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Development of Agricultural Land in a Hilly Area of the Tha Khoei Basin

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Abstract

This paper focuses on the development of agricultural land and its relation to soil erosion problem in pineapple fields in a hilly area of the Tha Khoei Basin in the upstream of Lam Phachi river basin. We surveyed and discussed, using statistical data, farmer interview and satellite images, the historical development of agricultural land and crop production, the background of agricultural land development and the movement of eroded soil in pineapple fields in the hilly area. This study clarifies that (1) the development of agricultural land has been extending from flat areas to hilly areas during last 30 years; (2) pineapple cultivation has increased especially in sloped fields; (3) as for the background of the rapid development of agricultural land, there may be three factors which are the increase in population, the enlargement of farm size and the innovation in farming technologies; (4) the coverage of the catchment area of irrigation ponds, which have been extensively constructed throughout the area, is high as 70 % of the Tha Khoei Basin, thus having substantial effect on the soil movement in the basin.

Keywords: development of agricultural land, soil erosion, pineapple cultivation, irrigation pond

1. INTRODUCTION

Almost all land in the Tha Khoei basin of Lam Phachi river basin was covered by forest in 1970. Many immigrants from other area in Thailand moved there and some farmers had already lived in Ban Kha Sub-district in the upstream of Tha Khoei Basin in 1975. Immigrants developed forest areas into agricultural land. Development gradually extended from flat areas to hilly areas, thus resulting in more than 60,000 rai (about 10,000 ha) of agricultural land in Ban Kha Sub-district in 2000. Some 70 % of

agricultural land serves for pineapple cultivation. Hilly areas, which suit to a pineapple cultivation, easily receive soil erosion after a heavy rain. There are some problems which are (1) eroded soil from pineapple fields flows out, (2) fertility of soil in pineapple fields is degraded, (3) eroded soil flows into Tha Khoei river, a tributary of Lampachi river, etc.

In this paper, the authors aim to analyze the historical development of agricultural land and pineapple cultivation, the background of the development of agricultural land and the function of an irrigation pond for holding eroded soil from pineapple fields.

2. HISTORICAL DEVELOPMENT OF AGRICULTURAL LAND

2.1 Analysis by remote sensing

(1) Used data and methods

In order to detect the pineapple field area in Tha Kohei sub-basin in the upstream of Lam Phachi river basin, we analyzed four satellite data sets. Used satellite data sets are Landsat/ETM+ (acquired on 9 Nov. 2000), JERS-1/VNIR (acquired on 26 Jan. 1997 and on 30 Jan. 1994) and Landsat/TM (acquired on 30 Jan. 1993). Outline of analysis is shown in Fig.2.1. Four data sets were geo-corrected using 1:50,000 maps. Each satellite data sets was classified by unsupervised classification, ISODATA method. Classified images were identified from ground survey data and crop calendar (Fig.2.2). Each classified images was overlaid and land use change is extracted. Further more, pineapple field and slope angle image made from map are overlaid and analyze the relationship between slope steepness and pineapple fields.

In this area, main field crops are sugar cane, cassava and pineapple. Most important crop is pineapple. The cropping calendar of these crops and others are shown in Fig.2.2. Used satellite data sets were acquired in dry season.

(2) Estimation of pineapple field

When it is seen from the planting calendar of the crop, sugar cane and cassava are growth periods, and it can't be classified clearly with the pineapple on November 9. The other hand, It can be distinguished from the pineapple field because it changes in bare condition by harvesting on January 30. It was classified in the same way from 1993 years and the image in 1994 (Fig.2.2). The pineapple field of 4 terms was estimated by overlaying all these classified results.

Many fields where a pineapple was grown in 1994 and 2000 are seen in the center of the basin area. The fields, which were changed to the pineapple fields in 2000, are seen in a circumference part. The field which changed in the pineapple field in 2000 shows a tendency of spreading out in the circumference part, that is, the urgent inclination area with both year as well shown by yellow when this result was seen.

The area which changed in the pineapple field is smaller than the area which is pineapple field in both year in 0% slope angle by overlaying DEM made from the topographical map of 1:50,000 and classified pineapple field.

