Incorporating Agro-biodiversity to Market-oriented Organic Rice in Northern Thailand: An Enabling Innovation Process and Achievement

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ABSTRACT

The greatest challenge to organic agriculture is for the system to become sustainable in economic, ecological and social dimensions in time of uncertainty. This paper draws on working experiences with the transitions to market-oriented organic rice in Chiang Mai province, Northern Thailand. We outline how smallholder farmers make decisions towards organic rice and at the same time, incorporate rice biodiversity, and improve agronomic performance, entrepreneurial skills and competences through multi-level social interactions. We employed supervised and unsupervised learning approaches to document how smallholder farmers incorporate agro-biodiversity in their organic farming design. The study covered farmer groups in Chiang Mai Valley with varying experiences and scale of operation. It focused on farmers' perception on agro-biodiversity, its functionality, and decision to incorporate it into organic rice system, as well as the outcome. We observed several farmer innovations of utilizing agro-biodiversity to stabilize productivity and enhance farm income. Three genetically diverse rice varieties with different processing techniques were produced to increase value addition. Farmers tested rice varieties for site specific adaptation before embarked on large scale production. They also modified and adapted dry seeded rice technique to improve water management and reduce production cost. We studied the trading partnership between farmer groups and organic farmer-cum-trader through contract arrangement to see how social mechanism makes contract farming work for smallholder farmers. Despite several obstacles faced by farmers during the transition to organic rice, we conclude that incorporating rice biodiversity in organic system provides a starting point for farmers to value functionality of agro-biodiversity.

Key words: Organic rice, Agro-biodiversity, Innovation process, Contract farming, Northern Thailand

INTRODUCTION

Chiang Mai valley has highly diversified and intensive agro-ecosystems in Northern Thailand. Its fertile alluvial lowland, which is serviced by both traditional and governmental irrigation systems, and coupled with favorable climatic conditions, provides suitable environments for cultivation of tropical and sub-tropical crops, notably fruits and vegetables, in association with rice-based faming systems.

The recent increase in consumer concerns about health care, negative environmental impacts, and new demands for quality and safe food products are all putting pressures on producers, processors, and distributors to change. The smallholder farmers, in particular, are facing competing challenges for sustaining their farming livelihoods. These external influences include producing quality and safe food products for consumers, minimizing environmental degradation and pollution, and ensuring economic viability of farming enterprises. Meanwhile, the internal drivers making farmers reconsider their farming strategies are increasing input costs and personal health problems as a

consequence of long term use of pesticides. To meet these challenges, the smallholder rice farmers in Chiang Mai valley have converted their farming systems into less chemical dependent production practices, ranging from safe-use of chemicals, pesticide-free, and organic systems. The transitions also offer opportunities for certain farmers to learn, adapt, and improve their entrepreneurial skills and competences. The transitions see dynamic changes in agronomic practices, farmers' innovations, organic product development, chains and markets with inclusion of rice biodiversity.

The Ministry of Agriculture and Cooperatives (MOAC) supports the organic agriculture initiatives and movements through policy instruments in research, training, and community-based organic development projects since the 10th National Economic and Social Development Plan (2007-2011). In fact the initiative has long been launched and promoted by the local and national NGOs under the movement of alternative agriculture or sustainable agriculture in 1990s. For smallholder farmers who are marginalized and less with access to markets and services, organic practice has been embedded in their bio-diverse and integrated the farming systems with low inputs, producing food with available resources to meet household food security. When the organic system has been promoted as a strategy for value addition, there also emerged the localized food system, which is also accompanied by highly acclaimed "Localness" as a means for supporting the local. The consequence is the increased demand of local rice varieties produced by smallholder farmers. The varieties are adapted under low external input systems. At present, many local rice varieties from different agro-ecosystems produced under organic are available in the retail markets.

Agro-biodiversity within the farmer-managed agro-ecosystems is of two types, namely planned and associated agro-biodiversity (Perfecto et al., 1997; Vandermeer, 2011). The planned agro-biodiversity is practiced when farmers intentionally design their farming systems with various species and varieties, as commonly observed in the integrated farming systems; and the associated agro-biodiversity is the added biodiversity resulting from environmentally friendly cultural practices, for instance in organic rice ecosystems, the aquatic insects, frogs and fishes spontaneously arrive. Many studies provide strong evidence that increased agro-biodiversity has improved household food security status (Hardon-Baars, 2000; Thrupp, 2000; Chappell and La Valle, 2011)

In this paper we outline how smallholder farmers make decision to transform their rice farming into organic systems and gradually incorporate rice biodiversity to increase market opportunities. We also examine farmers' innovation to improve agronomic performance, their entrepreneurial skills and competence through multi-level social interactions. In this empirical study we focus on farmers' perception on agro-biodiversity in association with organic rice system, its functionality, and farmers' decision to incorporate agro-biodiversity into organic rice system. The research questions addressed in this paper are: How do farmers perceive agro-biodiversity in organic rice systems? Is it embedded in the system or a separated entity? How useful is the agro-biodiversity to support the transformation of smallholder farmers to organic and subsequently to market oriented organic rice systems?

