

Chapter 2

Literature reviewed

2.1 Introduction

The chapter begins with the general information of Thailand, Northeastern and in Khon Kaen province. This describes the National Development Plan. The economic condition such as GDP, GRP of whole kingdom and Northeastern region will be introduced. The chapter also shows the government policy based on agricultural development such as Debt Moratorium and Village Fund. The irrigation, poverty and research and extension in this region will be demonstrated. Moreover, the chapter will show the sustainable agricultural systems in Thailand, for instance, integrated farming system, organic farming, agro-forestry, New theory farming. This also presents the conditions of Khon Kaen province such as physical characteristics, administration, population and labor force, agricultural production of main products: rice, cassava, sugarcane, marketing of farm products, and GPP. The chapter propose the lesson learnt of agricultural development in Northeastern Thailand which still wait to improve. The concept of learning and innovation and grounded theory will be demonstrated. This also presented the concept and theory of learning and innovation and technology adoption. Furthermore, learning theory, grounded theory, philosophy sufficiency economy had been reviewed to gain more knowledge and idea for improving the dissertation. This chapter also presents the story of jasmine rice which a popular and important rice production in the north east Thailand.

2.2 General Information of The Country

Thailand is located in the Indochina Peninsula and the Malay Peninsula. The country borders on Cambodia in the East, Lao P.D.R. (Laos) in the Northeast, Myanmar (Burma) in the West, and Malaysia in the South. The territorial boundary includes the Gulf of Thailand (in the South China Sea) and a part of the Andaman Sea. Thailand is commonly identified into six regions: 1) the Central, 2) the East, 3) the North, 4) the

Northeast, 5) the South and 6) the West. Two main rivers, the Mekong and the Chao Phraya, contribute to various socio-economic activities in the Northeast and the Central Plain respectively. Topographically, Thailand can be characterized by (a) mountainous areas (particularly in the North and the West), (b) the Central Plain/Chao Phraya River Basin (in the Central and the southern part of the North), (c) the Korat Plateau (in the Northeast), and (d) coastal areas and islands (particularly in the West and the South). In terms of climate, most part of the country belongs to tropical-savanna zone, while southern region belongs to tropical-monsoon zone (characterized by longer rainy season). Three seasons can be identified through a year: rainy season (mid. May-October), dry season (October-mid. February), and hot season or “summer” (mid. February-mid. May). Average temperature fluctuates between 20°C and 30°C throughout a year. The amount and frequency of rainfall varies from season to season, causing both floods and droughts. The Northeast is particularly vulnerable to such natural weather risk, leading low agriculture productivity and the poorest region in the country.

2.3 Agricultural Development in Thailand

According to the First National Economic Development Plan 1961-1966, the agricultural sector was supposed to play a role for national development, based on an import substitution industrialization strategy. In contrast, an agriculture continued to provide foreign currencies needed to finance the industrialization scheme. It also had to provide cheap food sources for the rapidly growing urban and industrial population. Therefore, a main objectives of agricultural policy during this period was to improve yield and productivity. Another important intervention was the imposition of an export tax on agricultural raw material. This was an important revenue for the government budget. This framework was the basis of the government’s policy intervention in the agriculture sector until the early 1990s.

Farmers were left with little choice but to intensify production with the policy to keep prices of agricultural products low. This was one factor such farmers gained low farm income. Throughout the 1960s to the early 1980s, the agricultural growth was achieved with little change in farm management. Farm inputs were used to a limited extent, except in the central plain region where a full-scale Green Revolution took place. In this area, double and even triple rice cropping is widespread with massive

applications of fertilizers and pesticides. Farm mechanization, especially plowing tractors and combine-harvesters, was introduced and has operated in the region since the mid-1980s.

Another change in the agricultural aspect has been shown in late 1970s. A structural shift from farm modernization change to be the industrialization of the agriculture sector (NESDB, 1997). Farm production began to be vertically integrated with factory processing and agribusiness management. Farmers were contracted to produce a specified quality and quantity of output for agro-processing businesses. Farmers were provided with credit, necessary farm inputs, technical advice and even consumption loans for in-between harvest periods. This system is normally referred to as “contract farming”. With almost farm products supported to agri-industrial sector, causing off-farm value was high as OAE (1997) reported within the last 25 years, the non-agriculture sector (manufacturing and service) has expanded from 75 per cent of gross domestic product (GDP) to over 85 per cent, while the agricultural sector's share has declined (Table 1 below).

Table 1 Comparative performance of agricultural and non-agricultural sectors, 1972-1996

Unit : percent (%)

Plan /growth rate	Third Plan 1972-1976	Fourth Plan 1977-1981	Fifth Plan 1982-1986	Sixth Plan 1987-1991	Seventh Plan 1992-1996
Growth rate of agriculture	5.24	4.15	3.69	4.58	2.51
Growth rate of non-agriculture	7.04	6.91	5.73	12.61	9.18
Percentage of agriculture in GDP	25.08	21.39	19.01	14.88	10.29
Percentage of non-agriculture in GDP	74.92	78.61	80.99	85.12	89.71

Source: Office of Agricultural Economics, 1997

Since the green revolution began in 1960, the agriculture sector of Thailand has developed in response to market forces. Monoculture crops, chemical fertilizers, and pesticides were promoted to increase production and maximize farmers' incomes and to generate foreign exchange for the country. The natural resources in Thailand were

exploited and depleted by commercialized agricultural and economic development, both intentionally and unintentionally. Problems of forestland encroachment, water shortages, water pollution, drought, flooding, soil erosion, soil degradation, and natural disasters are among the problems derived from such development. The government has placed a high priority in addressing these policies to solve the problems. The Process of decentralization and community participation in natural resources management and planning are means being used to reduce the natural resources exploitation in the country. (Narkwiboonwong, 2000)

As known Thailand is an agricultural country, approximately 21 million ha. or 40.9% of the total area is used for agricultural production, 31.3% and 27.8% are under forest and unclassified land respectively. About 49.8% of the agricultural land is used for growing rice, 21.5% for field crops, 21.2% for fruit or horticultural crops and 7.5% for others (OAE, 2005). It can be seen in Table 2 that production of major agricultural commodities from 2001-2005 was more than consumption in the country, even though the productions of four main crops was fluctuation: rice, cassava, corn and sugar cane. Thailand is almost self sufficient in food production. Agriculture is an important sector and the largest source of employment of rural population of the country. About 46.6% of the total population is engaged in this sector.

Agricultural production does not only contribute to domestic consumption but also play significant role in export earnings. Although, the importance of agriculture has declined a bit due to the expansion of other sectors (industry, tourism, construction and other service sectors), its contribution was still about 10.1% of total GNP in 2007 (FAO, 2009).

Table 2 Production of Major Agricultural Commodities

Unit: 10,000 tons

Year	2001	2002	2003	2004	2005
Rice	2,652	2,606	2,704	2,386	2,700
Cassava	1,840	1,687	1,972	2,144	1,694
Corn	447	423	418	422	418
Sugarcane	4,956	6,001	7,426	6,497	4,957

Source: FAO, 2003

2.4 Information of Northeast, Thailand

2.4.1 Topography

The Northeast of Thailand is relatively poor and disadvantaged compared with other regions of Thailand. The Northeast region of Thailand is the largest, occupying area of 16.88 m. ha, approximately one-third or about 32.8 per cent of country's land. The Northeast region level is on average from 122 to 183 meters above sea level (Myers, 2005). It is located on the Khorat Plateau and a few low hills. The Northeast located near two neighboring countries, bordered by Lao to the Mekong River to the north and east, and by Cambodia to the south. To the west it is separated from Northern and Central Thailand by the Phetchabun mountain range. The plateau consists of two main plains: 1) the southern Khorat plain is drained by the Mun and Chi rivers, and 2) the northern Sakon Nakhon plain is drained by the Loei and Songkhram rivers. Two plains are separated by the Phu Phan mountains. In terms of administration, the Northeast region consists of 19 provinces, moreover, the cabinet has proved to set up a new province in Northeast in 2010, it is Beung Kan which previously under Nong Kai province. At a moment it is waiting for proving by the parliament.

2.4.2 Geology and soils

The Northeast plateau is basically composed of fine-grained sandstone and shale strata which overlay in valley depressions of alluvium and river terrace deposits. Ekasinhg et al (2007) reported that here are 35 different geologically soil types in the Northeast but the majority of soils fall into on of five major groups: ustifluvents, tropaquepts, dystropepts, paleaquults, paleustults. Tropaquepts and dystropepts lie on the adjacent flood plain. They are fine textured and poorly drained, and used for rice cultivation. The recent alluvial soils being. They are fine to medium textured, well drained and slightly acidic; they are used primarily for garden crops and vegetables. Paleaquults and paleustults soil cover over 65 per cent of the region area; they are terrace soils, with more clay and a finer texture in the lower horizon than on the surface. The paleaquults are on the lower terraces, poorly drained and are saturated with water at some periods of the 2 year. Rice is planted in these soils. The paleustults are on higher terraces; they have lower water holding capacity and are dry for more than 90 days in the year. The KKU-Ford Cropping Systems Project (1981) suggested that this kind if soil is suitable for upland crops such as cassava, kenaf, and sugar cane. The quality of

soil in the Northeast is mostly poor. Approximately 2.8 million ha. of the total agricultural land (8.6 million ha.) is affected by saline contamination. This leads the soil not well suitable for agriculture purposes. Thus many farmer cut down the forest for cultivation is a common response to the problem of saline soils.

2.4.3 Northeast economy and its context

The Northeast has a reputation of being a backward region, far distant from Thailand's economic hubs. However its economic record shows that this image is misleading in reality. The difficult natural conditions have made agriculture unattractive and consequently forced people to seek for other income generation alternatives such as off-farm employment in urban areas and other regions. Poor resource endowment of this region is a major barrier for the northeastern development, and its agricultural sector in particular.

2.4.4 Growth indicators

Over the three decade, the Northeast's economy expanded greatly (Ekasingh et al., 2007). Its economy is three times larger now than in 1970: Real GDP increased from 131,837 m. baht in 1981 to 365,969 m. baht in 2004, measured in 1988. Real GDP per capital in 2004, measured in 1988 prices, amounted to 34,000 baht, compared to only 11,000 baht in 1970. (NESDB and the World Bank, 2005). This growth has come from in both the agricultural and non-agricultural sectors.

2.4.5 Agricultural sector

Four main crops: rice, cassava, sugar cane and corn have dominated the Northeast's economy. Rubber and fruit crops are also increasing dramatically in the region. Livestock production also plays an crucial role in the Northeast with poultry and cattle (National Statistical Office, 2003).

Regarding the gross regional product (GRP), the agricultural sector in the Northeast's share reduced from 27 per cent in the late 1980s to 19 percent in 2004, on the other hand, industry increased from 18 per cent to 28 percent (NESDB and the World Bank , 2005). Since the late 1980s, with an average annual GDP growth rate in manufacturing of 10 percent, while the real growth in agricultural sector averaged 4.2 per cent during 1970s and 1980s. Until the early 1980s, agricultural expansion depended on increased area by farmers found out their farm lands from destroying forest areas.

The crops that farmers cultivated in the Northeast are: wet-land glutinous rice (the staple food of the area), field and regular rice, along with sugar cane, cassava root (tapioca), tobacco, watermelons and others . While the pastoral farmers raise water buffalo, dairy cow, cattle, pigs, chickens and ducks. The Northeast is more dependent on rice than any other region. More than 60 percent of all agricultural land holdings of around 10 m. ha. are under rice cultivation during 1978- 2003 (OAE, 2003). Rice is the primary subsistence staple for the Northeastern. Production of adequate rice is a main factor of food security.

The production methods and technology of rice cultivation has remained traditional systems, low external input use, from the 1950s - 1990s (Rigg, 1987). Rice growing for the Northeastern farmers is to ensure survival and stability of production than to maximize yields. The traditional varieties have been used due to its large degree of ecological flexibility which is able to deal with a varying water supply. Although crops are more diversified nowadays than previously, only 870,000 farmers out of 3.3 m. farmers (26 per cent) in the Northeast were keen on non-rice crops with a total of around 2.5 m. ha (31 per cent of total cropped areas in 2003) as compared to 5.67 m. ha for rice in 2003 (National Statistical Office, 2003).

2.4.6 Number and Area of Holdings

The 2003 Agricultural Census showed that the total number of holdings in the Northeastern region was 2.7 million. Nakhon Ratchasima province occupied the largest number of holdings with 253,111 (9.5%). It was followed by Ubon Ratchathani, Khon Kaen, Si Sa Ket and Roi Et provinces (7.7, 7.6, 7.3 and 7.1% respectively) and Mukdahan province had the smallest number of holdings with 47,007 (1.8%). With the total area of holding of around 51.1 million rais or about 16.0% of the total area of the country. For the provincial area, Nakhon Ratchasima province occupied the largest area of holding with 6.4 million rais (12.5%), followed by Ubon Ratchathani, Udon Thani, Khon Kaen and Buri Ram provinces with 8.6, 7.1, 6.8 and 6.7% respectively, and the smallest area was in Mukdahan province (1.6%). The average area per holding of the Northeastern Region was 19.3 rais, it showed a gradual decrease from 21.3 and 19.8 rais in 1993 and 1998 respectively. The holding in Nakhon Ratchasima province had the largest average area of 25.2 rais, and the smallest average area was in Kalasin province with 14.6 rais.

2.5 Conditions of Agricultural Economic and Development in Northeast

The Northeast contributes a good part of Thailand's agricultural commodities. It produces two fifths of the rice, three fifths of the cassava, one tenth of sugarcane and whole supply of kenaf. If the Northeast farmers were as productive as farmers in other regions, the Northeast should contribute about half of Thailand's agricultural output. It can be seen that the Northeast generated only just over one fifth of agricultural GDP in 2004 (Figure 2), while the central part of Thailand produced one fourth, and the South occupied 60 percent more output.

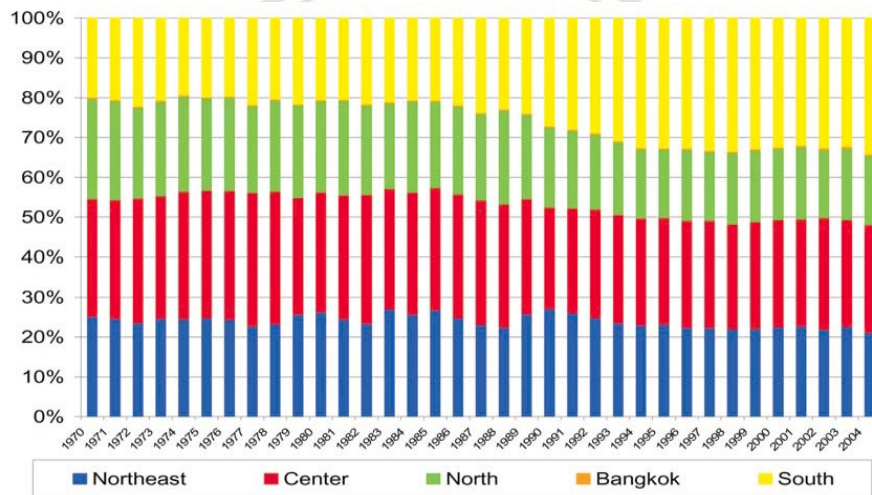


Figure 2 Agricultural GDP, 1970 to 2004 on Regional Contribution (Percent of Total)

2.5.1 Labor productivity

While the Northeast depends on agriculture more than other regions, labor productivity is lowest.

