CHAPTER I INTRODUCTION

I.1 Statement of Problem

I.1.1 Shifting cultivation

Shifting cultivation (swidden agriculture) is the predominant form of agriculture in the highlands and still a practice in most developing countries, as well as in Thailand. Generally, the term shifting cultivation refers to farming or agricultural systems in which a short but variable cultivation phase of slash and burn alternates with a long, equally variable fallow period (Okigbo, 1989). Most of shifting cultivators clear virgin or secondary forest. According to UNESCO, UNEP and FAO (Sajise, 1986), the world forest destroyed annually by shifting cultivation was estimated at 30 to 50 million hectares.

In Thailand, there are several estimations for forest areas that have been destroyed by this activity. In 1969, the Royal Forestry Department (RFD) estimated in a report of the FAO that total area being cleared annually by farmers was about 30,000 to 40,000 hectares (187,500 to 250,500 rai), and in northern Thailand alone, based on aerial photographs taken in 1956-1959, about 3,000,000 hectares or 18,750,000 rai of the ever green forest had been cleared in the most important watershed areas of the country (Komkris, 1978).

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Another version is that the country's forest depletion was estimated to be 557 thousand hectares/year during the period 1961-1982; and 135 thousand hectares/year occurred in the North (Bhumibhamon, 1986) , and Ratanawaraha (1988) reported that the upland forest area had decreased sharply from 23 million hectares in 1961 to 14.9 million hectares in 1985 with an equivalent to 50 and 29 percent of the total land area of the country, respectively.

There are two extreme forms of shifting cultivation found in the hill areas of Thailand. The first is practised by Hmong or Meo tribe who lives at the altitude of over 1,000 meters above sea level and has mostly migrated into Thailand from China during the present century. They clear an area of the primary forest where they can find it and cultivate the land as long as economic yield of crops can be obtained, and then abandon the area. They moved to search new lands, often in a distance of more than hundred kilometers away. The second is practiced by Karen and Lawa tribes who live at intermediate altitudes between about 500 meters and 1,000 meters above sea level and have been in Thailand for centuries. They cut and burn the forest and cultivate rice for one year only, and then allow the forest to regenerate for ten years. The period varies little, depending on site factors before clearing and cultivating again (Jackson, 1984).

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Another form of shifting cultivation was classified by Tribal Research Centre over 8 provinces (Chiang Mai, Chiang Rai, Lampang, Lampoon, Mae Hong Song, Nan, Uthaithani and Kanchanaburi. Two forms of shifting cultivation can be distinguished with the rotation and the abandoning systems. Most of the Karen, Thai, Khamu, Lua, Htin, Lisu, Haw and Thai Yai usually adopt rotation system of shifting cultivation. On the other hand, Hmong, Yao, Lahu, and Akha do not intend to reutilize the abandoned field in foreseeable time. They abandon them temporarily and look for other mature trees for a new shifting cultivation after two or three years, in some cases up to five years or more utilization (FAO/UNFPA, 1980).

This extensive agricultural systems have been practised by hilltribes since many years ago, including Chiang Mai province. About 60 percent of this province is forested highland occupied by hilltribesmen who practise swidden agriculture (Srimongkol and Marten, 1986). Since the rapid population growth in the highland areas as a result of migration from the lowlands of Thailand, Burma and Laos and high birth rate had caused pressure on the land for agriculture, land scarcity, rapid decline of the land/man, and shorter fallow periods had resulted (Schubert et al., 1986). It damaged the environment both in highland and lowland areas. Soil loss of the order 50-100 tons/ha/year is a common feature. Consequently, soils are degraded, biological

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diversity is hampered and the off-site damages are increasing (IBSRAM, 1987).

As human population and expectations increase and the limited area of slash and burn, fallow periods are shortened, accelerating at an alarming rate, soil deterioration and infestations by weeds, pests and diseases, critically decreasing basic food yields precisely as needs are increasing (Bishop, 1984).

The shortest fallow was found to be four years for some regions (Sahunalu and Hoanwangkaew, 1986). Frequently, there are no more fallow periods and the farmers may settle permanently.

I.1.2 Opium poppy growing

Another problem related to the highlands which is faced by the Thai government is the illicit cultivation of narcotic crops. In the past, hilltribes in some areas grew opium poppy. Use of opium as a narcotic was first introduced in Central Thailand by chinese, but its history as a crop for local consumption or cash in the northern has not been written (Sabhasari, 1978). This crop could be found in 10 provinces of the north including is Chiang Rai, Phayao, Mae Hong Son, Chiang Mai, Lampang, Tak, Nan, Petchaboon, Phitsanulok and Uttaradit (Suwannapiam, 1984). Historically, the Karen, Khamu, Hatin and Lau, etc., who are earliest tribal migrants to settle in the northern area of Thailand, did not

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traditionally cultivate this crop until other groups of hilltribes such as Hmong, Yao and Lisu etc migrated into the same area and transferred the practice to them.