RESEARCH METHODS

This development-oriented research employed participatory action approach as the process framework to work with farmers through the transition period. The research initially identified individual farmers and farmer groups who were working towards organic rice system in Chiang Mai province. The selected sites included organic rice farmers in northern districts of Chiang Mai province, namely Mae Rim, Mae Taeng, Phrao, and Chiang Dao. The selected farmers have engaged in different stages of organic rice farming and marketing arrangement. The Mae Rim and Phrao have been involved in organic farming more than 5 years producing rice for normal market and niche market, contracting with distributors such as Rainbow Farm, and Chiang Mai Organic Agriculture Cooperative (COAC), etc., while the farmer groups from Mae Taeng and Chiang Dao are in the early stage of conversion to organic farming, distributing their rice within the villages and niche markets. Many farmers who participated in the workshop are also network members of Institute for Sustainable Agriculture Communities (ISAC). However, there is variation within each

village where its farmer members have different periods of organic engagement.

Among these diverse groups, individual farmers and group members exhibited a different scale of operation in terms of planted areas, production capacity, and market outlets (Table 1). Participatory learning approaches accompanied by site visits were used to create social platform for different groups to share and learn about production practices and alternative markets. However, the supervised and unsupervised learning approaches were applied in this paper. In supervised learning, often also called directed knowledge, is obtained from learning methods from school or training; the unsupervised learning, on contrary is closer to practical knowledge and experiences of peoples. The unsupervised learning encourages social learning and exchange, and enables people to comprehend dynamic and more complex situations better than with supervised learning, which is less dynamic. The unsupervised learning with moderate facilitation process as often practiced in the Farmer Field School (FFS) approach, is found very effective in IPM in rice farming (Röling and Van de Fliert, 1994). A series of farmer workshops were conducted to address common features of production process and quality control, technology development and marketing channels. Other emergent issues related to organic rice include impacts of transformation, such as planned and associated agro-biodiversity resulted from the organic practice, observed changes, and prospects of organic system. Key informants interviews and informal group meetings were conducted to create social learning platforms between farmers and farmer groups. The study was also accompanied by field visits and participant observations to create working relationships and mutual understanding with farmers.

Table 1. Farmer group characteristics.

1. Farmer members	Group members were flexible; Rainbow Farm seems to accommodate more than 100 farmers under contract. They are non-membership based farmer organizations. The COAC is a membership-based farmer organization. Farmers working with ISAC are not registered members, but they are morally and ethically committed to ISAC's sustainable agriculture ideology and principles.
2. Average farm size	Farm size ranges from 2-10 rai, with an average of 4.8 rai; 70 percent of farmers cultivated on rented land, but the relationship between absentee landowners and farmers are more than two decades. Renting arrangement is negotiable. Farmland in the irrigated lowland where intensive cropping is practiced, land rent can be very high up to Baht 5,000/rai/year. eg. Chiang Dao district.
3. Average age of farmers	85% of farmer respondents aged between 41-60 years, 14% were above 60. But younger members aged about 40 with higher education had developed entrepreneurial skills and helped improve market distribution.
4. Average size of farm households persons/household)	2-4 members; majority had working members of 2, consisting of husband and wife.
5. Average level of education	80% did not complete primary school of 4 years; 17% completed 6 years primary school. a few had secondary and tertiary educations. The farmer cum entrepreneur of Rainbow Farm is a Ph.D. student at Faculty of Agriculture, Chiang Mai University.
6. Years of practicing organic farming	Farmers have diverse experience in organic farming, even within a group, ranging from 1 to 5 years. The longest organic farming is from Mae Taeng (Ban Don Jiang), with 18 years of experience. The farmers have close association with ISAC. Rainbow Farm initiated commercial organic rice production and marketing since 2002.

RESULTS

The nature of change of individual farm system

Change is unpredictable. Farmers learn from past experience and combine their knowledge and introduced knowledge through various sources. The nature of change to organic system is considered as adaptive.

Farmers who own and work on most of their farmland on hill-slopes develop integrated land use and allocate low-lying field for rainy season rice, and utilize upper slope for cultivating a mixture of seasonal vegetable species. The surplus is sold at farmer market, so the grading of farm produce is not as strict as those for supermarket. Livestock is an important component, for cash as well for manure. Thus farmers develop their organic system on existing farm resources and design resource recycling system. Most have claimed that they are able to build their farm resilience based on agro-biodiversity and following sufficiency economy philosophy. The farmers engaging in integrated farming system with organic practices are members of ISAC, an NGO advocating organic as the only form of sustainable agriculture. Farmers invest on farm ponds to provide supplementary water. A few have access to village reservoir for irrigation.

Rice farmers in the irrigated lowlands work on 2 to 10 rai of paddy field, and about 70 percent are rented land. The change is in the production process, transforming from chemically based to organically based system. All organic rice farmers followed the regulative system of three year transition as recommended by organic rice certifying agencies. The farming systems are less diverse, dominated with rice-soybean sequential cropping systems. A few farmers would consider their organic system not eligible for organic standards, as the irrigation water is also shared by farmers who are practicing non-organic farming. The water quality remains a controversial issue for organic rice system in the irrigated lowland where quality control is still in question. However, chemical analysis of rice grain for contamination provides negative result, indicating that the product is safe.