The productivity gap increased over the last 14 years (Figure 3). Labor productivity of Northeast workers in 2004 was 250 percent higher in industry, and 500 percent higher in services than in agriculture.

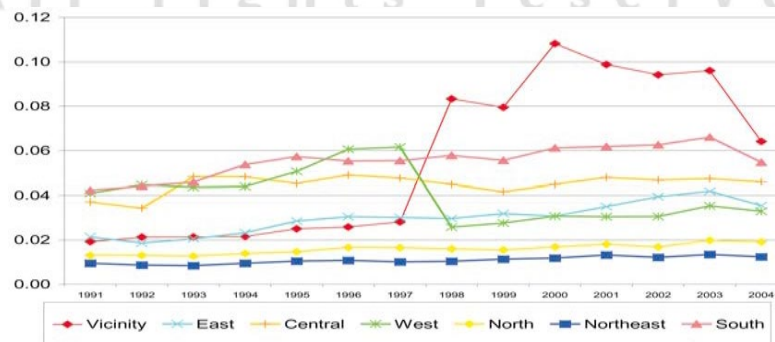


Figure 3 Agricultural Value Added by Agricultural Worker, 1991 to 2004

The figure 4 presents the evidence on agricultural productivity from the perspective of farming households. They account for over 60 percent of all Northeast households, compared to over 42 percent to 45 percent in the North and South, and one quarter in the Center (Figure 4). Farmers in the Northeast have smaller plot of land than in the North and Center (Figure 5). While Northeast household have more farm labor than in other regions (Figure 6), but the agricultural productivity is lowest, it is measured in terms of revenues, margins per land and per labor (Figure 7).

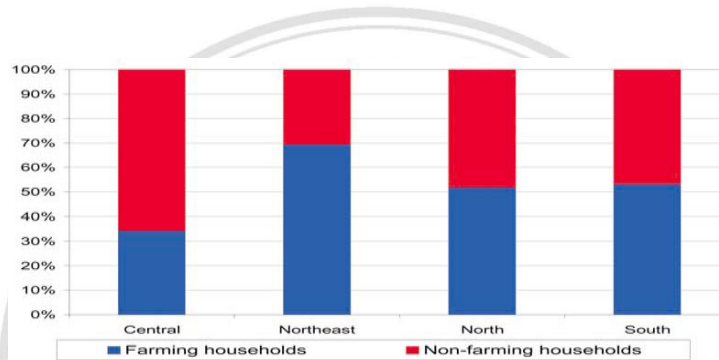


Figure 4 Farming Households as a Percent of All Households in 2002

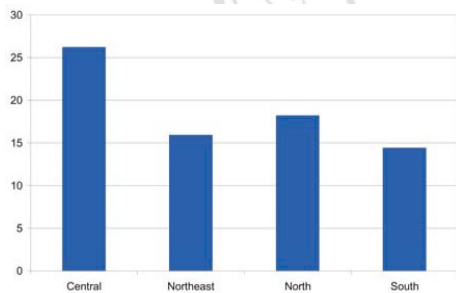


Figure 5 Farm Size (Rai)

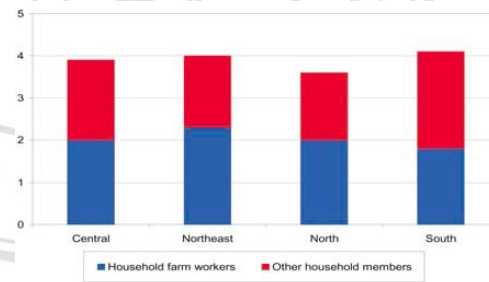


Figure 6 Farm and Non-Farm Workers per Household

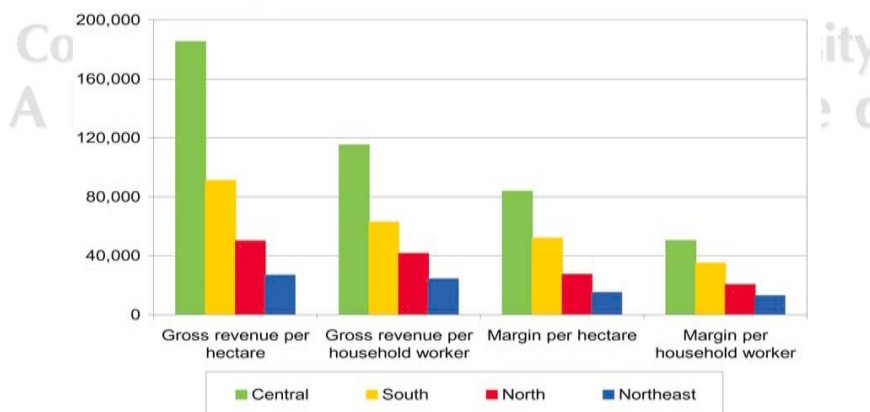


Figure 7 Gross Revenue and Margin per Hectare and per Household Worker

2.5.2 Land quality

One important factor which led low agricultural productivity in the Northeast is the weak natural resource base. It can be seen that the soil is sandy with low water holding capacity. Farming systems have contributed to high salinity levels and soil erosion. One third of all crop land suffers from high saline content. Soil erosion is aggravated by a declining forest cover which acts as a natural barrier for soil conservation. The forest area fell from approximately 6 million hectare in 1990 to only 2 million hectare in 2002. These caused farmers gaining low productivity, especially small farmers who have low investment on farms.

Farmers in the Northeast used little inputs, such as fertilizers and pesticides, to improve farm yields. While more farmers in the Northeast apply such inputs, the amounts among users are only one third to one ninth of the levels observed in the Center. The shortfall to other regions is largest for pesticides (Figure 8). Farming households using fertilizers and pesticides are less poor than those who do not use these inputs (Figure 9-10). Poverty headcounts in the Northeast increase from 4.5 percent to 6 percent for the non-users, implying poverty among farming households operating without these inputs is at least 20 percent.

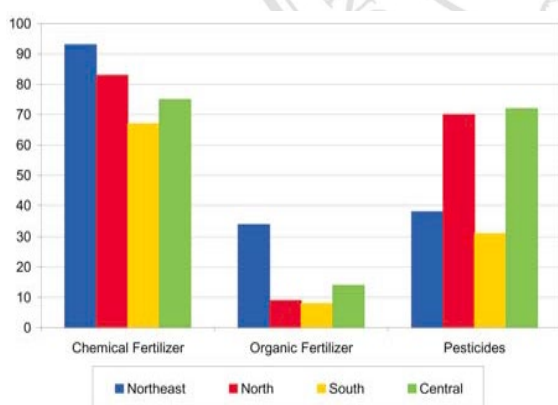


Figure 8 Percentage of Household Using Farming Input

Source: NESDB and WB, 2005

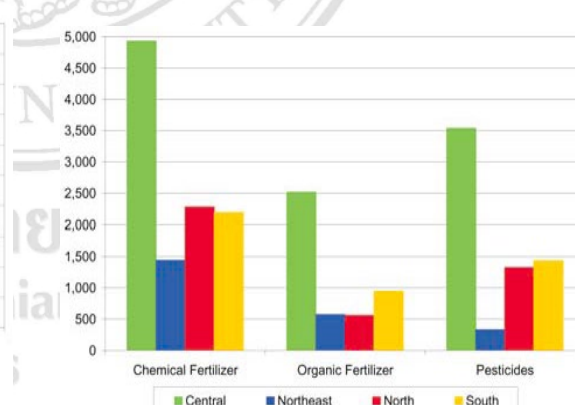


Figure 9 Baht spent on Farming Input among Users

Source: NESDB and WB, 2005

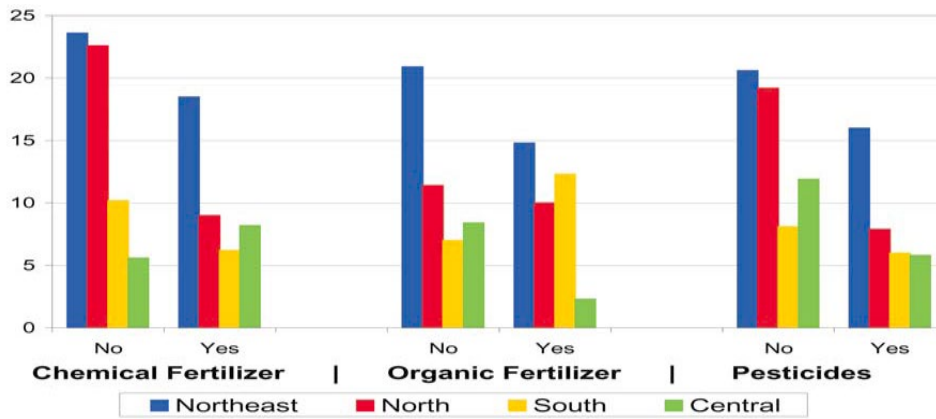


Figure 10 Poverty Headcount by User Status, Percent

Source: NESDB and WB, 2005

2.5.3 Poverty in rural area and population

Low productivity of farm land leads the number of poverty was high. Poverty is more severe in rural areas, where livelihood depends on agriculture, than in urban areas, which offers employment opportunities in industry and services (Figure 11). Two thirds of the population live in rural areas, where the poverty incidence is especially high. Hence, almost nine out of ten poor live in villages, and more than half of all the poor in Thailand live in rural Northeast (Figure 12).

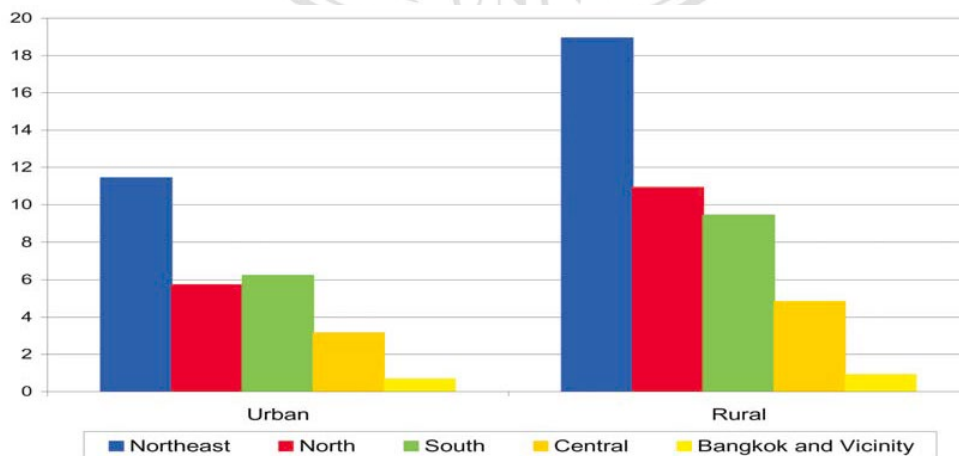


Figure 11 Poverty Headcount (Percent) in 2002

Source: NESDB and WB, 2005

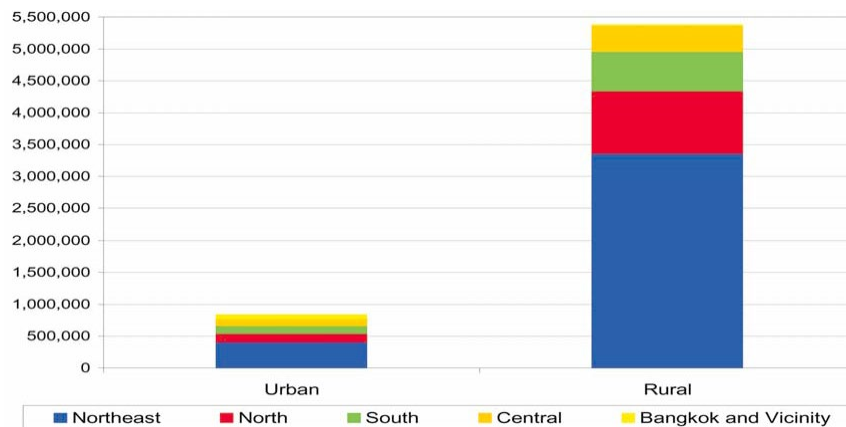


Figure 12 Number of Poor in 2002

Source: NESDB and WB, 2005

The Northeast of Thailand comprises approximately one-third of the nation's population. The region was populated predominantly by Lao families who resettled there in various waves from the 14th century up until the mid 19th century. The region formed for centuries a buffer zone between the Lao and Siamese kingdom. The distinction is primarily one of culture and language (NESDB and the World Bank, 2005).

The Northeast population had been increased from 3 million to 18 million within the 65 year period from 1920-85 (Thomas, 1988). In 2000, the population of the Northeast is 20.8 million, a third of the whole kingdom which is 60.9 million (National Statistical Office, 2002). After decades of very fast population growth, the rate of natural growth in the Northeast decreased continuously since 1970s. It was 2.8, 2.3, 1.81, 1.64 and 1.38 per cent during 1972-76, 1976-81, 1985, 1991, 1995 respectively. During 2000-2005, it was 0.6 per cent (NESDB, 1982, National Statistical Office, 1995, 2007). The total farm households increased from 1.68 million in 1975 to 2.62 million in 2001 (OAE, 1975, 2001). The proportion of total Northeast population in agriculture was 93.5 per cent in 1960 decreasing to 91.8 per cent in 1970 and by 2000, still as high as 78.8 per cent (National Statistical Office, 2002). About 40 per cent of the population is concentrated in the provinces of Nakorn Ratchasema, Ubon Ratchathani, Udon Thani and Khon Kaen (NESDB and WB 2005). In this region, Khon Kaen was the most urbanized province, while Roi Et was the least.

The national poverty headcount, defined as the share of people living in households with income below the poverty line, fell from 32.6 percent in 1988 to 9.8

percent in 2002 (Figure 13). Thailand has already reached its Millennium Development Goal (MDG) poverty target of halving the poverty headcount between 1990 and 2015. In addition, the Thai Government focused on 9th National Economic and Social Development Plan that target of poverty incidence under 12 percent has been met. Both targets were achieved ahead of time.

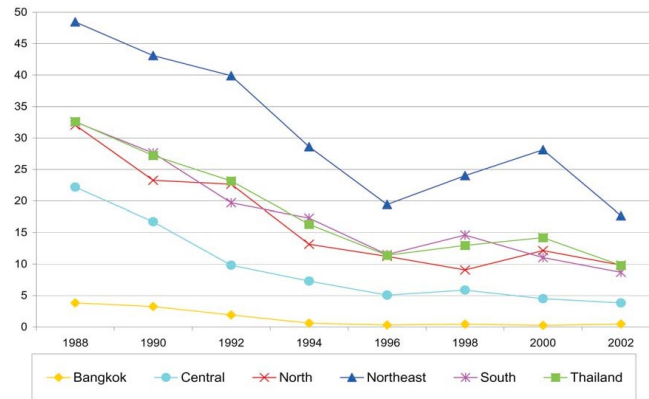


Figure 13 Poverty Headcount in each region 1988 to 2002

Source: NESDB and WB, 2005

Poverty reduction was not limited to Bangkok and surrounding areas but extended to all regions in the country. Although poverty falling faster in other regions, poverty becomes more and more concentrated in the Northeast. One in two poor persons lived in the Northeast in 1988, compared to one in three of the total population (Figure 14). The Northeast still accounted for one third of the total population in 2002, but the share of poor had increased to 60 percent. This translates into 3.8 million poor living in the Northeast, and 2.3 million in the rest of the country.

