	1,041.60
Migrant do non-ag permanent (Persons)	19,772.50	-17,057.50	988.63

Source: Author's calculations.

3.5.2 Scenario results

Table 3.9 summarizes the scenarios briefly explained in the methodology section for exploring by means of the PMP model. For the price of maize three variants are tested and for wage two variants are being explored by the model.

Table 3.9 Overview of Model Scenarios

Scenario (S)	Maize (M)			Wage (W)	
Sub-scenario	M1	M2	M3	W1	W2
Description	% change in Price			THB/day	
Quantity	+ 14.61	-14.61	+47.34	325	350

Source: Author's illustration.

Generally, the results of the scenario analysis show that there are no drastic changes in the village economy in response to the hypothesized changes in external conditions. A decline in the price of maize will reduce occupation in own agriculture by 10 % (Table 3.10). However, wage increase has minor effects on own agriculture, self-employment and migration while the effects on wage labor are stronger. Yet, elasticity of labor supply remains low.

Table 3.10 Change in village occupations (in %) for model scenarios

	Scenarios				
Occupation	M1	M2	M3	W1	W2
Own Agriculture	0.04	-10.84	0.04	0.00	-0.03
Wage-labor	0.00	0.00	-0.12	1.76	3.04
Self-employment	0.00	0.00	-0.12	-0.02	-0.16
Migration	0.00	0.00	-0.35	0.41	0.57

Source: Author's calculations.

As expected an increase in the wage will increase wage labor supply and migration while labor in self-employment is reduced. As regards the area planted to crops in the village, a 14 % reduction in the price of maize will reduce the area planted to this crop by over 15%. An almost 50 % increase in the price will raise maize area by 7 % (Table 3.11). Thus maize supply is price elastic. This is reasonable since maize is likely to remain a major crop for the farmers in the village, both for households whose base is in agriculture and those who keep agriculture as a sideline. Crop substitution effects with cassava and rice take place. In the high maize price scenario then model predicts a complete substitution of fruit trees as Tamarind and Mango. However, this result must be treated with care since abandoning of perennial crops would cause sunk costs which are not captured in the PMP model. As expected changes in the wage has only negligible effects on cropping (Table 3.11).

Table 3.11 Change in area planted to crops for model scenarios

Crops activities	M1	M2	M3	W1	W2
Maize1	2.95	-15.19	7.32	0.00	-0.03
Maize2	2.95	-15.19	7.34	0.00	0.00
Beans	0.00	0.00	-0.05	-0.01	-0.06
Rice	-47.00	0.00	-100.00	0.00	0.00
Cassava	-6.66	0.00	-22.82	0.00	0.00
Tamarind	-4.44	0.00	-15.23	0.00	0.00
Mango	-3.45	0.00	-11.85	0.00	0.00

Source: Author's calculations.

In Figure 3.2, the effects on the total village gross margin are shown. The highest change in income with over 23 & result from scenario M3. On the other hand, wage increases have very small income effects.

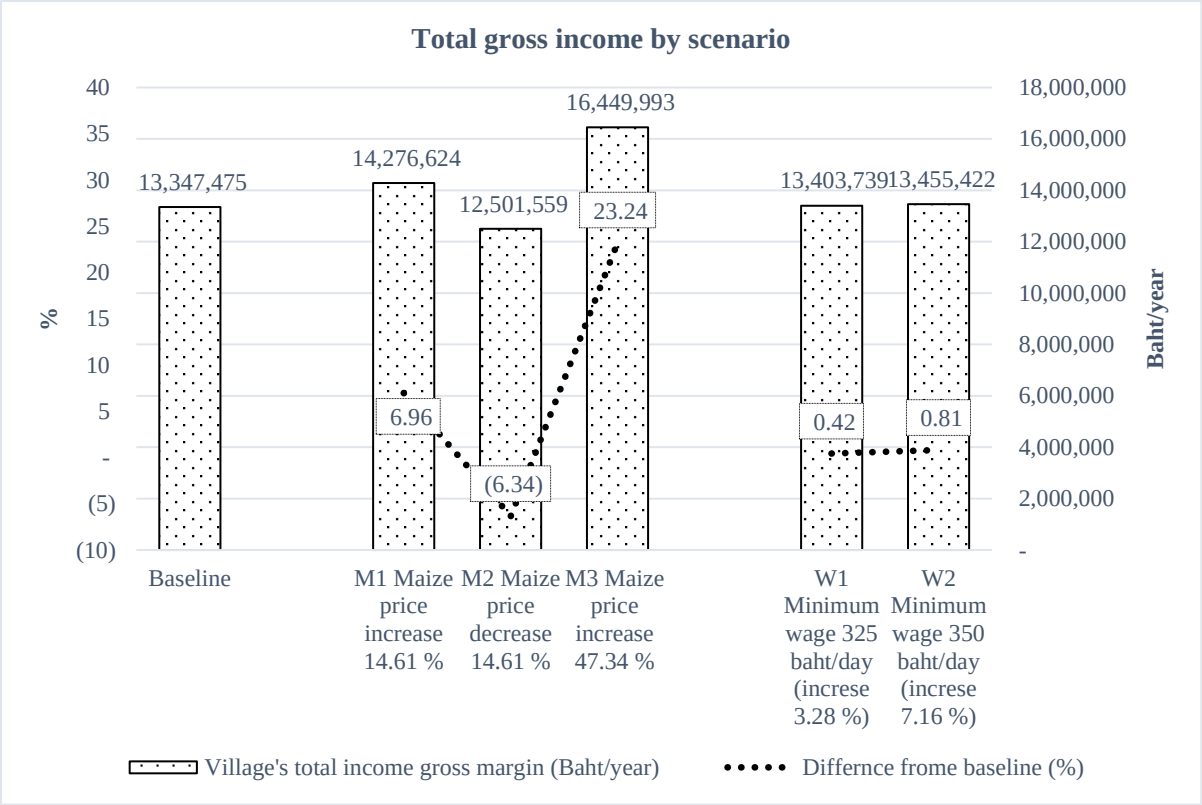

Figure 3.2 Total gross margin by scenario
Source: Author's calculations.

3.6 Summary and conclusions

This paper had two objectives. First, to describe changes in socioeconomic conditions of a typical rural village Thailand over a ten-year observation period. Second, to explore the impact of future scenarios in possible external economic conditions on village development and welfare.

The data base for the analysis were two village censes conducted in 2009 and 2018. In the descriptive analysis it can be shown that almost all households are practicing some form of agriculture. Broadly, there are two types of households, namely those whose main occupation is in own agriculture and those whose base is in non-agricultural occupations but who nevertheless practice farming as well. Comparing the 2018 with the 2009 data, revealed firstly that households who diversified into wage or self-employment had an income growth comparable to the growth of the Thai economy while agriculture-based households significantly fell behind. Secondly, in-migration exceeded out migration so that the village population had grown by almost 20 %.

By means of a Positive Mathematical Programming (PMP) model two future scenarios calculations were undertaken. First a drastic price increase in maize, the main crop in the village and second an increase in wages are explored. Results show that in general both scenarios will not reverse the trend of households maintaining their "backbone" in agriculture. Changes in the cropping system will occur as a results of an increase in agricultural commodity prices. A 47 % increase in maize prices will make farmers to expand maize cultivation at the expense of other crops. For wage increases in off- and non-farm employment labor supply response is only moderate and is unlikely affect farming.

In conclusion, firstly, the model can be refined and further scenario analysis can be performed. Secondly, policies aimed at an increasing the welfare of rural village populations and promoting inclusive growth and shared prosperity must recognize that part-time farming is the dominant farming system. This is especially the case in areas with low agricultural potential. Policies must take into account that rural households have multiple sources of income, including agriculture, even though the share of the latter is declining. For the foreseeable future, farming will remain the safety net of rural villages in Thailand.

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3.8 Appendix

Table 3.A Plant schedule for crops activities

Crop	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Maize1												
Maize2 & Bean												
Rice												
Cassava		Harvest time			Plant							
Tamarind	Harvest time											
Mango		Harvest time										

Source: Author's illustration.

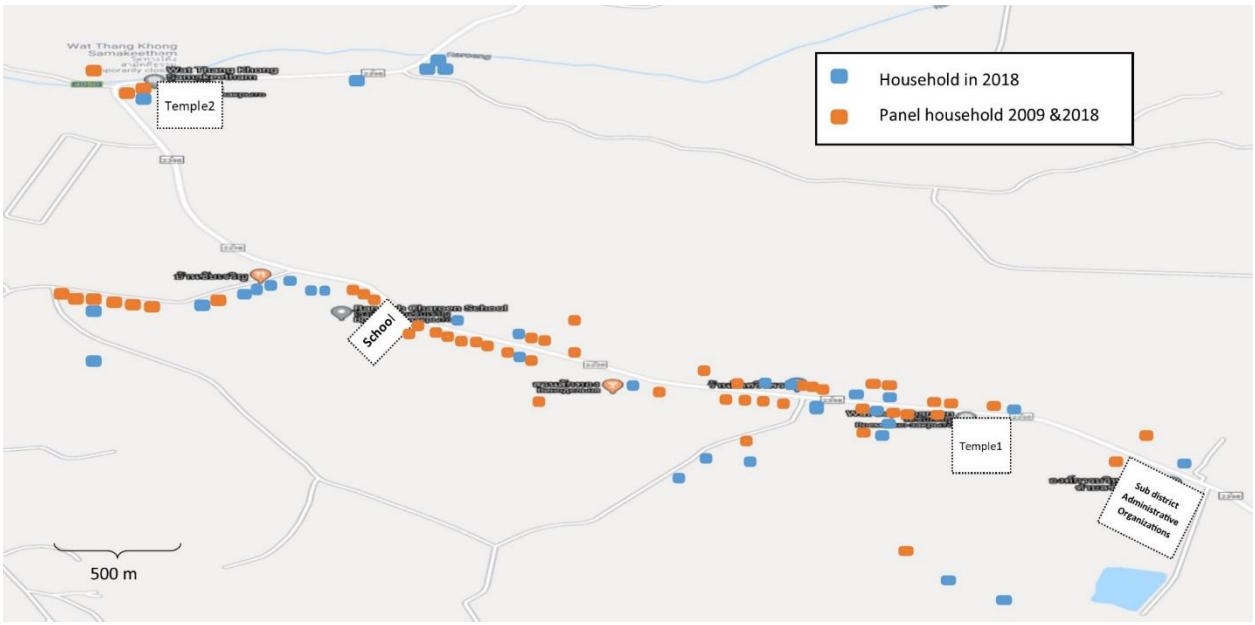

Figure 3.A Household location of Sub Jaroen village in 2009 and 2018

Source: Authors' illustration.

CHAPTER 4: Development of rural village infrastructure and its impact on household well-being in Northeast Thailand.