Both rainfed and irrigated rice farmers who engage in organic rice system would produce non-glutinous rice for market, since the non-glutinous rice is in higher demand than the glutinous rice, which farmers will plant it for household consumption. Farmers would plant both types of rice on separate plots. Recent increase in market demand for colored non-glutinous rice has prompted farmers to plant several non-glutinous rice varieties under organic system, as the colored rice fetches higher price, due to continued promotion by health conscious groups. The present preferential varieties include Mali Daeng, Hom Nin, etc.

The decision to change

In the studied farmer samples, there is no clear indication that age and education would influence farmers' decision to convert to organic system. Such observation is becoming common (Khaledi et al., 2010), as the process of technological innovation and transformation in agriculture has relied more on social learning through facilitation process (Limnirankul, 2011).

The key driving forces influencing farmers' decision to convert their farming practices to organic are both external and internal. The key external factors include the increasing health concerns of consumers, which results in high demand of organic rice and other organic food products, and increasing cost of material inputs, which forces farmers to seek alternative production systems. Although government has made organic agriculture as a national agenda, the implementation is heavily invested in training on production technology, such as compost technology, bio-fertilizers, and use of natural enemies, plant and herbal extracts in integrated pest management. There is little support on marketing arrangement or facilitating the dialogue on trading opportunity between private sectors and farmer groups. The key internal factors influencing organic transformation are changes in farmers' perception on farming, health concerns and cost reduction. All farmer respondents indicated that for sustainable production of organic agriculture, new mindset about organic farming has to be constructed with new beliefs and values systems. So it is about self determination and context-based transformation. Many farmers with successful conversion have claimed that change

from within is utmost important. Before transforming the systems, one has to make own transformation, either morally or intellectually (Bawden, 2010). Majority who are commercial rice farmers pointed out that price incentive of organic rice is the key determinant. Many would link organic farming practice to sufficiency economy. It is considered to be dynamic, adaptive, self-organized and persistent to changes. The system can be best understood as adaptive and evolving, and building resilience in organic farming is basically learning by doing. The immediate outcome from the organic practice is household's safe food production and consumption. This is then followed by economic gain through organized contract farming with trading partners, either with cooperatives, farmer cum trader, or private firm. In the studied groups, farmers deliver their organic rice through local traders on contract, where payment is transferred immediately at the site after delivery of organic rice is completed, and through COAC.

The systems of beliefs, assumptions and values towards sustainabilism (Bawden, 2010) is adopted during the farmer workshop to assess their beliefs and values systems with respect to organic rice system. The philosophical system of sustainability under the organic agricultural context views the outcome of organic practice is more than conventional production performance. It covers ecological, ethical, spiritual and cultural entities as the consequence of organic practice. While productionism views the outcomes simply from technical, economic, social and political dimensions. Table 2 shows changes in beliefs and values systems of farmers who are engaging in organic rice production system.

Table 2. Beliefs and values of organic rice farmers and their outcomes.

Properties	Belief and values	Outcomes	Farmers' responses (Likert scale)
1	Technological feasibility	Yield of organic rice is stable and is not less than conventional rice cultivation. Farmers have developed locally adaptive technology for organic rice farming practices.	All were satisfied with organic rice yield, but would continue develop further to improve rice yield.
2	Economic viability	Organic rice generates stable income. Organic rice farmers claimed that the system helped them to recover financially and enable to payback farm debt. The system also reduces external material costs.	4.36
3	Social desirability	There is high consumer demand for organic food products especially those who are health conscious. Organic rice is now available in farmer markets supermarkets, and hypermarkets.	4.32
4	Political acceptability	Organic agriculture is a national agenda. The Ministry of Agriculture and Cooperatives (MOAC) established nation-wide training programs for farmers on organic agriculture. The promotion of organic agriculture is part of activities towards the "World Kitchen" policy.	Farmers were aware of the government program, but were not directly involved.
5	Ecological responsibility	Organic rice system enhances agro-biodiversity in paddy rice ecosystem (associated agro-biodiversity), and many are used as food.	4.46
6	Ethical defensibility	Organic rice farmers have social responsibility by producing quality and safe food for consumers, and in return, consumers would help support organic rice farmers. This is a notion of interdependence. ISAC and Rainbow Farm strongly advocate ethical values of organic system.	2.98

7	Spiritual sensibility	Organic system allows one to develop deep understanding of how nature works, and should not overshoot the limits, as pointed out by organic farmers of Ban Don Jiang, Mae Taeng district. ISAC and Rainbow Farm work on this premise.	Only organic farmers in integrated farming systems strongly felt about this issue.
8	Cultural sensitivity	Organic system offers strong sense of sharing and giving, between farmers, and between farmers and consumers, as seen in the farmer markets where active social interaction occurs between farmer-producers and consumers. The local food system is built on this belief and value. ISAC initiated farmer market based on cultural value.	4.39

Source: Adopted from Bawden (2010).
Remarks: Farmers' responses survey from 72 farmers. 1: strongly disagree, 5: strongly agree based on five level Likert scale.

