Potential role of Integrated Farming Systems (IFS) for Poverty Alleviation in the Mekong Basin: An Assessment of Farmer-based Networks in Promoting IFS

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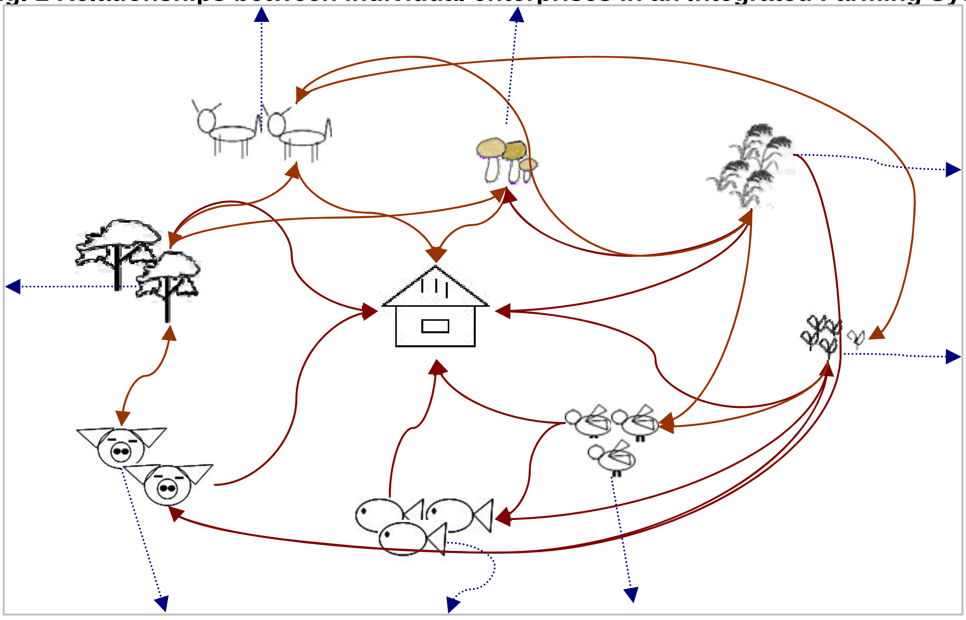
1.1 Introduction

The concepts associated with integrated farming systems (IFS) are practiced by numerous farmers throughout the globe. A common characteristic of these systems is that they invariably have a combination of crop and livestock enterprises and in some cases may include combinations of aquaculture and trees.

The definition of IFS is varied and dependent on the context. Agbonlabor *et al*. (2003) in their studies undertaken in Nigeria, defined the concept as a type of mixed farming system that combines crop and livestock enterprises in a supplementary and/or complementary manner. Okigbo (1995) defines these systems as a mixed farming system that consists of at least two separate but logically interdependent parts of a crop and livestock enterprises. Contrasting these definitions Radhammani *et al*. (2003) describes IFS's as a component of farming systems which takes into account the concepts of minimizing risk, increasing production and profits whilst improving the utilization of organic wastes and crop residues. Jayanthi *et al.* (2000) based on experiences from Tamil Nadu, India, described these systems as a mixed animal crop system where the animal component is often raised on agricultural waste products while the animal is used to cultivate the soil and provide manure to be used as fertilizer and fuel. Edwards (1997) narrowly defined the system as an aquaculture system that is integrated with livestock and in which fresh animal waste is used to feed fish. It is clear from the above that there are synergies and complementarily between enterprise that comprise a crop and animal component that form the basis of the concept of IFS (Lightfoot and Minnick, 1991; Jitsanguan, 2001; Radhammani *et al*., 2003). In this respect integration usually occurs when outputs (usually by-products) of one enterprise are used as inputs by another within the context of the farming system. The difference between mixed farming and integrated farming is that enterprises in the integrated farming system are mutually supportive and depend on each other (Csavas, 1992). This is best exemplified on Figure 1 where the inter relationship between individual enterprises in the farming systems show clear linkages where for example droppings high in nitrogen (N) and phosphorus (P) from chickens promote the production of beneficial algal and phytoplankton that fish feed on within the pond system.

Fig. 1 Relationships between individual enterprises in an Integrated Farming System



Note: The red arrows present the resources flow direction between production units in the farm. The blue arrows pointed out to the edge of the frame representing resources that are moving off farm.