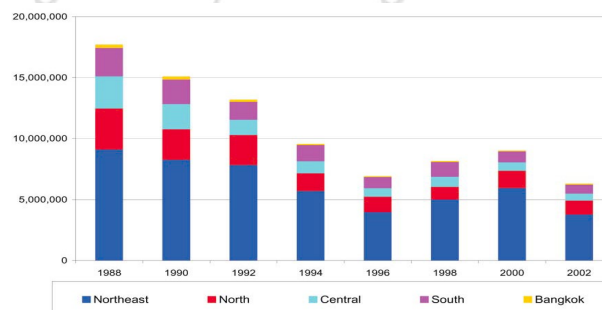


Figure 14 Number of Poor during 1988 to 2002

Source: NESDB and WB, 2005

2.5.4 Farming enterprise

One reason for low living standards of farmers in the Northeast Thailand is the high dependency on low-yield and low-price varieties of rice. Farmers is more dependent on rice. Almost two in three farmers produce mainly rice. This compares to one in two in the North, two in five in the Center, and one in seven in the South. Similarly, land use in 2003 showed that 70 percent of all land holdings are under rice (Figure 15), compared to 54 percent in the North, and two 43 percent in Central (NESDB, 2005). Agricultural households were poorer than non-agricultural households. Rice farmers are also poorer than other agricultural households sectors (Figure 16-17), resulting to rice farmers in the Northeast account for 44 percent of Thailand’s poor. Northeast households are poorer than other households not only in agriculture but also outside of agriculture.

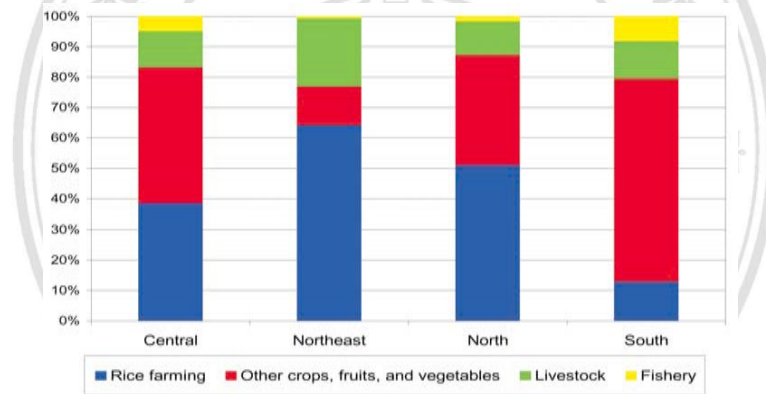


Figure 15 Farming by type (%)

Source: NESDB and WB, 2005

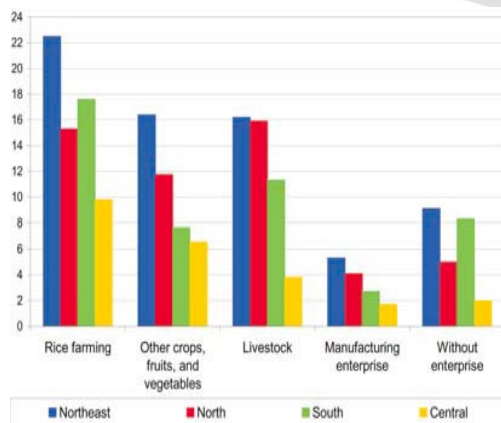


Figure 16 Poverty Headcount and enterprise Type (%) (head)

Source: NESDB and WB, 2005

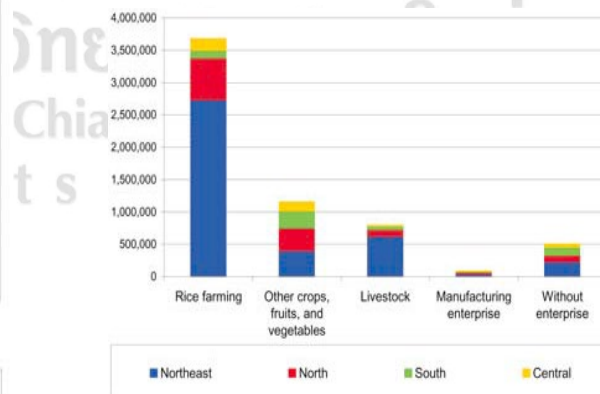


Figure 17 Number of Poor and Enterprise Type

Source: NESDB and WB, 2005

2.5.5 Public spending

Although, the rural Northeast Thailand has lagged behind other regions in terms of productivity and commercialization, but the Thai government has allocated less budget in the agricultural sector than in other regions. It can be seen that in FY 2002, the Northeast spent 577 baht per capita on agriculture, only about half the amount of the North and the South, and two fifths of the amount of the Center (Figure 18). This is one reason why the farmers in this region are still poor and the agriculture is less developed.

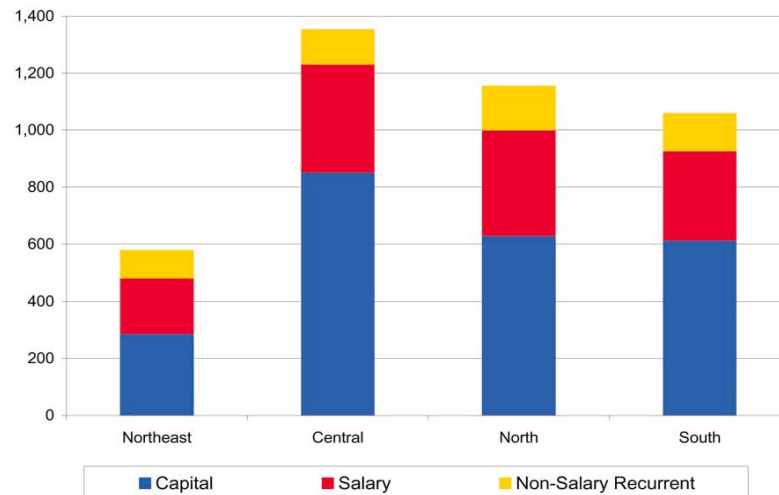


Figure 18 Public Spending on Agriculture, FY 2002

Source: NESDB and WB, 2005

2.5.6 Government's policy for development programs

The government has assisted the farmers through subsidized inputs and credit, debt moratorium programs and village funds. Total government expenditures on agricultural subsidies in FY2003 reached 11,500 million baht, equal to about 15 percent of spending on agriculture. The main channel of subsidies is the Bank for Agriculture and Agricultural Cooperatives (BAAC), which allocated 6,000 million baht for the Debt Moratorium Scheme to 1,200,000 farmers, and 900 million baht in interest compensations.

NESDB and WB (2005) reported that approximately 40 percent of whole of farmers had Debt. About two in five farmers in the Northeast had farm debt in 2002, similar to the Center and North, and more than the South. It amounted to 6.2 times their monthly household income, the lowest share of any region (Figure 19). However, farmers with debt tend to be less poor than farmers without debt, as access to credits is restricted for low-income farmers due to lack of collateral. Under the debt moratorium

program, the Bank for Agriculture and Agricultural Co-operatives suspended the repayment of principal on small-amount loans for three years, starting from July 2001. Eligibility requires are farmers borrow from BAAC with a credit no more than 100,000 baht and no history of deliberate default. The Northeast accounts for the largest share of participating farmers. About 8 percent of non-poor farmers with farming debt benefited from the debt moratorium program in 2002, compared to 7.4 percent of poor farmers, which implies that about one in ten beneficiaries of the program are poor (Figure 20).

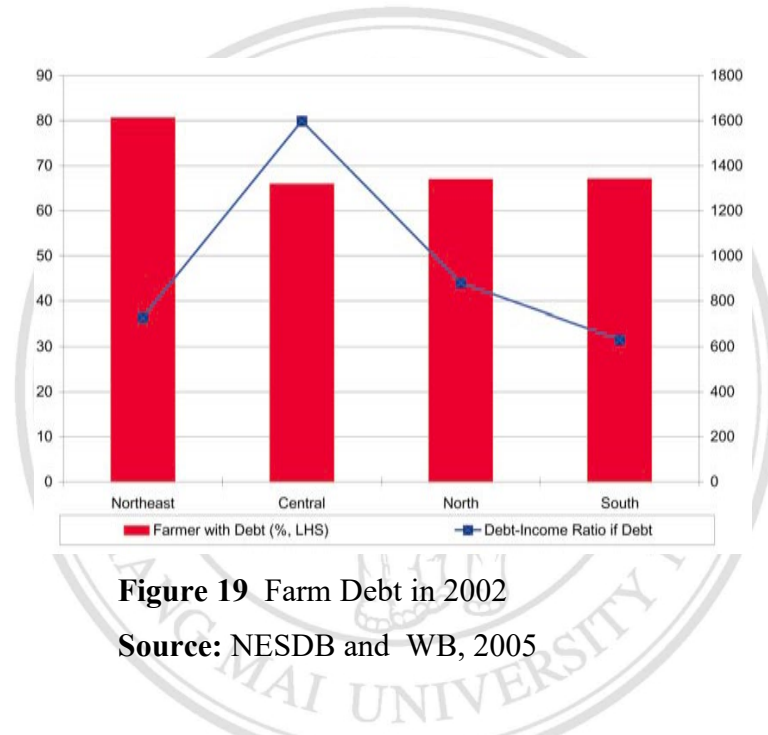


Figure 19 Farm Debt in 2002
Source: NESDB and WB, 2005

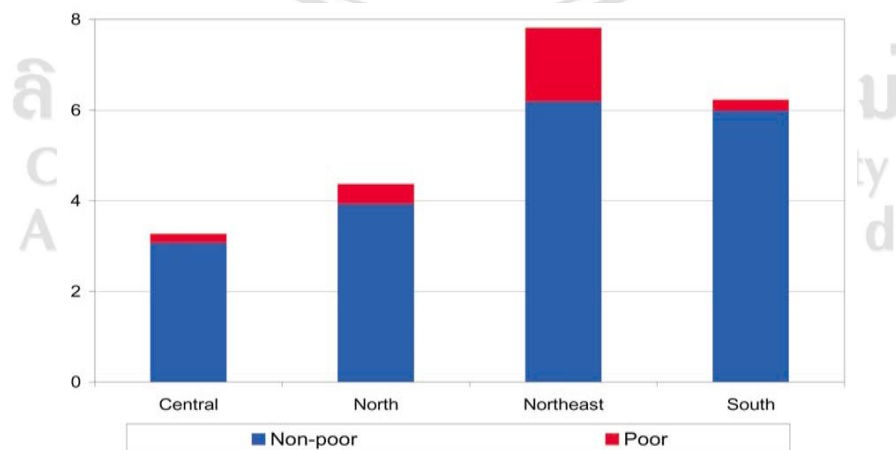


Figure 20 Beneficiaries of Debt Moratorium Program among Farmers with Debt in 2002
Source: NESDB and WB, 2005

The Village Fund program launched in 2002. It is a revolving fund of one million Baht (about US\$ 25,000) per village to the 70,865 villages and some 2,000 urban communities. Village Fund committees hand out small short term loans at low interest rates (about 6 percent or depending on members' agreement) to village members. However, the extent to which this program benefits poor farmers depends on how funds are distributed by the village-level committees. The access of non-poor farmers to the village fund loans is about 4 percent to 5 percent higher than for poor farmers. Similar to the debt moratorium program, this implies that more than 90 percent of the beneficiaries of the Village Fund program are non-poor households (Figure 21).

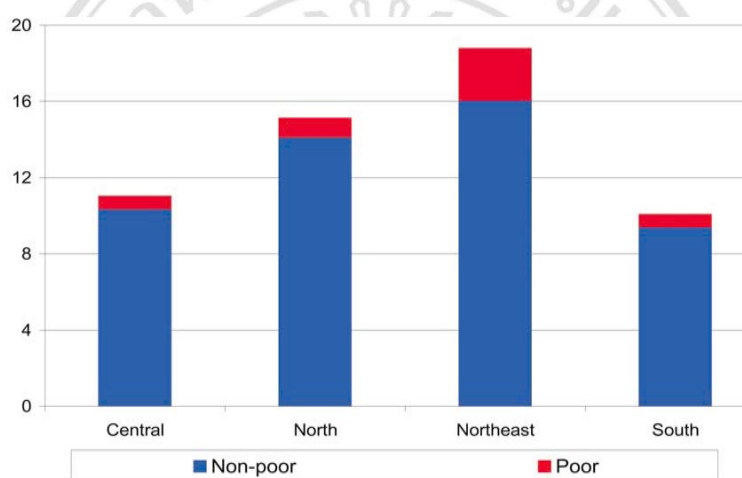


Figure 21 Recipients of Village Fund Loans in 2002

Source: NESDB and WB, 2005

Thai government has initiated the *One-Tambon-One-Product* (OTOP) project as a way to enhance community revenues. OTOP aims to promote the production of local goods by communities and assist communities in the marketing of these products that some raw materials from their farms. As seen the products are divided into six categories: 1) food; beverages (tea, fruit juice, herbal drinks and powdered ginger); 2) clothes and garments made at least partially of natural fiber; 3) ornamental products (scarf, hats, bags and necklaces); 4) decorative products, household furniture, 5) arts and souvenir articles; and 6) natural herbal products (cosmetics, herbal shampoo, and aroma oil). More than 10,000 items are now produced of which approximately 460 items have been initially selected as outstanding products with fine quality, as called OTOP Champion

(Five Stars level). The government sponsors training program for communities in administration, promotion of production and marketing, and quality product development. The government also set guidelines to select the most outstanding product from each province which has potential for export, regular production with standards of quality, quality standards. These OTOP products must create customer satisfaction and tell its history.

2.5.7 Irrigation system and water resources

Irrigation is the most important infrastructure for agriculture. If farming is to rely on rainfed, the intensive farming systems cannot be established. Irrigation not only prolongs the farming period, but also allows farmers to regulate water levels according to the requirements of crops. Low agricultural productivity and high poverty in Northeast caused by lacking of water and irrigation. Although an annual rainfall is not lower than in other parts of Thailand (about 1,300 millimeters per year), the region suffers from poor rain contribution over the growing periods. The region is drained by two rivers, Nam Mun and Me Chii rivers. Unsustainable water extraction have led to declining water balances. While average landholdings are small, lack of water results in difficulty to cultivate. This is also another reason that farmers in Northeast cannot use their land productively and efficiently.

Irrigation in the Northeast has lacked behind the rest of the country, and the gap relative to the North and South has remained unchanged in the last 25 years (Figure 22 and Figure 23). In addition, only one third of irrigated lands are actually used during the dry season . According to NESDB 2005 data, 84 percent of the Northeast villages experience problems for farming in 2001 during the dry season, compared to 80 percent in 1996. This is more than twice the share as in the Center and South, and 28 percent higher than in the North. Figure 24 also illustrates the Northeast has less irrigation than other regions.