Earlier versions of this paper were presented at:

1. UBU-TVSEP data user conference organized by TVSEP and Ubon Ratchathani University (UBU), 4 September 2020. (presented online)
2. the 10th ASAE international conference, Beijing, China organized by the Asian Society of Agricultural Economists (ASAE), 6-8 December 2021. (presented online)

Abstract

In this paper, we examined rural village infrastructure and it impact on household well-being in North-east Thailand. We use the panel data from the Thailand Vietnam Socio-Economic Panel (TVSEP). We selected a dataset of 1,770 identical households from 220 villages of the 2007 and 2016 panel waves. Our results show, that within a decade, rural infrastructure, in particular transportation, communication, irrigation and agriculture mechanization, have improved considerably. Households with access to well-developed roads, modern communication devices and mechanized assets are shown to have improved outcomes regarding income from agriculture and poverty reduction. In addition, we found that rural household income increasingly relies on non-agriculture. Therefore, investing mainly in agricultural infrastructure may not be an adequate policy for rural areas in Thailand.

Keywords: Rural area, Infrastructure development, Village study, Thailand

JEL Classification: R11, O18

4.1 Introduction

Economic development in countries such as Thailand is often highly skewed towards urban centers. The implicit and underlying policy paradigm has been that rural villages are mainly a source of cheap labor for the industrialization process in urban areas. Therefore, rural areas have received less attention in terms of public investment for infrastructure. By and large, rural development policy is still geared towards promoting and subsidizing small scale farming activities while ignoring the multi-functionality of rural household systems. The fact that infrastructure investment is a major ingredient for inclusive economic growth, lessening of inequality between urban and rural areas and poverty reduction (e.g. Esfahani & Ramírez, 2003; Fan et.al., 2004; Sahoo & Dash, 2012; Palei, 2015; Manggat et.al., 2018; Chaurey & Le, 2019; Khan et.al., 2020). Roads, irrigation facilities, public water supply systems, schools, health centers, financial institutions, markets and telecommunication are prerequisites for achieving shared prosperity in rural areas.

The development economics literature has many examples for the benefits of rural infrastructure. For example, good quality roads and advanced logistics enable rural households to efficiently transport goods and services to urban areas, thus providing improved opportunities of employment, access to markets, healthcare and education (e.g. Jacoby & Minten, 2009; Puentes, 2015; Asher & Novosad, 2016; Aggarwal, 2018). Access to telecommunication networks and the internet not only enhances socialization but also improves access to information on, for example, agricultural technology, employment opportunities, or business ideas (Aker & Mbiti, 2010; Hjort & Poulsen, 2019). Irrigation helps to increase agricultural productivity and land use intensity, can stabilize crop yields in risky environments and offer opportunities for aquaculture (Huang et.al., 2006; Floch & Molle, 2013). Agricultural mechanization stimulates labor efficiency in crop production and farm productivity (Dauda et.al.; 2012, Hormozi et.al., 2012; Amare & Endalew, 2016)

This paper takes a closer look at village development in Northeast Thailand since 2007. Within the administrative set up of the Thai government, a village is the lowest administrative unit, under sub-district, district and province. Commonly, a rural Thai village is a settlement of around 100 households. Social live in the village differs profoundly from urban settlements, town and cities. For example, in the rural village, the principle of mutual help and exchange of labor and machinery is common. People know each other and generally care about each other. The leader of a village is a government officer but elected in regular intervals by the village population.

The study presented in this chapter has two objectives:

1) to contribute to a better understanding of the factors that drive socio economic development of rural villages in Northeast Thailand

2) to analyze the effects of public infrastructure investments on household income and poverty reduction.

The paper is organized as follows: In section 2, we describe the process of data collection. Section 3 is the methodology. Section 4 presents the descriptive analysis of socio economic changes in the 220 village infrastructure as well as the results of the difference in difference model, to assess the

impact of infrastructures on growth in household well-being. The last section presents conclusions and policy recommendation.

4.2 Data collection

To address development over time and the importance of rural infrastructure facilities, panel data on rural infrastructure and household wellbeing are needed. In this paper, we use data from the Thailand Vietnam Socio-Economic Panel (TVSEP), which provides data for research on topics such as poverty dynamics and sustainable development. TVSEP is a long-term panel project in Thailand and Vietnam funded by the German Research Foundation (DFG FOR 756) (see www.tvsep.de). TVSEP conducts household and village surveys with a sample of 4,400 households in 440 villages in rural areas of six provinces in Thailand and Vietnam by using structured questionnaire. The household questionnaire includes the usual living standard measures (e.g., consumption, income, assets), but also household characteristics, shocks, risks, other subjective assessments and expectations, as well as some behavioral traits relevant for development. The household questionnaire also includes information on each individual household member (e.g. age, gender, education, health, employment, shock and assets). Simultaneously, the village questionnaire contains information on village infrastructure, including access to roads, irrigation, schools, markets, sanitation systems and geographic data such as the distance to the nearest town, type of road, and whether a school, market, public waste facility, or irrigation system is present in the village.

In this study, we utilize the Thai data from both household and village survey. In total, we employ a dataset of 1,770 identical households from 220 villages with a 10-year gap from 2007 to 2016. The data cover three provinces in Northeast Thailand including Nakhon Phanom, Ubon Ratchathani and Buri Ram (see also Figure 4.1).

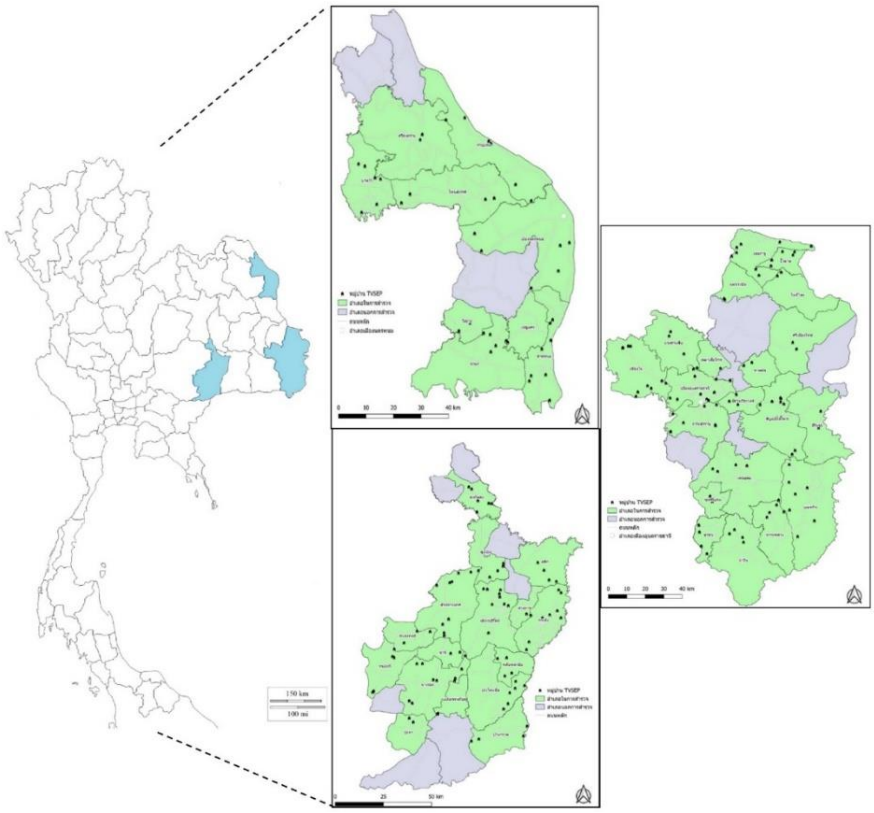

Figure 4.1 Study area and village sample in Northeast Thailand
Source: Authors' illustration.

4.3 Conceptual framework and methodology

4.3.1 Conceptual framework

According to literature, economists distinguish between two types of infrastructure: economic infrastructure and social infrastructure. Economic infrastructure is comprised of roads, electricity, communication, water supply and other types of infrastructure that are considered to directly promote economic growth. In contrast, social infrastructure is defined as infrastructure that promotes quality of life and cultural standards of the population, such as schools, clinics, hospitals and playgrounds (Fourie, 2006; Torrisi, 2009; Kumari & Sharma, 2017). In this paper, village facilities that contribute to the community will be observed. Hereby, economic infrastructure is the focus and is hypothesized as key to improving village economies.

Progression of rural economies is commonly measured by accounting for improvements of the overall income of a population and its impact on poverty reduction, e.g. headcount ratio. Moreover, measuring rural development is more complex than the overall country economy, as rural residents frequently draw their income from multiple sources (Fan et al., 2004). Rural household income sources can be classified in two main categories, namely agricultural income (e.g., income from crops and livestock) and non-agricultural income (e.g. wage employment, self-employment, or remittances). In this study, we examine the effect of village infrastructure on the income

composition of rural households based on these two categories. In addition, we consider both per capita and annual household income in our analysis as a robustness check (Datta & Meerman, 1980; Nolan et al., 2016).

In the literature, infrastructure overall, has been shown to have a positive effect on economic development. In addition, different types of infrastructure are shown to have effects on different components of household income. For example, transportation and telecommunication infrastructure are found to provide benefits to all types of household income. Improvement of transportation infrastructure provides access and more opportunities to non-farm employment and reduces expenditure on transportation costs, in particular for agricultural activities (Jacoby & Minten, 2009; Puentes, 2015; Asher & Novosad, 2016; Aggarwal, 2018). Telecommunication networks improve access to information on employment opportunities, business ideas as well as agricultural technology (Aker & Mbiti, 2010; Hjort & Poulsen, 2019). In contrast, access to irrigation and agricultural mechanization results in direct increases to agricultural income driven by improvements in terms of agricultural productivity (Huang et.al., 2006; Hormozi et.al., 2012; Amare & Endalew, 2016).

Aside from the effects of infrastructure, household welfare and their poverty status are also influenced by household characteristic such as the share of workers, level of education, number of land plots, shocks, etc., and village characteristics such as the size of the village, its location, the distance to the nearest town, or the number of enterprises in the village (Cherdchuchai & Otsuka, 2006; Paweenawat & McNown, 2014; Mukaila et al., 2021). Hence, studies on the effect of infrastructure on income outcomes should control for such characteristics.

The conceptual framework of this paper is shown in Figure 4.2

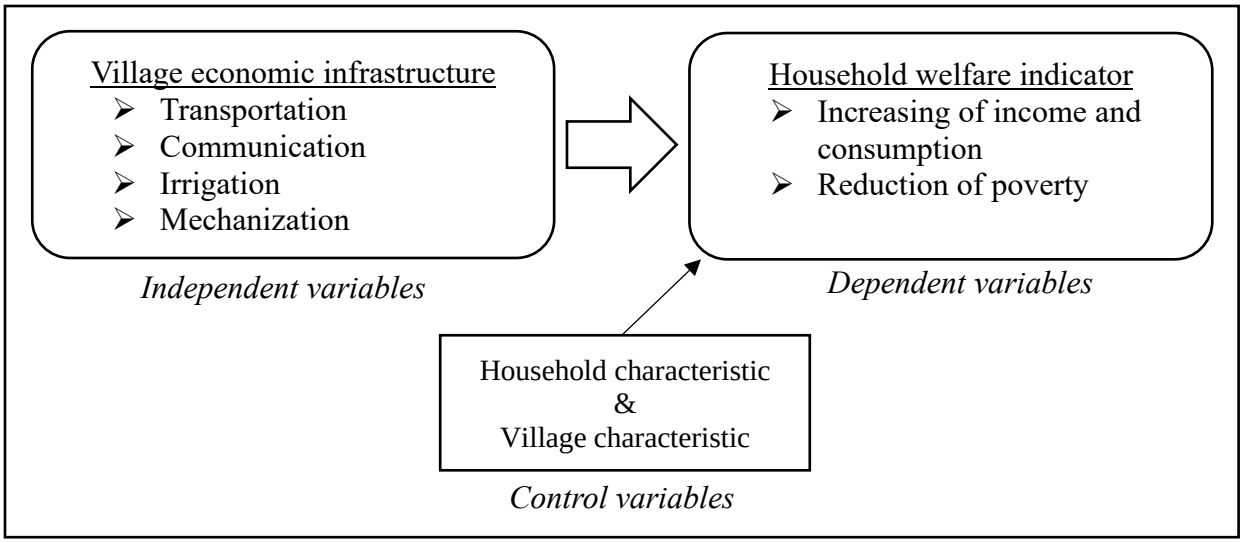

Figure 4.2 Conceptual framework
Source: Authors' illustration.