It is clear from the above discussion the primary objective of the IFS is to maintain production of food and other goods and services that contribute to food security and income generation. Other functions that are just as important are achieving environmental sustainability and contributing to ecosystem services. This would imply that these systems have components that incorporate the concepts of multifuctionality. Multifunctionality is interpreted in terms of multiple roles assigned to agriculture (Price 2000; Groenfeldt, 2005). In the framework of multifuctionality agriculture as an activity is entrusted with performing four main functions in society, namely, food security and environmental, economic and social functions. In general, increasing the number of functions tends to increase the stability of agriculture and land use (Price 2000).

1.2 Integrated farming systems – the practice

Integrated farming systems are effectively systems that have traditionally been undertaken by farmers in countries that include Indonesia, China, Malaysia, Vietnam, Rwanda and Thailand (Gliessman et al., 1981; Csavas, 1992; Tokrishna, 1992; Choosakul 1999; Praphan 2001). However, in many countries these traditional systems have been replaced by the establishment of commercial cash and staple crop production systems that have been promoted by governments (Ruaysoongnern and Suphanchaimart 2001).

Continuous production of crops without external inputs reduce the ability of the soil resource base to both provide and retain nutrients which often results in a decline in productivity (Willett 1995; Craswell, 1998; Limpinuntana et al., 2001; Noble and Ruaysoongnern 2002). In addition, the reliance upon a few crops in combination with a high risk of crop failure due to a range of factors (i.e. disease, drought) exposes farmers to a high degree of variability with respect to yields and income and therefore risk (Reijntjes et al., 1992; Ashby 2001). Further, some authors indicate that commercial farming systems are a threat to the environment through a loss of genetic diversity and the possible negative impacts of these systems and their associated inputs (Ashby 2001).

Integrated farming systems are often viewed as a sustainable alternative to commercial farming systems particularly on marginal lands with the objective of reversing resource degradation and stabilizing farm incomes. Lightfoot and Minnick (1991) reported that the integration of trees into these systems offers income security and ecological protection. Added to this, the use of diverse plants and animals broadens possible sources of income generation. The generation of wastes and by-products from these entities are transferred between enterprises, thereby reducing the need for external inputs such as feeds and crop nutrients (Cavas, 1992; Little and Edwards, 2003). Animals on a farm provide inputs to other enterprises and constitute a source of meat and milk, a means of savings, and a source of social status (KKU 2001; Schierre et al, 2002; Little and Edwards 2003).

Diversification of farming activities should invariably improve the utilization of labor, reduce unemployment in areas where there is a surplus of underutilized labour and provide a source of living for those households that operate their farm as a full time occupation (Thamrongwarangkul 2001; van Brakel et al. 2003). Based on evidence and synthesis of published literature, the important characteristics of the integrated farming system that differentiated if from commercial farming systems are presented in Table 1. The table presents differences that exist between farming systems that include the high degree of diversity of genetic species in the integrated farming systems and enterprises and practices, which are employed to attain the household objectives. The synergy between enterprises increases with on-farm diversity and is fundamental to the integrated farming system concept. The commercial system cannot be moved to the direction of the integrated system if there are no synergies between enterprises through the integration of activities. Therefore, the distinction between the integrated farming system and the commercial farming system is not absolute, but is rather a matter of degree of integration of resources in the farm system (Tipraqsa, 2006).

1.3 The role of integrated farming systems in agriculture

Within the published literature there are two main areas that have been intensively studied, namely 1) studies that assess the financial viability of IFS through the analysis of farm budgets; and 2) studies that optimize resource allocation.

Financial viability: On farm trials in which farmers incomes form the basis of research have found that the incorporation of trees and vegetables crops are highly lucrative (Dillon and McConnell 1997; Ashby 2001). Govindan et al. (1990) studied the financial budgets of farms in Tamil Nadu. The study was designed to assess the financial viability of a poultry and fish culture system. The study concluded that under the prevailing conditions, higher incomes and on-farm labor use can be achieved by integrating different enterprises on the farm. Similarly, Rangasamy et al. (1996) studied the integration of poultry, fish and mushroom with rice cultivation over a five-year period. The study concluded that the integrated system that included the aforementioned three components increased net farm incomes and on-farm labor when compared with the conventional rice cropping system. Radhamani et al. (2003) also reviewed several studies on the financial viability of integrated farming system and concluded that they positively influenced the economic viability of these systems. The results from these structured studies that received regular inputs such as genetic resources, labor, irrigation and information are somewhat removed from reality. In most cases the availability of and access to these inputs is variable and is often contingent on factors that are beyond the control of the farmer.

