Research article

Indigenous Agricultural Knowledge - A Sample of Practice in Northeast Thailand

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Abstract The Northeast is the largest region of Thailand with approximately one third of both the total land area and population of the country. However, the region has the lowest per capita income. This is due to the region's agricultural systems being dominated by rainfed farming, poor soil quality and fluctuation in market demand and price for the agricultural produce. In general, more than 50% of farm income is earned from the crop sector rather than livestock. In a risky business, farmers have learned to understand their environment which includes physical, biological and socio-economic and site-specific factors. In response to the environment, farmers have adapted their practices and this has been given the name "indigenous agricultural knowledge" to improve crop yield and household income. This paper illustrates the overview of indigenous agricultural knowledge in Northeast Thailand which includes land preparation, pre-germinated seeds, thinning buds, detaching flowers, decreasing leaf area, suppressing weeds, alleviation of insect damage, improving soil quality, post-harvest techniques and multiple cropping. Indigenous agricultural knowledge has not been systematically recorded in written form and therefore is not readily accessible to agricultural researchers. Indigenous agricultural knowledge is an immensely valuable resource that provides farmer-to-farmer training or local technology transfer.

Keywords indigenous agricultural knowledge, farmer training, Northeast Thailand

INTRODUCTION

Amongst the four regions of Thailand, Northeast Thailand has the most land devoted to agriculture (Office of Agricultural Economics, 2008). The region is considered an integral component in agricultural production with rice being grown on 65% of the arable land. Other major crops include sugarcane, cassava, rubber and peanut. Indigenous knowledge is local knowledge unique to a given culture or society. Indigenous knowledge is an immensely valuable resource that provides small holders and resource-poor farmers with insights on how they have interacted with their changing environment for survival (Chamber et al., 1989; Reijntjes et al., 1992; Bouguera et al., 2003; Cools et al., 2003). It is not possible in such a brief paper to give a full inventory of the indigenous agricultural knowledge in Northeast Thailand. However, a sample of practices will serve to highlight the good sense shown by farmers.

OBJECTIVE

The objective of this paper is to give some examples of indigenous knowledge and practices in Northeast Thailand to illustrate that farmers have a holistic understanding of the specific environment and how they adapt with limited resources for survival.

INDIGENIUS AGRICULTURAL PRACTICES

Land preparation

Increasing cropping intensity by planting on the residual moisture left in fields following the rice harvest presents a challenge in which farmers demonstrate considerable imagination. Soil preparation for rice involves puddling to reduce water loss and the leaching of nutrients through percolation. To plant a second crop like peanut, this surface, which becomes hard as it dries, must be broken to aerate the seed zone and allow oxygen to penetrate the water free macro pores. This is critical to germination but must be done at exactly the right time. If the soils are too wet and top dry it is not possible to obtain a good tilth. Land preparation is again dictated by measuring soil moisture. Once the monsoon has passed it is important to start preparation as soon as possible. To encourage soil drying to optimum levels, field tests were carried out by the scientist under the conditions indicating that the soil moisture is close to field capacity. Farmers cut the rice straw as close as possible to the ground, and then put it on the bunds of the paddy fields, to allow sunlight to dry out the soil surface. The ground is ploughed and harrowed three to four times. After each ploughing the land is harrowed several times. Therefore, time devoted for land preparation could be shortened, thus allowing adequate soil moisture for peanut without irrigation throughout the growing season. Good land preparation also provides water-free macro pores with advantages to conserve soil moisture in deeper soil layers by cutting capillary rise to the soil surface.

Pregerminated seed

Peanut grown after rice harvest in the post-monsoon period requires rapid seed germination and seedling growth in order to reach maturity before the plants are subjected to water stress and reduced yield.

To receive rapid seed germination, farmers soak peanut seeds in water for 1-2 days before seeding. Some farmers soak the seeds for 24 hours and subsequently place them in a wet sack for another day before seeding. This results in a quick and uniform peanut germination. Pre-soaking of peanut seeds before seeding is very useful for promoting seed germination especially when seeds are sown in slightly dry soil (Chippendale, 1934). Pre-germinating seeds before planting minimizes the lag period between sowing and seedling establishment. Moreover, pre-soaked seeds will not be easily exposed to pests, especially rats and ants. The early emerged seedlings also have a competitive advantage over associated weeds.

Re-nutrition of planting material

Mature stems of cassava after harvest is used as planting material. Normally, farmers do not plant cassava soon after harvest due to unfavorable weather conditions. Mature stems are, therefore, kept in the shade for 1-2 months prior to planting. During this period, axillary buds initiate at the upper nodes. Most of the food reserves will be used during this period. To solve this problem, farmers dip stem cuttings (15-25 cm long) into an aqueous solution containing 13-5-5 (N-P_2O_5-K_2O) fertilizer, some farmers use liquid fertilizer diluted in water before planting. Dipping stem cuttings into nutrient solutions will restore nutritional status in stem tissues. This results in an increasing rate and percentage of shoot emergence, early rooting and fast shoot growing. CIAT (1981) reported that the nutrient status of stem cuttings influences their development. Cuttings of stems taken from plants grown on fertilized plots give an early shoot growth and higher yields when these cuttings are planted in an infertile soil.