In Chiang Mai Province, about 21,288 rai poppy growing areas which spread in 13 districts (Figure 1) was estimated by official anti-narcotic sources (Bangkok Post, 1988).

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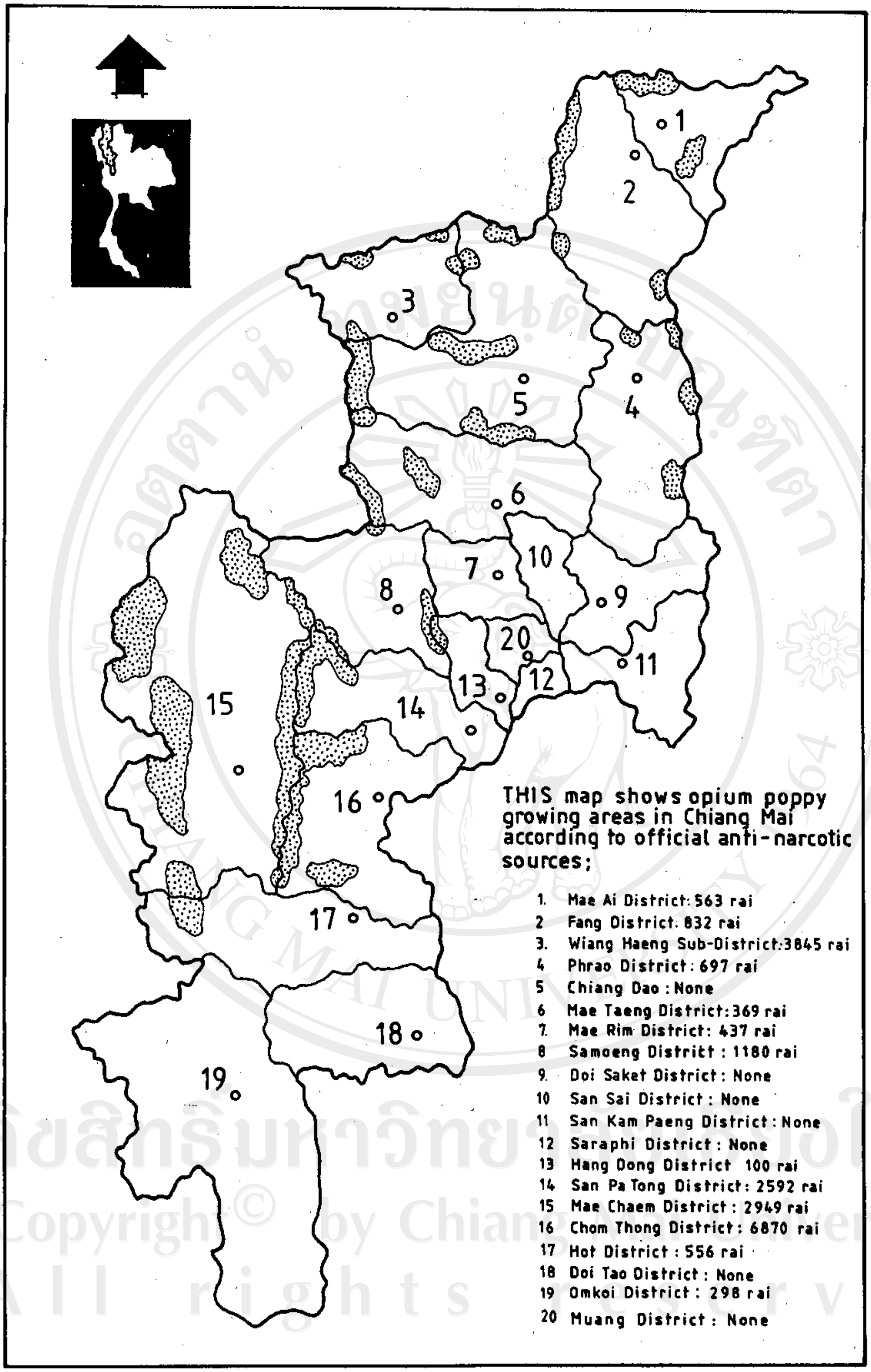

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Figure 1. Map of opium poppy areas in Chiang Mai (Bangkok Post, 1988)

Since the government of Thailand declared eradication of illegal production of opium poppy and replacing those with other cash crops, the acreage and quantity of production of opium poppy decreased impressively by 69 percent and 77 percent, respectively during 1965-1983 (Table 1).