Table 1. Relative characteristics comparison of the integrated farming system with the commercial farming system in Northeast Thailand (adapted from Tipraqsa, 2006)

Aspects and properties of systems	**Farm type**	
	Integrated	**Commercial**
Biophysical characteristics		
1. Farm age	Young	Old
2. Irrigation infrastructures	Many	Few
3. Diversity (of crops, animals & enterprises)	High	Low
Socio-economic characteristics		
4. Farming area owned by the household	Large	Small
5. Family labor	Much	Little
6. Labor saving technologies (tractors, water pumps)	Few	Many
7. Hired labor	Much	Little
8. Off-farm income	Much	Little
Outputs		
9. Productivity	High	Low
10. Soil fertility	High	Low
11. Financial profitability (gross farm income)	High	Low
12. Flexibility of product use[a]	Much	Little
13. Diversity (of activities, products & income sources)	High	Low
14. Stability[b]	High	Low

[a]*The flexibility of product use refers to the availability of alternative ways of product disposal such as home consumption instead of sales (Dillon and McConnell 1997).*
[b]*System stability refers to the absence or minimization of year-to-year fluctuations in either production or value of output. It also implies either stability in input costs, yields and prices or counterbalancing movements in these influences on values of output (Dillon and McConnell 1997).*

Dalsgaard and Oficial (1997) outlined an approach to model, describe, analyze and quantify the productive and ecological characteristics of the agroecosystem at the level of the farm. The study employed a range of techniques (bioresource flow diagrams, farm transects, direct observation, field measurements, farm records and informal discussion) to develop a model and compare it with the commercial farming system. The comparative analysis suggested that diversification and integration of resource management can be productive, profitable and manageable, given access to labor and secure tenure. Similarly in the Cameroon, Ngambeki et al. (1992) demonstrated the profitability of the system by integrating livestock into a crop based farming through increased financial benefits and a better use of intermediate farm resources such as manure, draft power, and crop residues.

A significant number of studies have been undertaken in Thailand into the financial viability of IFS. In a study by Tokrishna (1992) integration of duck raising and fish enterprises resulted in farmers being able to earn a net profit of US$ 1,850 ha^{-1} of which 87% came from fish with yields of 3.5 t ha^{-1}. In the Nakhon Ratchashima and Khon Kaen provinces, Kaewsong et al. (2001) evaluated the socioeconomic status of 30% of the members of a farmer network that promoted IFS in 2001. The study revealed that the average total income of the members was higher than in other areas in the northeast region. Pant (2002) assessed the potential and economic viability of integrated agriculture-aquaculture (IAA) systems under three different agro-ecological zones in the northeast of Thailand, namely: drought prone, rain-fed lowland, and rolling land in the Khon Kaen and Buriram provinces in 1999. An assessment of 234 farm households practicing IAA revealed that enterprise compositions within the IAA system varied between the three agro-ecological setting, yet rice paddy, fruit, vegetables, chicken, ducks, and aquaculture enterprises were common on all farms. In all agro-ecologies, livestock production was extensive due to limited use of supplementary feed. In the drought-prone agro-ecology, rice yields were 2.5 t ha^{-1}, approximately double that of rain-fed lowlands. The study also reported that farm households in the lowlands responded to demands in nearby market by producing significantly higher amounts of fruit and vegetables than the other two agro-ecologies. Among the different agro-ecologies, the rain-fed lowland had the lowest gross farm income.

Allocation of resources: A further aspect that has been comprehensively studied is the aspect of resource allocation within the context of IFS. Schiere *et al*. (2002) studied the role of livestock and provided criteria for the sustainability of integrating livestock into a crop production system, which was then used for scenario analyses. The study used linear programming (LP) to optimally allocate resources over time and space. The results of the scenario studies illustrated options and trade-offs between different crop and livestock combinations in terms of their sustainability criteria. The study concluded that livestock are essential for the sustainability of the system. In southern Nigeria, Agbonlahor *et al*. (2003) determined the optimal resource allocation for farm planning that both satisfy productivity requirements to meet economic profitability and continued soil fertility to achieve sustainability. The study employed a LP approach to determine the optimal resource use. The study concluded that a sustainable system is possible in this area through the integration of poultry and crop enterprises.