Eliminating buds

Cassava is one of the most important cash crops for the farmers in Northeast Thailand. Due to decreasing of land holdings, increasing tuber yield per unit of land area is an important way increase farm income. To increase tuber yield, farmers eliminate bud from stem cuttings used as planting material. Normally, stem cuttings used for planting are around 15-25 cm long. Nowadays, farmers use stem cuttings around 50 cm long and eliminate buds before planting. The longer stem cutting as planting material means that there are more buds and consequently increased number of tubers in the soil. However, deep plowing, animal manure and chemical fertilizer application are required to obtain a high tuber yield. Deep plowing improves soil aeration and facilitates the growth of tubers in the deeper soil layer. Adequate amounts of nutrients need to be applied to the soil in order to increasing root (tuber) weight per plant.

Detaching flowers

In crop plants, the fully expanded mature leaf is a major “source” of food (photosynthates) for the plant. The organs which store or use photosynthates are known as a “sinks”. In yambean plants, tubers, flowers and fruit are important sinks. Therefore, flowers and developing fruits have a significant effect of the distribution of assimilates in the plant. The supply of photosynthates is finite and competition between sinks will eventually occur. Therefore, detaching flowers to prevent fruit development leads to greater allocation of assimilates to tubers. When yambeans begin to flower, the farmers use a long bamboo stick striking the top of plant to detach the flowers for improving tuber yield.

Decreasing leaf area

Cassava grown on soils containing high levels of organic matter or nitrogen, in general, produce excessive leaves but low tuber yield. To solve this problem, farmers cut the tops off young shoots at 2-3 months before harvesting to improve tuber yield. Cock (1985) reported that heavy applications of fertilizers, particularly nitrogen, can stimulate top growth. Although total plant weight increases, the yield of tubers may decrease. Top cutting is a manipulation of the source-sink relationship. If cassava has a leaf area index (leaf area/unit of land area) over the optimum value, mutual shading will occur. Photosynthates will be allocated to lower shade leaves where the respiration rate exceeds the photosynthetic rate. As a result, there will be less allocation of photosynthates to tubers. Farmers also practice top cutting young shoots of rice at the vegetative growth stage to improve grain yield similarly to cutting the tops of young cassava shoots.

Suppressing weeds

Dry direct-seeding or broadcasting rice utilizes rain from the first peak of the region’s bimodal rainfall pattern for crop establishment. This allows the early planting of rice at a time when rainfall is often insufficient for transplanting, thus guaranteeing a crop and also reducing the yield losses often associated with late transplanting of the photo-sensitive rice varieties used in rainfed areas in the Northeast. To maintain a satisfactory yield, however, an effective weed control method is required in dry direct-seeded or broadcasting rice. In general, farmers practice weed control by cutting rice and weeds using a hand lawn mower at the vegetative growth stage. Rice stubble and weeds are cut around 5-10 cm above the ground surface. The rice regrows faster than the weeds and cutting results in better competition with associated weeds.

Polthanee (2006) conducted an experiment to study the effects of cutting rice and weeds on subsequent weed growth and grain yield of dry-direct-seeded broadcast rice. Rice and weed cutting at 30, 45 and 60 days after seeding reduced weed dry weight as compared with that from the uncut-unweeded treatment. Grain yields following cutting after 30 or 45 days were significantly higher than from the uncut-unweeded treatments (Table 2).

Table 1 Weed dry weight (g/m^2) after regrowth at flowering growth stage as affected by cutting dates at 30, 45 and 50 days after seeding (DAS)

Treatment	Weed species				Total
	Grass [1]	Grass [2]	Broadleaf [3]	Sedge [4]	
Uncut-unweeded	66.2[a]	89.1[a]	3.9	4.7	163.9[a]
Cut 30 DAS	19.9[b]	47.9[b]	2.3	3.4	73.5[b]
Cut 45 DAS	49.9[b]	21.2[c]	3.1	3.6	76.8[b]
Cut 60 DAS	49.7[a]	14.7[c]	3.5	1.7	69.6[b]
F-test	**	**	NS	NS	*
C.V.(%)	18.1	27.2	24.7	21.4	31.4

[1]*Ischaemum rugosum*, [2]*Panicum repens*, [3]*Ludwigia sp.*, [4]*Fimbristylis miliacea*

Table 2 Yield and components of rice as affected by cutting dates at 30, 45 and 60 days after seeding (DAS)

