



Traditional ecological knowledge in Thailand: Mechanisms and contributions to food security



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ABSTRACT

Despite worldwide advances in science and technology, human well-being of the rich and poor has been threatened by food insecurity. Due to socio-economic and environmental pressures on agriculture, developing countries have faced a shortage of food access and degraded quality of food resources. We argue that traditional ecological knowledge (TEK), when appropriately used and adapted could play a significant role in addressing food security for rural, smallholder farmers. Data were collected in two rural farming communities located in the drought-prone and poverty-stricken Northeast Region of Thailand. Both were situated in diverse ecological settings: one characterized as a subsistent, lowland rice farming community and the other, the upland, all of which were dominated by cash crops. We employed a combined data collection method including in-depth interviews, participant observations, and household surveys to examine household-based food acquisition patterns. We found that the lowland subsistence farming community was endowed with a higher level of TEK and showed a stronger indication of food security than the upland cash-crop focused community. Furthermore, under environmental change, local villagers drew upon TEK to support their way of life. TEK also helped villagers to adapt to new environmental and socio-economic changes, to sustain ecosystem services and agricultural activities, and to build a secure and safe food system. This finding suggests that over-promotion of export-oriented agriculture could leave smallholder farmers and disadvantaged populations in a vulnerable situation. Their food security could be enhanced by the conservation of community-based natural resources with respect given to the role of TEK.

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Introduction

Food security is a global concern, particularly for the “poor” and disadvantaged sector of the population. Given the continued impact of climate change on agriculture and natural resources, the future of food security for low-income people is full of uncertainty. Research shows the majority of low-income countries, in particular, have

continued to encounter problems associated with food shortage, access to food resources, health, and well-being (Ingram, Eriksen, & Liverman, 2010). As such, food security is more complex an issue than generally perceived, as it encompasses a multi-faceted food production system. In other words, food encompasses a number of key concepts: availability, accessibility, and quality. The consumption of food is not only linked to human nutrition, but also to socio-cultural needs (Kuhnlein, 2009).

The availability of sufficient food to provide for a country's entire population requires both capital investments and technological resources. However, food

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acquisition is also susceptible to external factors, such as a rise in global oil prices. Access to key resources (that is, land, water, markets, labor) are intertwined with concepts like social justice, particularly in terms of the right to access food (Ingram et al., 2010). Both the availability and accessibility of food could easily hurt low income populations in food-deficit countries (United Nations, 2010). With regard to food quality, even when availability is high, as in developed countries, new health problems have arisen from overconsumption of processed foods (Thai National Food Committee, 2012). Research also shows that new diseases, such as diabetes, high blood pressure and heart failure, are directly related to diets based on high levels of carbohydrates, fat, and refined sugars, all of which are the characteristics of modern food acquisition (Kuhnlein, 2009).

This paper examines the impacts of changes in food acquisition on communities of farmers through a study of two rural communities in Thailand's drought-prone and poverty-stricken Northeast Region. Our analysis sheds light on some of the mechanisms and contributions of traditional ecological knowledge (TEK) to community food security.

Literature Review

Impacts of Climate Change

Global ecological degradation and climate change has become real threats to agriculture, the major source of food production in both the affluent and low-income countries. We have begun to witness the impact on the majority of the world's disadvantaged and marginalized populations, namely indigenous people, minority-ethnic groups, and smallholder farmers, most of whom live in remote rural areas. For example, in the Mekong River basin, where rain-fed rice cultivation was widespread, many farmers have experienced water shortages due to severe seasonal changes (Chinvanno, 2008).

In low-income countries, a decline in agricultural production due to global climate change has led to a dependence on imported grains. High demand has led to price surges in both the domestic and international markets. According to the World Bank 2012 reports, major food crops such as sugar reached a 30-year high in 2011, and a 12 percent increase since January 2010. Therefore, the future of food security world-wide cannot be taken lightly and there is an urgent need to explore an alternative way forward (Corway & Edward, 1990; Shiva, 1991).

Impacts of the Green Revolution on Community Livelihoods and the Natural Environment

In most low-income countries, an increase in agricultural production levels has not only been an option to raise income, but a necessary one. In the early 1960s, the global community witnessed the adoption of what was to be a promising solution for developing countries to feed their ever increasing population. This new approach called the "Green Revolution" drew upon the applied sciences and new technologies to increase yields on traditional farms (Shiva, 1991). However, a large number of experts have

questioned the successes offered by the transfer of "Green Revolution" technology to the developing world. Chiefly, the Green Revolution has been criticized for causing environmental damage, such as biodiversity loss due to excessive and inappropriate use of fertilizers and pesticides and land degradation through a focus on mono-cropping (Eakin, Webhe, Avila, Sanchez Torres, & Bojórquez-Tapia, 2007).