In the lowland areas of Tamil Nadu, India, Jayanthi *et al*. (2000) estimated the water use efficiency of systems by integrating crops, poultry, pigeon, fish, and mushroom cultivation. The results indicated that integrated farming requires less water per unit of production than monocropping systems. In Malaysia, Alsagoff *et al*. (1992) evaluated the contribution of aquaculture to the overall farm income. The study indicated that aquaculture has the potential to increase present farm income 3.3 times if resources are allocated optimally to fish culture and broiler meat enterprises. In Thailand, Kobayashi (1996) developed appropriate technologies to reduce water loss from farm ponds in IFS floating materials (foam, bamboo, and dry coconut) in the farm ponds. The studies suggested that the foam and bamboo are suitable for this purpose, whereas dry coconut husks were not.

Resource degradation in rice farming systems in Thailand endangers food security, but the systems may become more sustainable by combining them with aquaculture and livestock farm enterprises by capitalization of their synergies in resource use and re-use, i.e. by adopting integrated farming systems. Most empirical studies that assess this potential have focused on a few specific aspects, but not on the multiple social, economic, and ecological functions of resource integration. A study by Tipraqsa et al., (2007) used a multifunction agriculture framework to assess the performance of integrated farming systems in Northeast Thailand and compared their performance with that of 'normal-rice' or non-integrated farming systems. Integrated farming systems were found to outperform the normal or commercial farming systems in all four dimensions of a multifunctional agriculture: food security, environmental functions, economic functions, and social functions. The findings support the notion that diversification and integration of resources on farms is feasible in both economic and ecological terms. The analyses indicated that integrated farming does not, however, diminish the need for external inputs. High start-up cost might constrain farmers from switching to integrated farming and from exploiting the benefits of resource integration.

1.4 Constraints of Integrated Farming Systems

Although the aforementioned studies have clearly shown that the system is feasible with respect to socioeconomic imperatives, actual adoption rates of integrated farming are limited and unevenly spread among farmers.

The study by Ngambeki et al. (1992) in the Cameroon revealed that the major production constraints are animal feed shortages throughout the year, labor bottlenecks, and soil degradation. Csavas (1992) reported that in most farms studied in China there was a dependency on imported feed rather than internal recycled inputs. This was concluded to be due to resource-poor farmers in general not having feedlot type systems in which to undertake livestock production. Lightfoot (1997) suggested that the four main constraints to adoption of integrated farming systems in the Philippines and Ghana were: 1) the long transition period that often occurs when implementing an integrated production system. This lead-in time can vary between 3 to10 years. Farmers could not forgo declines in food production and income generation over this period; 2) labor shortages, especially where the family size is small, which effectively prevented them from adopting integrated farming techniques; 3) lack of secure land rights; and 4) disincentives to adopting integrated farming resulting from government subsidies, credits for fertilizers, and herbicides. Banerjee et al. (1990) assessed the impact on allocation of the farm area to different types of crops and livestock. The study revealed that there are few opportunities for increasing farm net returns with the limited amount of capital available. This conclusion is supported by the study of Tipraqsa et al., (2007) who alludes to the fact that high start-up costs may constrain farmers from switching to integrated farming and from exploiting the benefits of resource integration.

In the case of Northeast Thailand, the study by Thamrongwarangkul (2001) reported that resource-poor farmers often cannot go beyond the transition period due to their need for food and for immediate economic returns to meet cash needs such as schooling, medical treatment, and loan-repayment. A similar conclusion was reached in a study by the FAE-KU (2000). Contrasting this Tokrishna (1992) pointed out that a farmer who becomes successful and wants to expand the area of his integrated farm in Thailand would be limited by access to adequate water supply, animal feed, and market outlets.

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2. The Need for Collective Capacity: Farmer Networks and Their Role

2.1 Introduction

For as long as people have managed natural resources, they have engaged in various forms of collective action. There are several pertinent examples that demonstrate the value of collective action that include labour sharing and marketing; management of water resources; and pastoralists co-managing grasslands (Pretty, 2008). In all of these cases collaboration has been institutionalized in different forms that include the formation of associations, traditional leadership structures, water user groups, clubs, farmer experimentation groups and religious groups (Pretty, 2002).

