

## Health Impacts of Climate Change: Case study on Rain-fed Farmer in Kula Ronghai Field, Thailand

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### Abstract

Kula Ronghai is the largest area of high quality of jasmine rice or KDML105 rice in Thailand and in the world. Climate change threatens is a new threats to kula Ronghai. The expected changes in climate would impact on rain-fed agriculture are a particular concern because farm livelihoods that are based on cultivation of rain-fed crop are highly vulnerable to climate stress and rain-fed agriculture is the dominant economic activity of this area, 70.8 percentage of household income is from rice production, Climate change is impacted to main income of farmer. The results from the study found that in the climate stress year, rice yield damage average 45.5 percentages is mean that farmer lose money near 50 percentages of household income. However, in some area rice yields are almost damage. In the present, climate stress year is more frequency than in the past. Climate change impacted to health of farmer in Kula Ronghai both direct and indirect. It found that in the climate stress year, farmer is worry about rice yield which is less than he could get it in the normal year and it affected to household income in this year. Farmer will stress if income is less than outcome. He has to seek a job in downtown for reimburse income in the year. If he can not earn more income is means that he has to loan money from a neighbor or the bank. He has a debt all time. It is affected to mental health. In the family which has baby or child, the children have to take care by the older when parent go to work in the city. Some children have malnutrition. It is affected to physical, social and mental health. In past decade, some area which high risk from climate change, severe from drought and food, people migrated to working in the urban

very much and in the long time. The people have no time to joint in cultural work and the common wealth. It shown indirect affect of climate change is affected to spiritual well-being.

## **Introduction**

Kula Ronghai field is well known in jasmine rice or Kawhommalii (KDML105) of Thailand. It is locating in the Northeast of Thailand. It has area about 430,294.1 hectares which cover the area of 5 provinces; Roi Et Province, Surin Province, Srisaket Province, Mahasarakham Province and Yasothon Province. The south of the area is parallel with Moon River which the longest of the area is about 150 kilometers and the widest is about 50 kilometers. Almost areas of Kula Ronghai field are 46.8 percentages locate in 4 districts of Roi Et Province; Kasetvisai district, Suwannaphum District, Pratumrat and Phonsai District. 27.3 percentages of the area locate are in Tatum and Chumponburi District of Surin Province. 13.6 percentages of the area locate in Rasrisarai and Sirarat District of Srisaket Province. 9.2 percentages of the area locate in Prayakaphumpisai District of Mahasarakham and 3.1 percentages locate in Mahachanachai District and korwang District of Yasothon Province.

Kula Ronghai is the largest area of high quality of jasmine rice or KDML105 rice in Thailand and in the world. This area is planting KDML105 rice about 204,176.5 hectares or 60 percentages of total areas.

## **Variation of Weather in Kula Ronghai Filed**

Variation of rainfall in the past decade (year 1995-2004) from 3 meteorology weather stations show that rainfall in Kula Ronghai is different from station to station and year by year. Kosum Pisai weather station has a total of rainfall more than Roi Et weather station and Tatum hydrology station respectively.

## **Farmers' Concerns about Climate**

Climate change threatens to magnify existing climate threats, as well as bring new threats to the countries of the lower Mekong River basin. The expected

changes in climate would impact on many systems and sectors. Impacts on rain-fed agriculture are a particular concern because farm livelihoods that are based on cultivation of rain-fed crop are highly vulnerable to climate stress and rain-fed agriculture is the dominant economic activity of the region, engaging a high proportion of the population (Schiller et al., 2001).

The study was conducted through household interviews and focus group meetings in farm communities of Kula Ronghai field. Amount of 623 households participated in the interviews and meetings, which were conducted in 2004.

The interviews and focus group discussions explored farmers' perceptions of climate hazards, the risks to their farming activities, observed changes in climate and the impacts, strategies and measures used to cope with climate risks, and options for improving the management of climate risks. The climate risks found to be major concerns for farmers vary from location to location, it depend on the geographical characteristics of the farmland, farming practices of the community and local features of the climate.

Climate risks are not new risk factor for farmers at Kula Ronghai field like in the lower Mekong River basin sub region. Farmers have been adapted to climate impacts throughout history, and strategy for managing climate risks have evolved through times. However, two climate phenomena are identified by farmers as significant threats to their livelihoods. Important climate risks that are common to farmers include midseason dry spells that can damage young plants and late-season floods just before harvest that can cause severe crop loss. Farmers have developed and used various measures to cope with these and other climate risks. Rice farmers' experiences have measures to manage climate risks and their perspective on the potential for applying the same measures to adapt on climate change. The most of farmers in Kula Ronghai field rely mainly on natural rainfall for growing crops. Farmers of rain-fed rice practice single wet-season cropping, which normally starts in mid-April to May and ends in November. These farmers start sowing rice at the beginning of the rainy season. Farmers who use a transplanting technique begin the process in mid-May to mid-July and harvest in November.