In Thailand, farmers have become dependent on synthetic fertilizers and agricultural chemicals to sustain productivity. Foreign fertilizer companies have benefitted as the demand for imported fertilizers is high. Inappropriate use of pesticides is evidently harmful to farmers' health. A 2003 survey of 606 agriculturalists from six provinces revealed that almost every person showed at least one symptom of toxicity from the chemicals they used; 56 percent had moderate symptoms and one percent had severe symptoms. In addition, blood tests from 187 agriculturalists showed that 11 percent were at high risk (Thai National Food Committee, 2012). Despite strong opposition, the Green Revolution innovations are still the predominant form of agriculture on a global scale and there have not been any new ways to replace long lines of productivity with a pro-Green Revolution reference.

The Challenges of Small-farmers and TEK Relating Ecosystems

TEK is most easily understood within the context of ecology. Conceptually, an ecosystem is a dynamic complex of plant, animal, and microorganism communities and the nonliving environment, interacting as a functional and adaptive unit (Berkes & Carl, 1998). Humans are an integral part of ecosystems, interacting through services (Millennium Ecosystem Assessment, 2005). Viewed from a holistic ecological perspective, human beings borrow from the ecosystem to attain well-being through knowledge passed on from generation to generation and shared among members of society such as observation and classification, situated knowledge, management system, and world views (Brigg, 2005). Broken down into a series of skills and abilities TEK is applied in the following fields: 1) observation and classification, for example, by type, weight, color, 2) situated knowledge by transmitted knowledge of the past and current uses of the environment transmitted through oral history, 3) management system by constructed norms and local law, 4) world views by connection between belief and ways of life (Berkes, 2008; Grenier, 1998).

These characteristics have directly and indirectly been turning scholars and researchers toward TEK as an alternative form of sustainable development (Grenier, 1998). In this paper, we offer an alternative way to cope with food security, especially in low-income countries where a large number of disadvantaged and politically marginalized populations live in rural, farming areas. We are strongly convinced that the key to achieving food security in disadvantaged groups of people rests upon the components of what we refer to as TEK. This study will show the ways in which communities that uphold the practice of TEK in relation to agricultural practices, biodiversity conservation, and as a form of self-help to support, have a higher

likelihood of food security than in communities where TEK is not in place.

Methodology

As suggested earlier, food security is a highly complex issue involving the contentedness of both the environmental resource and human systems. The needs for individual's and communities' well-being and opportunities to satisfy them are shaped by both national and global-scale social and economic developments and changes. Recognizing these complexities, we employed an interdisciplinary approach in data collection and analysis, combining community-based ethnographic studies.

Concentrating on the acquisition of sources such as natural food resource, commercial food access, and agricultural food, we chose two rural communities in the diverse ecological setting of Dansai district, Loei province, Northeast Region (*Isaan*) of Thailand: Ban Na village characterized as a long-settled lowland, rice farming community and Ban Pa, an upland community located in an upland forest area. Both villages are in the northernmost reaches of *Issan*, characterized by uneven terrain and unpredictable rainfall patterns. Ban Na village has a total population of 221 (80 households) and the highland Ban Pa has 710 (140 households).

The first stage of data collection involved the use of eight key informants who were local experts and practiced TEK for in-depth interviews and then later, some members (around 40) drawn from the total population of 931 in the two communities were involved in focus group interviews during February 2012 to January 2013. This study also applied plant identification by surveying wild plants in the community forests of each village and crop plants that local people cultivated. In the community forests of the two villages, the research considered a consensus area of around $4 \times 4 \text{ km}^2$. For crop plants, the research surveyed the land of each household. Natural and crop plants were identified by local specialists in plants and animals.

We analyzed data from the in-depth interviews, participant observation, and household surveys on TEK of rice and corn production from two case studies of community food systems by sampling 50 percent of the Ban Na and Ban Pa households who planted rice and corn. The sampling selection of members and households involved villagers knowledgeable about different aspects of TEK, such as wet and dry rice cultivation, hunting, and gathering from natural food sources. We examined secondary data sources: published material, documents, and literature.

Furthermore, practicing knowledge was classified into three levels; high, moderate, and low, where high indicated more than 60 percent of total households (HHs) practicing knowledge, moderate indicated 40–59 percent of total HHs practicing knowledge, and low indicated less than 40 percent of total HHs practicing knowledge (Creswell & Clark, 2007).

