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Fruit Crop Production under Highland Environment of Northern Thailand

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ABSTRACT

About two to three decades ago, the highland areas of Northern Thailand was very rich in natural resources of forest trees. This area was comparatively unknown and therefore neglected. The natural environment there had been very well preserved until the migration of hill peoples from China and Burma. The traditional practices of shifting cultivation by these hill tribes turned the rich forest to poor and infertile land.

Soil erosion followed the destruction of forest trees resulting in the altering of watershed system. This in turn caused floods followed by drought in the lowland areas. To restore the ecological environment, reforestation of these previously shifting cultivated land has been practiced by the Royal Forestry Department. However these reforested trees are slow growing and have high mortality rate especially during the dry period. Furthermore, these young forest trees do not receive maintainative attention from hilltribes in the area.

Many horticultural crops have been introduced to these hilltribe farmers with the aim of providing income in place of opium cultivation. Among them, perennial fruit trees have great potential as an important tool in solving the problems created by the hilltribe people living in the highland areas. Fruit trees may provide a steady and reliable income for these people. It will also eventually eliminate the practice of shifting cultivation by setting them in one place permanently. If other factors are also favorable, it could curtail the practice of opium poppy cultivation as well. Furthermore, planting of fruit trees conforms with the normal reafforestation practices and conservation plans and assist the development of a more natural environment. The effects of some crops on the environment in the highland areas are discussed.

INTRODUCTION

In the past, the head watershed areas in the north of Thailand were covered with dense evergreen forest which was the main water supply catchment to the lowland in the north itself and also in the central region through to Bangkok. The situation has changed, at present only about 20 percent of the mountainous land of the north remain as forest. The majority of the hill area has been destroyed by the traditional

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practices of shifting cultivation by tribesmen living in these hill areas. Recently it was estimated that at least 700,000 tribesmen are living in the highlands of Northern Thailand which cover many watershed areas (Subhadrabandhu, 1984). These people normally grow annual crops such as upland rice and corn for their own diet and their main cash crop is opium poppy, the crop that has high notoriety world-wide. In general these people are poor and have a difficult lifestyle. His Majesty the King was the first to display a willingness to help these people by setting up the Royal Project which aims at minimizing hunger among these tribesmen (Bhisatej Rajani, 1977). The main purpose of the Royal Project is to help these people to produce enough food or to produce enough income from agricultural crops, in place of opium poppy, for a reasonable standard of living.

The growing concept on watershed management with regard to restoration of natural resource conservation are pursued whilst trying to satisfy the dietary needs of these hilltribes in these watershed area. The Royal Project also aims to stop the production of opium poppy by growing substituted crops. All combined, these tend to enlarge the problems of highland development in Thailand. The problems that will be discussed in this paper have in three aspects ; they are 1) ecological and environmental problem, 2) economical problem and 3) sociological problem.

Ecological and environmental problem.

As mentioned earlier, the highland areas of Northern Thailand used to be very rich in natural forest resources. The environment there had been very well preserved until the migration of hill tribes who practiced shifting cultivation and gradually turned the rich forest to poor and infertile land. The result of this change can be seen especially in the high soil erosion rates which occurred on cultivated steep slopes. Previously this ecological break-down, however, would have been compensated and regenerated by soil formation processes during the fallow period afterwards. This system provided long-term ecological sustainability as long as there was no population pressure to force the inhabitants of tropical hill forests to shorten the cultivation cycles.

Population pressure will result in increased deforestation, a reduction of fallow periods, and an accelerated degradation of the soils (Voraurai et al., 1980). Since population pressure into the remaining forests of the northern hill areas seems to be unavoidable, measures are needed to reduce soil erosion and thus enable a shortening of fallow periods without long-term deterioration. Appropriate agricultural systems which respond to the changing situations are critical for the recovery of large parts of the tropical hill forests. The term appropriate in this case refers to both the natural environment and the local inhabitants. The conflicting requirement of these two elements makes the finding of acceptable solutions extremely difficult.