The midseason dry spell normally occurs after seeding and /or transplanting and a prolonged one would seriously damage young rice plants (July-September). In some year, dry spell occurs in the early season (May-June). Such events can increase the cost of production, as farmers may have to replant their rice. However, in some cases of delayed or prolonged dry spell, replanting may not be feasible because the rainy season would end before the replanted rice would reach maturity.

Flood that occurs late in the rainy season, October or November or September-November, which is quite common in Kula Ronghai field, poses serious risks for rice cultivation (near harvesting time) and farmers' livelihoods. This period is close to rice harvesting time. Therefore, there would be no time to replant rice for that year if the crop destroyed or damaged by a late-season flood, because they grow a photo sensitive rice variety (KDML105) and in Kula Ronghai field is no water reserve for planting rice in the dry season. In the discussions with farmers' community, the possibility of increasing flood risk due to climate change raised high concerns among the farmers.

### **Vulnerability of Rain-fed Farmers**

The assessment analysis on risk and vulnerability of rain-fed farmers to climate change impact was based on multi-criteria by taking sensitivity, exposure and coping capacity to climate impact criteria as frame of analysis under condition. These criteria used household economic condition, farmer's dependence on their farms production, the coping capacity to climate impact as proxy of each criterion, of which each criterion was explained by multiple indicators. The results from risk analysis shows that under normal climate condition, the farmer could be categorized into low risk, moderate risk and high risk to climate impact at 8.8%, 61.6% and 29.6% respectively.

Vulnerability of rain-fed farmers based on the analysis of sensitivity in the risk profile of farmer's livelihood to climate impact. By comparison between the risk profile under normal climate condition and the risk profile under climate stress, the analysis showed that 77% of total surveyed households were vulnerability to

climate impact from extreme climate event, why only 23% may be consider as non-vulnerable, climate resilience group. Majority of the household's livelihood is not sustained as income came from rice production. Most of the vulnerable household has high debt and if the climate change cause more frequent extreme climate event, these farmers are likely to unable to recover the debt condition and may be forced out of the rice production system to other sectors.

### **Managing Climate Risks and Potential Adaptation**

Farmers surveyed identified numerous practices currently is use in their communities which they believe lessened their vulnerability to present-day climate variability and hazards. Some of the measures are motivated by climate risks. Others are primarily motivated by different concerns, yet nonetheless reduce climate risks by increasing the resilience of farmers' livelihoods to multiple sources of stress. They include on-farm and off-farm measures that are implemented at the household level (table 1), the community level (Table 2), and the national level (table 3). Although none of the measures are motivated by perceived needs to adapt to human-induced climate change, many measures that are focused on near-term climate risks could be developed further for longer-term climate change adaptation (Kates, 2001). Implementation and effectiveness of the measures is different depend on location to location and geographical characteristics of the farmland.

Rice farmers in Kula Ronghai filed are mostly commercial farmers who live in a monetary oriented society and grow rice primarily for national and international markets, KDML105 or RD6. They produce a single rice crop each year using mechanized and modern technologies and institutional instruments. Only a small portion of farmers which larger farm are able to divide their farmland to grow both commercial rice variety for sale and local rice variety for their own consumption or sale in the local market. The sale of rice is their main source of income, which is used primarily to purchase household basic needs, including rice for consumption in some year. The farming communities are closely linked to urban society. The surrounding land area is populated and used for settlements or

is deteriorated natural forest that can provide only limited natural products as a supplement or alternative source of food and income (Kerdsuk and Sukchan, 2005).

According to the field assessment, farmers at the study sites tend to rely on household and national-level measures for reducing climate risks, whereas the role of community-level measures has declined or been neglected. The household-level measures focus on income diversification, primarily from off-farm sources, which are not as sensitive to climate variations as income from rice (Kerdsuk and Sukchan, 2005) The main practice is seasonal migration to work in the cities, which can lead to the permanent migration of some members of the family in order to secure fixed income for the household. Wage income from city employment is less sensitive to climate and helps to insulate the farm household from climate-driven variations in farm income. Seasonal and permanent migration to diversify and supplement household incomes are common in the study sites and should be possible by close links between the rural villages and urban areas where there is demand for labour.