Table 1. Area and production of opium poppy 1965- 1983

Y e a r	Area (rai)	Production (ton)
1965 - 1966	112,000	145.6
1975 - 1976	63,123	68
1981 - 1982	46,196	57
1982 - 1983	34,568	33

Source : Suwannapiam (1984).

According to Wiboonpongse et al. (1989), the hilltribe farmers ceased opium cultivation, because of the awareness of its illegality, availability of new cash crops and prohibition to grow opium by the government and the Royal Project. On the other hand, the main reasons that made some villagers remain growing poppies were: high income, drug addiction and market certainty.

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I.2 Rationale

Considerable changes must be taken in order to alleviate the problems of shifting cultivation, soil erosion, environmental degradation and opium cultivations. The most radical measure like evacuation of the highlanders exercised by the 3rd Army Force could certainly lead to different set of problems and thus questionable. Gradual changes in terms of cropping systems and technology improvement have been pursued in order to raise productivity without further deforestation and soil depletion. The success of the resolution relies heavily on viability of agricultural production in the highland both in the short run and long run.

Permanent farming system with perennial crop as main crop is one of the promising solutions to solve these problems because it has potential for ensuring consumption needs for the people and at the same time it enables to preserve the natural environment (TA-HASDP, 1990). It can provide both immediate and longer term incomes and, if designed well, can minimize erosion. The Thai Government through various research and development agencies, tries to introduce and develop a permanent farming system by means of growing economic crops such as coffee and tea as main crops.

Fukunaga (1975) after visiting the various projects and hilltribe people's farms convinced that Arabica coffee was the best crop to replace opium poppy in all frost free areas,

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although the production may not be as lucrative as opium production. None of the other crops now being tested came close to coffee for providing cash to hill people to supplement their subsistence farming.

Suwannapiam (1984) also mentioned that Arabica coffee seems to be a distinguished crop to be promoted and is widely grown nowadays. Coffee is socially, economically and ecologically desirable.

In Thailand, the demand for coffee is substantially higher than supply, Yodmanee (1988) reported that the consumption of Arabica coffee was about 1,000 tons while the production was about 250 tons in 1987/1988. From this information, the local demand for Arabica coffee is tremendous and the promotion is quite promising.

Unlike coffee, tea is not a new crop to northern Thailand and has been grown for hundreds of years although farmers still use traditional cultural practices. Both soil and climate in the northern area are suitable for production as growing rhythm induced by the wet and dry seasons and the acid soils help improve the flavor (TA-HASDP, 1988).

Even though the world tea market is not very promising, there is sufficient demand from three commercial plantations, one in and one nearby the Mae Taman Zone and one at Mae Salong in Mae Chan Zone. They in turn provide expertise, planting materials and market for tea leaves, and also there are some small green factories scattered around northern Thailand.

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Another perennial crop introduced in the highlands is lychee. This fruit tree is originally from Canton Province, Southern China. In the northern region, the first planted lychee was in Sansai District, Chiang Mai Province, about 40 years ago.

According to Souco and Menini (1989), lychee can tolerant relatively high temperatures, but it grows satisfactorily in temperatures ranging from $20\ ^{0}C$ to $30\ ^{0}C$ with a high relative humidity. Moderately high temperature and humidity are also important during fruit development. Acid soils with pH of between 5.5 and 6.5 are generally recommended as ideal, but the crop can tolerate soils with pH of less than 5.5.

These conditions can be found in the North, particularly the Upper North Provinces. In 1987/1988 cropping season, the northern region, mainly Chiang Mai and Chiang Rai contributed to 87 and 82 percent of the whole country's total production and area, respectively. Most of lychee production in the country is sold in the domestic market in which Bangkok has high potential demand. Lychee is also exported as fresh and canned products.

A question arises on how can the farmers optimize their permanent farm activities to meet their consumption needs, since most of the farmers in the northern highlands have low resources and relatively small farms. It is, therefore, essential to investigate optimum plans for permanent farming system in the northern highlands considering

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their consumption needs, minimum soil erosion and the reduction of opium poppy area. This study intends to incorporate only the existing permanent farming systems at Huai Tadd village which include coffee, tea and lychee.