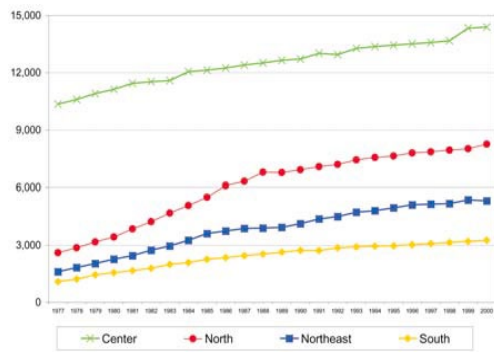


Figure 22 Irrigated Area (1,000 rai), 1977 to 2000

Source: NESDB and WB, 2005

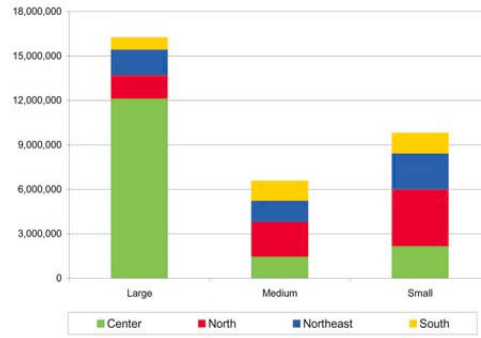


Figure 23 Irrigation Area by Scale of Irrigation Scheme, 2001

Source: NESDB and WB, 2005

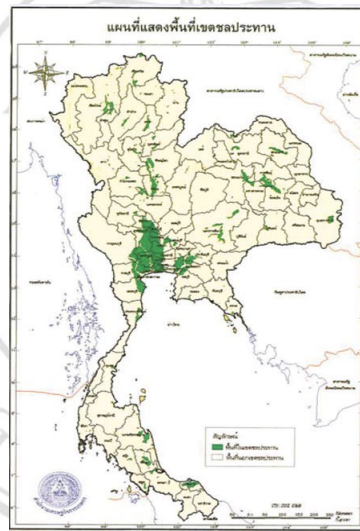


Figure 24 Irrigated Areas as green-shaded in 2002

Source: NESDB and WB, 2005

There are two main rivers inside mainland of the Northeast region: Mun and Chi rivers which all drain into the Mekong River. However, there are small areas get benefits from beyond their reach. The Mun River rises in the Khao Yai National Park near Khorat and runs east joining the Mekong in Ubon Ratchathani Province. The other main river is the Chi River, which flows through central Northeast through Khon Kaen before turning south to meet the Mun in Sisaket Province. The smaller Loei, in the North of the region, and Songkhram rivers, in the east of the region, are also tributaries of the Mekong. It is difficult to estimate the sustainable water extraction rates per year leading to declining water balances. As seen that the average landholdings are small, the lack

of water in growing season results in one third of the land not being cultivated (NESDB and the World Bank, 2005).

The irrigation in the Northeast has less number of the country, with 19 percent in the Northeast (Pholtani, 2003). Smaller irrigation programs are prominent in the Northeast known as Meung Fai, which normally managed by communities. This kind of small irrigation schemes provide typically wet season irrigation only.

2.5.8 Weather risk and condition

In the Northeast has normally faced the risk of agricultural aspect. As seen that the rural economy depends heavily on weather conditions, like drought and floods. Agricultural growth fluctuates widely from one year to the next due to changing weather conditions as shown in Figure 25. The Northeast has a long dry season including its red and porous soils that retain water poorly. The short monsoon season brings heavy flooding in some areas such as river valley, near mountainous area. However, Figure 26 presents only two provinces receive more than 1500 mm of rainfall per year, while five provinces receive less than 1300 mm. Late rainfall, flooding and drought are the main constraint of rice production. Thus, when farmer met these kinds of situation, Thai government is forced to provide the subsidize such as farm inputs and in cash.

In addition, the Ministry of Agriculture and Cooperatives compensates production costs to farmers who lost crops due to drought or flood, and the BAAC also regularly experiences lower repayment rates during bad-weather years as crop failures reduce or eliminate yields and farm incomes. After the moratorium has expired on March 31, 2005, a large number of distressed farmers were still unable to start repaying BAAC loans.

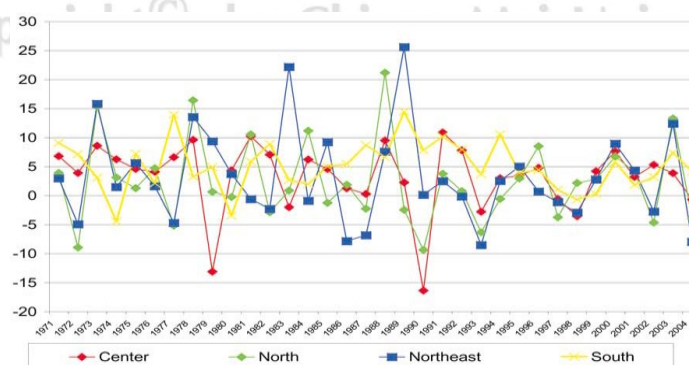


Figure 25 Real Agricultural Growth Rates, 1971 to 2004

Source: NESDB and WB, 2005

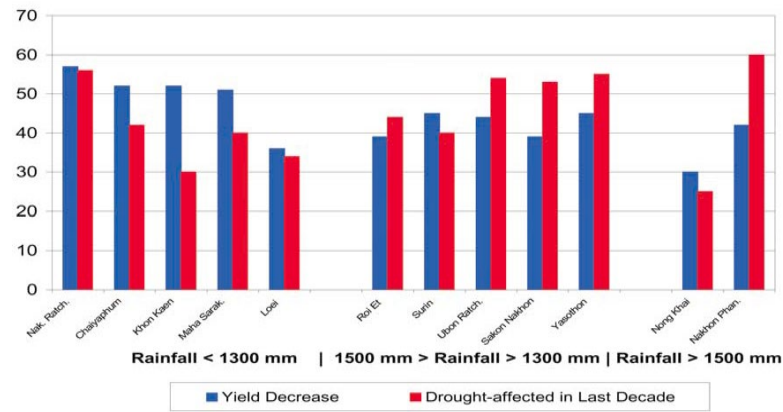


Figure 26 Drought Statistics among Rice Farmers for 1991 to 2001 in the Northeast

Source: Polthani 2002

Because of the mountain ranges that prevent the southwesterly monsoons from the area (southern part of Nakhonratchasima province), the climate in the Northeast is distinct from other regions, even though Thailand is a tropical monsoon climate. Normally, the Northeast still gets the rainfall from the many thunderstorms from the South China Sea. The amount of rainfall is variable, causing unpredictable agricultural productivity. Rainfall is concentrated in the rainy season from May to October. Average annual precipitation can vary from the rest lie between 1,300-1,500 mm. The short monsoon season brings heavy flooding in the river valleys (NESDB and the World Bank, 2005). Although an average rainfall of 1,310 mm annually is not much different from other regions, the absorption capacity in the region is considered poor due to sandy soils. This results in a shortage of water resources for year-round cultivation. As water resources are not sufficient; irrigation is an alternative, but possible for only less than one-fifth of the farm land. The Northeast experiences a long dry season and is typically hot and dry in the hot season (February to May), although cold northeasterly winds from Siberia and China chill the area during the cold season (October to February). The average temperature range is from 19.6 °C to 30.2 °C. The highest temperature recorded was 43.8 °C in Udon Thani province, the lowest 0.1 °C in Loei province (Ekasingh, et al., 2007). The uncertain weather affects directly to agricultural productivity in Northeast region. The rural economy depends heavily on weather conditions like drought and floods. Agricultural growth fluctuates widely from one year to the next due to changing weather conditions (NESDB and the World Bank, 2005).

2.5.9 Agricultural Value Added and Household production

High number of small scale farmers living in farming communities through the region. They also work on small land plots, practice overwhelmingly raw material production. Over 70 percent of agricultural value added comes from crops, some 10 percent from agricultural services and processing, about 10 percent from livestock, and the rest from forestry and fishery. The main change since 1994 is the increase in crops at the expense of livestock (Figure 27). At this aggregate level, the Northeast differs from Thailand only through the absence of a significant fishery industry (Figure 28) which is compensated for by a greater reliance on crops and livestock.

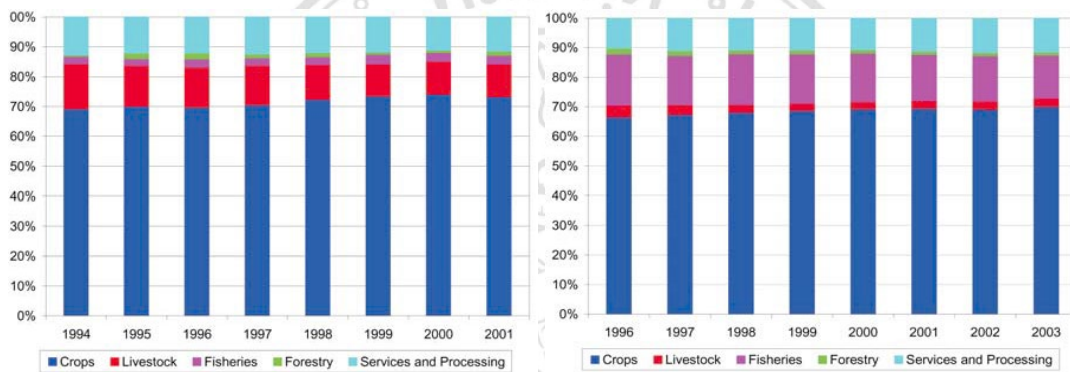


Figure 27 Composition of the Value Added of the Agricultural Sector, Northeast (1994 to 2001)

Figure 28 Composition of the Value Added of the Agricultural Sector, Thailand (1996 to 2003)

Source: NESDB and WB, 2005

Source: NESDB and WB, 2005

2.5.10 Regional Growth in Northeast

The Northeast's economy expanded greatly over the last four decades. GDP per capita in 2004, measured in 1988 prices, amounted to 34,000 baht, compared to only 11,000 baht in 1970. The Northeast was the poorest region in 1970, it has also remained the poorest region up to a present. The Northeast would be the only region Thailand's to be classified as a low income country, while the North and South expanded at a comparable speed, especially the Center that was faster. Figure 29-30 present the regional GDP per capita relative to the Northeast. The Northeast's income gap was constant relative to the North; increases moderately since the mid 1980s compared to the South; rises continuously, and at a higher rate since the mid 1980s, relative to the Center; and increases between the mid 1980s and 1993, before declining to about the same level as in 1990, compared to Bangkok.

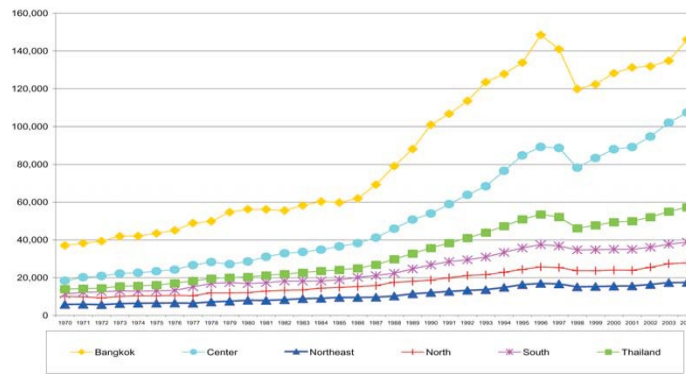


Figure 29 Regional Per Capita GDP, 1970 to 2004, 1988 Prices

Source: NESDB and WB, 2005

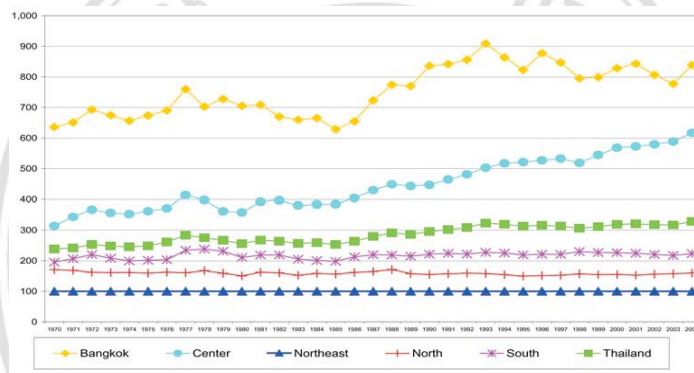


Figure 30 Regional GDP Per Capita Relative to Northeast, 1970 to 2004, Northeast=100

Source: NESDB and WB, 2005

2.5.11 Regional population and GDP shares

GDP per capita measures the output of goods and services produced in a country, divided by the number of population. The Northeast's population totally were 12 million in 1970 and 21 million in 2004, an annual population growth rate of 1.7 percent. In contrast, the Thai population increased from 34 million to 64 million over the same period, at an annual population growth rate of 1.8 percent (Figure 31). Overall, the economic and population growth rates imply that the Northeast GDP share fell from 16 percent in 1970 to 10 percent in 2004 (Figure 32). The Thai economy is more and more concentrated around Bangkok and the Center. Their GDP shares rose more or less continuously during the 1970s and 1980s. By contrast, the Center's share continued to rise in the 1990s up to now. It accounted for 45 percent of Thai GDP in 2004, compared to 35 percent in 1990 and 30 percent in 1970. In the last decade of the Thai economy spread from Bangkok to surrounding regions.

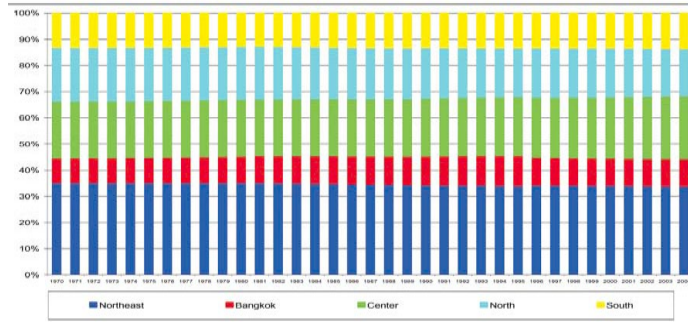


Figure 31 Regional Population Shares, 1970 to 2004

Source: NESDB and WB, 2005

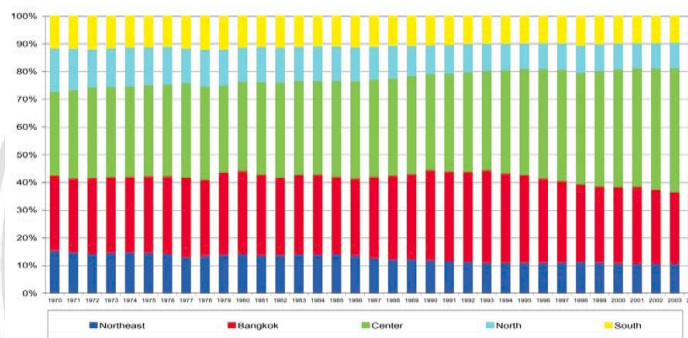


Figure 32 Regional GDP Shares, 1970 to 2004, 1988 Prices

Source: NESDB and WB, 2005

2.5.12 Structure of Economic Change

Economic growth typically brings about structural change in the sectoral compositions of output. One of the fact of development is that it comes with shifts in output from the primary (agriculture) to the secondary (manufacturing, mining, and construction) and the tertiary sectors (services) (Fisher 1939 and Clark 1940 cited by NESDB, 2005). On the basis of comparative advantage, Thailand's leading sectors should be agriculture and related processing industries. On the basis of comparative advantage, Thailand's leading sectors should be agriculture and related processing industries. Agriculture underwent a larger contraction in the Northeast than in other regions. The share dropped from close to two fifths to just under one fifth of GDP (Figure 33). Industry sector increased only from the early 1990s onwards, rising from around 15 percent to one fifth. The service sector expanded by more than 15 percent since 1970 and accounted in 2004 for over three fifths of GDP.