Evidence of resource management rules and norms that are embedded in many cultures and societies are present throughout history: for example, the collective management of water resources in Egypt, Mesopotamia and Indonesia through to the management of grasslands by herders in the Andes and dryland Africa. However, in recent times the importance of such local groups and institutions in agricultural and rural development is often overlooked. In both developing and industrialized countries, policy and practice has tended not to focus on groups or communities as agents of change (Pretty, 2003). In some contexts this has meant that local institutions have been undermined to a point where they no longer monitor, regulate and protect local resources. For example, the loss of management systems for common property resources in India has resulted in over-exploitation of resources, inadequate maintenance and physical degradation (Jodha,1990). Furthermore, private ownership of the operation of surface and groundwater use for irrigation has generally replaced collective systems in many parts of India (Kothari, et al., 1998). Further it is clearly evident that where access is marginally regulated or not at all, the likelihood of 'free riding' increases with a corresponding exploitation of resources in an unsustainable manner. Under such circumstances, a 'tragedy of the commons' scenario arises, and sustainability of the resource cannot be assured (Pretty, 2008).

It has been argued that social institutions based on trust and reciprocity, and agreed norms and rules for behavior, can mediate this kind of unfettered exploitation. There is increasing evidence to show that when people are well organized in groups whose knowledge is sought, incorporated and built upon during planning, implementation, then the productivity of agriculture and natural resources can benefit in the long-term (Pretty, 2008). These are elements that are embodied in the concept of farmer-based networks that pervade parts of Southeast Asia and form the basis of this study. It has been argued that there is a need to develop new social organizations that are structurally suited for natural resource management and protection at the local level (Cernea, 1991). In the following section the concept of social capital and its elements is discussed as backdrop to selected examples of where it has been used effectively to mobilize communities and farmers.

2.2 Social Capital

The term social capture encapsulates the idea that social bonds and norms are important for sustainable livelihoods. Coleman (1988) describes it as 'the structure of relations between actors and among actors' that encourages productive activities. As it lowers the costs of working together, social capital facilitates cooperation. This is in part due to people having the confidence to invest in collective activities knowing that others will do the same (Pretty, 2008). The concept of social capital is built on four central aspects (Pretty and Ward, 2001; Pretty, 2003; Westerman et al., 2005) namely: 1) relations of trust; 2) reciprocity and exchanges; 3) common rules, norms and sanctions; and 4) connectedness, networks and groups.

Trust reduces the transaction costs between people and so liberates resources. Instead of having to invest in monitoring others, individuals are able to trust them to act in an appropriate manner. This has a positive impact on both time and money. Trust can only work if there as an appropriate monitoring framework in place, such as a social network. In this way, social capital is both dependent on – but also creates – trust through the monitoring that it generates (Pretty, 2008).

Reciprocity and exchanges also function to improve trust. There are two types of reciprocity: specific reciprocity that relates to exchanges of items of roughly equal value; and diffuse reciprocity, which is a continuing relationship of exchange that at any given time may not be met but eventually is repaid and balanced. This contributes to the development of long-term obligations between people (Pretty, 2008).

Common rules, norms and sanctions are the mutually agreed or handed-down norms of behavior that place group interests above those of individuals. They allow individuals to have the confidence to invest in collective or group activities, knowing that others will do the same. Individuals can also take responsibility and ensure their rights are not infringed. A feature of this aspect is that mutually agreed sanctions ensure that those who break the rules are aware that they will be punished – and, in a network, there is a high chance that they will be detected if they violate these rules. Such norms are often understood to be social institutions, and high social capital implies that a community or group of people have a strong internal institutional fabric, in which individuals balance individual rights with collective responsibilities (Pretty, 2008).

Connectedness, networks and groups are a vital aspect of social capital. There are three types of connectedness that are important: bonding, bridging and linking types of social capital (Woodcock, 2001). Bonding describes the links between people with similar outlooks and objectives, and is manifested in different types of groups at a local level (Putman, 2000). Bridging describes the capacity of groups to make links with others that may have contrasting views, particularly across communities (Putman, 2000). Linking describes the ability of groups to engage vertically with external agencies, either to influence their policies or to draw on resources (Pretty, 2008).