I.3 Objectives of the Study

The objectives of this study are :

1. to investigate the major resource availability of the farmers and constraints in increasing productivity and family income;
2. to determine optimum plans for permanent farming system at Huai Tadd Village which will provide maximum net return and efficient resource use under methods of soil conservation and consumption needs.

I.4 Usefulness of the Study

The results of this study will provide :

1. the directions for the farmers to improve efficiency of their limited resource utilization and family income;
2. some valuable information and recommendation for policy makers and developers in solving the problems and formulating policies and guidelines for development of highland agricultural systems;
3. knowledge and suggestions for further research to be investigated by interested researchers.

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I.5 Literature Review

This literature review deals mostly with theory and conceptual issues on farm plans as well as experiences in other countries.

The traditional Linear Programming (LP) technique which has become very popular with agricultural economists after 1960 for preparing farm plans, seeks to maximize or minimize objective functions. Linear Programming (LP) provides effective method for dealing with the allocation of limited resources among the competing activities in determining the farm plan (Heady and Candler, 1958). The LP has been applied in many studies in the agricultural sector. Singh (1978) examined the optimum land use pattern in the Punjab, India. Profit maximization of LP technique was used in the study with the major constraints including land, labor, bullock and tractor, irrigation facilities, cash or working capital required to buy such inputs as seeds, fertilizer, insecticides, to hire labor and machinery, etc. It was found that the percentage of increasing cash input and net return from existing management to optimum farm plan ranged from 20.30-31.62 percent and 21.41-43.46 percent, respectively.

Sirohi and Sharma (1978) used the LP technique for working out optimum farm plans at three levels of fertilizer supplied in Alipur Block of Union Territory of Delhi, India.

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The total crop returns was used as an objective function for maximization subject to constraints of land, labor, working capital, fertilizer, specific area of crops and feed and fodder. They found that on small farms, the returns could increase by 58 percent even after the reduction of fertilizer supply by 50 percent. On medium farms, the returns could increase by 53 percent due to resource optimization with full quantum of fertilizer and 44 percent with reduction in fertilizer supply of 9 percent. On large farms, the returns could also increase by 44 percent due to resource optimization with no cut on fertilizer and 25 percent with 14 percent cut in the fertilizer supply.

The study on farm programming for the integration of crop with livestock and aquaculture in Zhenjiang Province, China was conducted by Tiangen (1989). A representative farm was selected to find optimal plan using the LP for original farming system of crop mulberry-silkworm (C-M) for the first year, crop mulberry-fish (C-M-F) during the second year and crop mulberry-fish - rabbit (C-M-F-R) during the third year. The farm income greatly increased after farming systems changed from C-M to C-M-F and finally C-M-F-R. The objective value increased from 1,992 yuan for the C-M farming system, to 2,212 yuan for the C-M-F farming system and finally to 3,291 yuan for the C-M-F-R farming system. The comparable figures for the actual plan implementing by farmer were 1,980, 2,140 and 3,527 yuan.

Another research about integration of crops and

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livestock was conducted by Kim (1989) at Shin-Kum village, Ku Hung district, Southern part of the Korean village. The optimum solution for the initial plan which did not include an activity on local cattle was obtained from a cultivation of crop activities of 7 tanbo rice, 2 tanbo barley, 3 tanbo potatoes, 6 tanbo chinese cabbage and 1.4 tanbo chilly (1 tanbo is approximately 1 hectare). This combination could generate farm income of 4,731 thousand won or 23.3 percent more than the present plan. The final solution of the alternative which included local cattle showed a combination of: 7 tanbo rice, 1 tanbo barley, 0.9 tanbo potatoes, 2.3 tanbo chinese cabbage, 2.6 tanbo chilly and 3 heads of local cattle. This combination generated an income of 5,138 thousand won or 33.9 percent higher than the present plan.

Saragih (1989) studied about farm modelling to increase farmers' income in Citanduy Project, Indonesia. The study used LP model to formulate optimal cropping pattern in Citanduy watershed. The cropping patterns were designed for two types of upland watershed : terrace farming system for lands with slope up to 50 percent and agroforestry farming system for lands with slope more than 50 percent. The optimal cropping pattern satisfied the multiple objectives of increasing farmers' income, increasing farm labor absorption and reducing soil erosion to the tolerable limit. Soil erosion was estimated using the Universal Soil Loss Equation (USLE). The optimal terrace farming system generated a farm income of 939,759 rupiah/year which was 50.6 percent higher

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than the existing level, an employment of 500 mandays/year which was 20.9 percent higher than the existing level, and reduced soil erosion from 14.5 tons/ha/year to a tolerable limit at 13.47 tons/ha/year

The optimal mix crop for agroforestry system produced farmers' income of 1,447,886 rupiah or 56.6 percent higher than the existing level, labor absorption of 399 man-days or 51.7 percent higher than the existing level, and reduced soil erosion from the existing dangerous rate of 49.03 tons/ha/year to below tolerable limit at 12.48 tons/ha/year.