Results and Discussion

Based on field research, Ban Na has a continuous history going back around 300 years, whereas, Ban Pa has a short

history (Vanliphordom, 2008). The inhabitants of both villages have similar ancestry through immigration from Luangprabang, Laos. We found that Ban Na villagers practiced a number of rituals that were linked to the use of natural resources. Like Ban Na, Ban Pa villagers had traditional forms of knowledge, but as they shifted from subsistence agriculture to cash crops, they gradually became disconnected from this way of knowing.

Food Security and the Threats

Our findings suggest that to acquire food security, smallholder farmers in upland Ban Pa had to deal with relatively higher risks and uncertainties than those in lowland Ban Na. The natural forests in particular had a plentiful food supply, such as wild animals, vegetables, and fruit. The people of Ban Na had direct access to water resources, as their village is located in the Moun River valley. Ban Pa, on the other hand, is in the upland area of Phu Anglang and as such, villagers there only have access to a relatively small stream, the Huay Tad.

Natural Food Resource

Regarding food sources derived from agriculture, Ban Na and Ban Pa villagers cultivated a variety of crops throughout Dansai district. Villagers planted crops on their own landholdings and on patches of public land scattered around their communities. These communal land areas were located on the edge of the Moun River in Ban Na and the Huay Tad in Ban Pa. Villagers also had access to naturally occurring foods such as Amaranth (*Amaranthus lividus* Linn.), Shade palm (*Amorphophallus paeoniifolius* (Dennst.) Nicolson), and Passion fruit (*Passiflora foetida* L.). Regardless of natural food sources, rice (*Oryza sativa* L.) was the staple food for villagers and played a crucial role in community food security.

Commercial Food Access

In addition to forest and agricultural land, both communities acquired food from commercial sources. We found that villagers access food through four types of markets: 1) local shops; 2) food trucks and motorbikes that came into their communities; 3) weekly fresh markets—Talad Klongthom; and 4) a permanent market constructed in the district town of Dansai which was located 2 km away from Ban Na and 10 km from Ban Pa. Local shops included small-sized and medium-sized enterprises owned by local farmers. Ban Na's market place offered local people one place to buy commodities with a retail shop selling some convenience food, cooking ingredients, snacks, desserts, and beverages, while Ban Pa had four retail shops with similar items for sale.

Agricultural Food

For over five decades, the livelihoods of the people in both Ban Na and Ban Pa have undergone constant changes under pressure exerted from socio-economic development and modernization policies administered by the central authorities in Bangkok, Thailand's capital city. Under the changing conditions, the people in lowland Ban Na have continued to plant wet rice and to a lesser extent cash crop.

In addition, Ban Na villagers have had access to forested areas nearby to acquire natural foods on a seasonal basis. This shows that food security in lowland Ban Na has been relatively stable and self-sufficient.

In contrast, the livelihoods of Ban Pa villagers have depended on dry rice agriculture in hilly areas, corn (*Zea mays* L.) and para-rubber tree (*Hevea brasiliensis* (A. Juss) Muell. Arg) plantation. Villagers have become reliant on food sources from outside fresh markets. The last five years has seen an increase in provisions bought from markets. Worse still, in some years cash crops have produced decreased yields due to seasonal changes impacted by changes in the climate as observed by the interviewed locals. As a consequence of reduced income from agricultural activities, many villagers earned income insufficient to fulfill their household food needs. These problems raise the question of whether or not upland Ban Pa is encountering a food security problem? The question is not as simple as we originally perceived.

Mechanisms and Contributions of TEK

TEK mechanisms, as defined in this paper, are ways in which local people construct and organize knowledge as a means of harnessing the services of the ecosystem. They are both individual and collective processes involving a wide-range of activities and experiences, namely creativity, accumulation, adaptation, and transmission of experiences to deal with, for example, natural resource systems, institutions, world views, enhancing political voices, and preserving indigenous cultures or revitalizing them (Grenier, 1998).

Ban Na and Ban Pa villagers exhibited TEK through the ways they acquired food and the way they utilized ecosystem services in two principal ways. First, participants showed knowledge of the names and taxonomy of wild animals and plants. They also understood different ways to utilize their products to sustain their way of life (for example, construction, food, and curative purposes). Collectively, they were capable to organize the hunting and gathering, conservation, collection, and distribution of wild plants. The latter included the bartering and selling of the surplus. Second, as agriculturalists, participants learned how to work with diverse soil types, terrain, and water regimes, coupled with highly variable rainfall patterns and seasonal changes. TEK was also embedded in collective rites and rituals, most of which were related to cultivation cycles and ways in which to distribute the proceeds.