The properties 1 to 4 are basic requirements for any technological innovation or production system to be adopted and scaling out. These represent productivism as stated by Bawden (2010). However, for systems to be sustainable, new beliefs and values systems are to be cultivated. Properties 5 to 8 are believed to be important as a new framework for sustainability. Through farmer workshops and field observations, we conclude that ISAC and Rainbow Farm have developed their organic agriculture and organic rice based on more on social-ethical-cultural-spiritual values.

Farmers' perception on incorporation and contribution of agro-biodiversity in organic system

Farmers perceived that it is physically less feasible to incorporate agro-biodiversity by planting more species in paddy rice ecosystem, due to the fact that the field will be flooded and occasionally under submerged conditions. Unless raised beds or ridges were built to facilitate drainage, field crops and vegetables will not be able to thrive and be productive. So incorporating agro-biodiversity in rice paddy without physical modification is physically infeasible and will not be accepted by farmers. Farmers who have transformed their rice paddy to rice-based integrated farming systems would invest in farm pond structure for self-sustaining in water supply. Agro-biodiversity by design is then adopted and implemented to establish eco-farming systems. Organic system will add values to farm products.

Using intensification-diversification matrix as a way to assess farmers' farming systems design, as depicted in Figure 1. The intensification is understood as intensity of resource uses, such as material inputs, labor, and capital; while diversification means diverse farming enterprises within a farm system. It has connotation of agro-biodiversity in practice; both planned as well as associated (Vandermeer, 2011).

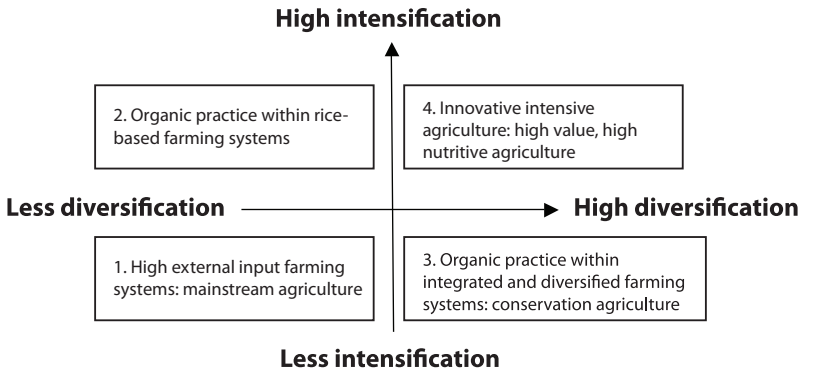

Figure 1. Agricultural transformation as categorized by intensification-diversification matrix.

Most farmers identified themselves as organic farmers in category 2, whose farming enterprise is less diversified, and their main emphasis is to produce organic rice for market. They have not considered seriously and consciously to incorporate planned agro-biodiversity in their farming system design. Their common cropping system is rice-soybean double cropping. Only a few farmers from Ban Don Jiang, Mae Taeng district, who have converted their integrated farming systems into organic practice are said to be in category 3. They are the earliest group practicing organic, gradually building up farm resilience through integrated farming systems, including rice, vegetables, herbs, fruit crops, livestock, bamboo, and forest tree species in their upland-lowland landscape. They practice sustainable agriculture with emphasis on organic and resource conserving technologies. Their farm produce are diversified with strongly based on local and seasonal vegetables and fruits, in addition to organic rice. This group of organic farmers is the key members of ISAC network. Thus the organic farmers in category 3 engaging in similar practices as farmers in category 2, their mindset and basic principles as well as values systems in farming are different. So far, the organic rice farmers in our studies fall into these two categories, with majority are included in category 2. No one has moved towards category 4 which is more innovative and intensive in nature. Farmers in this category would be producing commodities for high-end markets, which have high demand for commodities such as sub-temperature vegetables, small fruits, and fruit crops under clean and safe production systems. A diversity of leaf-typed vegetables for salad making grown under hydroponic systems with controlled environment and precision application of nutrients are being adopted by private entrepreneurs in Chiang Mai, and are available in selected supermarkets.

As far as organic rice farmers are concerned, they are presently interested in diversity of rice varieties with high nutritive values. They have learnt through several sources that colored rice, red, purple, or black, would possess high nutritive properties, and are in high demands for health conscious consumers. Farmers are less concerned about associated agro-biodiversity and have less knowledge about their functional relationship in organic rice ecosystems. This might be due to the fact that there is no direct utilization of associated agro-biodiversity as perceived by commercialized organic rice farmers.