4.3.2 Methodology

Estimation of village infrastructure impacts on household well-being necessitates panel data at the village level alongside data on village infrastructure. Such data allow for the calculation of household well-being. In order to estimate the impacts of infrastructure on household income and consumption, we applied a difference-in-difference model with a fixed effects estimator. in equation 1 the model is formalized:

$$Y_{it} = \delta_i + \tau_i + \gamma D'_{iIN} + \alpha\left(D'_{iIN} * T_{post}\right) + \beta_1 X_{it} + \beta_2 V_{jt} + \varepsilon_{it} \qquad (1)$$

Where $Y_{it}$is the outcome variable representative of household well-being (Y = Annual household income, household income from agriculture, household income from non-agriculture, income per capita and consumption per capita) of household i in period t (t = 2007, 2016). D'_{iIN} is the treatment status of the i^{th} household, which The IN is a vector of dummy variables on infrastructure (IN = Road Type (Made road = 1 and dirt road =0), Smart and mobile phone (yes =1), Irrigation (yes =1) and 4-wheel tractor (yes =1)). T_{post} is a binary indicator for the post period (2016). The interaction term $D'_{iIN} * T_{post}$ captures the treatment effect of each infrastructure indicator. We include X_{it} and V_{jt} as a set of controls for household and village level characteristics. The δ_i and τ_i are time and household fixed effects. ε_{it} is the error term. In this model, the standard error is clustered at village level to account for serial correlation.

In addition, the IN were selected based on transportation (road type), ICT infrastructure (smart and mobile phones), irrigation (access to irrigation) and mechanization proxies by presence of 4-wheel tractors, Table 4.1 & Table 4.3)

Table 4.1 Description of key infrastructure variables

Infrastructure variable	Type/Unit	Description
Transportation	Dummy (yes = 1)	Households located in village with main road type as made road
ICT infrastructure	Dummy (yes = 1)	Households with at least either one phone, mobile phone or smart phone.
Irrigation	Dummy (yes = 1)	Households located in a village with an irrigation system.
Mechanization	Dummy (yes = 1)	Households that owned a 4-wheel tractor.

Source: Authors' illustration.

The second model is a probit model used to measure the effect of infrastructure on the poverty status of a household. As poverty threshold, a monthly per capita consumption under 1,717 THB in 2007 and under 2,396 THB in 2016 as specified by the Thailand National Economic and Social Development Board (NESDB, 2020). The model to estimate poverty is specified as follows:

$$Pr(P_{it} = 1|X_i) = \Phi\left(\beta_1 X_{it} + \beta_2 V_{jt} + \alpha \mathrm{D}'_{\mathrm{iIN}} + \varepsilon_{it}\right) \quad (2)$$

Where Pr(.) = probability of dummy variable;

$\Phi(.)$ = the cumulative distribution function of the standard normal distribution;

P_{it} = Dummy variable of poverty (Poor household = 1; Non-poor household = 0);

i = household (i = 1 , ... , 1770);

j = village (j = 1 , … , 220);

t = 2007 and 2016;

$\mathrm{D}'_{\mathrm{iIN}}$ is the treatment status of infrastructure (IN)

Xi = Vector of household characteristics, (including household size, education, land use, shocks, assets).

Vj = Vector of village characteristics, (including number of total households in the village, minimum distance to nearest town, number of enterprises in the village)

ε = the error term, the standard error is clustered at village level.

4.4 Results

4.4.1 Characteristics of study villages

The village in the TVSEP sample are located in three provinces in rural areas of Northeast Thailand. In Table 4.2, the characteristics of the villages are presented. The average number of households between 2007 and 2017 increased from 148 to 165 while the average village populations declined slightly. On average, the minimum distance from a village to the next town is 13 km. In most cases, villagers can reach important infrastructure such as markets, banks, clinics, hospitals and post offices within 10 km radius from their village center. For half of the sampled villages, access to primary education is given, with a primary school being located in the village. For the remainder of the sampled villages, school children must travel approximately 3km to the next village to access primary education facilities. Junior and Senior secondary school are on average 5-10 km from the village. Motorcycles are shown to be the main mode of transportation for rural households. Villagers can refuel gasoline at small petrol stations, which are mostly located in front of local grocery stores.

Almost all households have access to electricity and are integrated into the water supply. However, many villages are still lacking public waste disposals. In 2016, more than half of the villages in the sample discharging waste water to the ground and burning solid waste.

Table 4.2 Village facilities in 2007 and 2016

Village infrastructure	2007	2016
Number of households (No.)	148.29	165.95
Number of inhabitants (No.)	684.68	675.76
Temple (%)	78.90	88.64
Market (km)*	10.35	8.94
Bank (km)*	13.05	10.48
Clinic (km)*	8.13	9.24
Hospital (km)*	12.89	11.09
Post office (km)*	10.66	9.86
Primary school (km)*	2.99	0.78
Junior secondary school (km)*	6.11	3.66
Senior secondary school (km)*	9.70	6.80
Petrol station (km)*	5.25	6.37
Household access to electricity (%)	98.96	99.18
Public water supply (%)	86.82	88.64
Public waste disposal (%)	14.55	41.36

Source: Own calculation.
Note: *In 2007, the unit of measurement was in minutes. These were converted to km following the assumption that average travel speed lies at 35 kilometers per hour.

4.4.2 Development of rural infrastructure

From the descriptive statistics, we observe that there are four types of rural infrastructure, which improved between 2007 and 2017. These comprise transportation, communication, irrigation and mechanization.

Table 4.3 shows the improvement of rural facilities. In terms of transportation, motorcycles retain their role as the dominant mode of transportation in rural areas. However, the overall number of households owning pickup trucks, has increased. The quality of transportation infrastructure also improved. In 2007, 15% of villages had access to mainly dirt roads with this share decreasing to 4% by 2016. Public transportation provided by the government such as public buses more frequently stop in the villages. Consequently, private buses operate less. The improvement in transportation indicates that access for rural areas is becoming more convenient and may be a key factor for improving livelihoods of rural households.

Communication structures of rural area improved during the study period from 2007-2016, in particular due to emergence of smartphone technology. Within the same time frame, competition between telecommunication companies resulted in increasing coverage of the rural areas. This change is shown in our descriptive statistics in Table 4.3. Almost every household has access to a telephone. In 2007, smartphones were not yet sold in Thailand commercially. Later in 2016, we found that more than half of rural households have adapted using smartphones. However, landline internet is not popular mainly due to the cost of extending land line cables from urban to more remote areas.

Within a decade, irrigation has improved. The share of villages with irrigation systems has increased from 30 % in 2007 to 45 % in 2016. In addition, the number of villages with year-round irrigation increased from 20% to 40% by 2016. Their main type of irrigation is relying more on community reservoir and private wells (see in Table 4.3).

Mechanization has increased, i.e. in 2016, the percentage of households who owned a knapsack and an engine sprayer increased in comparison to 2007, from 14% to 31.5% and from 4% to 13% respectively. Increasingly, households shift form one-axis (2-wheels) tractors to 4-wheel tractors, although still less than 10 % in 2016 had a 4-wheel tractor.

Table 4.3 Infrastructure development between 2007 and 2016

	Infrastructure parameter	2007	2016
Transportation	Household level		
	Motorcycle (%)	81.19	86.78
	Pickup truck (%)	16.16	32.54
	Village level		
	Road Type		
	two-lane made road (%)	50.91	90.45
	single-lane made road (%)	32.27	5.91
	all-season dirt road (%)	8.64	3.64
	dirt road, seasonally not viable (%)	8.18	0.00
	Public bus (%)	2.27	15.91
	Private bus (%)	72.73	50.45
ICT infrastructure	Household level		
	Mobile phone (%)	74.86	76.33
	Smart phone (%)	n.a.	51.41
	Computer (%)	9.04	17.91
	Village level		
	Access to telephone (%)	78.48	99.18
	Access to home internet (%)	1.49	4.73
Irrigation	Village level		
	Major irrigation type		
	no irrigation (%)	70.91	54.55
	well irrigation (%)	4.55	10.00
	river irrigation (%)	12.27	7.27
	reservoir (%)	5.00	24.09
	dam (%)	7.27	4.09
	Year-round irrigation (%)	22.73	39.55
Mechanization	Household level		
	2-wheel tractor (%)	48.36	43.45
	4-wheel tractor (%)	1.98	8.53
	Knapsack sprayer (%)	13.73	31.53
	Engine sprayer (%)	4.18	12.99

Source: Own calculation.

4.4.3 Changes in household characteristics

In Table 4.4, we compare household characteristics between the initial 2007 and 2016 waves. Rural household size is increased but number of nucleus members are decreased, which is likely driven by outmigration. The demography of the rural areas follows the national-level direction towards an aging society. Average education has increased due to both government support and a cultural push. Labor movement is not observed to negatively influence land ownership. Thai culture, especially in the North-east, strives to return to the home village and remain in their natal village during retirement. Return migrants able to save some money, keep their land or even buy more land as indicated by the increase in the average number of land plots.

Rural household wellbeing is shown to have increased with income per capita doubling and consumption increasing by more than 60% by 2016. The poverty head count was halved and reached 25% by 2016. Furthermore, income inequality and inequality of land ownership has decreased (See Table 4.4).

Table 4.4 Household characteristics and well-being in 2007 and 2016

Household parameter	2007	2016	diff (%)	t-test
Household size (No.)	5.00	6.12	22.24	***
Household nucleus size (No.)[1]	4.10	3.71	-9.57	***
Average age (Year)	34.35	40.91	19.10	***
Household education (Year)	6.74	8.03	19.03	***
Land owned (Rai)[2]	16.29	17.80	9.30	**
Land used (Rai)	19.42	19.22	-1.06	ns
Income per capita (THB)[3]	30,453.44	62,919.83	106.61	***
Consumption per capita (THB)	33,864.40	55,467.89	63.79	***
Poverty[4] (%)	44.24	24.52	-44.58	
Gini of income	0.60	0.46	-23.82	
Gini of land own	0.55	0.49	-11.26	

Source: Own calculation.

Note: [1] Nucleus member is any person who spent at least 180 days in the household during the reference period.
[2] 1 Ha = 6.25 Rai
[3] 1 $ = 36.29 Thai Baht (12 September 2022)
[4] based on the poverty line as defined by the National Economic and Social Development Board (NESDB). The poverty line is based on monthly per capita household consumption of 1,717 THB in 2007 and 2,396 THB in 2016.