In the two communities under investigation, TEK made a contribution to the local people in many different respects (Table 1). They allowed people to harness the services of the ecosystem, of which they are part, enabling them to adapt their lifestyles to cope with ecosystem change and to secure access to food resources on a year-round basis. These activities all acted to raise their level of well-being. TEK also enabled the people to harvest a wide-range of ecosystem services in a sustainable way. As the data suggest, there was a contrast in the use and application of TEK in three areas related to food resources.

Forest Conservation

Based on our household survey, participants from (lowland, paddy-based) Ban Na were able to identify and make use of 146 wild plants and forest products. The people of highland (cash-crop oriented) Ban Pa reported only 102 species.

In terms of intangible heritage, Baan Na villagers have long worshipped spirits which are believed to inhabit the natural forest. They believe that the spirit known as Phu Anglang, lives in the national forest reserve nearby and provides protection, water, and forest resources. Villagers believe that if someone violates local norms such as cutting down trees, Phu Anglang will punish not only that person, but also the people of their community. In this context, Phu Anglang worship was not only a traditional practice, but also a norm that encouraged forest stewardship and watershed conservation. Villagers' use of natural resources was done in a way that sustained ecosystem services and enhanced forest biodiversity. In contrast, Ban Pa villagers did not practice these types of rituals.

In this context, TEK-related mechanisms for forest conservation in both villages varied widely. Ban Na village leaders had the organizational capacity to bridge the gap between individuals, communities, and natural resources through ritual practice. The community also used rituals as a form of cultural norm to conserve the nearby forest and watershed. On the contrary, as Ban Pa villagers have shifted to Green Revolution agricultural methods, TEK-related mechanisms for forest conservation have gradually disappeared. Our findings suggest that these rituals were cast away as socio-economic pressures led to short-cycle cultivation practices. For example, Ban Pa villagers changed their agricultural ways from sufficient plantation to cash crops resulting in deforestation to accommodate the expansion of agricultural land. As such, Ban Na villagers were more inclined toward forest conservation and had access to a stable source of natural food. Significantly, Ban Na people were able to access and utilize forest resources on a year-round basis; whereas, in Baan Pa, natural food resources were in decline.

Rice Paddies and Terraces

Owing to the different geographical characteristics (watershed and slope of the land), wetland rice cultivation could be practiced only in Ban Na where the farmers constructed rice terraces to cultivate rice at higher elevations. The use of these terraces helped to cut down the water flow during the rainy season and also to store water during the dry season. This practice also contributed to the maintenance of water levels in their rice paddies during cultivation. If too much water flowed into these areas, farmers were able to drain excess water. If farm lands were prone to drought, they closed a set of clay doors built at the edge of rice fields, to stop water from draining. These practices showed that Ban Na villagers had a high capacity to both control soil erosion and enhance production through natural methods.

Integration of Traditional and Modern Ways

With regard to soil conservation, Ban Na and Ban Pa villagers used many methods. Ban Na villagers built rice

Table 1

Role and capacity of traditional ecological knowledge (TEK) as an influence on community-based food acquisition in Ban Na and Ban Pa

Mode of food acquisition	TEK roles and typologies	TEK capacity level of Ban Na villagers	TEK capacity level of Ban Pa villagers
Natural food resources	Forest conservation: Phu Anglang worship	High ^a	Low ^c
	Fishing, hunting, and methods of food gathering	Seasons and varieties of natural food	High
		Mushrooms and gathering methods	High
		Wild animals and insects: trapping and hunting	High
		Local vegetables (in rice fields) and gathering methods	High
Agricultural food	Land management	Rice terraces	High
		Soil conservation	High
	Weather knowledge	Crop rotation	High
		Combination of traditional and new methods	High
		Organic farming	Low
		Monsoon and rice plantation	High
		Agricultural activities	High
		Folklore and weather forecasting	High
	Water management	Water mills	Low
		Ponds	Low
Commercial food access	Barter system	Low	High

^b Moderate represents 40–59 percent of total HHs practicing knowledge^a High represents more than 60 percent of total households (HHs) practicing knowledge^c Low represents less than 40 percent of total HHs practicing knowledge

terraces in the semi-lowlands and uplands to cope with soil erosion. They also employed crop rotation to sustain soil fertility rather than use the 'slash and burn' methods employed by highland people in other areas of Thailand (Panya & Sirisai, 2007). Notwithstanding, some Ban Pa villagers also practiced crop rotation and used organic farming methods. Some Ban Pa villagers who were able to manage water all year round, rotated a variety of crops (corn, rice, and black beans). A few households blended chemical fertilizers and organic materials in their farming practices. As discussed in Table 1, Ban Pa villagers had a low capacity to practice TEK to deal with modernized agriculture.