There is growing evidence to suggest that social capital is associated with improved economic and social well-being. Households with greater connectedness have been shown to have higher incomes, (Narayan and Pritchett, 1996; Krishna, 2002; Wu and Pretty, 2004), improved education (Fukuyama, 2000), and better social cohesion and more constructive links with governments (Putman, 2000). Not all forms of social relations are good for everyone in a community. A society may be well organized, have strong institutions and have embedded reciprocal mechanisms but may not be based on trust but on fear and power, such as in feudal, racist and unjust societies (Knight, 1992). Formal rules and norms can also trap people within harmful social arrangements. Again a system may appear to have high levels of social assets, with strong families and religious groups, but contain abused individuals or those in conditions of slavery or other exploitation (Pretty, 2008).

2.3 Evidence of collective resource management

There has been a dramatic expansion of collective management globally that has been referred to as community management, participatory management, joint management, decentralized management, indigenous management, user-participation and co-management. These investments in social capital creation and development have centred around participatory and deliberative learning processes. It has been estimated that since the late 1990's 400,000 – 500,000 new groups have arisen mostly in developing countries (Pretty and Ward, 2001; Pretty, 2003). Most have evolved to be of limited size, with 20-30 active members, putting the total involvement at some 8-15 million. Most groups show the collective effort and inclusive characteristics that are identified as vital for improving community well-being and leading to sustainable outcomes (Flora and Flora, 1993). Selected examples of some of these collective management entities are presented below.

2.3.1 Watershed and catchment management groups

The protection of watersheds and catchments cannot be achieved without the willing participation of local people. In this respect, for sustainable solutions to emerge farmers need to be sufficiently motivated to want to use resource-conserving practices on their own farms. This in turn needs investment in participatory processes to bring people together to deliberate common problems and form new groups or associations capable of developing practices of common benefit (Pretty, 2008). The resulting uptake of this collective action to resource management has been amazing with programs reporting significant improvements in yield of crops/livestock in the order of two or threefold. Most of these projects report substantial public benefits, including groundwater recharge, reappearance of springs, increased tree cover and microclimate change, increased vegetation cover of common lands and significant benefits to local economies. It is estimated that more that 50,000 watersheds and sustainable agriculture groups have formed over the past decade in Australia, Brazil, Burkina Faso, Guatemala, Honduras, India, Kenya, Niger and the USA (Pretty and Ward, 2001).

2.3.2 Water user groups in the irrigation sector

Without regulation and control, irrigation water can be over-used by those that are fortunate to be at the head of an irrigation canal, resulting in shortages to tail-enders, potential conflicts over water allocation, and degradation of biophysical resources associated with waterlogging, salinity and drainage problems. The development of social capital through the formation of water user associations or groups with locally developed rules and sanctions are able to more effectively utilize the available resources than individuals working alone or in competition. The resulting impacts invariably result in increased yields, increased farmer contributions to operation and maintenance, dramatic changes in the efficiency and equity of water use and a decline in breakdowns of the systems and reduced complaints to government departments (Ostrom, 1990; Uphoff, 1992; Singh and Ballabh, 1997). An analysis of 150 irrigation systems in Nepal indicated that irrigation systems that are governed by farmers themselves delivered more water to tail-enders and had higher productivity levels than those run by state irrigation departments (Lam, 1998).

2.3.3 Farmers' co-learning and research groups

The normal mode of agricultural research has been to experiment under controlled conditions on research stations, with the resulting technologies being passed on to farmers. Farmers have little control and in many cases the technologies are not well suited to the prevailing conditions thereby reducing the efficacy of the research systems. Farmers' organizations can help research institutions become more responsive to the local needs and can create extra local value by working on technology and adaption (Pretty, 2008). Self-learning is important for the development of sustainable agricultural production systems, and by experimenting themselves, farmers increase their awareness of what does and does not work. There have been many innovations in both industrialized and developing countries, though generally the numbers of groups in each initiative tend to be much smaller than in watershed and irrigation programs (Pretty, 1995; van Veldhuizen et al., 1997; Uphoff, 2002; Gallagher et al., 2005).