The hill tribes inhabitants of these highland areas have to grow crops for their food supply as well as for their income. Hence the ideal crops to be introduced into the areas must be able to

create a mere natural environment similar to the former indigenous forests and at the same time these crops must contribute some income to the growers (Subhadrabandhu, 1979). In this sense annual crops that need intensive cultivation may not be suitable especially on the sloping land. Being perennial, fruit trees would be better recommended to these sloping areas since they can be treated in the same manner as forest vegetation.

The influence of cultivated crops on soil erosion and soil losses in the northern Thailand can be seen from the study of Dr.Hans Hurni (1982) who worked at Huai Thung Choa. He estimated soil losses from the traditional upland rice swiddens to lay around 70 tons per hectre per year, this was on an area 20 metre long with 50% slope. With the introduction of perennial trees grown in combination to annual crops, the figure of soil losses was much reduced (Table 1). Our previous study on the kinds of land suitable for cropping showed that the area less than 50 degree slope can be used for agriculture production including fruit tree plantations. Whereas places steeper than 50 degree are not suitable for crops and are allocated for forest trees (via reforestation) which need lesser care (Subhadrabandhu, 1984).

Economical aspects in the highland

In an effort to improve the fertility in the highlands as well as to bring back the environments closed to those created under rich forests, temperate fruit crops were introduced into the area and are expected to serve as the main source of income for hill tribes. Fruit trees could have great potential in both commercial and social ways, for they can provide a steady and reliable income to these hill tribes. If successfully established, these trees will eventually minimize the practice of shifting cultivation by encouraging more permanent settlement of hill tribe people and may curtail the growing of opium poppy. Furthermore, planting of fruit tree is an acceptable practice in reforestation and conservation plans, thus it represents a potential for overall improvement to the environment.

Among the fruit trees known, some of them that have been considered to show promising in the highland area of northern Thailand included.

1. Japanese apricot

Japanese apricot is eaten in Japan, China, and Thailand as pickles and preserves. The fruit trees are extensively grown in Japan and Taiwan. Japanese apricots have been cultivated in lowland areas of northern Thailand for 30-40 years (Punsri, et at., 1982). Presently, a local variety is found in some villages of Chiang Mai Province. It is fast-growing and thrives in poor soil, but the fruits are rather small and of inferior quality. It can be used as a rootstock, however, for introductions.

Seven varieties from Japan, Shirakaga, Bungo, Koshyukoume, Koshukuome, Koshuko, Baigo, and Kobai, were tested. After four growing seasons, their performance was very poor and the trees showed signs of insufficient chilling. They were removed from further study. Two other varieties, Ping Ting and Jen Toa, were introduced from Taiwan. These cultivars

grew very well at Ang Khang and bore fruit after the fourth year. Average yields per 5-year-old and 10-year-old trees were 40 and 100 kg, respectively. At present, these varieties have been propagated and distributed to the hill tribes.

2. Peach

Three distinct varieties of peaches are grown locally in the highland area of northern Thailand (Punsri et al., 1976). These varieties were probably introduced years ago by the hill tribes (Subhadrabandhu, 1973). The people often plant peach trees near their villages, and since the hill tribes move about on the highlands, "wild" peaches have been scattered across the mountains. These three local varieties are Ang Khang Red, Ang Khang White and Doi Pui.

As of 1980, 87 varieties of peaches had been introduced to the area. They include low-chilling, medium-chilling, and high-chilling varieties.

Peaches with a low chilling requirement (i.e., up to 400 chilling hours), represented by Flordared, Flordasun and Flordabelle, performed very well, as did Ying Ku and Luh Yueh from the Republic of China (Taiwan) (Table 2). The trees began to flower and set fruit after the second year.

Medium-chilling peach varieties, i.e., 400-600 chilling hours, such as Ventura showed some effects of insufficient chilling. Vegetative growth was slow and opening of flower buds very late. The flower buds gave rise to many abnormal flowers which rarely set fruit.

High-chilling varieties, i.e., over 600 chilling hours, such as Alberta, Hakuto, Hakuho, were poor performers. Overall growth was slow, with many disease-infected leaves. No flower buds opened due to insufficient chilling. These varieties were later discarded for use in the area.