Technological innovation

All farmers who have converted to organic systems have indicated that the required knowledge on technological information is essential and necessary. Many have gone through organized training programs, workshops, and field visits arranged by state agencies, local administrative organizations (LAO), research institutions, NGOs, and universities. The Land Development Department (LDD) of the Ministry of Agriculture and Cooperatives (MOAC) is the leading agency providing technological knowhow on organic farming, and supplying soil and nutrient improving materials known as Por Dor series, and seeds of green manure and cover crops (GMCCs), notably cow pea, sword bean, *Crotalaria juncea, Sesbania rostrata,* etc. Farmers claimed that rice yield of the first year of conversion were dropped by 10-30 percent from 700-800 kg/rai (4.38-5.00 t/ha). The solution was to use GMCCs and composts for soil and plant nutrient improvement, accompanied by better water management. In the second year, rice yield could drop by 10 percent. Farmers used younger seedling for transplanting, about 20-25 days old, as compared to common practice of 40-45 days; and changed rice varieties. The younger seedlings enable better establishment and better tillering. This was followed by improved water management and continued applying soil improving technologies. In the third year, yield might drop by 5 percent. Farmers solved yield decline by using legume crop rotation, or leaving the plot fallow. Farmers made their own herbal extracts as insect repellents. Various formulae of plant and animal extracts commonly known as bio-fertilizer solution extracts (BFSE) were used as plant nutrients by foliar applications at tillering and booting stages. Weed was controlled by land management, water control, and hand weeding. Farmers were increasingly interested to learn and practice better water management, for effective controlling of weed, and pink snail. The agronomic practices by organic rice farmers to maintain stable and high rice yield are given in Table 5.

It is noted that bio-extracts are more commonly used by organic rice farmers for nutrient as well as pest management. The extracts are made of plants (vegetables, fruits), pink snail, fishes and molasses through anaerobic fermentation process. The use of bio-extracts as "universal" material input for organic system is still controversial, and remains skeptical by professional soil scientists. However, the use of beneficial and effective microorganisms for sustainable agriculture and environment has been well established, particularly at the International Nature Farming Research Center (INFRC) at Atami, Japan (Higa and Parr, 1994), and its outreach program, The Asia Pacific Natural Agricultural Network (APNAN, http://www.apnan.org), in Bangkok, Thailand.

Table 5. Farmers' agronomic management of organic rice production.

Agronomic practices	% Farmers practice
1. Nutrient management	
- Compost and animal manure	15.4
- GMCCs	11.5
- Granular organic fertilizer, bio-fertilizer solution extract	73.1
2. Insect pest management	
- Herbal extracts as repellents	11.5
- Bio-extracts and herbal extracts	69.2
- Mechanical control: net, trap, etc	19.3
3. Weed management	
- Hand weeding	38.5
- Water control	38.5
- Land management	23.0
4. Water management	100

The organic rice farmers in Chiang Mai continue to develop cost saving technologies. The recent adoption of dry seeded rice technique in non-puddling soil has shown promising results. Farmers could save about 30 percent of water use, and reduce labor cost by almost 50 percent while maintaining the same level of rice yield. The system can be managed by family members of two easily. The system does not require seedling nursery, pulling seedling, and transplanting. Pre-germinated seeds are planted directly into moist soil. With careful water management weed could be controlled.

Throwing clump of young seedlings of 15 days old is another planting technique being introduced by agricultural extension to reduce seedling rate and labor cost. The system is being verified by farmers. Ratooning technique has been used by a few farmers who grow non-photosensitive rice, such as NSPT-1 during the rainy season. The dry season rice planted in early April with irrigation will be harvested in early August. The harvested rice plants are allowed to re-grow with application of bio-fertilizers. The rice will be harvested in 75 days. But yield will be reduced by 30 percent. The high value crop such as onion is planted in late October to early November. The system works well in rice-rice-onion triple cropping system. The lower rice yield from re-grow will be compensated by low production cost in rice and high return of onion crop from early harvest. However, the system has been adopted by farmers who practicing pesticide-free production system. The water saving technology such as System of Rice Intensification (SRI) (Africare, Oxfam America, WWF-ICRISAT Project, 2010) has been adopted by a few farmers who are the members of ISAC.

From field observations and farmer dialogues, organic rice farmers are adaptive and responsive to new practices. So far, farmers are well aware of the values of rice diversity and the nutritive values. Value addition and value creation can be developed by growing organic of local rice varieties. Rice yield can be enhanced by integrative approach such as use organic bio-fertilizers which can be prepared on farm with available resources, better water management, and improved cultural practices.

The economic, social and ecological implications of organic system

An informal workshop was conducted with 26 farmers who were organic rice farmers with a few were in the transition by producing rice under pesticide-free. The activity aimed to identify observed changes under organic or pesticide-free systems.

The health impact was ranked first. Majority saw themselves with improved health (84.6%) as consequence of organic farming practice. A few had lesser health problems (11.6%), and some indicated that they need not worry about chemical risks (3.8%).

On economic benefits, seventeen indicated that they had higher and more stable incomes (65.4%). Other mentioned about reduction of input costs (23.1%), and contented by having no farm debt (11.5%). The price incentive and organized marketing system under contract is seen as major contribution to the successful adoption of organic rice production among smallholder farmers.

On social impact, farmers appreciated the values of collective cooperation and group formation among organic rice farmers (46.2%). Different forms of funds were established resulting from group work, such as organic vegetable funds (in addition to organic rice engagement) (11.5%). Many social activities were created from group work, particularly in relation to village development (11.5%). The need for collective and cooperative action was felt among farmer members as the market-led organic system requires group organization and institutional setup. Community-based rules and regulative systems has been worked out and implemented, and has been proved to be effective in organic system management, from production to marketing. Regular group meetings help improved social learning and information exchange (23.1%). Many also indicated that they had more two-way interactions and support from state agencies as well as non-governmental organizations (7.7%), through hosting study visits and attending workshops. The strength and capability of farmers to be self-organized and worked collectively help move the organic rice system forward.