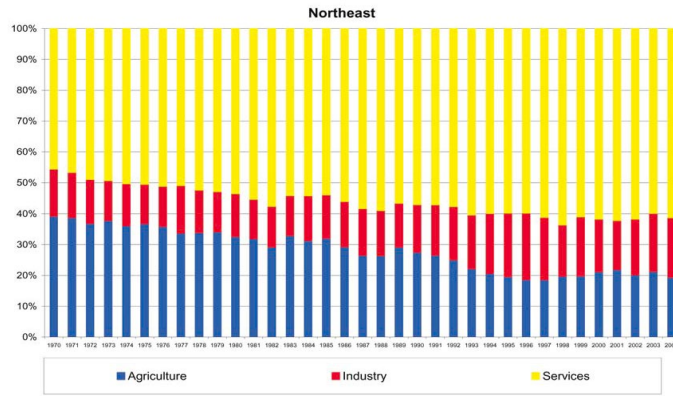


Figure 33 Northeast Regional GDP Composition, 1970 to 2004

Source: NESDB and WB, 2005

2.5.13 Research and extension

In Thailand, the agricultural research has implemented since 1961 up to a present. The public research accounts for almost 90 percent of all agricultural research (Fuglie, 2000). The government research funding concentrates on rice, cassava and sugarcane, on the other hand, while the private sectors focus on corn and vegetables. The Ministry of Agriculture and Agricultural Cooperatives manages the budget of the research and extension work. Furthermore, the public universities gain government research grant. Extension accounts for over 90 percent of the expenditures on agricultural research and extension. It can be seen in Figure 34 that half of all funds are spent in Bangkok and Vicinity, on the other hand, the Northeast received only one seventh.

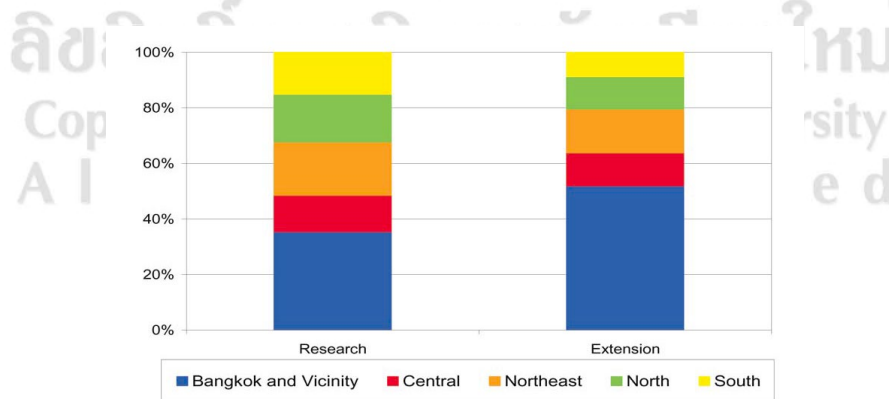


Figure 34 Public Expenditure on Agricultural Research and Extension, FY 2003 (%)

Source: NESDB and WB, 2005

2.6 Lesson learnt with agricultural development

The Thai government has promoted high input, export orientated agricultural systems to increase the country's growth rate, however the environmental and socio-economic effects of this agricultural strategy has resulted in the slowly of the country's agricultural sector development. More specifically poor farm management techniques and inappropriate use of agro-chemicals has resulted in soil erosion and soil exhaustion (Tantemsapya 1995).

At the same time forest land has been cleared to make way for agricultural land, between 1961 and 1989 the area of forest land decreased from 187.5 million rai (1 rai = 1600 square meters) to 85 million rai (Office of Agricultural Economics 1992). This deforestation has created more erratic rainfall patterns, increased flooding, loss of top soil and a decline in the availability of traditional supplements to farmers diets in the form of wild birds, fowl and fish (Suksawasdi, 1996).

Death and illness to farmers caused by pesticides is a serious problem in Thailand. This stems from the Thai farmers' lack of knowledge with regards to agro-chemical application and safety procedures. In 1988 the number of people reported to be suffering from pesticide poisoning was 4,234, while the number of deaths from pesticide poisoning was 34 (Alternative Agriculture Forum 1992).

An agriculture is well suited to the concept of sustainable development (Jitsanguan, 2001). Agricultural deal with climate, soil, land, water, forests and biodiversity through production of crops and animals. At the same time, the agriculture is related to farmers, rural communities, poverty and other social aspects. In Thailand, agriculture plays important role just a way of gaining income, but it also is a way of life of rural community.

Thai farmers have faced various serious conditions. Expanding of the free market economy under globalization has resulted in high competitive market. This also led them to adapt of modern farm technologies. Another issue is small farmer are under pressure to commercialize through contract farming and large-scale agribusiness.

The issue to develop agricultural sustainability is more crucial for small-scale farmers in Thailand who have farm of 3-4 ha (19-25 rais) where located in rainfed areas (Jitsanguan, 2001). These farmers group are the poorest groups in Thai population. Promoting agricultural development for sustainability is an one important policy of Thai

government policy. In fact, the small-scale farmers may not contribute so much in terms of marketing value and exporting value, but they are an important group of Thai society, on food security, environmental conservation and solidity and self-reliance of rural community.

The agriculture of Thailand involves about 30 million people or about nearly 50 % of Thai population has a dual structure. The small farmers each own about 2.5-3 ha (15-20 rai) of land. They are approximately of total farm population, however, contribute only 25 % of the total market value of agricultural production.

Jitsanguan (2001) suggested that agricultural development in Thailand, especially for small-scale farmers, should concentrate on farming system on farming system in four features: 1) food security as the first priority-staple food is a basic need, cash income comes second, 2) minimizing costs as the main objective-resource and inputs are inside farmland, 3) diversification to avoid risk-an integrated farm system based on multiple type of production, residues and wastes from one type can be used for other types, and 4) agriculture as a way of life-small scale farmers are relatively poor, but they gain benefits from group and network and help each other, they consider agriculture as way of life rather than as an ordinary occupation.

Agriculture in a country needs to be highly efficient and be economically viable in order to be competitive and to sustain farmers livelihoods. At the same time the production methods should be environmentally friendly and sustainable and the food produced must be safe to consumers. Agricultural development, post 1945, has been achieving the first goal but neglecting the second. It shows that it is not a sustainable basis for agricultural development.

The lack of economic convergence in Northeast Thailand consists of two factors. First, unfertile soil, water shortage, high number of small landholding, and unsustainable farming methods have resulted in the lowest labor productivity in agriculture. Second, geographic disadvantages such as landlocked and, urbanization and weak natural resources are main difficulty of the Northeast to develop industrial or service sectors. Low yields in agriculture and absence of local employment in other sectors have also resulted in widespread poverty. Families have supplemented incomes from remittances by sending young family members to Bangkok and other big cities including outside of Thailand in search of jobs.

NESDB and World Bank (2005) suggested agricultural and farmer issues must be changed, at list two reasons. First, the high concentration of resources in low-productivity activities. Many people in Northeast are stuck in low-yield subsistence farming that leads them to near poverty. If they have enough irrigation and adequate land, Northeast farmers should contribute about half of Thailand's agricultural value added, instead they produce only one fifth. Unsustainable farming methods lead to declining forest coverage and soil erosion that make it increasingly difficult to increase yields. The Northeast is Thailand's most rural region, and agricultural households are poorer than non-agricultural households. The rural sector is also more subsistence oriented than in other regions. Second, farmers in Northeast have faced with adversity in terms of about one in two Northeast families rely on migration. This makes Northeast households dependent on labor demand in Bangkok and other big cities. While migrants' remittances, that they send back home, help to reduce poverty and support the local economy. However, their communities feel that migration is also main social problem. Moreover, migrants are exposed to many risks. Apart from dry season, comparison migration ratio, it is one in four to one in six in other regions.

In terms of GDP and GPP in Northeast, the product values highly contribute is the industrial sectors instead of agriculture. Agricultural products mainly are produced to food security for partial home consumption and mainly industrial supply such as rice, cassava, sugar cane and eucalyptus. Thus, high yield is the target for production with less consideration on cost. Thus, farmers spend high cost cultivation for fertilizer, pesticide, labor and land preparation. It can be seen that all inputs price increase sharply, while farm products price slightly increase. Thus, looking for reducing farm cost and change the direction to agricultural sustainability will be the alternative way for farmers.

2.7 Three Main Crops in Northeast: Rice, Cassava and Sugarcane

2.7.1 Rice

Rice is a dominant sub-sector of Thailand's agriculture. It is not only a domestically vital largest rice exporter although since 1992 it has been ranked as the sixth largest producer after China, India, Indonesia, Bangladesh and Vietnam, respectively (FAO, 2006). There are two main growing seasons for rice in Thailand classified by planting season: 1) wet season for major rice, and 2) the dry season for second rice. Since the

plantation of major rice relies heavily on natural water supply, it is planted only in the rainy season in Thailand (May to October). Second rice can be planted all year round in irrigation is sufficient. Most rice is rain-fed, as only one quarter of the rice areas are irrigated and most of those are located in the Central plains (NESDB and the World Bank, 2005).

Table 3 presents during 2001-2009, planted area of rice is not big different in whole country, while the production slightly increase in the same period as such the yield per rai also increased until 2007. In contrast, the farm price has steady increased in the same period, even though slightly dropped again in 2009-2010. In 2007, the many provinces in Thailand had faced the flooding problem leading farmers gained low productivity according to many countries which main rice producers got serious problems about natural disaster such as China, India, Bangladesh. This is similar to the situation in 2010 harvesting season in which Thailand met the same problems whole country, thus the rice farm is going up at 13,500 baht per ton (in December 2010) at moisture less than 15 %.

Table 3 Rice (Major and second) : Area, production, yield and farm price, 2000-2009

Year	Planted area (1,000 rais)	Har. area (1,000 rais)	Production (1,000 tons)	Yield per rai (Kgs.)	Farm price (Baht /ton.)
2000	66,492	61,819	25,844	418	4,351
2001	66,272	63,284	28,034	443	4,825
2002	66,440	60,335	27,992	464	5,051
2003	66,404	63,524	29,474	464	5,569
2004	66,565	62,455	28,538	457	6,653
2005	67,616	63,532	29,642	467	6,832
2006	67,616	63,532	29,642	467	6,832
2007	70,187	66,681	32,099	481	11,271
2008	69,825	66,772	31,651	474	9,689
2009	71,542	68,519	31,508	460	10,855

Source: OAE, 2010

Rice is widely planted in Thailand especially in the Northeast, North, Central and South. The Northeast region is the main area of production for major rice in Thailand. In contradiction with the planted area, yield per rai of rice in Northeast are the

lowest yield compared to another regions because Northeast farmers particularly focus on low-yielding traditional and high-quality varieties, weather risk and non-irrigation. The Northeast contributed approximately 10.8 m. ton (major rice 10.4 million tons and 0.4 million tons from second rice) of Thailand's 29 million tons (major rice 23.5 million tons and second rice 5.8 million tons) in 2005.

2.7.2 Cassava

Cassava or tapioca is a tropical root crop which has played an important role for the Thai economy. It contributed about 7,000 million baht in Gross Domestic Product and ranks sixth following rice, rubber, vegetables and fruits, sugarcane and maize (FAO, 2003). The cassava planted area for the whole country was 0.17 million ha in 1968. It rose at the average rate of 13.2 percent per year and reached its peak at about 1.6 million ha in 1989 due to its drought tolerance property. The planted area expanded rapidly in response to the growing demand for animal feed in Europe as the main market of Thai cassava pellets. But when the Common Agricultural Policy (CAP) in the EU changed in 1993, cassava became less competitive with locally produced barley, and exports of cassava pellets decreased rapidly. It caused the reduction in planted area from 1993 to 2005 at the average annual rate of 2.52 percent. In 2005, the planted area was about 1.0 million ha. or 6,524,000 rai. In contrast, after 2005, the plated area has been increased since the price of cassava went up (Table 4). Another reason was some farmers wanted to stop cultivate sugar cane for a while to break the host of white leaf disease. In 2010, the farm price of cassava increased up to 3.5-4.25 baht/kilograms led farmers expand more cultivated land.

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Table 4 Cassava : Area, production, yield and farm price, 2001-2010

Year	Planted area (1,000 rais)	Harvested area (1,000 rais)	Production (1,000 tons)	Yield per rai (Kgs.)	Farm price (Baht / kg.)
2001	6,918	6,558	18,396	2,805	0.69
2002	6,224	6,176	16,868	2,731	1.05
2003	6,435	6,386	19,718	3,087	0.93
2004	6,757	6,608	21,440	3,244	0.80
2005	6,524	6,162	16,938	2,749	1.33
2006	6,933	6,693	22,584	3,375	1.29
2007	7,623	7,339	26,916	3,668	1.18
2008	7,750	7,397	25,156	3,401	1.93
2009	8,584	8,292	30,088	3,628	1.19
2010	7,560	7,302	21,941	3,005	1.77

Source: OAE Thailand, 2010

Office of Agricultural Extension (OAE) (2010) reported total production of cassava increased from 2.6 million tons in 1968 to its peak at 24 millions ton in 1989 before falling to 17 million tons in 2005 due to the decrease of planted area. Cassava yields vary with cultivars, season of planting, soil type and fertility. In 1965, cassava yield was at 14.5 ton per ha, it has been increased to 16.7 ton per ha. with the lowest record at 14.2 ton per ha. in 1996. during 2007- 2010 cassava yield average was 18.5 ton per ha. higher than before. For the Northeast region, the average yield at the same period was a little bit lower (16.1 ton per ha (1 hectare = 6.25 rai)

2.7.3 Sugar cane

Sugar cane is one of the major field crops grown in Thailand. In the North and Northeast, where sugarcane is mainly cultivated under rain-fed conditions, the planting time is at the end of the rainy season, October-November. The remaining moisture in the soil supports the germination of cane and guarantees its survival through the dry season. The sugarcane planted area in the Northeast region covers the provinces of

Nakhon Phanom, Sakol Nakhon, Nong Khai, Udon Thani, Nong Bua Lam Phu, Loei, Mukdahan, Yasothon, Amnat Charoen, Kalasin, Khon Kaen, Maha Sarakam, Roi Et, Buri Ram, Chaiyaphum and Nakhon Ratchasima. The largest producing province in the region is Udon Thani with a production of 5.23 million ton of sugarcane. Throughout the period of 1996/97-2002/03, increasing yields were observed from all regions. The average yield in the Northeast region, for instance, increased from 54.5 to 66.1 ton per ha in this period. The planted area reduced after 2004 (Table 5 and 6) as farmer faced the problems about white leaf disease, some change to grew cassava to break the cycle of insect.