The composition of household income shows the ranking in the source of income for households. In 2007, off-farm employment is followed by remittances, self-employment and agriculture (crops, livestock, natural resource extraction). In 2016, self-employment rose to the second rank, whereas remittances declined (see Table 4.5). The remaining income sources are hereby cumulated and classified as non-agricultural income. On average, income from agriculture is shown to increase by 6.19 % from 2007 to 2016.

Table 4.5 Composition of household income

Income source	2007		2016		diff		t-test
	(THB)*	(% Share)	(THB)*	(% Share)	(THB)	(% Share)	
Crop	19,290.91	17.64	43,362.88	19.55	24,071.97	1.91	***
Livestock	1,919.48	1.75	18,696.01	8.43	16,776.54	6.67	***
National resource extraction	3,896.46	3.56	2,600.11	1.17	-1,296.35	-2.39	**
Remittance	22,548.76	20.62	34,364.21	15.49	11,815.45	-5.13	***
Off-farm employment	38,514.45	35.21	67,263.21	30.32	28,748.76	-4.89	***
Self-employment	18,743.31	17.14	44,021.58	19.84	25,278.27	2.71	***
Public transfers	2,395.36	2.19	9,682.79	4.36	7,287.44	2.17	***
Others (Land rent, lend in and savings)	2,067.22	1.89	1,862.21	0.84	-205.01	-1.05	ns
Total annual income	109,375.94	100.00	221,853.01	100.00	112,477.07		***
Agriculture income	25,106.85	22.95	64,659.01	29.14		6.19	***
Non agriculture income	84,269.10	77.05	157,194.00	70.86		-6.19	***

Source: Own calculation.
Note: * Deflated by National Consumer Price Index (CPI) to 2015.

4.4.4 Poverty reduction in village

In Table 4.6 poverty head count over time at village level is interpreted. Villages can be grouped into 4 groups, based on how well that village successfully reduced poverty. First group is village where poverty increased. Second group is village that remain the same poverty head count ratio. Third are villages that successfully reduce poverty but less than average. And the forth group are villages with high poverty reduction. The result show that almost half of the village sample did well on poverty reduction. Table 4.7 shows that key infrastructures are most improved in the group with success on poverty reduction.

Table 4.6 Poverty head count ratio in village level over time from 2007 – 2016

Poverty over time group	No. of village	% Of village
Increase poverty	25	11.36
Unchanged	33	15
Poverty reduces 1-20 %	61	27.73
Poverty reduces > 20 %	101	45.91

Source: Own calculation.
Note: on average poverty reduce 19.41 % in village level from 2007 to 2016

Table 4.7 Key infrastructure by group of poverty head count over time from 2007 – 2016

	Poverty head count over time					
	Increase poverty			Unchanged		
Key infrastructure	2007	2016	diff	2007	2016	diff
Transportation (%)	92	100	8	85	97	12
ICT infrastructure (%)	68	88	20	76	88	12
Irrigation (%)	36	40	4	33	39	6
Mechanization (%)	4	4	0	6	0	-6
	Poverty reduces 1-20 %			Poverty reduces >20 %		
Key infrastructure	2007	2016	diff	2007	2016	diff
Transportation (%)	87	97	10	78	95	**17**
ICT infrastructure (%)	77	90	13	71	92	**21**
Irrigation (%)	28	41	13	27	51	**25**
Mechanization (%)	0	5	5	2	8	**6**

Source: Own calculation.

4.4.5 Model results: Impact of infrastructure on households' well being

Table 4.8 shows the results of the difference-in-difference, fixed effects model. In the first row, the outcome variables are given namely, annual household income, income from agriculture, income from non-agriculture, income per capita and consumption expenditures per capita.

As shown in Table 4.8, ICT infrastructure is positively significant for all model variants. Generally, also, most coefficients are plausible. For example, mechanization and irrigation is positively and significantly related to agricultural income. Roads is significant in the equation for non-agricultural income. Overall, our results generally suggest that households with access to better infrastructure facilities are better off than household without access. In addition, each type of infrastructure has a different effect on a specific category of the income composition.

Table 4.8 Treatment effect from DID fixed effect model

Variables	(1) Annual income (THB)	(2) Ag-income (THB)	(3) Non-Ag income (THB)	(4) Income per capita (THB)	(5) Consumption per capita (THB)
Transportation	18,149.68	-20,038.74	38,188.43***	-4,382.63	-4922.137
	(21,291.65)	(16,807.76)	(12,466.72)	(6,866.40)	(3213.21)
ICT infrastructure	92,556.22***	35,925.75***	56,630.47***	18,158.88***	8,324.907**
	(16,118.39)	(7,238.30)	(14,161.21)	(5,531.49)	(3609.21)
Irrigation	24,766.28	16,528.11*	8,238.16	-1,531.98	-1735.29
	(15,991.61)	(9,728.01)	(13,204.64)	(4,142.66)	(2,263.06)
Mechanization	153,018.80***	128,442.40***	24,576.42	36,648.43**	36,147.13***
	(50,459.38)	(22,423.00)	(42,710.59)	(14,383.66)	(7,505.96)

Source: Own calculation.

Note: Cluster standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.
The full model result is in Appendix Table 4.A.

4.4.6 Difference between poor and non-poor households

In the majority of literature, household resources such education, land and share of worker are important factors in reducing poverty in rural areas as illustrated in Table 4.4 above. Table 4.9 shows that poor households have fewer resources at their disposal than non-poor household. At the village level, there are more poor households when the distance to the next town is longer and when infrastructure facilities are of low quality. In terms of household income composition, no difference is observed between household above and below the poverty line (see Figure 4.3).

Table 4.9 Descriptive statistics of variables in poverty model

Variables	Poor	Non-poor	diff	t-test
Household size (No.)	5.87	5.40	0.47	***
Share of worker (%)	60.34	66.64	-6.31	***
Average education of household (year)	4.99	6.24	-1.26	***
Land use (rai)	16.14	20.99	-4.85	***
Motorcycle (No.)	1.07	1.45	-0.38	***
Computer (yes =1)	0.04	0.19	-0.15	***
Pickup truck (yes =1)	0.06	0.34	-0.28	***
Number of households in village (No.)	148.73	156.77	-8.04	***
Minimum distance to next town (km)	12.63	11.87	0.76	***
Enterprise in village (no.)	0.14	0.20	-0.06	**
Transportation (made road =1)	0.84	0.92	-0.08	***
ICT infrastructure (smart/mobile phone =1)	0.72	0.90	-0.18	***
Irrigation (yes =1)	0.34	0.39	-0.06	***
Mechanization (4-wheel tractor =1)	0.01	0.07	-0.06	***
Observations	2,323	1,217		

Source: Authors' own calculation.

Note: Calculate used pool data of 2007 and 2016.

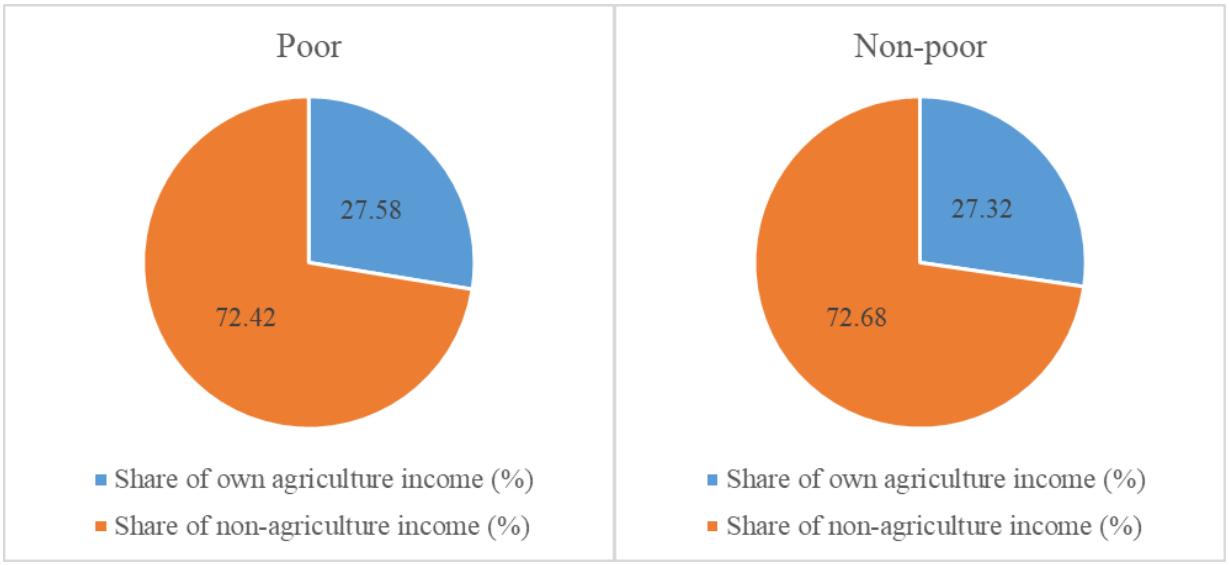

Figure 4.3 Share of household income by poverty group
Source: Authors' own calculation.

4.4.7 Model results for poverty

Table 4.10 presents the correlation of key infrastructure on poverty. Results show that the type of road, ownership of a smartphone or mobile phone, as well as owning a 4-wheel tractor are significantly and negatively related with the likelihood of a household being poor. The results indicate that if households have access to such infrastructure, there are more opportunities for the household to escape poverty. Despite being significant in the income equation (Table 4.8) irrigation is not significant in the poverty model. This may be explained by the overall low share of agricultural income in the sampled rural households (see Table 4.5 & Figure 4.3).

Table 4.10 Impact on household poverty status from probit model

Variables	Marginal effect on poverty
Transportation (made road =1)	- 0.0616***
	(0.0238)
ICT infrastructure (smart/mobile phone =1)	-0.1214***
	(0.0175)
Irrigation (yes =1)	-0.0146
	(0.01507)
Mechanization (4-wheel tractor =1)	-0.1743***
	(0.0484)

Note: Cluster standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.
The full model result is in Appendix Table 4.B.
Source: Authors' own calculation.

4.5 Summery and conclusions

In this study, we can conclude that from 2007 – 2016, income per capita on average of some 1,700 households in 220 villages in Northeast Thailand has doubled. Further, the headcount ratio of households below the poverty line has decreased by half. While income inequality is declining, the Gini coefficient of income remains high. Village infrastructure facilities have been substantially improved, especially in terms of road quality (transportation), access to smartphones and internet (ICT infrastructure), irrigation systems and investment of households in agriculture mechanization.

The model results show that each type of infrastructure has different effects on the sources of household income. ICT infrastructure and mechanization are significantly and positively correlated with all components of household income. On the other hand, transportation infrastructure is positively related solely with non-agricultural income and irrigation with agricultural income only. In terms of poverty reduction, results suggest that investment in transportation, communication, and agricultural mechanization for rural households alleviates poverty. While irrigation is not shown to be significant for poverty reduction, this may be explained by the overall low share of agricultural income in the sampled rural households which is around 30%. Therefore, we recommend to policy makers or stakeholders to invest in information and communication technology especially in remote and traditional villages.