On ecological implications, organic rice farmers observed gradual improvement in their soil physical properties (26.9%), and increasing soil flora and fauna, and beneficial insects (26.9%). The associated agro-biodiversity of aquatic resources, such as fishes, tadpoles, and aquatic vegetables were collected as food source (19.2%). Farmers perceived that there would be less chemical pollution in soil and water as consequence of organic practice (15.4%). They also felt that as environmental conditions being improved, they were morally and spiritually better-off and more prepared to engage in social activities (15.4%). This would be an indirect impact of improved ecological integrity.

Marketing arrangements and entrepreneurial skills

Marketing arrangements among different organic rice groups under studies are managed through several pathways. These include independent traders and cooperatives. The independent traders are of varying capacity in terms of capitals, market outlets, farmer networks, and organizational structure. The Chiang Mai Organic Agriculture Cooperative (COAC) and Institute for Sustainable Agriculture Community (ISAC) are two important membership-based farmer organizations engaging in organic rice production and marketing in Chiang Mai. The COAC limits its activity to organic rice, while ISAC, an NGO initiative, works on organic agriculture as the key feature of sustainable agriculture. ISAC has developed farmer market known as Im-boon market for distributing organic agriculture and food products for its farmer members, and the market is now fully established as an institution which is co-managed by farmers and consumers. Meanwhile ISAC is experimenting with social marketing by establishing an independent and autonomous marketing channel, assembling and distributing organic products from the known and traceable sources.

The working principles of ISAC are to advocate organic farming for sustainable production and rural livelihood systems. The main output is to meet household need and the surplus would then be marketed in an organized farmer market specifically for organic products. The campaign of "eat what you grow" is to emphasize the movement of localized food system, and the ISAC has stressed the significant role of consumers since the early stage of localized food movement. The farmer members who are participating in the localized organic food movement would receive not only technical training, but most important is to "purify" the mind, with emphasis on sustainability paradigm. The farmer members have adopted integrated and diversified farming systems with

organic practices. Farmers have selected a few local rice varieties to fulfill household need and meet consumers' demand. These include Hom Mail, Mali Daeng and Hom Nin as well as local rice varieties. However, the inclusion of entrepreneurial engagement into the markets enables farmers to play leading role linking agri-food chain and farm agro-biodiversity, and in turn enhances farmers' capabilities to innovate.

The COAC is a self-help farmer initiated cooperative. The committee members are from local farmer-traders and leading farmers. It was first established as a farmer club in 1994 which named "Agricultural Producers for Good Health and Environmental Concern Club". The mission was to solve farmers' debt as the result of conventional chemically-based farming practices, and to improve farmers' health by stopping the use of chemicals. The Club was later changed to COAC when farmer members have converted to organic rice production and managed their own market. The cooperative is able to work with many agencies, governmental organizations, private sectors and local NGOs, such as ISAC and Rainbow Farm. The cooperative will provide registered members with rice seed at low price. Practical training on organic rice production will be given to new members. At present, the members are from several districts of Chiang Mai province, namely Prao, Mae Taeng, Mae Rim, San Khamphaeng, Doi Saket, Sameong, and Mae On. The COAC has established trading arrangement with Chiang Mai and Bangkok whole-sellers. Recently, it has linked to export markets in Singapore and Hong Kong, which are the major organic rice importers in the region. The annual export output is 500 tons producing from three varieties: KDML 105, Hom Nin, and Mali Daeng. All products are certified by Northern Organic Agriculture Standards (NOAS).

The Rainbow Farm is operated and owned by a young farmer-university student. The Farm began its organic rice operation in 2002. At present over 110 farmer sites have been extended with annual production of 200-300 tons. The organic rice is certified by NOAS and received "Q" quality standard from Ministry of Agriculture and Cooperatives (MOAC). The Rainbow Farm develops own seed, establishes seed exchange program, and breeds and releases new glutinous rice variety "Hom Viang Ping". The Rainbow Farm helps organize the market outlets for its member groups who then can have direct contact with the potential buyers or outlets. There is no business obligation for farmers to deliver their organic rice exclusively to the Farm. However, so far there is no evidence that any farmer members have delivered their organic rice to other buyers. It is understood that farmer members are strongly bounded to the cultural norm and social commitment to the Rainbow Farm. There is relationship of trust and reciprocity between farmers and the Farm. At present The Farm has established 60 outlets to distribute organic rice under "Rainbow Farm" brand in Chiang Mai, Bangkok, and the Northeast, including small retailers, big retailers (Tops supermarket, Rim Ping supermarket in Chiang Mai). In the Northeast, it is distributed under the brand name of "Luk Esarn" (Children of the Northeast). The Farm produces three varieties under organic: KDML 105, Hom Nin, Mali Daeng. It also collaborates with the COAC in supplying organ rice grains and seed when the COAC has short supply.