Because they grow rice for national and international markets, they are limited in their ability to use local seed varieties, which fetch lower prices than commercial rice varieties. In contrast, semi-permanent changes in seed varieties to commercial varieties that are more resilient to climate stresses are common practice for farmers. This is made possible by department of rice that provides new rice varieties that are both accepted in the market and more resistant to stress. This option could be moderately effective for adapting to climate change. Limitations on wider use are financial, technological and environmental.

Other on-farm measures for reducing climate risk practiced by rice farmers include changing seedling technique, using hired machinery, growing alternative crops between rice seasons and raising livestock. Some farmers make investments to increase and sustain the productivity of their farms in ways that make them more resilient with respect to climate variations and changes. For example, they construct small-scale irrigation systems to provide an alternative source of water for midseason of dry spells or for growing a crop during the dry season. They may

also build embankments to protect their fields from flood damage. A small number of farmers with large landholdings implement mixed-farming practices.

National-level policies and measures that serve to reduce vulnerability to climate hazards are more prevalent in Thailand than in Lao PDR and Vietnam. These policies and measures are not motivated by concerns about climate stress, especially climate change, but mainly by poverty reduction goals. Yet, national measures in Thailand have supported financial needs, infrastructure development, transitions to more diversified farming systems, marketing of local farm products and farm planning, which have helped to improve the livelihoods of farmers and increase their resilience to climatic stresses. For example, an initiative of the Ministry of Agriculture and Cooperatives in 2004 (Department of Livestock Development, 2004) diversified farming activity by promoting and providing support to farmers to raise livestock. Another initiative promotes transition from rice cultivation to other plantation crops that are more resistant to climate stresses, such as Eucalyptus tree. Research and development by government research facilities have provides new varieties of rice that are more resilient to climate variations, while maintaining the quality that is required by the market.

Community-level measures are diminishing in Kula Ronghai Field, with the exception of village funds for local investments to support farm livelihoods, which are managed by the government. But community or local administration units could play an expanded role to assist in planning as well as implementing future adaptation to climate change. The advantages of involving local institutions are that they are more aware of local risks, priorities and resources than national authorities and can be more flexible and timely in implementation.

Climate stress and disaster are more magnify and aggressive occurred than the past. It is pressed the farmers' adaptation to climate risk by reducing rice cultivation risk and sustainable of Household income. For example, Comparing adaptation of farmers between in the year 2004 and in the present(2008), now adaptation of farmers for decrease a disaster events and increase stability of rice farmer in Kula Ronghai field are planting Eucalyptus tree on the bund, planting Eucalyptus tree in the paddy field which has often flooding every year

(plattitudinous flood area), planting floating rice in the flood area, second rice growing in the dry season (just grown it in the year 2008), rice leaf cutting, planting a sugarcane in upper paddy field, and planting a cassava after rice. Successful of planting a field crop in Kula Ronghai field, the area of field crop will expand in the future.

### Health Impacts

Farm livelihoods of paddy farmer in Kula field are based on cultivation of rain-fed crop are highly vulnerable to climate stress and rain-fed agriculture is the dominant economic activity of this area, 70.8 percentage of household income is from rice production, Climate change is impacted to main income of farmer. The results from the study found that in the climate stress year, rice yield damage average 45.5 percentages is mean that farmer lose money about 39, 887 baht of rice income or 38 percentages of total income in the normal year. In normal year, Total house income is 105,022 baht/year: income from rice 71,869 baht. In stress year, Total house income is 76,911 baht/year: income from rice 40,411 baht. However, in some area rice yields are almost damage. In the present, climate stress year is more frequency than in the past. Climate change impacted to health of farmer in Kula Ronghai both direct and indirect. It found that in the climate stress year, farmer is worry about rice yield which is less than he could get it in the normal year and it affected to household income in this year. Farmer will stress if income is less than outcome. He has to seek a job in downtown for reimburse income in the year. If he can not earn more income is means that he has to loan money from a neighbor or the bank. He has a debt all time. It is affected to mental health. In the family which has baby or child, the children have to take care by the older when parent go to work in the city. Some children have malnutrition. It is affected to social and mental health of farmer. In past decade, some area which high risk from climate change, severe from drought and food, people migrated to working in the urban very much and in the long time. The people have no time to joint in cultural work and the common wealth. It shown indirect affect of climate change is affected to spiritual well-being. Not

only yet, in some year, the farmer risk to get Leptospirosis disease during he is work in the paddy field, especially in the flood area. Farmer who has Leptospirosis disease will pay more money to cure it.