Table 5 Sugar cane : Area, production, yield and farm price 2001- 2010

Year	Planted area (1,000 rai)	Production (1,000 tons)	Yield (kg./rai)	Farm price (baht/ton)
2001	5,481	49,563	9,042	514
2002	6,320	60,013	9,496	435
2003	7,121	74,259	10,429	469
2004	7,012	64,996	9,269	368
2005	6,670	49,586	7,434	520
2006	6,033	47,658	7,899	688
2007	6,314	64,365	10,194	683
2008	6,588	73,502	11,157	577
2009	6,023	66,816	11,094	700
2010	6,310	68,808	10,905	861

Source: OAE Thailand, 2010

Table 6 Planted areas, production, yield/rai of 4 crops of whole country during 2001-2005

Crops	Issues	2001	2002	2003	2004	2005	Growth rate (%)
Major rice	Planted (mill.rai)	57,838	56,907	56,792	57,651	57,774	0.11
	Production(mill.ton)	22,410	21,566	23,142	22,650	23,539	1.48
	yield (kg./rai)	387	379	406	393	407	1.38
Second rice	Planted (mill.rai)	8,717	8,434	9,533	9,432	8,914	-1.58
	Production(mill.ton)	6,056	5,624	6,426	6,332	5,888	-0.94
	yield (kg./rai)	695	667	674	671	661	-0.94
Cassava	Planted (mill.rai)	6,918	6,224	6,435	6,757	6,524	-0.35
	Production (mill.ton)	18,396	16,868	19,718	21,440	16,938	-0.75
	yield (kg./rai)	2,659	2,710	3,064	3,173	2,596	-1.10
Sugarcane	Planted (mill.rai)	5,481	6,320	7,121	7,012	6,670	-5.09
	Production (mill.ton)	49,563	60,013	74,259	64,996	49,586	0.81
	yield (kg./rai)	9,042	9,496	10,429	9,269	7,435	-4.07

Source: OAE Thailand, 2005

2.8 Conditions of Khon Kaen province

2.8.1 Physical characteristics

Khon Kaen province covers totally 6.8 million rais, approximately 10,886 square kilometers. It is located at latitude 15-17 degree north, longitude 101-103 degree east. The distance about 445 kilometers from Bangkok by road, takes 6 hours by car and 45 minutes by plane. The average annual rainfall is about 1,056.8 milliliters, however mostly it falls during May to September, this is the cultivating season. The average daily temperature ranges from 22-30 degree C. (Pakuthai et al., 1998).

Geographically, Khon Kaen is located on highland, sloping down toward the south and the east. The soil is normally sandy with undulation, resulting in fast water flow and difficulty in retaining water in paddy rice filed and crop fields. Furthermore, the quality of soil is unfertile, with a great problem of salinity in the southern part of the province such as Ban Phai, Basn Haet, Phol and Munjakeeree districts.

Three main rivers flow thorough the provincial area: Nam Chi, Nam Pong and Nam Choen. Ubonratana dam is only one multipurpose dam is designed for irrigation, generating electricity, source of fish and water reservoir for piped water in Khon Kaen and other cities, including various industrial factories. In 1995, Khon Kaen university

reported that the use of river water downstream discovered that annual water consumption amounted to approximately 1,123,162 million cubic meters. The consumption had been classified into three purposes: about 3.3 percent for tap water supply, 1.8 percent for industries, and about 94.9 percent for agriculture.

2.8.2 Administration, Population and Labor Force

There are totally 1,883,751 population in Khon Kaen province (January, 2010). The birth rate is approximately 16.3 out of 1,000 persons, while the death rate is 4.7. The population growth rate is 0.9 percent. The average population density is about 161 persons per square kilometer. The highest population density is in Muang district, which consists of 219 persons per square kilometer. Khon Kaen municipal area covers 46 square kilometers, population is about 144,545. Regarding the administrative system, there are 26 districts which consists of 198 Tambons and 2,139 villages in 2009. The minimum wage according to law is 167 baht per day in 2004, however farmers hired 220-250 baht per day (with lunch provide) for rice harvesting in December 2010.

2.8.3 Agricultural Production

The total agricultural land holding in Khon Kaen is approximately 4,171,881 or about 61.3 percent of the total provincial area. Agricultural area mostly is under rainfed area, with a consequence of low and fluctuating productivity. In general, farmers grow rice and sugarcane increasingly, while kenaf, cassava and maize decreased during 1985-1995 as shown in Table 7. Furthermore, vegetable both for fresh production and seeds still remain.

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Table 7 Crops: Annual planting areas in Khon Kaen 1985-1995

(unit: rai)

Crop year	Major rice	Second rice	Maize	Cassava	Sugarcane	Kenaf	Soybean
1985/86	1,722,093	27,646	78,795	464,904	120,329	150,105	24,093
1986/87	1,522,171	63,307	66,622	403,622	119,825	125,691	39,169
1987/88	1,491,156	28,464	42,965	468,185	130,335	73,635	46,717
1988/89	1,742,321	103,309	69,062	454,275	118,790	90,182	73,145
1989/90	1,839,886	109,976	70,832	499,049	119,005	90,841	103,910
1990/91	1,840,612	86,006	60,069	433,669	150,713	86,404	63,254
1991/92	1,839,711	90,048	54,066	424,084	194,629	64,884	64,565
1992/93	1,752,018	109,976	49,573	454,126	187,578	35,996	90,930
1993/94	1,605,387	71,428	25,600	400,902	202,352	29,259	74,450
1985/86	1,721,584	1,244	27,489	381,289	263,058	26,078	93,039
Growth rate	0.81	-12.47	-9.91	-1.41	8.63	-18.54	11.58

Sources: Thailand's Agricultural Statistics cited by Pakuthai 1998.

2.8.4 Marketing of Farm Products

In general, there are merchants or “middleman” buying farm products at the sources farm products then sell to wholesale traders in Khon Kaen city or other big districts. Then, products are sold to the bigger markets or supply for agri-bussiness industries such as rice, cassava and sugarcane, while vegetable, flowers and fruits are sold in the local markets and the central market in Khon Kaen city. The farm products that farmers know the price in advance or with minimum guaranteed price are: rice, sugar cane raw milk, eucalyptus. The price of other farm products vary according to market situation. Some farms product, especially sugar cane and eucalyptus, the company agency and middleman set up the buying point in the villages since there are high competition between those companies.

BAAC established the central market for rice trading in Khon Kaen city. This has increased the price of local paddy, as rice export trader some to compete with rice mills and various rice companies from other provinces. Regarding vegetable and fruit, there are three big markets in Khon Kaen city available for local farmers and merchants whole region and some from the North, East and Central regions.

It has been shown that Khon Kaen is the center market of farm products as its geographically, locally and road conjunction. Thus agricultural markets in Khon Kaen do not serve farmers only in Khon Kaen, but also support farmers and merchants all Northeast region. It is also a distribution market of the region.

2.8.5 Gross Provincial Products (GPP)

The GPP of Khon Kaen slightly increased, up to over 100 million in 2006 (177,225,000 baht), then it was 143,184 million baht in 2009. Manufacturing constituted nearly one third of total in 2009, flowed by wholesale, agriculture and education. Table 8 shows that the product values from industrial sector was higher than agricultural sector since 2002. The product value of agriculture also increased continuously since 2002-2009, while went up sharply in 2003. Agro-business plants built up in Khon Kaen and near by such as ethanol plant in Phol district, Sugarcane factory in Mashasarakam province. According to manufactory, there were many industrial set up in the area such agri-business plants, paper factory expanded production scale, electronic and computer part, shoe and apparel factories.

Table 8 Gross Provincial Product of Khon Kaen at current market price 2002-2009

(Unit: million baht)

Issues	2002	2003	2004	2005	2006	2007	2008	2009
Agriculture	8,369	10,239	10,635	11,514	13,385	15,050	15,979	17,495
Crops, hunting, forestry	8,025	9,766	10,129	11,030	12,904	14,564	15,415	16,856
Fishery	344	473	506	484	482	486	564	639
Non-agriculture	65,951	73,047	80,914	85,584	103,840	111,800	123,727	125,689
Mining	2,272	2,087	1,733	1,796	1,610	1,517	1,488	1,759
Manufactory	20,409	24,747	28,534	31,255	43,363	45,416	52,372	52,336
Electricity, gas	1,507	1,578	1,792	1,926	2,178	2,233	2,252	2,484
Construction	4,334	4,803	5,021	3,993	4,743	5,323	5,677	5,440
Wholesale and retail, trade	13,608	14,749	15,870	16,865	18,761	20,894	23,293	22,883
Hotel and restaurant	1,588	1,571	1,571	2,268	2,666	2,945	3,103	3,557

Table 8 (CONTINUED)

Issues	2002	2003	2004	2005	2006	2007	2008	2009
Transportation and communication	3,966	4,091	4,406	3,944	3,946	4,292	4,307	4,488
Financial intermediation	2,108	2,298	2,717	2,869	3,601	3,928	4,204	4,419
Real estate, renting	2,394	2,431	2,485	2,591	2,703	2,780	2,732	2,711
Public administration	4,522	4,726	5,364	5,906	6,455	6,898	7,277	7,341
Education	6,557	7,224	8,089	8,951	10,235	11,639	12,971	13,978
Health and social work	2,201	2,253	2,490	2,605	2,967	3,315	3,420	3,588
Personnel services	361	361	445	482	480	482	488	558
Private households with employed persons	124	128	132	134	134	139	143	147
GPP	74,320	83,286	91,549	97,098	117,225	126,850	139,706	143,184
GPP Per capita (baht)	41,266	45,860	50,019	52,648	63,168	67,975	74,487	76,055
Population (1,000 persons)	1,801	1,816	1,830	1,844	1,856	1,866	1,876	1,883

Source: NESDB-NE (2010)

2.9 Learning theory

Learning theories, in general, are conceptual frameworks in which knowledge is absorbed, processed, and retained during learning. Cognitive, emotional, and environmental influences all play a part in how understanding. This is acquired or changed and knowledge and skills retained (Illeris, 2004 and Ormrod, 2012).

Basically, the behaviorists look at learning as an aspect of conditioning and will advocate a system of rewards and targets in education. Many educators believe that the definition of learning as a change in behavior is too narrow. They, however, prefer to study the learner rather than their environment and in particular the complexities of human memory. Those educators also believe that a learner's ability to learn relies to a large extent on what they already know and understand. Furthermore, the acquisition of knowledge should be an individually tailored process of construction.

Both technology and knowledge must be transferred to other people. Transfer of learning is the idea that what one learns in education institutions somehow carried over to situations different from that particular time and that particular setting. Transfer was amongst the first phenomenon tested in educational psychology. The educators found that though transfer is extremely important for learning, it is a rarely occurring phenomenon. Those found that the prior information did not help the subjects; instead it impeded their learning.

Learning are necessary both in the school and out of education institution, this focus on adult learning that people who are working and can study everywhere both academic and occupation contents. Herod (2012) gave the definition on learning that learning is cognitive/physical/affective acquisition and processing of skill knowledge to varying depth, in which depth refers to one's understanding of, ability to manipulate, apply, or communicate the skill and knowledge.

However, Mary Ann (2011) mentioned the adult learning provided sight into how adults learn, and can help instructor be more effective in their practice and more responsive to the needs the learners they served. Mary Ann (2011) also discussed about adult learn differently than do children and used the terms andragogy to described the philosophy of the art and science of teaching adults.

Furthermore, in terms learning as Tighe (1983) explained that the learning was distinguished from behavior change arising from such process, as maturation and illness, to intellectual skills, such as reading and to attitude and values. For learning, there are various methods models to transfer knowledge and do practices, however, Tighe (1983) had d3vided learning model into three methods: 1) classical condition, 2, operated condition and 3) cognitive learning.

Although there are many different approaches to learning, there are three basic types of learning theory: behaviorist, cognitive constructivist, and social constructivist. This section provides a brief introduction to each type of learning theory. The theories are treated in four parts: a short historical introduction, a discussion of the view of knowledge presupposed by the theory, an account of how the theory treats learning and student motivation, and finally, an overview of some of the instructional methods promoted. The overview of learning Theories is present as Table 9 below.

Table 9 Overview of Learning Theories

Content	Behaviorism	Cognitive Constructivism	Social Constructivism
View of knowledge	Knowledge is a thing or persons can do, of behavioral responses to environmental stimulation.	Knowledge systems of cognitive structures are actively constructed by learners based on pre-existing cognitive structures.	Knowledge is constructed within social contexts through interactions with a knowledge community.
View of learning	Passive absorption of a predefined body of knowledge by the learner. Promoted by repetition and positive reinforcement.	Active assimilation and accommodation of new information to existing cognitive structures. Discovery by learners.	Integration of students into a knowledge community. Collaborative assimilation and accommodation of new information.
View of motivation	Extrinsic, involving positive and negative reinforcement.	Intrinsic; learners set their own goals and motivate themselves to learn.	Intrinsic and extrinsic. Learning goals and motives are determined both by learners and extrinsic rewards provided by the knowledge community.
Implications for Teaching	Correct behavioral responses are transmitted by the teacher and absorbed by the students.	The teacher facilitates learning by providing an environment that promotes discovery and assimilation/accommodation.	Collaborative learning is facilitated and guided by the teacher. Group work.

Cherry (2017) mentioned a number of psychologists became increasingly interested in turning psychology into a more scientific endeavor. To be more scientific, they argued, psychology needed to study only those things that could be measured and quantified. A number of different learning theories emerged to explain how and why people behave the way that they do. The learning theories of development are centered on the environmental influences on the learning process.

In terms of learning, Nixon *and et al.* (1996) mentioned there are many condition, such different kind of leaning had different conditions. Figure 25 below presents how learning start, with curiosity about particular problem or puzzle in which issues in questions to be answered. This can explain as triggers for learning. The inquiry stimulated by such triggers lead us to form idea or theory but what cause the problems and then to these idea. Deliberation on experience can illuminated the underlying process and produce learning which change the way we arrange an activities.

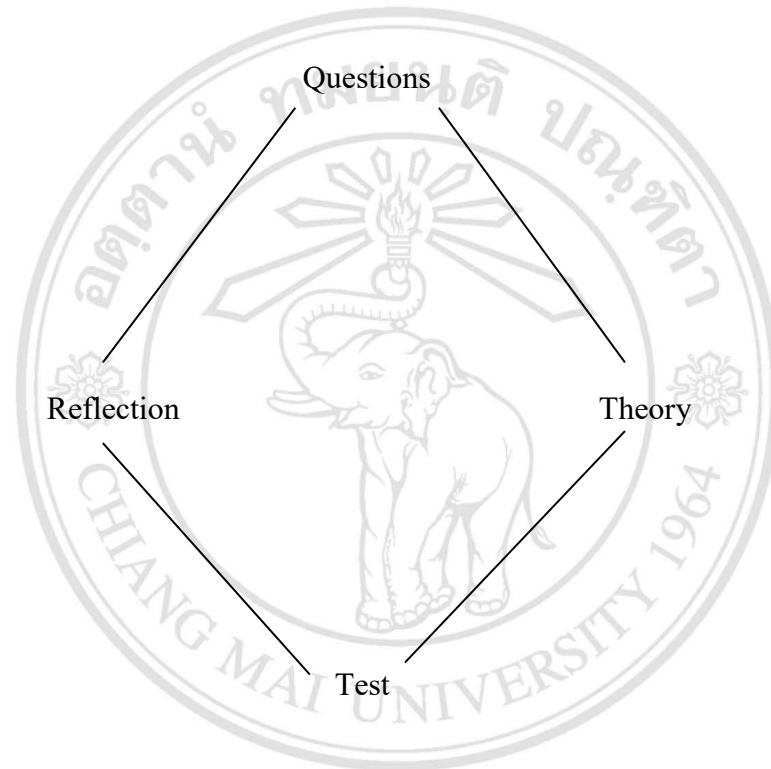


Figure 35 The learning cycle

When adults have learnt and transferred the knowledge, they must applied various skills to inform each other understood. As Argyle (1995) argued that the social skill is very important for adult learning. Social skill is also a patterns of social behavior which make individual socially component, able to produce the directed effects on other people. Moreover, Michael (1995) generally pointed that social learning effects may be related to personal motivations such as to be popular or task goal.

Generally, social skill is a model of social behavior which uses the analogy between social performance and technique skills, like driving a car. In conclude, This can be explained more deeply that the social skill are the pattern of social behavior

which make people competent in social situation. They can be assessed by role-playing, interviews, rating by others, or objective results. Social skills are, furthermore, mainly acquired from experiences in the family and peer groups, and later work.