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4.7 Appendix

Table 4.A Full estimate of the results of impact of infrastructure on household income and consumption by DID fix effect model.

Variables	Outcome variable				
	Annual income	Own-Ag income	Non-Ag income	Income per capita	Consumption per capita
Household size (No.)	16,867***	4,616*	12,251***	-3,671***	-2,640***
	(5,642)	(2,617)	(4,312)	(1,140)	(703.0)
Share of worker (%)	364.5	163.0	201.5	125.5*	157.3***
	(239.7)	(126.3)	(194.8)	(69.73)	(44.45)
Average education of household (Year)	6,435**	-1,563	7,997***	106.9	-965.3
	(3,027)	(1,364)	(2,742)	(1,023)	(674.8)
HH member suffer from disease (No.)	-7,350	-3,678	-3,672	-2,217	-622.8
	(7,334)	(2,658)	(6,626)	(1,498)	(901.5)
Land use (Rai)	1,485***	1,179***	305.2	263.2**	11.50
	(450.5)	(323.5)	(289.5)	(106.7)	(49.08)
Motorcycle (No.)	23,443*	2,613	20,830*	612.8	818.5
	(13,577)	(3,688)	(12,440)	(3,011)	(1,004)
Computer (yes =1)	9,122	3,473	5,649	3,357	8,043**
	(21,196)	(8,580)	(19,390)	(5,019)	(3,212)
Pickup truck (yes =1)	20,110	-16,196*	36,306***	1,390	14,669***
	(16,571)	(8,410)	(13,542)	(3,478)	(2,050)
Flood (yes =1)	21,234	-5,639	26,873**	788.5	2,768
	(16,313)	(11,319)	(13,281)	(4,688)	(3,615)
Drought (yes =1)	-21,594**	-3,375	-18,219**	-5,381**	-1,287
	(9,746)	(5,230)	(7,861)	(2,564)	(1,623)
Number of household in village (No.)	-99.69	97.33	-197.0	-90.67***	-26.91
	(141.0)	(64.69)	(121.3)	(33.96)	(27.22)
Minimum distance to next town (km)	-1,211	339.1	-1,550	-539.8*	-125.2
	(1,366)	(544.5)	(1,302)	(314.0)	(231.9)
Enterprise in village (No.)	10,201	566.2	9,635	2,202	-419.0
	(6,647)	(1,535)	(6,361)	(1,522)	(963.5)

Bank in village (yes =1)	-11,942	-34,699***	22,757	-4,591	3,379
	(31,988)	(12,068)	(31,111)	(6,497)	(4,544)
Road type (made road =1)	-26,538*	6,088	-32,626***	-3,836	-970.4
	(14,228)	(11,591)	(10,794)	(3,968)	(2,455)
DID of road type	18,150	-20,039	38,188***	-4,383	-4,922
	(21,292)	(16,808)	(12,467)	(6,866)	(3,213)
Smart ,mobile phone (yes =1)	-38,050***	-5,584	-32,466***	-10,663***	-7,559***
	(12,580)	(7,064)	(10,229)	(3,311)	(2,089)
DID of smart and mobile phone	92,556***	35,926***	56,630***	18,159***	8,325**
	(16,118)	(7,238)	(14,161)	(5,531)	(3,609)
Irrigation (yes =1)	-4,968	2,000	-6,968	2,083	2,375
	(15,547)	(8,408)	(12,575)	(3,417)	(2,250)
DID of irrigation	24,766	16,528*	8,238	-1,532	-1,735
	(15,992)	(9,728)	(13,205)	(4,143)	(2,263)
4-wheel tractor (yes =1)	-10,219	-40,567*	30,348	-10,989	-1,235
	(57,307)	(24,193)	(47,104)	(15,243)	(7,803)
DID of 4-wheel tractor	153,019***	128,442***	24,576	36,648**	36,147***
	(50,459)	(22,423)	(42,711)	(14,384)	(7,506)
Time (2016 =1)	-1,743	12,587	-14,331	33,935***	26,189***
	(22,691)	(15,958)	(16,127)	(7,673)	(4,610)
Constant	-32,694	-44,129**	11,435	59,420***	42,745***
	(46,731)	(20,730)	(37,816)	(10,045)	(5,896)
Observations	3,530	3,530	3,530	3,530	3,530
R-squared	0.270	0.171	0.206	0.279	0.412

Note: Cluster standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.
Source: Authors' own calculation.

Table 4.B Full estimate of the results of impact of infrastructure on poverty head count.

Variables	Poverty		Marginal effect on poverty	
	Coef.	Std. Err.	dy/dx	Delta-method Std. Err.
Household size (No.)	0.144***	(0.0136)	0.0396***	(0.0035)
Share of worker (%)	-0.000586	(0.00142)	-0.0002	(0.0004)
Average education of household (year)	-0.0914***	(0.0163)	-0.0251***	(0.0044)
Land use (rai)	-0.00478**	(0.00191)	-0.0013**	(0.0005)
Motorcycle (No.)	-0.0843**	(0.0349)	-0.0231**	(0.0095)
Computer (yes =1)	-0.455***	(0.0880)	-0.1249***	(0.0242)
Pickup truck (ye s=1)	-0.951***	(0.0777)	-0.2609***	(0.0199)
Number of households in village (No.)	-0.000377	(0.000494)	-0.0001	(0.0001)
Minimum distance to next town (km)	0.00784**	(0.00386)	0.0022**	(0.0011)
Enterprise in village (no.)	-0.0367	(0.0243)	-0.0101	(0.0067)
Road type (made road =1)	-0.225**	(0.0873)	-0.0616***	(0.0239)
Smart and mobile phone (yes =1)	-0.442***	(0.0649)	-0.1214***	(0.0176)
Irrigation (irrigation =1)	-0.0534	(0.0550)	-0.0147	(0.0151)
4-wheel tractor (yes =1)	-0.635***	(0.177)	-0.1743***	(0.0485)
Time (2016 = 1)	-0.548***	(0.0629)	-0.1504***	(0.0161)
Constant	0.538***	(0.170)	0.3435***	(0.0079)
lnsig2u	-1.947***	(0.417)		
sigma_u	.378			
rho	.125			
Wald chi2(15)	571.62			
Prob > chi2	0.000			
Observations	3,530			
Pseudo R2	0.194			

Note: Cluster standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.
Source: Authors' own calculation.

CHAPTER 5: Covid-19 and Rural Development in the Mekong River Region: Case studies from Thailand and Laos

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Abstract

This study is using household and village level data as well as personal interviews with village representatives in Mekong-near villages in Laos and Thailand. Results largely confirm what has been reported in various literatures on the development of the Mekong region and its downsides. The paper has three simple messages: 1) the rural people living in Mekong villages are the ones paying for the environmental costs of hydropower development while the benefits occur elsewhere in the economy; 2) the loss in natural resources is likely to exceed the gains in agricultural productivity by far and 3) Covid-19 has exposed the weakness of rural economies in the Mekong region and makes it harder to cope with other ongoing changes such as climate change. It is recommended that Governments pay more attention to rural development with digitalization and sustainable intensification in agriculture as core elements.

Keywords: Mekong region, Covid-19, Rural development

JEL Classification: O13, O18, O19, R11, R58

5.1 Introduction

The Mekong River, some 4900 km in length and passing six Asian countries, has been labelled as the "River of Life". However, such attribution is becoming disdained by the actual appearance of the river in some parts and during some months of the year when the river looks more like a "dying giant". The dramatic changes that have occurred in the Mekong Region in connection with the river are the results of economic development and structural transformation aside from changes in the global and regional climate. Most visible are the hydropower projects, making the river and its tributaries a vehicle for generating electricity to supply the expected growth in energy demand of the countries in the Greater Mekong Region. According to reports by the MRC (2021), the Mekong River Commission in the Upper Mekong River Basin (UMB) in China alone, 11 hydropower dams, were already established by 2019 and another 11 projects are planned making the total production capacity to exceed 30,000 MW. In the lower basin, i.e. Laos, Thailand, Cambodia and Vietnam, currently 89 hydropower projects with over 12,000 MW capacity exist and numerous further projects are planned until 2040.

Undeniably, investment in hydropower dams and other development activities in connection with the Mekong River has facilitated economic growth but has also brought about negative environmental externalities. On the plus side, river-based investments directly and indirectly have created off-farm employment opportunities for many of the rural poor in the Mekong Region. Also, investment in irrigation has facilitated agricultural growth in Mekong-near communities and hereby contributed to an increase in agricultural output and thus rural household income. Also, domestic and international tourism in Thailand and Laos was facilitated by the construction of bridges connecting the two neighbouring countries. For example, the bridge, connecting Vientiane, the capital of Laos, with the provincial capital of Nong Khai in Thailand has turned the latter into a major tourist hub prior to the Covid-19 pandemic. Last but not least, navigation and river transportation is facilitated by increasing trade among regions and countries.

Overall, it appears that the economic benefits of Mekong River development activities are huge. In a technical report, the Mekong River Commission (MRC) has calculated the economic benefits of aggregate investments related to the Lower Mekong Basin (LMB) development (excluding China) with 140 billion USD (expressed as net present value (NPV) until 2040, using hyperbolic discounting). The economic loss of externalities arising from hydropower dams on the fisheries sector, has been put at 23 billion USD (MRC, 2008). While both figures are debatable due to problems of valuation and dynamic effects, there is a broad consensus that human interventions along the Mekong river have been detrimental to natural resources, have increased the risk of natural disasters and have led to a less sustainable environment. The disappearance of wetlands, deforestation and the destruction of mangroves are unavoidable consequences of interferences which in one way or another alter a river's natural flow. Foremost, dams and reservoirs change the seasonal flow of water and modify the drift of sediments. This increases the risk of flooding when water flow exceeds the capacity of a dam. For example, in 2018, the uncompleted dike of a hydropower project on the Xepian River in Laos collapsed, killing at least 39 people, another 100

went missing and numerous people lost their homes in several villages downstream (Lovgren, 2018). With weather extremes such as heavy and erratic intensive rainfall events on the rise, as a result of climate change, the risk of dams breaking or being forced to open, is going up considerably.

Sand extraction is another variable in this "externality equation". Sand is a natural resource increasingly in demand, needed as construction material for the rapid expansion of urban developments in Asia. As pointed out by Bendixen et al. (2019), on a global level, sand and gravel are being extracted faster than they can be replaced. Jordan et al. (2019) show that in the Mekong Delta, almost 18 million $m^3$of sand per year has been extracted and that the natural sediment supplies from upper parts of the river are insufficient to compensate for the loss of extracted bed, thus facilitating the intrusion of salty sea water with negative implications for agricultural productivity. As pointed out by Xiao et al. (2021) 62 % of the changes in the annual streamflow is attributable to dams upstream reducing sedimentation in the Delta. Further erosion of river banks and have negative effects on land loss and degrading water quality.