## Conclusion

Kula Ronghai is the largest area of high quality of jasmine rice or KDML105 rice in Thailand and in the world. Climate change threatens is a new threats to kula Ronghai. The expected changes in climate would impact on rain-fed agriculture are a particular concern because farm livelihoods that are based on cultivation of rain-fed crop are highly vulnerable to climate stress and rain-fed agriculture is the dominant economic activity of this area, 70.8 percentage of household income is from rice production, Climate change is impacted to main income of farmer. The results from the study found that in the climate stress year, rice yield damage average 45.5 percentages is mean that farmer lose money near 40 percentages of household income in the normal year. However, in some area rice yields are almost damage. In the present, climate stress year is more frequency than in the past. Climate change impacted to health of farmer in Kula Ronghai both direct and indirect. It found that in the climate stress year, farmer is worry about rice yield which is less than he could get it in the normal year and it affected to household income in this year. Farmer will stress if income is less than outcome. He has to seek a job in downtown for reimburse income in the year. If he can not earn more income is means that he has to loan money from a neighbor or the bank. He has a debt all time. It is affected to mental health. In the family which has baby or child, the children have to take care by the older when parent go to work in the city. Some children have malnutrition. It is affected to social and mental health. In past decade, some area which high risk from climate change, severe from drought and food, people migrated to working in the urban very much and in the long time. The people have no time to joint in cultural work and the common wealth. It shown indirect affect of climate change is affected to spiritual well-being.

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**Table 1** Household level on-farm measures for managing climate risks

Measure	objective	Current implementation	Effectiveness	Enabling and limiting factors
Change rice variety - season	Avoid productivity loss from adverse climate condition, improve food security	Limited use	moderate	Market acceptance of seed varieties; consumption preference
Change rice variety- permanent	Reduce variability of crop yield and income	Common practice	Moderate	Development of new seed varieties; market acceptance; consumption preference
Multiple, spatially separated farm plots	Diversify exposure to climate hazards	Limited use	High	Land availability and characteristics; population growth
Match method and timing of cultivation practices to seasonal climate	Avoid productivity loss from adverse climate conditions, improve food security	Change seedling technique. Crop calendar constrained by the market.	Low	Length of rainy season; market constraints on crop calendar
Manage water with	Water source during dry	Moderate use	Moderate to high of	Geographical features;

small-scale irrigation, embankments	spells; control flooding		sufficient resources	financial resources for investment and operating costs
Grow alternate crops between rice seasons	Increase and diversify food supply and income	Limited to moderate use	moderate	Water availability in dry season; market for alternate crops; size and condition of farm land
Grow crop resilient to wider range of climate conditions than rice	Reduce variability of food supply and income	Limited to moderate use	High where feasible	Know-hoe; markets for other crops; financial reserves; farm size and soil condition; local culture
Livestock	Reduce variability of income food security	Common practice at small scale	High	Financial reserves; farm size and condition

**Table 2** Household-level off-farm measures for managing climate risks

Measure	objective	Current implementation	Effectiveness	Enabling and limiting factors
Harvest natural products	Increase and diversify	Limited use	moderate	Productivity, diversity and

	food supply and income			condition of natural ecosystems near villages
Produce and market non-farm products	Increase and diversify income	Moderated used	Moderate	Know-how; access to market; market conditions
Seasonal migration for off-farm labour	Increase and diversify income	Common practice	High	Labour demand in urban areas; access to labour market; networks for job search
Permanent migration by family member	Increase and diversify income	Common practice	High	Labour demand in urban areas; access to labour market; reduced farm labour for family

Table 3 Community-level measures for managing climate risks

Measure	objective	Current implementation	Effectiveness	Enabling and limiting factors
Shared resources-rice reserve/fish pond	Spread risks by creating food reserve; increase	Limited use	Low	Cultural practices; strength of community

	income for community			institutions; guaranteed replenishment of rice reserve
Village fund	Finance investments to improve farms, livelihoods	Common practice; managed by government	Moderate	Guaranteed repayment by borrower
Cooperative network among village	Spread risk by sharing rice production food supplies and labour with other villages	Limited use	Low	Relationship between village leaders; cultural practices
Cooperative processing and marketing of farm and natural products	Increase and diversify income	Limited use	Moderate	Know-how; financial reserves; market access; market conditions