2.10 Grounded theory

Grounded theory is a research methodology that results in the production of a theory that explains patterns in data, and that predicts what social scientists might expect to find in similar data sets. When practicing this popular social science method, a researcher begins with a set of data, either quantitative or qualitative, then identifies patterns, trends, and relationships among the data. Based on these, the researcher constructs a theory that is "grounded" in the data itself. While other educators, such as Boyd (2008) mentioned the grounded theory is a research method that involves forming a theory based on the gathered data as opposed to gathering data after forming a theory. In other words, it kind of turns the whole research process around. Grounded theory is called 'grounded' because the theory is grounded in the data. Thus, Ground theory is the research methodology that explain the data on trends, and relationships among the data that involves forming a theory based on the gathered data.

Grounded theory involves the progressive identification and integration of categories of meaning from data. It is both the category identification and integration as method and its product as theory. Grounded theory acts as method provides us with guidelines on how to identify categories, how to make link between categories and how to establish relationships between them. While grounded theory as theory is the end-product of this process. It provides us with an explanatory framework with in which to understand the phenomenon under investigation. To identify, refine and integrate categories, and ultimately to develop theory, grounded theory researchers use a number of key strategies, including constant comparative analysis, theoretical sampling and theoretical coding (Bryant and Charmaz, 2007).

Furthermore, Grounded theory is a research tool which enables you to seek out and conceptualise the latent social patterns and structures of your area of interest through the process of constant comparison. Initially you will use an inductive approach to generate substantive codes from your data, later your developing theory will suggest to you where to go next to collect data and which, more-focussed, questions to ask.

This is the deductive phase of the grounded theory process.

(<http://www.groundedtheoryonline.com/what-is-grounded-theory>)

As known, the grounded research method differs from the traditional approach to science, which begins with a theory and then seeks to test it through scientific method. As such, grounded theory can be described as an inductive method, or a form of inductive reasoning.

Boyd (2008) mentioned the grounded theory allows researchers to be scientific and creative at the same time, as long as the researchers follow these guidelines:

- Periodically step back and ask questions. The researcher needs to step back once in a while and ask the following questions: What is going on here? Does what I think I see fit the reality of the data? Data does not lie, so the researcher needs to make sure their own ideas about what is happening matches what the data is telling them, or the researcher may need to alter their idea of what is going on.
- Maintain an attitude of skepticism. All theoretical explanations, hypotheses, and questions about the data should be regarded as preliminary, whether they come from the literature, experience, or making comparisons. They should always be checked out against the data and never accepted as fact.
- Follow the research procedures. Research procedures (data collection, analysis, etc.) are designed to give precision and accuracy to a study. They also help the researcher break through biases and lead him or her to examine some of his or her assumptions that might otherwise be unrealistic. Therefore, it is important that the correct research procedures are followed so that an accurate conclusion is reached.

2.11 Agricultural Systems in Thailand

One major policy of the government is promoting sustainable production systems for small-scale farmers. Small landholdings, rainfed cultivation, low yields and lack of storage facilities lead farmers in Northeast largely depend on middlemen. Although these farmers may not contribute much in terms of market value and export, they are an important backbone of Thai rural society. Furthermore, they make an essential important contributions on self-reliance, food security, and environmental conservation. Thus, they also search for appropriate farming systems that is more better

in harmony with the natural resource base. Furthermore, innovation and the value chain are key elements of strategy which aim for reducing costs, increasing profitability, and the better returns. These agricultural farming system below are presenting to be the alternative farming system which farmers should make decision to implement for sustainable agriculture based on efficiency, environmentally, safety farming system.

2.11.1 Integrated farming system

The integrated farming system is a good example of sustainable agricultural production. This type of farm shows the wise use of limited farmland to increase the number of farm activities. Thus, reducing risk and making use of waste from one type of production in another type is an important aspect. As Aphinantara (1998) mentioned that integrated farming system means agricultural production system is farming is diversified, but all part support each other, farming activities also run continuously throughout the year. Integrated farming implies at least two kinds of agricultural production operating simultaneously, and complementing each other in one way or another. This lead farmers reduce production costs.

Regarding economic aspect, the integration of complementary farm activities is considered economy of scope, due to cost sharing and recycling of farm inputs. It can be seen very often like the fish-rice production and pig-fish-vegetable production. The resources needed for integrated farming system are found throughout Thailand, especially this farming system need based on water such as farm pond on farmers' land.

2.11.2 Organic farming

Organic farming uses organic matter as the fertilizer: manure, organic fertilizer, compost, while pests and weeds are controlled by herbal bio extraction which made from herbs. The aim is to increase food safety or health food and restore soil fertility and water quality which have been damaged by chemical use. The improved environmental impact associated with organic farming can be expected to improve quality of underground water, the conservation of natural enemies and biodiversity, especially improve quality of farmer health. The organic farming system can be practiced in any farming system. Both crop production such as rice, vegetable, fruit tree, and animal farm can modify to use on farms.

The production of organic rice, fruits and vegetables to supply niche markets in Bangkok and other major cities of Thailand, especially educated people target is becoming increasingly common (Jitsanguan, 2001)

The system of organic farming means more than using organic inputs, it is a method which needs effective ecosystem management in order to be successful. The main characteristics of organic farming include: 1) maintaining soil fertility by protecting organic matter levels in the soil; 2) nitrogen self-sufficiency by using legumes to encourage nitrogen fixation; 3) the recycling of on-farm organic materials, especially crop residues and livestock waste; 4) controlling weeds, disease and pests using crop rotations, natural predators, organic manuring and resistant crop varieties; 5) careful attention to the impact of the farm on the surrounding environment and the conservation of wildlife and natural habitats. (Setboonsarng and Gilman, 1999)

2.11.3 Natural farming

The natural farming concept concentrates on preserving the natural ecology, by planning and controlling the equilibrium between different life cycles of crops, animals and weeds. Natural farming attempts as much as possible to avoid the use of inputs from outside the farm. This system also try to reduce all physical methods which disturb the ecological balance in soil. Natural farming system is probably the ultimate pattern of sustainable agriculture, in terms of conserving resources and the environment. Farm activities which are not practiced under a natural farming system are key treatments such as plowing, weeding, chemical use and applying fertilizer.

Jitsanguan (2001) indicated that practice of natural farming system is still relatively rare in Thailand. However, the real farms can be found of natural rice farming in northeast Thailand. Some famers in the Northeast region cultivate rice and vegetable by using their traditional way and local wisdoms.

2.11.4 Agro-forestry

One farming system that farmer gain both farm products and conserve the environment, called an agro-forestry farming system. This type of system is a combination of farm production and forestry. Cash crops and livestock are raised within forested areas. The concept of system is to conserve the forests, as well as biodiversity and the natural ecology. The aim of agro-forestry is not only to produce food and earn income for farmers, but to enhance forest resources. Agro-forestry sustains the

economic benefits of forest, for instance as soil fertility and nutrients from trees, topsoil protection, windbreaks, watersheds. Thus, it is a good example of a compromise between agricultural and environmental needs. This is also a solution to the widespread problem of deforestation since the forest land has been provided for agricultural purposes.

The practice of agro-forestry can be observed everywhere in Thailand where the natural conditions are appropriate, but especially in marginal areas such as the mountainous Northern and Southern regions.

2.11.5 New Theory farming

The concept of the “New Theory” of His Majesty the King in a number of royal initiative projects involved the land and water management. It, furthermore, is applicable for farmers with various sizes of land holding. The principle of the “New Theory” is there are the number of varieties of crops and animals in the agricultural land together with a farm pond. The land use is optimized by division of the land in the ratio of 30:30:30:10 in which the land in each section is used for farm pond, rice production, horticultural crops and residential area including animal barn, respectively (Silapapun, 2005).

This special farming pattern for small-scale farmers in Thailand was initiated by His Majesty the King of Thailand. New Theory farming is the application of integrated farming systems to poor farmers on small land holdings with scarce water resources, as in the Northeast region. Its main aim is to bring food security and self-sufficiency to poor farmers who live in areas where water is scarce. The most important concept of New Theory farming is effective allocation of land to serve the different needs of farm households, including paddy fields for rice, a farm pond for water and fish, and cash crops and trees for farm income, plus a residential area. The area allocated to each kind of land use can be flexible, according to local resources, but is usually 30:30:30:10. New Theory farming is expected to provide food security and a decent quality of life at a farm level. It is also considered an important step under the royal philosophy of economic self-sufficiency.

New Theory agriculture is now being promoted and extended throughout the country, especially in the Northeast region where poverty and water shortages are still serious problems. As Silapapun (2005) indicated that after the first year of the project,

five different groups of farmer showed the average monthly income increase of 76, 156, 74, 70 and 35 percent respectively, as compared to the income before joining the project. New appropriate technologies were introduced to increase productivity. The results obtained show that this approach can be used as an alternative concept in agricultural and community development of Thailand and other countries.

It should be noted that there is the potential for many other kinds of farming system suitable for small-scale farmers, depending on local resources and environmental conditions, as well as the culture and values of farmers in each area. It should be investigated the characteristics of the five main farming systems recommended for small-scale farmers in Thailand sufficient economy, and their implications in terms of resources and the environment.

2.12 Philosophy of Sufficiency Economy

Sufficiency Economy is a philosophy bestowed by His Majesty the King to his subjects through royal remarks on many occasions over the past three decades. The philosophy provides guidance on appropriate conduct covering numerous aspects of life. After the economic crisis in 1997, His Majesty reiterated and expanded on the Sufficiency Economy in remarks made in December 1997 and 1998. The philosophy points the way for recovery that will lead to a more resilient and sustainable economy, better able to meet the challenges arising from globalization and other changes.

Sufficiency Economy is a philosophy that stresses the middle path as an overriding principle for appropriate conduct by the populace at all levels. This applies to conduct starting from the level of the families, communities, as well as the level of nation in development and administration so as to modernize in line with the forces of globalization. Sufficiency means moderation, reasonableness, and the need of self-immunity for sufficient protection from impact arising from internal and external changes. To achieve this, an application of knowledge with due consideration and prudence is essential. In particular great care is needed in the utilization of theories and methodologies for planning and implementation in every step. At the same time, it is essential to strengthen the moral fibre of the nation, thus everyone, particularly public officials, academics, businessmen at all levels, adheres first and foremost to the principles of honesty and integrity. In addition, a way of life based on patience,

perseverance, diligence, wisdom and prudence is indispensable to create balance and be able to cope appropriately with critical challenges arising from extensive and rapid socioeconomic, environmental, and cultural changes in the world.

Wibulswasdi, Piboolsravut and Pootrakool (2010), presented the last part of the definition of His Majesty's SEP is as follows: “...*creating balance and the ability to cope appropriately with critical challenges arising from extensive and rapid changes in material, social, environmental, and cultural conditions in the world.*” That is to say, the SEP approach has a wider view of development than the standard sustainable development concept, which mostly focuses on the impact of development on natural resources and the environment. The SEP path of development emphasizes a balanced use of material resources, social capital, environmental reserves, and cultural wealth as well as the balanced preservation of these four kinds of resources at all stages and levels of development.

Mongsawad (2010) mentioned The King of Thailand's philosophy of sufficiency economy highlights a balanced way of living. Three principles 1) moderation 2) reasonableness and 3) self-immunity can be applied to any level of the society—from an individual to a country. The philosophy of sufficiency economy conveys new theory in addressing current development challenges, which are issues of institutions, human capital, environmental sustainability and the role of government. The philosophy of sufficiency economy, as a new paradigm of development, aims at improving human well-being as a development goal. The framework of philosophy of sufficiency economy is illustrated in Figure 36 below.

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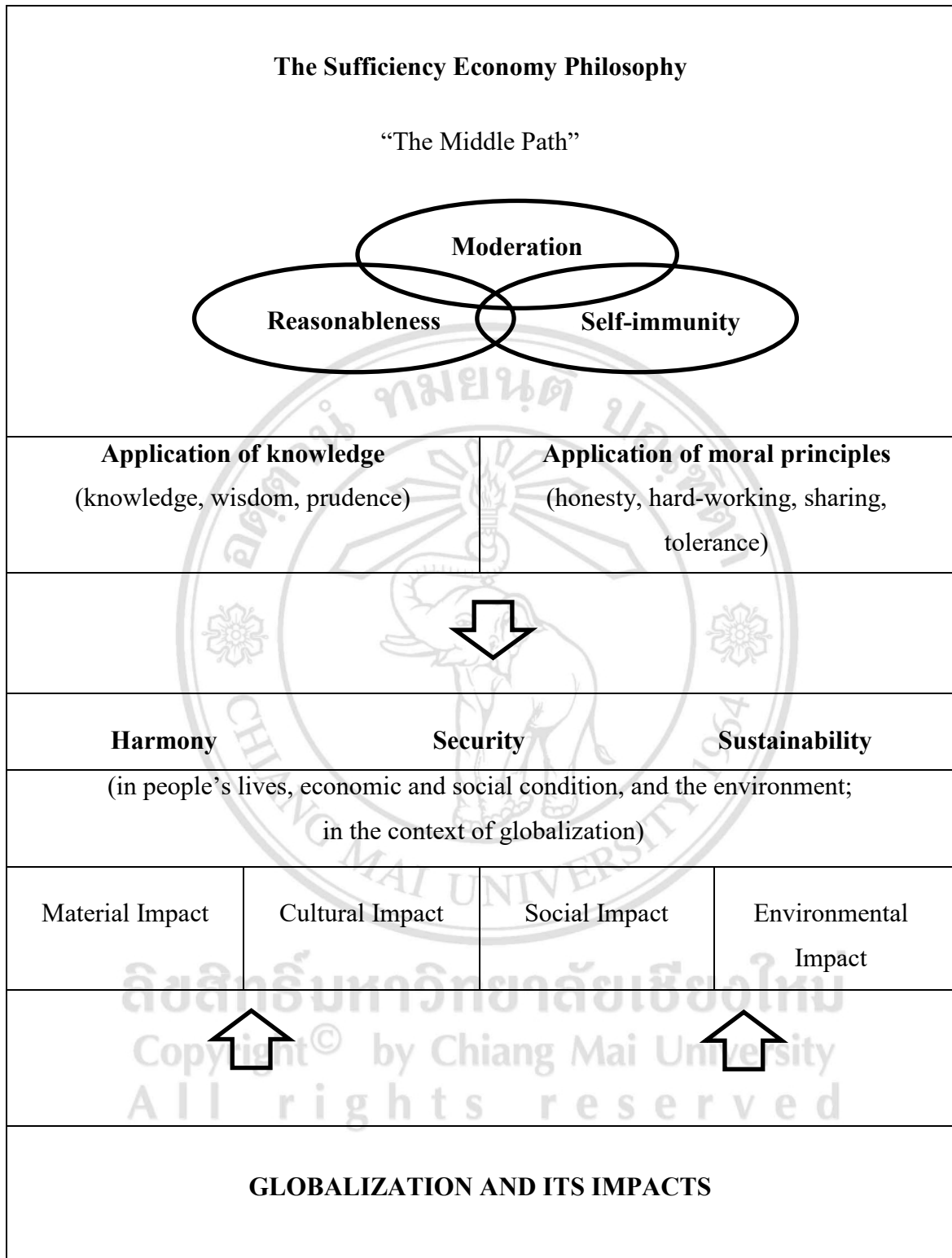


Figure 36 The philosophy of sufficiency economy

As shown above the philosophy of sufficiency economy (PSE) framework. The three interlocking elements represent the three principles of the PSE: moderation, reasonableness and self immunity. These three principles are interconnected and interdependent. Moderation conveys the idea of people living their lives on the middle path, not the extremes. People should rely on themselves without overindulgence. This way of living occurs when people have reasonableness—accumulated knowledge and experience, along with analytical capability, self-awareness, foresight, compassion and empathy. Importantly, they must be aware of the consequences of their actions, not only for themselves but also for others. The third principle, self-immunity, refers to the ability of people to protect themselves against any external turbulence and to cope with events that are unpredictable or uncontrollable. It implies a foundation of self-reliance, as well as self-discipline. Apart from these three components, two other conditions are needed to make the principles of sufficiency economy work: knowledge and morality. Knowledge encompasses accumulating information with insight to understand its meaning and the prudence needed to put it to use. Morality refers to integrity, trustworthiness, ethical behaviour, honesty, perseverance, and a readiness to work hard.