A case of small, independent, local trader is included here to highlight the notion that there is opportunity for small enterprise to be developed in organic rice value chain. The example is from the local trader who has developed himself as a trader specializing in organic rice. The trader does not have enough land to produce rice, but through several years of engaging in farmer niche market selling pesticide-free vegetables, small fruit and mushrooms, has observed the increasing demand of organic rice. He has visited rice farmers and learnt about organic rice production process. He attends training on rice processing, particularly processing germinated rice which becomes popular among high-end consumers. The germinated rice produced organically is priced at 60 Baht/kg at retail while ordinary organic rice is sold at 35 Baht/kg. He personally makes direct contact with growers whom he can trust, providing organic rice seed, and offering guaranteed price, adding one Baht/kg higher than the quoted price given by the COAC. The Local trader is then interested more in producing germinated rice. He has acquired enough skill, through learning by doing, to stabilize his germinated rice production for farmer niche market at several city outlets. The local trader uses milling services from the local miller, paying one Baht/kg for milling service, in return he will receive milled rice, broken rice, and rice bran. With brown rice, the local mill can produce about

70-72 percent of brown rice which is considered being satisfactory to convert from paddy grain to brown rice. With polished rice, the conversion is much lower, about 55 percent of milled (white) rice.

Table 3 summarizes the key features of different institutions and actors engaging in the chains and markets of organic rice. There are free flows of information among these key actors, particularly among individual trader, ISAC, COAC, and the Rainbow Farm. The members are often met in the seminars and workshops organized by the government agencies, research institutions, and universities. The informal and flexible linkage, where each organization continues to work independently, offers opportunity for each to develop and adapt to its own pacing and circumstances.

Table 3. Key features of different organic rice trading systems in Chiang Mai.

Trading system	Individual local trader (own agro-enterprise)	Rainbow Farm (structured, own agro-enterprise)	Chiang Mai Organic Agriculture Cooperative Ltd. (COAC)	Institute for Sustainable Agriculture Communities (ISAC)
1.Motive	An innovative farmer cum entrepreneur sees the opportunity of increasing organic rice market, gradually invests in organic rice distribution in niche markets.	To develop good organic food for good consumers from good farmers (good=socially responsible consumers and farmer producers).	To increase the product value and farmers' incomes by trading organic rice.	To develop localized organic agri-food system to benefit both farmers and consumers.
2.Strategy	Small scale agro-entrepreneurship; farmer niche market with estimated demand; selection of highly marketable rice varieties: KDML 105, Mali Daeng and Hom Nin.	Science-based organic production system; capacity building to strengthen farmers' knowledge on organics, establishing marketing alliance.	Forming membership-based farmer organization which later developed into cooperative. The well structured organization can easily get access to government support and services.	Advocating sustainable agriculture and alternative markets; Provides rigorous training workshop to "purify" the mind and to build up farmer capacity engaging in resource conserving sustainable agriculture practices.
3.Mechanisms	Contracting farmer friends and relatives who are trustworthy to produce specific varieties on basis of fair sharing system; establishing good working relationships through regular visits.	Developing own organic farm and marketing as learning model for others; forming partnerships with universities, research institutions and funding agencies to scaling out the organic rice farming practices; providing practical training on-farm.	Forming partnership with farmers groups of five districts in Chiang Mai to produce organic rice. The COAC provides seed and buys all organic rice from members, processes and distributes to domestic and export markets.	Collaborates with local communities, and local governments to co-manage rural resources with community participation; sets up farmer market "Im-boon" to distribute organic agri-food products from the farmers members.
4.Trade negotiation and agreement	Direct contract; offers same price as the COAC.	Establishing diverse market outlets for own products; developing brokerage system to increase production and marketing; providing fair financial incentives for brokers;	The COAC establishes trading agreement directly with distributors in Singapore and Hong Kong for export market and It also delivers organic to wholesalers and retailers in the country.	Farmers bring their organic agri-food products to "Im-boon" market and interact directly with consumers. ISAC does not engage in marketing of organic products directly.
5.Market outlets	Farmer niche market at the Chiang Mai University MCC research station; small proportion delivered to "green market" food store. Annual production 20 tons.	About 60 market outlets in the North, the Northeast and in Bangkok; annual production 200 tons.	Domestic and export markets (Singapore and Hong Kong); annual production 500 tons.	Im-boon market and its subsidiary market outlets in Chiang Mai managed by farmer groups.

Table 3. Continued.

6.Certification	None	Certified by Northern Organic Agriculture Standards (NOAS) and "Q" certified trademark.	Certified by NOAS	Certified by NOAS
7.Product uniqueness	Germinated brown rice; brown rice.	Germinated brown rice; brown rice, polished (white) rice, also from own developed glutinous rice (Hom Viang Ping).	KDML 105, Mali Daeng, and Hom Nin, both polished white rice and brown rice.	KDML 105, Mali Daeng, and Hom Nin, and local glutinous rice; brown and polished white rice.
8.Social network	Close association with farmer producers and consumers.	Strong links to farmers groups, distributors, COAC,	Links to organic farmers groups in five districts, NGOs, Rainbow Farm, and universities and research institutions.	Farmers groups coordinated by ISAC; ISAC also has connection with the national NGO, such as Sustainable Agriculture Foundation Thailand (SAFT).
9.Constraints on agro-biodiversity conservation	Rice biodiversity is determined by consumer preference and marketing pull, at present it is limited to three varieties of high market demand.	So far it is one- man activity; there is no community involvement in the conservation of rice genetic resources.	The rice diversity is confined to high quality (KDML 105) and high nutritive rice (Mali Daeng, Hom Nin) for market; glutinous rice RD 6, SPT-1, for home consumption.	ISAC farmer members engage in bio-diverse integrated farming systems with organic practices. Farmers are encouraged to conserve and exchange seed and planting materials. Practically, farmers value *in-situ* conservation.
10.Opportunities for agro-biodiversity conservation	Farmer producers do not keep and produce their own seed. The local trader supplies new seed every growing season. Farmers do not deliberately practice agro-biodiversity conservation.	Conserving and utilizing local varieties in breeding program; has successfully develops one glutinous rice variety (Hom Viang Ping). Rainbow Farm manages and arranges its own rice genetic resource conservation and utilization.	The COAC does not produce own seed, seed renewal every three years. When in short supply, the COAC contacts Rainbow Farm for seed.	The ISAC promotes incorporation of agro-biodiversity in integrated farming systems; majority of farmers adapt the systems, and the organic products are sold in the Im-boon market; the availability of farmer market is conducive to conservation of agro-biodiversity on-farm.