Peach growers, most of them hill tribesmen, sell inferior quality fruits of the local varieties to small pickling factories and get a very small income from the trees. If the local peaches were top-worked with better varieties, they might bring higher income in a shorter time. A top-work trial with Flordabelle, Flordasun and Flordared was carried out at a Hmong village called Nong Hoi with good cooperation from the orchard owners. Local Doi Pui peach trees were used as rootstock. The average yield per tree after the fourth year of grafting was 25 kg.

3. Apple

Forty-five varieties of apple were introduced and overall growth was observed for 5 growing seasons. Low-chilling varieties such as Anna, Ein Shemer and Dorsett Golden grew well under Ang Khang conditions. These varieties seemed to have no problem in floral bud differentiation. They flowered readily and the fruit set was satisfactory. However, fruit set of Anna was much better if cross pollinated with Ein Shemer or Dorsett Golden.

With high-chilling varieties such as Golden Delicious, McIntosh, Fuji, and Granny Smith, failure of lateral buds to grow was the most important problem. The plants showed symptoms of insufficient chilling very clearly. Attempts to overcome this problem have been tried, and branch bending, Indonesian style (Janick, 1974), seemed to give good results on Rome Beauty.

With branch bending, lateral buds are forced to open and hence more branches can be developed on the tree. The terminal bud of each branch, at the proper stage, will differentiate into a mixed bud which can be forced by stripping the leaves on that branch. A flower cluster could then be expected on each branch of the tree, and one to three fruits from each cluster. To get good results from the branch bending method, proper timing of the operation must be observed. Also, the procedure may be too difficult for hill tribesmen to follow; simplification of the method may be needed.

4. Asian pear

A total of 31 varieties of Asian pear were introduced from Taiwan, Japan, and India. The European pear *(Pyrus communis* L.) grew poorly due to insufficient chilling. Only a few buds opened and a few leaves were produced in a year. Most died in the nursery.

Among the Asian pear *(Pyrus pyrifolia)* varieties, Yokoyama Wase, Pien Pu, Song Mao, and Pathanak had the best performance. The first three varieties were introduced from Taiwan and the last from India. These varieties yield satisfactorily under highland conditions, but the eating quality of the fruit is inferior when compared to the popular high-chilling Asian pears such as Kosui and Hosui from Japan, However, the low-chilling varieties have been propagated and distributed to the hill tribes.

5. Persimmon

About 50 varieties of persimmon were tested, mostly astringent cultivars. After six years only one variety of non-astringent persimmon produced fruit of satisfactory quality, but with rather poor yield. Many astringent varieties bear good crops but the fruits have to be treated before sending to market. At present, due to the high yield, astringent persimmons such as Tanenashi, Nightingale, Szu Chou, Xichu, Hachiya, Thien Shan and Ang Sai have been released to growers, along with techniques to reduce astringency.

6. Income from fruit trees

Based on interviews conducted in 1982, average yearly income per hill tribe family varies from 3,000-25,000 baht, or U.S. $120-1,000 (Table 3). Estimated income from ten fruit trees compares favorably (Table 4).

Sociological problem

As mentioned earlier, there are at least 700,000 tribesmen scatter in the highlands of northern Thailand. Among them there are more than 20 tribes of different social and cultural ways of life, however the main 6 tribes which consist of Karen, Hmong (Meo), Yao, Lahu, Lisu and Akha are commonly known to live in the Thai territory, while some tribes are moving around the Thai-Burmese border. Each individual tribe has its own culture, language, dress etc. These differences in culture of hill tribes cause problem in crop extension work. Some tribes such as Hmong and Yao can be easily taught and are fast to learn new technologies in crop production (Punsri and Subhadrabandhu, 1983) However it takes quite some time to get the other tribes to accept the newly introduced crops and technology for producing them. Superstitions and lack of marketing knowledge are other

factors which are not easy to overcome. These social problems must be taken into consideration for the success of any kind of development in the highlands

One main factor facing crop substitution to opium poppy program is the market of the introduced crops. It takes some time for adviser to gain the confidence of hilltribe growers to enable the introduction of new crops. From our survey, it has been found that there is always a great demand for temperate fruits in the local market. Apples, pears, Japanese apricots, persimmons for instance, can be sold at any time provided that the price is not too high. They are well-liked by the Thai people. One apple of medium size retail for at about 10 baht (50 cents) and salted Japanese apricot can fetch about 200 baht (US $10) per kilogram. A six-year old Anna apple on semi-dwarf stock of MM 106 with 3×3 meter planting space, can bear about 30 to 50 fruits which means that the grower can earn 300 to 500 baht from 9 square meters of land. This income is quite attractive compared with the earning from the laborious opium cultivation.