Undoubtedly, the major negative effects on natural resources has been taking place in the fisheries sector. Dams in the Mekong River cut off fish migration and hydropower turbines can destroy fish. The near disappearance of the "Mekong giant catfish" is the most prominent example for the decline in fish populations. While capture fisheries in the river is decreasing, some argue that substitution effects are taking place through animal protein supply from aquaculture and livestock development. Although such effects can be expected, their magnitude also depends on how well river development systems are being managed. By and large, the consensus is: "*compensation for loss in yield from river fisheries due to dam construction is impossible to achieve through development of reservoir fisheries''* (Dugan, 2008). As regards substitution effects, Orr et al. (2012) using a water footprint model, found that the amount of additional land and water required to replace lost fish protein with livestock products is high and thus the authors conclude that overall river development is likely to have negative food security effects.

This brief review of some of the main Mekong river development issues will help to set the scene for this paper. Based on our empirical data of some 54 villages at or near the Mekong River in Thailand and another 10 villages in Laos, we will be able to undertake some ground-assessment of the hypotheses that have emerged from the literature. While the longstanding economic-growth-versus-environmental- externalities paradigm, or as phrased through the concept of Environmental Kuznets's curve, "*grow first and clean up later*", is already a difficult question, the analysis is further complicated by the emergence of the Covid-19 pandemic. Although, initially, countries in the Mekong Region handled the pandemic very well and had very low infection rates until about early 2021, virtually all GMS countries with the exception of China are now fully hit by the disease. During the 1st lock-down in early 2020 when the crisis started, infection in rural areas was basically absent and resilience of rural households in GMS countries was considered to be high (Waibel et al., 2020). However, the mass return of migrant workers during the second quarter of 2021 has brought the disease to the villages. Moreover, return migrants came back to rural villages

with the burden of temporary or permanent job loss due to closure of construction sites and factories.

The paper proceeds as follows. In the next section we introduce our methodology and data collection approach. In section 3 we present and discuss our findings and in the last section we draw some conclusions.

5.2 Methodology and data

This paper takes a qualitative research approach based on descriptive statistics from village case studies in Central Laos and Thailand and a data base of villages at or near the Mekong in Northeast Thailand. We use village and household level information to explore and investigate the major hypotheses that have been extracted from the brief literature review in section 1. In this way we obtain real-time, on-the-ground verification of the claims made in numerous papers about the river. Recent information about the implications of the pandemic for villages along the Mekong basin, can enhance our knowledge of the effects of the crisis and the coping mechanisms applied.

As regards our empirical basis, in Thailand, villages are located in the provinces of Nakhon Phanom and Ubon Ratchathani and in Laos in the province of Savannakhet. The villages can be divided into two groups, namely those who were in close vicinity of the Mekong River, i.e. about 5 km or less and those at a distance of up to 40 km maximum. Our study sites are located at similar latitudes, representing comparable ecosystems on both sides of the river in the two countries.

For Thailand, the number of villages included in the study is 54 while these are 10 in Laos. The reason for the discrepancy is that in Thailand we can draw from an ongoing long-term household panel that includes 2200 households in 220 villages in Northeast Thailand and has commenced in 2007[3]. While the household panel is representative of rural areas in Northeast Thailand, we cannot claim this for the 53 households which we have selected due to their vicinity to the Mekong River. In 10 of our TVSEP villages in Nakhon Phanom, Thailand, one of the authors of this paper conducted semi-formal village head interviews using ten focal questions (see Appendix) in early July 2021, just prior to the severe Covid-19 related restrictions imposed by the Thai Government. In Laos, where restrictions are less severe, the same exercise was performed by another of the authors during the end of June 2021.

Our approach is that we first present the results of the semi-formal interviews with the 10 households in Nakhon Phanom, Thailand and the 10 households in Savannakhet, Laos. Making use and interpreting the testimonials of the 20 village heads on both sides of the river, we can get a first empirical evidence and concretization of the literature findings. We will pay particular attention to the subjective assessments of the village people regarding the course and expected impact of the Corona pandemic. These findings are complemented by selected results of a formal Covid-19 special survey in the TVSEP panel households during November and December 2020. In the last step we delve more deeply into the panel data of the over 500 households and basically

[3] Thailand Vietnam Socio Economic Panel 2020: TVSEP Data , in https://www.tvsep.de/en/data/ [20 SEP 2021].

compare the 2007 with the 2017 survey on the basis of selected economic and ecological parameters. This will provide quantitative evidence of the changes in the Mekong basin and its consequences and open up the avenue for drawing some conclusions and suggesting further research.

5.3 Results and discussion

The ten topics/questions of the semi-formal interviews can be divided into three parts. First, a discussion about the current village situation, the major shocks and their causes as perceived by the village heads. The second part dealt with the Mekong River, the perceived changes, its causes and consequences. The third part focused on the pandemic, i.e. how is the situation in the village, what are the consequences and what are future expectations.

5.3.1 Development of Mekong villages

As shown in Table 5.A (Appendix), conditions, major shocks and their causes, past and expected changes in Mekong River and development prospects for the villages in Laos, based on subjective assessment of the respective village heads, are presented. Village # 1 – 5 are those located no further than 5 km away from the river while village # 5- 10 are between 5 and 40 km near the river. As revealed by the interviews, there has been considerable development progress in all the villages, independent of their location, primarily in infrastructure. However, all villages also realized downside effects of development. Aside from some infrastructure deficits like poor quality roads, human health care and veterinary services, overwhelmingly, negative effects, as perceived by village representatives, refer to the destruction of the natural environments and the monetization and commercialization of livelihoods. This has made households more vulnerable towards economic shocks and reduces their resilience in the absence of formal insurance systems which in the past has been provided by nature. As one village head has put it: “food from natural resources is now difficult to find”. The second interesting point that emerges from the interviews with village heads in Laos are that only in villages near the Mekong, do village heads make concrete observations about changes of the river and draw some connection with the prospects of village development.

In a nutshell, the following issues are of concern of the Laos villages linked to the Mekong: (i) hydropower development, (ii) sand extraction (iii) declining fish populations (iv) changed and irregular water flows (v) weakening of irrigations systems, (vi) eroding river banks with large inequality between the Laos and Thai side of the river.

Among the 10 corresponding villages on the Thai side of the river in the province of Nakhon Phanom, four of them are in close vicinity of river, (see Table 5.B in Appendix).

The same ten questions/topics were asked to the respective village heads (see Table 5.C in Appendix). Clearly, villages on the Thai side of the Mekong are more advanced in terms of infrastructure development and economic diversification as compared to Laos, reflected in the generally positive situation assessment of the former. On the other hand, Thai villages have

experienced downsides related to the process of commercialization, participation in markets including credit markets which has created a major problem of household debt. Natural resource destruction is mentioned as well but this is judged as less important, perhaps due to a higher share of non-farm income and a better integration in off farm labour markets. Remarkably, Thai village heads are more aware of the Mekong situation and overwhelmingly blame China for the negative changes that the river has undergone, even if the village is not in very close vicinity of the river. "*China's dams*", is the most frequent expression by the village heads (see Table 5.B) and as one respondent put it: "*Someday the Mekong will be just a sandbar*". Most village heads see the shortage of water as a major detriment to agricultural productivity in their villages.

While the interpretation of these in-depth interviews with Lao and Thai village heads would allow more discussion, the space requirements of this chapter demands to be brief. In summary, however, it can be well observed that many of the issues that emerged from the literature review in the introductory section, can be confirmed and can be illustrated with examples from the ground. In addition, further topics emerge that give motivation for more scientific socio-economic studies with a larger sample of the people directly affected by the changes in the Mekong River. Some first steps in this direction will be taken in the last part of this section.

5.3.2 Impact of Covid-19

In the following sub-section, we attend to the Covid-19 situation as referred to in questions 6 - 9 in our discussion guidelines (Table 5.C in Appendix). In Table 5.1, a comparison between the villages on both sides of the river based on four topics is presented. The first is about the implications of Covid-19 on the village economy and village life[4]. It becomes obvious from Table 5.1 that the impact of the pandemic is perceived differently between Laos and Thai village heads. While in both countries the economic implications of the anti-Covid-19 policies are apparent, in Thailand, psychological effects come in addition when people in the village no longer trust each other. In Lao villages, the fact that the Mekong is a boarder river suddenly became highly relevant. Majority of Laos village heads stated: "*people can't go any longer to the Mekong islands for harvesting crops and for fishing".*

The second point of discussion were the measures that villages had undertaken to cope with the pandemic. Again, there is a marked difference. While in Thailand, Thai villages react directly to the pandemic with various actions, including in one case establishing a "*crisis cabinet*" or even

[4] It must be noted that the interviews in Laos were undertaken during mid-June 2021 when infections in Laos were still very low and mostly confined to the capital Vientiane. This had changed profoundly by September 2021 when the final draft of the paper was prepared, and infections have been constantly going up due to return migrants from Thailand and local infection clusters. In Thailand the interviews were carried out in early July when the Covid-19 outbreak had started to affect the rural areas of Thailand due to lock-down measures in Bangkok and surrounding areas, including the closing down of construction sites and factories which laid off many workers from rural areas.

"*village quarantine centers*", in Laos, coping is somewhat indirect as farmers focus on production for home use in view of the trade restrictions[5].

The third criterion is about the long-term effects of Covid-19 for the future development of the villages. Here it is noticeable that Laos village heads are generally a bit more optimistic. While they also highlight the negative economic effects due to trade restrictions, on the other hand, they expect people to be more health conscious and give higher priority to sanitation, as a lesson learned from Covid-19. In Thailand, however, the majority of the respondents worried that joint village activities will be very difficult to implement as the pandemic has destroyed trust among people, seen as a precondition for participation and cooperation in village development projects. These social effects come in addition to the negative economic implications caused by the decline of the Thai economy in general.

Regarding the severity of Covid-19 as a shock (4th topic, see Table 5.1) the Lao village heads, although they almost unanimously said "*Covid is more severe than other disasters*", were less nervous about the disease in their villages, as the full impact had not reached there yet and was just "s*omething still in the news*". In Thailand, the Government, by early July, had adopted a policy of sending migrant workers back to their home provinces[6]. Hence, outbreaks of Covid-19 were no longer confined to the Greater Bangkok area. Consequently, village heads judged the severity to be of extraordinary magnitude, as strikingly expressed by one respondent: "*we can deal with flood - after 15 days it's over - but Covid never ends*".

[5] This situation had changed by September 2021 when Lao village authorities in some "red zone areas" which included Savannakhet had implemented similar containment measures as the villages in Thailand.

[6] There were specially arranged trains, called the "Covid-trains".