He suggested that future research should be directed towards dynamic analysis, especially for the agroforestry system which is dominated by perennial crops.

All of the studies above were based on the stationary equilibrium approach. Linear Programming for permanent agriculture can become more realistic by incorporating time dimension in the model. Dynamic Linear Programming (DLP) is a model which can overcome many of the limitations of the stationary equilibrium approach of modelling investment decision (Hazell and Norton, 1986).

Loftsgard and Heady (1959) applied DLP model to solve optimum plans for eight series of years where productivity of resources in the farm business were related to expenditure needs of farm family in Iowa. This study represented transfer of net income from one year to operating capital of the next year. The supply of operating capital was

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increased each year by the difference between (a) the net income of the previous year and (b) fixed cost and household withdrawals of previous year.

In the first year, the maximum profit was to invest in crops and 45 hog litters . In years 2 and 3 hog productions were increased to 56 and 80 hog litters, respectively, according to increases in operating capital. After the operating capital exceeded the capital requirement for crops and 80 hog litters, the optimum farm plan for years 4 and 5 were expanded by including 17 and 23 long-fed steers, respectively. In the sixth year, short fed heifers replaced long fed steers since the supply of home grown feeds became limited and gave higher returns to feed as compared to steers. With a combination of crops, 80 litters and 48 short-fed heifer, $ 9,579 of operating capital was required and other scarce resources on the farm were optimally utilized. Hence, an increase in operating capital could not increase return in year 7 and 8, the optimum farm plan remained unchanged.

The DLP was also employed by Dean and Benedictis (1964) to derive normative development plans through time for small land reform farms in the newly irrigated Metaponto Plain Southern Italy. The analysis indicated great potential for internal saving and investment by farm families and therefore rapid development possibilities for intensive fruit (oranges, peaches and grapes) and vegetable cultivation at 5.75 hectares total land available for each farmer. Government investment in low interest loans and grants for development cost had a

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high potential return (about 85 percent) on the farms. This model maximized the present value of future return from annual plans over a 60 year horizon, allowing capital formation and optimum choice between short and long-term activities.

Norton, Easter, and Roe (1980) used a multi-period linear model to assist an American Indian (the Sisseton-Wahpeton Sioux Indians) develop agricultural plans for their tribal farm on the Lake Transverse Reservation in Northeastern South Dakota. Five year crop, livestock, and investment plans were generated in consistent with the tribal resource base, goals and decision making features. The model had influenced the tribal farm decision making process and provided the primary farming guide for 1979 and 1980.

Barry (1972) employed a multi-period linear programming (MLP) model to evaluate the effect of investment in indivisible land unit on various measures of firm growth for cash grain farmers (corn-corn-soybean rotation) in Southwestern Ontario. The objective function was specified for the farmer who maximized the present value of asset indivisibility equity measured at the end of the 10 year planning period plus the present value of annual consumption during the planning period. The level of consumption had a declining marginal propensity to consume as income increment was above the reservation level. The evaluation of the impact of asset indivisibility on firm growth may differ depending on the measure of growth. Accordingly, the results were considered from the stand point of physical measures,

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financial measures, and planning horizon of decision makers. Land indivisibility was classed into indivisible sizes : 50 and 100 acres. The completed evaluation was found to depend upon the degree of asset indivisibility , the manager's planning horizon, and or chosen financial and physical measures of growth.

Shakya and Leuschner (1990) developed a Multiple-Objective Linear Programming (MOLP) model which could generate technically efficient land use plans and also the multiple objective achievement level by planning period and information for calculating the opportunity cost of alternatives plans. This model was demonstrated by using data from Phewa Tal Catchment in Nepal. The farms in this area practised integrated agricultural system embodying crops, livestock and forestry.

Five outputs were identified for the objective functions. Maximized outputs were food, fodder and fuelwood, and minimized outputs were soil loss and cost. The relative weights associated with each objective derived from decision maker preferences. A five year planning period and a 25 year planning horizon were chosen, so there were five periods (25/5). When the decision maker chose the relative weights set 0.455, 0.182, 0.182, 0.091 and 0.091 for food, fodder, fuelwood and soil erosion respectively, results show no change in irrigated terrace and a shift out of dryland terrace, unmanaged pasture, and unmanaged forest into managed pasture and managed forest.

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