CONCLUSION

From the study on crop substitution to opium poppy in the highlands of northern Thailand, it showed quite clearly that this area has a great potential for deciduous fruit culture. Peaches, nectarines, apples, Asian pears, Japanese apricots and persimmons could be grown successfully and commercially in the areas of about 1,000 to 1,600 meter elevation which is "opium land", very suitable for opium poppy cultivation. Cultivation of fruit trees on this land, will solve many problems at the same time, i.e. narcotics problem, conservation and watershed management problems, and also the problem on the national resource utilization

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Table 1. Soil loss and runoff from traditional and agroforestry testplots (25 m. length, 5 m. width, 54% slope) at Mae Muang Luang, Huai Thung Choa, Northern Thailand in 1981. (Nuntapong, 1982).

	Runoff[1/] (% rainfall)	Soil loss[2] (ton/ha)
1) Traditional upland rice cultivation	12	89
2. Fallow (not continuous, rarely weeded)	11	58
3) Agroforestry 1 (upland rice + ditches + lemon grass + coffee + fruit tree)	16	22
4) Agroforestry 2 (corn + ditches + lemon grass + coffee + fruit tree)	10	13
5) Agroforestry 3 (peanut + ditches + lemon grass + coffee + fruit tree)	10	10
6) Agroforestry 4 (corn + peanut + ditches + lemon grass + coffee + fruit tree)	12	10

1/ Annual total rainfall in 1981 = 1697 mm.

2/ Total erosivity in 1981 = 801 (10^{-2} Joules.m^{-2}.cm. ha^{-1}).

Table 2. Fruit characteristics of local and introduced peaches. (Subhadrabandhu and Punsri, 1987)

Variety	Diameter (cm)	Length (cm)	Weight (g)	Flesh color	Stone firmness	Remarks
Doi Pui	3.11	3.76	18.18	White	Free	Poor quality. Locally used for pickles
Ang Khang White	3.87	4.21	32.80	White	Free	--
Ang Khang Red	4.12	4.55	41.85	White	Free	Better quality, can be canned in syrup
Flordasun	3.92	4.12	31.41	Yellow	Semifree	--
Flordared	4.49	4.34	49.05	White	Free	--
Flordabelle	5.14	5.06	67.78	Yellow	Free	High quality
Ying Ku	5.85	7.06	117.49	White	Cling	Local markets

Table 3. Average yearly income per hill tribe family and sources of income (Subhadrabandhu and Punsri, 1987)

Tribe	Occupation		Income[1/] ($ U.S.)
	Major	Minor	
Hmong, Northern	Opium	Swine, potatoes	280
Hnong, Southern	Swine	Vegetables	240
Karen, Skaw	Swine, poultry	Pepper, vegetables	132
Karen, P'wo	Swine, pepper	Tobacco, vegetables	120
Akha	Opium	Swine, Jungle products	248
Yao	Opium	Swine, cattle, potato	520
Lisu	Opium	Swine, cattle	400
Lahu	Opium	Swine, Jungle products	200
Haw (Yunanese)	Trading	Opium, potato, animals	1000

[1/] Based on 25 baht per $ 1 U.S.

Table 4. Average yield and estimated income from recommended species and varieties. (Subhadrabandhu and Punsri, 1987)

Species	Variety	Average yield per tree[1] (kg)	Planting distance (m)	Net price of fresh fruit ($ U.S./kg)	Income from 10 tress ($ U.S.)
Japanese apricot	Ping Ting Jen Toa	80	10×10	1.20	960
Peach	Flordabelle Flordasun YingKu	25	8×8	1.60	400
Apple	Anna	8	3×3	2.40	192
	Ein Shemer	8			
Asian Pear	Yokoyama Wase Song Mao Pien Pu Pathanak	100	10×10	1.60	1600
Persimmon	Astringent	20	6×6	1.40	280

[1]Estimated for 6-10 year old trees, based on data from 1980-1984.