Table 5.1 Impact of Covid-19 on village development

Topics	Laos Villages	Thailand Villages	Comparison
Village Economy and Village Life	Boarder restrictions, *cannot go to Mekong island for harvesting crops and fishing* (m); domestic trade and travel restrictions; remittances stopped; "*children come home due to job loss*"	Negative effects on employment and income (m); restrictions of market activities; people are stressed and more suspicious, lack of trust	The Mekong as a boarder becomes important for Lao villages
Village Measures against Covid-19	Focus on own agriculture; engage in collection of non-timber forest products as substitute for fishing; watch Mekong to prevent illegal border crossing from Thailand (m)	Inform and encourage people to follow the rules (m); village Covid-19 cabinet (=special committee) to organize help; village quarantine centre; promote "*sufficiency economy concept*";	Lao villages react to Covid-19 related restrictions indirectly; Thai villages react directly to the pandemic
Long-term effects of Covid-19 for village development	Decline in economic growth (restriction in international and domestic trade, prices increase)(m); "*people will be more concerned about health and sanitation*"	Trust as a precondition for participation and cooperation is destroyed (m); lack of financial means due to economic decline will impair future village development	Lao village heads are more optimistic
Assessment of Covid-19 severity	No Covid-19 infections yet in village (m); *Covid is more severe than other disasters";*	The most severe among shocks (m); "*we can deal with flood - after 15 days it's over - but covid never ends*"	Thai villages already have Covid-19 cases, Laos villages don't

Source: based on semi-formal interviews of Phouvong Phami (Laos) and Somkid Naprom (Thailand)

The counterfactual - Covid survey 2020

In the next step we expand the case study mode based on the semi-formal interviews with village heads by making use of the data from a large-scale special household survey which is part of the long-term household panel, the TVSEP, as mentioned in the introduction. This special Covid-19 survey was carried out in November and December 2020, i.e. after the onset of the pandemic but prior to the surge of Covid-19 infections, in three provinces of Northeast Thailand[7]. Unlike previous TVSEP panel surveys, where a full account of living standard measurement variables, i.e. assets, income and consumption, was administered, this survey was fully focussed on identifying and to the extent possible, quantifying the impact of basically the first year of the Covid-19 crisis in Thailand. Since the survey was carried out by personal interviews of household heads or their representatives in November and December 2020, the reference period concluded

[7] Unfortunately, the household panel is available for Thailand and Vietnam only, but not for Laos.

in October. It is divided into three parts, i.e. before Covid-19 (05/2019 – 02/2020), during 1st lock-down (03/2020 – 05/2020) and post-lock-down (06/2020 – 10/2020).

In Table 5.2, a selection of survey variables is presented which provides a kind of "before (without) Covid-19 counterfactual" against the testimonials and the information delivered by the village heads and as summarized in Tables 5.A and 5.B and Table 5.1.

One of the key questions asked to the respondents was whether they had any one in their household with Covid-19 symptoms, confirmed by PCR test, or if they'd know of someone who got infected. The answer was a clear cut "no", there were simply no Covid-19 infections in any of the 54 villages by November/December 2020. It is worthwhile to note in this regard, by June 30, 2020, the total number of reported Covid-19 infections was just 3171 in Thailand (population about 70 million) and only 19 cases in Laos (population about 7.2 million). Another key question was the financial impact of the Covid-19 crisis. In fact, this was not due to the disease directly but rather attributable to the Covid-19 prevention or containment policies, implemented by the Thai Government. By 19 March 2020, the government ordered an almost complete lock-down with business closures and severe travel restrictions that lasted (with some gradual lifting of restrictions) until May 2020. Nevertheless, financial support by the Thai Government was rather generous with a 5000 THB per eligible person monthly dole out for the three months lock down period. Hence, an important question was if the lock-down had any severe negative effect on household income. The answer again is "no", as shown in Table 5.2 when comparing average monthly household income during the three periods. Basically, after the lock-down period, households got back to the pre-pandemic income level. This rather mild financial impact is also reflected in the perceptions of the respondents. Almost one half perceived no impact or they even saw a positive impact. This answer is not surprising as the lock-down did not affect rural people too much. Besides, they spend most of their time in their farm. The receipt of Government support which more than 80% of the households were able to get, with an average of almost 18 thousand THB, came as an unexpected benefit to many of them. This is well reflected in the expression of satisfaction with the government handling of the crisis at that time. When asked to rate the satisfaction with national, provincial and village government on a scale from 0 to 10 (= completely satisfied), between 30 and 44 % of respondents gave the highest score. Interesting to note that national government ranked clearly lower than the village administration. This also suggests a fair degree of social coherence in the village, a trait that village heads now see at risk (see previous section). In all likelihood the answers to this question would be very different if asked by mid-2021, i.e. a more negative assessment would be given. By and large, the 1st lock down in early 2020, other than the severe loss in the tourism sector, did not affect rural household too much. Confidence of the people that the crisis would be over soon is also reflected in the small share of 13.4 % of migrants who returned to their natal village during the 1st lockdown. A general lack of foresightedness (as is the case in most countries) may have contributed that the situation was getting out of hand in 2021.

Table 5.2 Selected parameters of Covid-19 survey 2020, 54 Mekong Villages in Thailand

Parameter	Unit	Value
Was infected or know someone who became infected with Covid-19	No.	0
Average Household Income before Covid (< 03/2020)	THB/month	15,305
Average Household Income during 1st lock-down (03 - 05/2020)	THB/month	12,851
Average Household Income after lock-down (06 - 10/2020)	THB/month	15,294
Households who perceived negative financial impact during Covid-19	%	53
Households who did not perceive any financial impact during Covid-19	%	33
Households who perceived positive financial impact during Covid-19	%	14
Households who received government support (until 10/2020)	%	83.5
Average Amount of Covid-19 assistance received	THB/HH	17,928
Households with return-migrants during 1st lock down (03 - 05/2020)	%	13.4
Households completely satisfied with National Government during crisis 1)	%	30.1
Households completely satisfied with Provincial Government during crisis 1)	%	38.1
Households completely satisfied with Village Administration during crisis 1)	%	44.5

Note: 1) on a scale from zero to 10, with 10 = completely satisfied.

Source: Own compilation based on TVSEP special Covid-19 survey 2020.

5.3.3 A decade of village development

As a last step, we expand the picture of villages in the Mekong basin further and assess what effects Covid -19 might have for the development prospects of rural people in the Mekong River basin. Hereby, we draw upon the full TVSEP household panel data base, starting with the years 2007 and extract relevant data from 54 Thai villages, located in the vicinity of the river.

Table 5.3 shows selected development parameters covering a full decade, taking 2007 and 2017 as two points in time. The sampling strategy of the household panel is such that in each village, 10 households were selected based on systematic random sampling. As expected, there is some attrition during the 11-year observation period, i.e. about 12 %. The 1st parameter in Table 5.3 is population. Both, in terms of households per village and village population, there was some increase between 2007 and 2017 which contests the fear of policy makers and development experts of "deserted" rural villages. Although rural-urban migration has taken place even before 2007, migrants maintain close ties with their natal household in the village by sending remittances, among others. During our observation time migration has declined both in terms of total numbers of migrants and migrants per household. While in 2007 households with migrants (~ 56% in 2007) on average had over 2 migrant members these were well below 2 a decade later. The decline is also reflected in the share of remittances in household income, going down from 20 to 16 %. On average, there are between 4 and 5 persons per household, i.e. between half and two-thirds of household members are absent from the village, at least for some parts of the year.

Table 5.3 A decade of development in 54 Mekong villages in Thailand

Parameter[1)]	Unit	2007	2017	Difference
Population				
Households per village	No./village	134	158	+ 24
Average Population	Persons/village	589	612	+13
Average Household Income	PPP $/HH	5012	9899	+4887
Income Shares:				
Crop production	%	17	18	+1
Livestock and Aquaculture	%	3	11	+8
Natural Resource Extraction	%	7	1	-6
Remittances	%	20	16	-4
Off-farm wage employment	%	34	23	-11
Non-farm self-employment	%	15	20	+5
Public transfers & others	%	4	11	+7
Households engaged in fishing	No.	276	141	-135
Households with migrants	No.	300	273	-27
Average No of migrants	No./HH	2.02	1.76	-0.26
Household Debt				
Annual Debt Repayment	PPP $/HH	663	3246	+2583
Over indebtedness (DSR>40)	% of HHs	12.5	25.4	+12.9

Note: 1) Numbers are rounded up or down.

Source: Own calculation by the authors (C. Nantajit) based on TVSEP panel data; Note: The number of households interviewed was 537 in 2007 and 469 in 2017; there are 10 households per village in the panel, however attrition has occurred.

Overall, household income, measured in 2005 PPP $, has almost doubled during the observation period, supporting the hypothesis that the development of the Mekong region has resulted in welfare gains, also for the rural population. On the other hand, the composition of income has changed profoundly. While crop production did not change much, livestock and aquaculture has gone up but perhaps not as much as expected. For example, only 33 households operated a fishpond in 2007 and in 2017 it was only 17 of the identical 436 households in the sample who kept their aquaculture business in operation. These data somewhat support the model calculations of Orr et al. (2012) as cited above. Most remarkable, however, is the reduction in the income share of natural resource extraction which includes fishing in the Mekong but also the harvesting of timber and non-timber forest products (mushrooms, honey, game hunting). This supports the claims of those who warned about the downsides of over-exploiting the river for hydropower generation.

These long-term panel data, collected independently and for research purposes only, fully support the testimonials of the village heads as reported in the section above. By and large, the natural safety net of rural people is gone which weighs even more heavily with the pandemic finally coming to the villages. Another factor worth pointing out is that shares of off-farm wage employment has been going down by almost one third, raising doubts if the pull-effect of industrial

development has been sustainable. A most dramatic picture emerges when analysing household debt. Annual debt repayments of rural households in the Mekong basin have increased by a factor of five and over-indebtedness, as indicated by a debt-service-ratio of greater than 40, has doubled in the same period. Rural debt and over indebtedness has become a major risk for future development progress in Thailand as demonstrated by several researches (e.g. Kislat, 2015; Chichaibelu & Waibel, 2017 & 2018).

In summary, while the panel data support the hypothesis that development and exploitation of the Mekong water resources has helped rural villages in the basin to gain more income, on the other hand, several factors suggest increasing vulnerability to external shocks, both co-variate and idiosyncratic, and a weakening of the resilience of rural areas, mainly because of natural resources destruction.

5.4 Conclusions and policy recommendations

Although this is largely a qualitative study it is based on solid household and village level data and trustful testimonials from people "on the ground". While the study may lack the rigor of parametric and non-parametric statistical tests and the "magic" of advanced positive or normative models, the authors believe that it can provide a lot of food for thought and opens up the avenue for more quantitative and more specific research questions. Furthermore, based on the data available to us, we feel confident to draw some concrete conclusions and submit a few policy recommendations.

Firstly, the simple reality that Governments of the Mekong countries have captured the Mekong river for its capacity to generate electricity, with an ever increasing number of dam projects in different parts along its course and considering that these are under different political and management regimes, this has made the river to "choke"[8]. Ultimately, this is the result of diverging economic interests where the people who live at or around the river have been largely ignored and are now trapped between a "rock" and a "hard place". As one village head in Thailand had put it: "someday the river will just be a sandbank")[9]. Although it is difficult to predict the "service life" of the Mekong River as the "battery" for the countries in Greater Mekong Sub region, recent studies (e.g. Siala et al., 2021) point out the possibility of alternative energy strategies that rely less on hydropower electricity. Such alternatives include solar photovoltaic and a better regional coordination with improved planning and more coordinated cross-border power trading. This could be a first step out of a one-sided development strategy that creates negative on-site, off-site and off-time external costs and instead fosters more sustainable pathways for the Mekong's ecosystems and the people living there.