The market of organic rice is dynamic. Due to changing market conditions and consumer demands, smallholder farmers in Chiang Mai are increasing becoming integrated into a global trading system, as seen in the case of COAC. The organic rice value chain promises access to new markets, and adding value to farmers' products.

DISCUSSION AND CONCLUSION

The evidence from this study strongly indicates that conservation and utilization of agro-biodiversity and enhancing farming livelihoods can be effectively achieved by adopting organic agricultural practices. The innovative farmers who settled and cultivated along the partially upland-lowland interface of Chiang Mai province are able to intensify their land use through integrated farming systems with organic practices by capitalizing the existing bio-resources. Farmers can see the values of agro-biodiversity, and they incorporate it in their farming system design for household food security and income stability. The diversification and integration enhances farmers' capabilities to manage their land and bio-resources adaptively, and gradually builds up farm resilience (Milestad and Darnhofer, 2003). The full benefit of intensifying is achieved through the managed planned biodiversity and an abundant amount of associated biodiversity, while organic practice provides

added values. In the irrigated lowland where the organic rice production and marketing has been actively promoted during the last five years, although the organic rice farmers are less diversified and cultivating rice-soybean as their main cropping systems, farmers make use of diverse rice varieties of high nutritive values, to diversify their organic rice produce and to achieve value addition. Farmers may notice spontaneous arrival of associated biodiversity such as aquatic insects, plants, frogs, and fishes in organic rice ecosystem, as consequence of improved environment. But direct utilization is found to be limited. The evidence also supports the conclusion that organic rice farming practice provides multiple benefits, satisfying four general goals of sustainable agriculture as defined by the Committee of 21st Century Systems Agriculture, National Research Council (NAS, 2010), namely satisfying human basic needs, enhancing environmental quality and the resource base, sustaining the economic viability of agriculture, and enhancing life quality.

The transition towards sustainable production of organic agriculture, as exemplified by organic rice production and marketing, needs more than the development and adoption of organic agronomic practices that comply with organic principles, production standards, and quality outcome. Based on Bawden' s beliefs and values systems of new paradigm of sustainability, the organic smallholder rice farmers in Chiang Mai have shifted their worldview towards sustainabilism by seeing organic farming is more than just technological transformation and economic gain, but becoming more social and ecological responsibility, and cultural sensitivity. They also view resources-based growth with endless exploitation and consumption is dangerously unsustainable. The holistic view is strongly advocated by ISAC and its farmer members who are practicing organic in integrated farming systems in the upland-lowland interface.

The incorporation of agro-biodiversity in organic rice system in practice is still limited. This is understood as rice diversity especially in the lowland ecosystems is not available, or almost non-existent. The rice system, both subsistence and commercial, has been replaced by MOAC' recommended varieties, namely RD6, SPT-1 for glutinous rice and KDML 105, RD15 for non-glutinous rice. These commercial varieties are easily accepted by local rice mills. The local varieties which were formerly grown for subsistence and were traded locally are not accessible. Besides farmers do not benefit from the use of local rice varieties, as there is insufficient market benefits from these materials. Many organic farmers, when asked about the possibility of including local rice varieties in their production systems, almost all declined and did not value the local rice genetic resources. However, in the highland ecosystems, where local highland rice varieties are better adapted to highland environment than the commercial rice varieties which developed for lowland ecosystems, the highland ethnic communities (namely Karen) value and continue to use rice diversity to stabilize their rice production.

Farmers incorporate rice diversity when they see the market value of rice diversity. The increasing market demand of coloured rice such as Hom Nin, and Mali Daeng has changed farmers' perception to look for exotic and nutritious rice. It is likely that when information of nutritive value of local rice is made available publicly, use of local rice varieties could be increased.

The organic rice production and marketing in Chiang Mai is growing, and the adopted farmers so far have made great achievement. Changes in consumption behavior and consumers' demands for organic rice, coupled with several market outlets, have offered new opportunities for smallholder rice farmers to further develop their organic system, not only on improving agronomic practices to enhance organic rice yield, but also from existing abundance of rice diversity to explore and capture its under-utilized nutritive characteristics.

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