Treatments	Grain yield (kg/ha)	Panicles (no./m^2)	Filled grain (no./panicle)	1,000 grain weight (g)
Uncut-unweeded	1,814[b]	163.5[b]	64.7[b]	25.4
Cut 30 DAS	2,159[a]	241.0[a]	80.9[a]	27.4
Cut 45 DAS	2,138[a]	233.8[a]	74.1[ab]	26.5
Cut 60 DAS	2,075[ab]	223.3[a]	66.4[b]	26.1
F-test	*	*	*	NS
C.V.(%)	19.1	16.3	11.6	7.5

** = Significant at 5% by DMRT, NS = Not significant*

Improving soil quality

Rice in Northeast Thailand is normally planted on undulating land which includes upper paddy and lower paddy, on sandy loam or sandy clay loam soil of low fertility. To solve this problem, farmers collect the fallen leaves from the forest area near the village and/or village settlement area. The leaves are incorporated into the soil during land preparation to improve soil fertility. Sae-lec at al. (1992) reported that tree leaves provide several important nutrients such as N, P, K, Ca and Mg but the concentration varies between tree species. Some farmers apply rice husks and incoporate them into the soil in order to improve rice yield when grown on saline soil.

Most sugarcane in Northeast Thailand is grown on coarse textured soil with sandy and sandy loam textures and having low fertility. To maintain soil fertility and maintain the sugarcane yield at a satisfactory level, farmers grow peanut as crop rotation after harvesting sugarcane (over a cycle of two years). The peanut crop is incorporated into the soil after removing the pods from the plant before planting sugarcane. Hemwong (2008) reported that peanut residues returned about 146 kgNha-1 to the soil and increased sugarcane tillering and yield.

Integrated farming is a system which combines the activities of agriculture, animal husbandry, crop production, fisheries, forestry and other sciences related to agriculture in one area of land. Some farmers manage the nutrient cycle to maintain soil fertility using crop residues and weed residues available on the farm to produce compost fertilizer for application to the soil.

Alleviation of insect damage

Subterranean ants are normally a major pest causing damage to peanut pods and consequently reduce peanut yield. To solve this problem, farmers use mature coconut fruit after removal of husk and place it in the soil in the area where peanuts are grown. Subterranean ants usually enter the coconut fruit to feed on the coconut meat through the coconut's eye. The ants become trapped in the fruit and are brought out of the field and destroyed by burning. Keerati-Kasikorn and Singha (1985) reported that the strong smell of coconut meat in a coconut fruit as a bait is more attractive to ants than peanut pods.

Post harvest technology

Harvesting of sesame cannot be delayed until all the seed capsules reach the fully ripened stage. This is because the capsules mature unevenly and some seeds in fully ripened capsules may be lost through shedding. To solve this problem, farmers estimate the optimum time to harvest the crop from experience. When a crop is mature enough for harvesting, they observe that most of the leaves of the sesame plant have turned yellow. At this point they open the third or fourth seed capsule from the top. If the seeds inside the capsules are brown, they decide that it is time to harvest the crop. The plants are cut with a sickle or pulled from the soil by hand and stacked into a small heap. Each heap is covered with rice straw or dry coconut leaves for 7-10 days. Then, they tie the sesame plants together to make bundles. Three bundles are tied together to form a tripod-like structure. The plants in the tripod-structure are left and dried in the field under the sun until the capsule tips open. The farmers then turn the bundles upside down and let the seeds fall on to plastic sheets. They found that the technique allows them to harvest all mature seed capsules and to obtain a maximum yield from the crop.

Multiple cropping

A form of intercropping is practiced by the farmers. Maize and cucumber are planted together in January after rice harvest under irrigated conditions. The maize is planted in rows by hand. Cucumber seed is then seeded into the soil near the maize seeds. The two crops have quite a different growth habit and maturation period. The maize matures first. The two crops grown together use solar radiation, water and nutrients more efficiency during the dry season.

Other forms of relay intercropping are practiced. Peanut or mungbean are planted with maize under rainfed conditions. The peanut or mungbean seed is planted with zero-tillage between rows of mature maize. If the maize is harvested early then the more profitable peanut which requires more moisture and a longer growing period will be planted. If the harvest is likely to be delayed farmers grow the quick maturing mungbean.

Other legumes are also grown with maize, maize and rice bean planted together in the one hole. The corn matures first and provides stalks for the rice bean to climb. The bean provides nitrogen to the maize through symbiotic fixation, provides a ground cover which protects against erosion and leaves a residue of nitrogen for the next crop.

CONCLUSION

A case study of indigenous agricultural knowledge practiced in Northeast Thailand has shown that farmers have an intimate understanding of their biophysical and socio-cultural environments, and have the capability to develop new technologies by trial and error, in order to improve production systems with limited resources.

To achieve better outcomes in agricultural development for small holder farmers, researchers need to take full advantage of any opportunity to receive information and learn from local knolwedge. A full exchange of information will enhance both the knowledge of scientists and their ability to design suitable ways of improving the lot of small holder farmers.

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