By practicing these three principles with the two underlying conditions, people would be able to live securely in harmony in a sustainable society and environment. Such a way of living does not signify self-sufficiency; rather, it reflects self-reliance—the ability to tolerate and cope with all kinds of malign impacts of globalization.

Mongsawad (2010) also discussed the application of PSE is not limited to the individual; it can also be applied to several different practices, one of which is private business. Philosophy of Sufficient Economy (PSE) encourages corporate pursuance of sustainable profit via ethical approaches, including good corporate governance, social responsibility, mindfulness of all stakeholders, and business prudence with risk management. Many private companies have adapted PSE to implement their businesses. For example, the Siam Cement Group, the PTT Public Company, Toshiba Thailand, the Pranda Jewelry Company and the Chumporn Cabana Resort are examples of corporations implementing PSE (RDPB, 2008).

The philosophy of sufficiency economy (PSE) can also be applied to a country's economic policy. The concept of PSE helps shape economic policy in managing factors of production: physical capital, human capital, natural capital and social capital towards

achieving quality growth. Such growth stresses people's well-being, sustainable environment,

The important elements of PSE: trustworthiness, honesty, integrity, sharing, and altruism, can be considered the social capital embedded in society that encourages proper economic and non-economic activities. PSE acts as an informal institution that can substitute for a formal institution in cases of a dysfunctional or missing formal institution. It also helps shape strong formal social capital in the society. One of the most important applications of the PSE is to help improve human well-being. The PSE emphasizes the self-reliance of an individual and of a community, together with the essentials of education. Poverty reduction can be achieved, by which PSE helps people reduce vulnerability, build their own capability to shape their lives, and have choices.

With the PSE mindset, people will be moderate, reasonable and self immune; therefore, they will not overexploit or abuse the environment or natural resources. They will embrace the environment, conserve it for the future and live in harmony with nature. Finally, a government with the PSE mindset would be able to achieve the optimal role in maximizing its people's welfare. Such a government will make policy with prudence and vigilance, resulting in good governance and a culture of honesty.

Thailand learnt many lessons from a financial crisis that followed the devaluation of the Thai baht in July 1997. The King's philosophy of self-reliance has gained new credence, reflected in government development policies aimed at improving the country's economic well being. Education and technology are being promoted as vital tools in line with an understanding of 'Sufficiency Economy' which implies moderation of aspirations and a balance between success and fulfillment. Education is the key to developing the full potential of the individual and is regarded by policy makers as instrumental in combating poverty. Human development as a concept and as a policy objective must encompass the economic, social and cultural dimensions of human life (Chalapati, 2008).

As known, the philosophy of sufficiency economy of the King of Thailand conveys a new paradigm for development. Emphasizing the three principles of moderation, reasonableness and self-immunity together with the two conditions of knowledge and morality, this philosophy helps address those development challenges.

Thailand is a developing country located in Southeast Asia. In 1997-1998, the country faced economic crisis where a significant numbers of financial institutions and businesses had to terminate themselves. However, Thailand recovered fast. Due to the nation's well-developed infrastructure including free-enterprise economy, generally pro-investment policies, and strong export industries, Thailand generated solid growth from 2000 to 2007 - averaging more than 4% per year. The country was unfortunately hit again by the global financial crisis during 2008-2009. This time, the country's export was severely cut with most sectors experiencing double-digit drops. The "Sufficiency Economy" concept then brought into public's interest and was taught and implemented nationwide actively. The goal of adopting Sufficiency Economy concept is to sustainably develop economy based on a principle of self-reliance "Sufficiency," according to this concept, means "to lead a reasonably comfortable life, without excess, or overindulgence in luxury, but enough")His Majesty the King's birthday speech on 4 December, 1998. It is crucial to study how such concept was successfully implemented and gained acceptance by members of a certain community.) Sathirathai, S. and Piboolsravut, P. 2004(

Sufficiency economy is the name of a Thai development approach attributed to the late King Bhumipol Adulyadej's "sufficiency economy philosophy")SEP(. It has been elaborated upon by Thai academics and agencies, promoted by the Government of Thailand. The sufficiency economy philosophy was elaborated upon in the king's speeches to students at Kasetsart University in 1974 and Khon Kaen University. To the latter he said, "Development of the country must proceed in stages. First of all, there must be a foundation with the majority of the people having enough to live on by using methods and equipment which are economical but technically correct as well. When such a secure foundation is adequately ready and operational, then it can be gradually expanded and developed to raise prosperity and the economic standard to a higher level by stages)Mongsawad, Prasopchoke 2010(.

Many questions from various people about what sufficient economy is. These are common explain to inform people know as three interrelated components and two underlying conditions are central to SEP's application. The three components are *reasonableness*) or *wisdom*, *moderation*, and *prudence*. Two essential underlying conditions are *knowledge* and *morality*. In contrast to the concept that the primary duty

of a company is to maximize profits for the benefit of shareholders, SEP emphasizes maximizing the interests of all stakeholders and having a greater focus on long-term profitability as opposed to short-term success.

In terms of philosophy, Prasopchoke (2010) explained that Sufficiency Economy is that stresses the middle path as an overriding principle for appropriate conduct by the populace at all levels. This applies to conduct starting from the level of families to communities and to the nation in terms of development and administration, so as to modernize in line with the forces of globalization. 'Sufficiency' means moderation, reasonableness, and the need for self-immunity to protect from impacts arising from internal and external change. To achieve sufficiency, an application of knowledge with due consideration and prudence is essential. Especially, great care is needed in the utilization of theories and methodologies for planning and implementation in every step. It is also essential to strengthen the moral fiber of the nation, thus that everyone such as public officials, academics, and business people in particular people at all levels, adhere first and foremost to the principles of honesty and integrity. In addition, a way of life based on patience, perseverance, diligence, wisdom and prudence is indispensable in creating balance and in coping appropriately with critical challenges arising from extensive and rapid socioeconomic, environmental, and cultural changes in the world. Prasopchoke (2010) also presented that self-sufficiency economy offers the idea of limited production in order to protect the environment and conserve scarce resources. Production should be aimed at individual consumption. Production in excess of consumption may be sold.

These can be concluded that the sufficient economic is suitable to Thai community development. From a growth-driven to a sustainable development policy, countries still face clear and present challenges in development. Those challenges stem from dysfunctional institutions, poor quality of people's lives, environmental degradation, and the optimal role of government.

2.13 Thai Jasmine rice (Kao Hom Mali)

Rice is Thailand main crop. It was grown by about three quarters of all farmer households in early of 1980s. Presently, Thailand has some 3,500 varieties of rice both wild and cultivated. Two main varieties of rice were cultivated : dry or upland which

were grown predominantly in North and Northeast; and wet land rice was grown in irrigated fields through the Central plain and the South. However, there are not so many varieties of which farmers grow for consumption and selling such as Kao Niaw San Pa Tong, Kiaw Ngu, Kor Kho 5,6,12, Leung Pra Tum, Pra Tum Tha Ni 60 and Jasmine rice or Kao Hom Ma Li 105. The most popular for consumption and export is Kao Hom Ma Li 105. Its name may be misleading to unknowing westerners thinking that the rice is infused artificially with the essence of blossoms. In actuality, the rice is naturally fragrant but its aroma is not that of jasmine flowers but closer to that of pandan leaves (or called *bai toey* in Thai). When the native rice was first discovered around 1950 and brought into cultivation by a farmer in Choburi province, it was cherished because the grains, when milled, had a beautiful long shape, a shiny translucence and were white like Jasmine blossom by a distinct sweet aroma (the rice does contain a substance also found in the sweetly fragrant pandan leaves). Initially, it was given the name "white jasmine blossom rice" (or *kao kaw dok mali*), but sometime later people mistakenly began calling it "fragrant jasmine" (*hom mali*) rice.

Jasmine rice is originally from Thailand. Thai Hom Mali Rice, popularly known as "jasmine rice," is an original species developed by a local Thai farmer and improved to be a premium white rice with pandan-like aroma, globally known for its quality, long grain, curled-up tips, and clear, glossy exterior. When cooked, the rice maintains its white color and long grain, although the texture becomes tender, fragranced with a fresh, appetizing aroma that goes well with almost all savory dishes. Hom Mali rice is filled with nutritional substances: vitamin B1, B2, niacin, carbohydrates, protein, and minerals such as iron, calcium, and phosphorus (Hays, 2014).

Kao hom mali, sometimes known as Thai fragrant rice, is a long-grain variety of rice that has a nutty aroma and a subtle and pandan-like flavor caused by 2-acetyl-1-pyrroline. The grains will cling when cooked, though it is less sticky than other rice as it has less amylopectin. Not all imported rice labeled as jasmine is a good grade of the rice. Good quality jasmine rice, when properly steamed, retains a wonderful fragrant aroma and delicious chewy texture so tasty. Each year, Thailand produces approximately three million tons of Hom Mali rice, or 10 percent of its total rice production, 75 percent of which is for local consumption while 25 percent is for export. Hom Mali rice is a major economic commodity that earns Thailand over 20 billion baht in export value, or 25-30

percent of the total rice export value. Its major importers are Asia and the United States (60 percent and 20 percent respectively). The rest is shipped to Europe, Africa, and Oceania (Lianchamroon et al. 2000).

According to the Thai government, Although there is a number of species of khao hawm mali (hom mali) rice, the one officially selected and promoted as Thai fragrant rice is "Khao Dok Mali Rice 105, which represents most of the Hom Mali rice grown in Thailand. Hom Mali rice not only gives off a unique fragrance while it is being cooked, but after it is cooked, the grains become tender, held together loosely by natural moisture, and with a heavenly flavor. Many consumers do not want any other rice once they get to taste this wonderful specimen. These attributes are for the "new crop" of Hom Mali rice, when it is marketed soon after its harvest and properly stored before consumption, so it tastes delicious and needs less water to cook.

Hays (2014) also discussed about the "old crop" is stored five to six months after harvesting. The fragrance fades slightly, and its unique tenderness and moistness after cooking are gone, although the taste is about remains the same. It needs more water to cook but it doesn't become tough, the way other species do. Because Hom Mali rice is "light-weight rice," it is ready for harvest sooner than other species, around the end of November. Consumers can get the "new crop" around that time and later go back to the old crop. Hong Kong and Singapore are the most avid consumers of Hom Mali rice.

Lianchamroon et al. (2000) mentioned that kao hom mali grows well in drought conditions and saline soils, so it suits the farming condition of north-east Thailand. On the other hand, the varieties of rice of International Rice Research Institution (IRRI) are made to suit higher-input chemical agriculture in irrigated lands, which poor farmers cannot afford. Thus, Thailand's future - and the future of the poor farmers in the north-east - will rely on sustainable management of the jasmine rice sector and the rice collective heritage. Someone as local wisdom people said "no one could claim ownership or monopoly rights in relation to jasmine rice. To patent jasmine or misuse it is plundering from the poor". Hays (2014) also presented the characteristics and size of the rice grain: Thai Hom Mali rice grains shall possess the characteristics and size as follows: 1) General characteristic: long grain; 2) Average length without breakage: not less than 7.0 mm; 3) Average width of the full grain rice without breakage: not less than 3.0 mm. Chemical Attributes: Thai Hom Mali rice shall contain not less than 12 percent and not more than 19 percent of amylose at the 14 percent humidity level

Hays (2014) also explained that general Stipulations: 1) White rice and unbleached rice mixed with other rice over 30 percent by weight is not classified as Thai Hom Mali rice by this Standard; 2) Humidity: The humidity of all types and classes of Thai Hom Mali rice shall not exceed 14 percent; 3) Rice sample: Any rice sample not classified in accordance with this Standard, supplied for trading purposes, shall be as the supplied sample and the agreement between the purchaser and vendor agreed upon; 4) Conflicts and issues: In case of contests or disagreements regarding the Thai Hom Mali rice quality, both parties shall forward the samples that passed the approval of the opposite party to the Department of Agriculture for examination and final ruling.

Categories of Thai Jasmine Rice or Thai Hom Mali rice shall be classified into three categories, depending on the percentage of the other rice species mixed with it: 1) Prime quality: other rice does not exceed 10 percent by weight; 2) Superb quality: other rice does not exceed 20 percent by weight; 3) Premium quality: other rice does not exceed 30 percent by weight.

Khao Dawk Mali 105 has bloomed in Lopburi for several years. Then it has been conducted to the North Eastern part of Thailand, there are Buriram, Surin, Srisakhet, Roi-Ed, Yasothon and Mahasarakham, by the government support for yield trial in farmers' field. Due to the huge advertising for promotion of this Thai aromatic rice in this part of Thailand, Thai Hom Mali Rice has generally been known worldwide.

The North Eastern (NE) area of Thailand has the specific geography which is different from the other regions of Thailand. The lowest soil fertility is in this area. Drought occurs in the early and middle season of crop planting. It also has land flooding in August or September in mostly every year. This land has a layer of rock salt under the planting soil surface. In the hot period of dry season, you can see the white salt patch on the soil surface. Even in Thailand, where this aromatic rice originated, the quality can vary considerably depending on where it is grown. The northeastern region of the country has the ideal combination of soil and climatic conditions to produce the best-tasting, most fragrant rice, commonly named Fragrant Pandan/Screwpine Leaf/Leaves. These fragrant leaves are used for flavouring desserts, cakes and. Leaves are, furthermore, used for wrapping meat or fish before frying, baking or grilling for added fragrance and taste.

Farmers in the north east Thailand has experience the long dry spell during a in a rainy season in decades. The dry spell, lasting from June until late August, reduced crop yields, lowering farmers' income and reducing food security. Some part of the north – east Thailand insists of a part of legendary “Weeping plain” names after its barren landscape. The plain spans five provinces: Surin, Srisaket, Buriram, Roi-et and Mahasarakam, covering more than 2.1 million rai (approximately 829,500 acres). The plain's dry conditions have made it suitable for growing the world-famous fragrant jasmine rice. These areas of the north-east Thailand are rainfed, with no irrigation facilities. Jasmine rice is light-sensitive and has to be grown during particular months of the year, thus when there are no rain, rice plants are left to wither in the scorching sun.

2.14 Chapter Conclusion

The chapter presents the brief of agricultural development in Thailand. The, it focused on the information about the Northeast region of Thailand, especially the condition of the regions based on the agricultural and economic development. Three main crops have been presented the situation. According to research area in Khon Kaen, the conditions of Khon Kaen related to agricultural development is also indicated. The chapter introduced the problems of agricultural development as occurring up to a present. Lastly, the alternative agricultural systems are introduced. This also presented the concept and theory of learning and innovation and technology adoption. Furthermore, learning theory, grounded theory, philosophy sufficiency economy and jasmine rice had been reviewed to gain more knowledge and idea for improving the dissertation. Next chapter will be discussed on research methods, which was divided into three main activities methods.