2.3.4 Farmer Networks of Northeast Thailand

Land degradation, resultant declining yields and concerns over health impacts of agricultural practices, has led to the formation of self-help farmer networks in Northeast Thailand. Farmers in this region have experienced declining availability of food resources at the village level and food insecurity, primarily due to degradation of soils and ecosystems, so severe that they could no longer sustain productivity without significant and unsustainable levels of external inputs. Consequently, out-migration to cities increased and in a negative feedback loop reduced on-farm productivity further and also negatively impacted natural resources of the area and family structures. Within these fast growing networks, farmers discuss their concerns, plan options and solutions, and move forward to create change. Three networks exemplify the positive social and environmental outcomes.

The Organic Farming Network is dedicated to organic rice production, and also promotes activities for the protection of forest resources, water and natural ecosystem rehabilitation. This network began with a group of farmers to address concerns over human health in their rural communities. Through a process of self-analysis and discussion of possible options to improve their livelihoods, the group decided that the growing of organic rice would be a viable option in addressing their problems. The adoption of organic rice growing has resulted in a reduction or cessation of chemical inputs into production systems and the conservation of organic materials and production of green manures for soil improvement. It includes more than 2000 households in several provinces, and their practices have resulted in conservation of natural habitat, and a gradual improvement in basic resources. Soils are more productive and higher water use efficiencies have been achieved. After early criticism and opposition from the government sector that perceived organic rice production to be a threat to overall rice production in the Kingdom, the concept of organic farming is now widely integrated into provincial development plans.

The Integrated Farming Systems Network identified their biggest natural resource constraint as access to sufficient water resources during the long dry season. They had observed that during the rice growing season there was some runoff from their fields and that it would be important to attempt to store this runoff. In the first year they took the risk of digging shallow ponds to harvest the rain water. This allowed them to store enough water to start the vegetable production and to grow fruit trees on the same plots. By repeating these water harvesting activities for the second and third years, the group was able to grow sufficient food for household consumption and also to create a surplus for sale to nearby households and villages.

Once water availability was secure, the integrated farming systems were intensively developed. These activities included the conservation of agricultural organic waste, such as rice straw for making compost and the adoption of extensive green manure systems for soil improvement. Poultry, pig and cattle raisings have also contributed to organic amendment development to the system. Apart from the improvement of water resources, soil resources have gradually improved for both upland and lowland farming systems. The primary objective of households is attaining food sufficiency. Thereafter income generation at the household level becomes the next goal that has significant added benefits through the community as well as at the local level. The concept of food sufficiency has also promoted a caring and sharing culture in the rural communities. From virtually a drought-prone area with limited potential, the area has been transformed into productive and sustainable farming systems with low external inputs that most farmers are able to follow. Currently, there are more than 3000 households that are active members of the network in the Khon Kaen, Nakhon Ratchasima, Chaiyapum Provinces.

The Agroforestry Network focused on securing food security at the household level by promoting the establishment of indigenous vegetables and native fruit trees. Over the years the number of plant species established around the home has gradually increased to cover a range of food and timber species, as well as species for environmental protection. A number of positive impacts of the Agroforestry Network include, enhanced food security at the household level, increased fuel wood security, social security and the revival of local wisdom with respect to agricultural production and development. Moreover, there has been a positive impact in the rehabilitation of the agricultural resources in the area.

Due to the diversity of tree species that have been established, there has been a high degree of soil fertility improvement through regeneration of ecosystems. In addition, there has been a significant increase in water use efficiency associated with the establishment of the agroforestry system. With the productivity improvements that have been achieved for both food and forest products, it is considered that this approach has enhanced the sustainable use of soil and water resources to the benefit of the environment and network household members. This network began modestly when a group of 15 farmer households in Dongbang village, Wangyai district, Khon Kaen province was approached in 1989 by a non-government organization (World Vision). From this rather small beginning associated with an individuals desire to promote the conservation of natural resources, the success of the group has stimulated awareness of nearby villagers both within the same and surrounding villages. This awareness initiated the formation of the agroforestry farmer network in Bua village, Kudbak district, Sakon Nakon Province, Northeast Thailand. The site is currently the network center of more than 30,000 household agroforestry network members. Their activities currently range from promoting tree planting, food processing, education development and support at the community levels. In addition, the networking is promoting expansion to other areas and to date the number of members has doubled annually.

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