TEK for Provisions from Market

With little time and interest in acquiring food sources from the nearby forest, Ban Pa villagers had a tendency to buy provisions from the commercial market and exchanged and bartered their cash crops for meat products. Food was transported regularly by truck from Phitsanulok province to the Southern-North Central Market (located on the West of Dansai district) twice a month. Food exchange trucks came into the area with many commodities that were scarce in these villages (for example, eggs, salt, instant noodles, fish sauce) which shows that Ban Pa had higher capacity to practice bartering than Ban Na because Ban Pa villagers had a social relationship with merchants. However, this barter system was used only by the households that planted rice.

However, Ban Pa villagers have taken on some risk with regard to the safety and health aspects of food security. Owing to the shift from sufficiency farming to cash crops, villagers have become dependent on processed foods for their dietary requirements. Our data suggest

there were linkages between changes in participant diets and their health. As such, participants reported an increased prevalence over the years in high blood pressure and cancer. These findings are similar to Kuhnlein's research on indigenous North Americans (Kuhnlein, 2009) which shows a number of diseases and disorders—including cardiovascular disease, diabetes, overweight and obesity, high blood pressure, some cancers, circulatory diseases, and strokes—were associated with forced changes in dietary systems. That is to say, these diseases and disorders arise where people have lost access to their food sources.

In summary, the roles of TEK as a mechanism of community-based food acquisition in Ban Na and Ban Pa have contributed to villagers' livelihoods in a number of ways. Like Ban Na, Ban Pa villagers were knowledgeable about the link between agriculture and natural resources. However, this knowledge was lost through a change in agricultural methods and food acquisition strategies. In the case of Ban Na, the level of TEK was similar to that in several communities in Thailand that have emerged from changing and degrading environments into more food secure ones. Outstanding among these is the Khiriwong village in the South of Thailand which demonstrated the potential and capacity to undertake resource management at the community level (Panya & Sirisai, 2007). The worldview of Ban Na villagers was influenced by the rituals that linked them to their local ecosystem. Under threat of climate change, local villagers drew upon TEK to support their way of life. TEK also helped villagers to adapt to new environmental and socio-economic changes, to sustain ecosystem services and agricultural activities, and to build a secure and safe food system. Our study shows that to enhance food security in a sustainable way,

rural communities must conserve and revitalize the ecosystem services of the community.

Conclusion

Ban Na and Ban Pa rain-fed rice agriculture is at threat due to severe seasonal changes and uncertainty. Socio-economic changes in rural communities brought on by the influx of new technologies have degraded food security. As such, it is important to understand the ways that TEK can serve to improve food security in agrarian societies.

Although Ban Na and Ban Pa face similar challenges, this study shows that through TEK, Ban Na villagers are more resilient to changes in their environment. These two villages have dealt with the problem of food security in different ways in addressing the environmental and socio-economic changes that have confronted community food acquisition, even though their core values are the same. Both villages employed TEK to manage changes in the weather, soil, seeds, plants, and animal. They organized institutions for ecosystems by practicing seasonal and yearly rituals, taboos, and cultural norms, all of which could reinforce the inter-relationship between the individual and the ecosystem. Hence, mechanisms of TEK have played a functional role in providing food security in subsistence economies, such as Ban Na. In contrast, TEK is dysfunctional in Ban Pa, owing to socio-economic pressures. Hence, Ban Pa villagers have changed their life style more toward cash crops economies.

Turning to the vulnerability of the Ban Pa community, it was clearly evident that food security was low due to a wholesale shift to market-based agriculture. Like many small-scale farming communities in remote areas of the world, Ban Pa had moved from subsistence agriculture to cash crops and agro-forestry, both of which require a high degree of individual competition as opposed to co-operation. As a result, family and community breakdowns have often been widely documented. To support Ban Pa in becoming a more food secure community, community re-building is needed. Traditional and modern leadership must be enhanced in order to lead the people in organizing forest conservation as an addition to access for food acquisition. A flexible and network-type of organization is recommended to rebuild a collective sense of community and enhancement of learning processes.

Finally, we can conclude that our studied communities in Thailand clearly show that over-promotion of engagement in the globalized economy can leave smallholder

farmers and the disadvantaged populations in a vulnerable situation with regard to food security and that conservation of community-based natural resources, including especially, forests, water, and seas, with respect given to the roles of TEK, could enhance food security in agrarian societies. Thus, to secure community food security, communities should manage and practice TEK to build resilience to the new environmental and socio-economic changes, to sustain ecosystem services and agricultural activities, and to build a secure and safe food system, including food acquisition.

Conflict of interest

No conflict of interest.

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