Secondly, it seems safe to conclude that the protein loss caused by depleted fish populations in the river has not been compensated by additional irrigated land, increased agricultural productivity, expansion of livestock and aquaculture development. This is suggested by our simple comparison

[8] Based on the concept of a "choke price" in the Hotelling (1931) model.
[9] One of the authors has repeatedly biked along (or near) different sections of Mekong river in China, Laos, Thailand and Vietnam between 2010 and 2020 and has clearly observed the number of sandbanks increasing.

of the 54 Mekong villages between 2007 and 2017 that showed only limited expansion of livestock and even a reduction in aquaculture and fisheries. This casual observation is however also backed by the scientific studies of Orr et al. (2012) which compared reduced fish catches and with additional demands for water and land to replace lost protein and calories. They found that, with some variation among the GMS countries, these demands are uncertain to be met and thus "basic food security is potentially at a high risk of disruption".

Thirdly, as found in numerous studies in developing and developed countries, Covid-19 exposes the weakness of economic and social systems. Thus, the negative environmental externalities of development along the Mekong will continue to occur, even after the pandemic is finally under control. However, the Covid-19 is definitely making it harder for rural villages to cope. Most strikingly, as pointed out in a recent cross-country assessment of the impact of the pandemic on Food systems in Asia, the natural resources, as a traditional safety net, with food from common property resources, is under threat and needs more attention (Dixon et al., 2021). Therefore, how resilient rural households in the Mekong basin will be on the longer term and how well they can overcome the challenges of both, the pandemic as well as climate change, will, to large degree, depend on the future policies implemented and on the willingness of Governments in the Mekong countries to cooperate.

Following results and conclusions of this study, three major policy recommendations are submitted. First, Covid-19 has reminded the world that globalization, based on the principle of a short-term view of comparative advantage in the production of goods has its limits. For rural villages in the Mekong regions this means that policy makers should promote the development of regional and local markets and reduce the incentive for a continuing flow of labour from rural areas to urban agglomerates. Secondly, more attention should be given to a rural development strategy that helps to make rural villages an attractive place of working and living. Foremost, digitalization and development of other infrastructures should be supported through public investments. Finally, agriculture must be steered towards an ecology-based path with the promotion of climate-smart technologies and a more judicious use of potentially damaging external inputs, following the principle of sustainable intensification.

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5.6 Appendix

Table 5.A Village Conditions, major shocks and causes, past and expected changes in Mekong River and Village prospects in Laos

Village No./Distance	Current Conditions	Major past shocks	Causes of shocks	Changes in River	Expected Changes in River	Village Prospects
1 (a)	Positive: Expansion of agricultural production (livestock, two rice crops; better market access; livelihoods improved; Negative: more soil erosion, less natural resources including fish; lack of irrigation	Flood & livestock diseases	Climate change, natural resource extraction; use of chemicals; poor quality of imported feedstuff	Soil erosion, fish population decrease; sand extraction; river bank protection in Thailand	Soil erosion, further decrease in fish stocks, changes in river water flow; agricultural land decreasing, flood and drought events increasing	Income of Farmer and fishermen likely to decline
2 (a)	Positive: infrastructure improved (road, health care, sanitation); no more poverty; more employment and trade. Negative: destruction of ecosystem soil erosion chemical, chemical pollution; lack of skills development;	Storms	Climate change, deforestation	Factories, tourism, hydropower dams; soil erosion, sand extraction, island in river disappearing, agricultural land decreasing	Tourism increasing; more landslides, soil erosion, declining fish stocks	Positive income effects of tourism but negative effects on environment, agriculture, aquaculture, "*fish becoming more expensive"*
3(a)	Positive: Infrastructure improved (road, water electricity); income increased; Negative: less agricultural land; "*bad smell coming from Mekong River*"; lack of good public water supply	Flood, Drought	Climate change, factories; hydropower plants	Soil erosion; illegal hunting, sand extraction, declining fish stocks, "*water level in Mekong changing quickly between high and low*", "*people no longer take a*	Fish stocks will decline further, more extraction of sand and stones (with explosives), more soil erosion, agricultural land and productivity declining,	"Difficult to make a living and generate income"

Village No./Distance	Current Conditions	Major past shocks	Causes of shocks	Changes in River	Expected Changes in River	Village Prospects
				bath in the river", development of river banks with factories (in Thailand).	more flood and drought	
4 (a)	Positive: infrastructure improved (road, water, electricity) Negative: natural resource base declined, less options for people lack of riverbank protection, lack of irrigation canal	Flood, livestock diseases	Climate change, natural resources destruction; use of chemicals and poor quality of imported feedstuff (livestock diseases)	Fish and aquaculture has declined, Loss of farmland	Illegal hunting, extraction of sandstones, river bank protection (Thailand) more soil erosion, fish stocks decline, shallow and deep part of river changed.	*"More difficult to generate income from agriculture due to loss of land and increased occurrence of flood and drought"*
5 (a)	Positive: Infrastructure (including houses) improved; no more poverty; Negative: Need irrigation canals, upgrade roads, and market for their production at reasonable prices. Also need more electricity power.	Flood, drought, livestock diseases	Climate change, destruction of nature, chemical use in agriculture poor quality of imported feedstuff (livestock diseases)	Water level in Mekong lower; fish populations declined; illegal hunting, extraction of sandstone, "*river regulation and flood protection in Thai side causes changes in water flow on Laos side*";	Further decline in fish stocks, price of fish increase, natural resource decrease, lower agricultural productivity	Poor prospects: "*Food from natural resources difficult to find, agricultural productivity declines"*
6 (n)	Positive: Economic and life condition improved. Negative: road conditions, lack of veterinary services	Flood, livestock diseases	Climate change and environment around the village destroyed; quality of imported feedstuff	None	None	No impact

Village No./Distance	Current Conditions	Major past shocks	Causes of shocks	Changes in River	Expected Changes in River	Village Prospects
			(livestock diseases)			
7 (n)	Positive: Infrastructure improved, quality of life better, crop production and income increase Negative: lack of irrigation canals, poor road condition and market access. Electricity insufficient	Flood, Dengue Fever	Climate change, environmental destruction; forest destruction (Dengue Fever)	None	None	No impact
8 (n)	Positive: Infrastructure improved (housing); increased yields and rice self-sufficiency and food security; Negative: poor road conditions, lack of market access	Drought	Climate Change Destruction of Nature	None	None	No impact
9 (n)	Positive: Infrastructure improved (roads, housing) Life is better; Negative: lack of health care center; lack of secondary school	Drought	Climate change, natural resources destruction	None	No answer	No impact
10 (n)	Positive: Infrastructure improved (transportation, electricity, water supply, school, housing, health care) Negative: Lack of veterinary services; lack of irrigation canals	Storms, livestock Disease	Quality of imported feedstuff (livestock diseases	None	No answer	No impact

Source: Own presentation based on interviews by Phouvong Phami.

Table 5.B: Village Conditions, major shocks and causes, past and expected changes in Mekong River and Village prospects in Thailand

Village No./Distance	Current Conditions	Major past shocks	Causes of shocks	Changes in River	Expected Changes in River	Village Prospects
1 (a)	Positive: people do more trading Negative: high expenditures	Flooding in rice fields	Don't know	less water; less fish; inconsistent water flow because of "*China's dam*"; forest loss, become rubber plantation	more drought and water shortage	Economic difficulties
2 (a)	Positive: None Negative: Price of rice is too low; household debts; drug problems	Flood	Nong Han and Mekong River are the cause flooding	Irregular water flow, can no longer predict; forecast like "*China's dam*: "*they open and close as they want*"	"*Some day the Mekong will be just a sandbar*"	Lack of water for agriculture
3(a)	Positive: off-farm employment increased (government jobs, trade, tourism) Negative: Poor irrigation system	Flood	More people *China's dam*	low and irregular water level; cannot forecast unlike before; flood, affect vegetable and aquaculture at river bank	More dam in China and Laos, more drought and more water disputes	Lack of water for agriculture
4 (a)	Positive: successful investment in rubber plantations, some migrant workers in Singapore and Taiwan Negative: unemployment	none	Not applicable	less water -more sandbanks because of , *China's dam*	river become shallower and more sandbanks	Lack of water for agriculture
5 (n)	Positive: most people have off-farm occupations; hire machinery services to	Flood	Poor drainage system	River become narrower and shallower;	Will become further narrow and shallow	No significant effect for village

Village No./Distance	Current Conditions	Major past shocks	Causes of shocks	Changes in River	Expected Changes in River	Village Prospects
	cultivate their farm land Negative: Lack of good jobs with long-term prospects			Many shops along Mekong shore extent the area to Mekong		
6 (n)	Positive: two rice crops per year due to irrigation system Negative: household debt is going up	Sometimes Flooding	Insufficient drainage system	River get dry and more sandbanks; Thai shore above Laos side, making river shore in Thai side drier	More drought	no effect to the village because of long distance of village to Mekong
7 (n)	Positive: no mention negative: welfare decreased and HH debt increased	Flood and drought	Natural resources destruction, especially forest, monetization of village life	There is more construction along Mekong shore, a landmark and more local attractive tree; development project of the province is changing nature	Mekong will be dirtier	No answer
8 (n)	Positive: aagricultural system has become diversified (rubber, oil palm, etc.); welfare of village much increased (most HH now have a car) Negative: infrastructure (road, irrigation, electricity) still insufficient	No mention	Village located on elevated land	more shops along Mekong; more concrete construction Because of trading, province's project, people have more income	Will be more beautiful	No answer
9 (n)	Positive: infrastructure improved Negative: "*nature is gone; climate becomes drier*"	Drought	negative effect of rubber plantation on microclimate and water table	-less water -the flow of water is not consistency China's dam -lack of knowledge	more drought	-lack of water for agriculture

Village No./Distance	Current Conditions	Major past shocks	Causes of shocks	Changes in River	Expected Changes in River	Village Prospects
				about managing water		
10 (n)	:positivepeople rely more on commercial crops (para rubber and vegetable in a dome); irrigation system improved negative: prices of inputs going up while product prices do not; lack of long-term prospects in villages	drought	Forest destruction, unreliable water supply from Mekong	Less water, China's dam and Lao's dam	more drought and more flood	Lack of water for agriculture

Source: Own presentation based on interviews by Somkid Naprom.

Table 5.C: Questions/Discussion Points for the informal interviews of village heads

1) Please describe the current situation and the life (economic / agriculture/ social / ecosystem) in your village. How did the conditions change during the past 20 years?

2) What changes did you observe in the Mekong River and its environment? Please describe these changes? How does it affect agriculture and livelihood of people in your village?

3) During the past 20 year what are the main disasters that happened in your village (flood, drought, wildfire or epidemic)? Please describe the disasters. What do you think are the major reasons that cause these disasters? Do you think the change of the Mekong River and its environment is a major reason for that too? If so, please describe.

4) In your opinion what are the reasons why the Mekong River and its environment has changed during the past 20 years?

5) What changes do you expect from the Mekong River and its environment in the next 10 years? How will these changes affect the development of your village?

6) Please describe the effects of Covid-19 for the livelihood of people in your village (economic/social and health).

7) Please summarize the severity of Covid -19 when compared to other disasters that happened in your village.

8) What measures did your village undertake to reduce the effects of Covid-19?

9) What are the long-term effects of Covid-19 for the development of your village?

10) In your opinion, what is the most important measure that government should do in order to improve development in your village on the long run? (note for interviewer: this is not in relation to Covid-19 but in general).