2.2 Analysis by interview to a farmer

Interview to a farmer living near the gauging station K 25A in Ton Ma Ka village, Ban Kha Sub-district, indicated that he and his colleague immigrated there from Nakhon Pathom Province in 1975 and developed forest areas into agricultural land in the flat part of this area, and that they had been developing fields in the sloped part areas since about 1990.

2.3 Crop production

Figure 2.7 shows the change of crop production in Ban Kha Sub-district during last four years.

The areas of pineapple fields in 2000 increased about twice than those in 1997 and are prominently greater than those of other crops. Because pineapple cultivation suits to sloped fields, to be mentioned

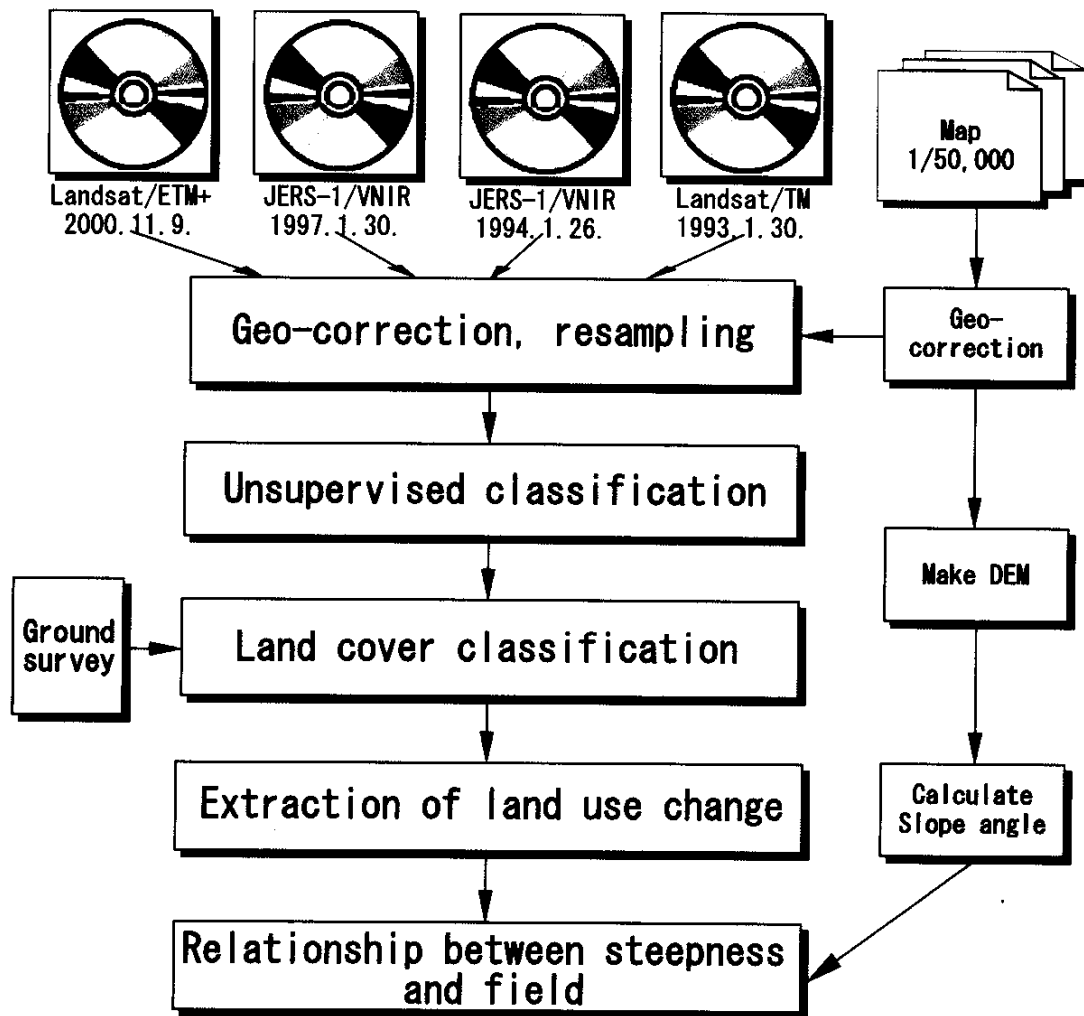


Fig.2.1. Analysis of pineapple field change using remote sensing data and GIS

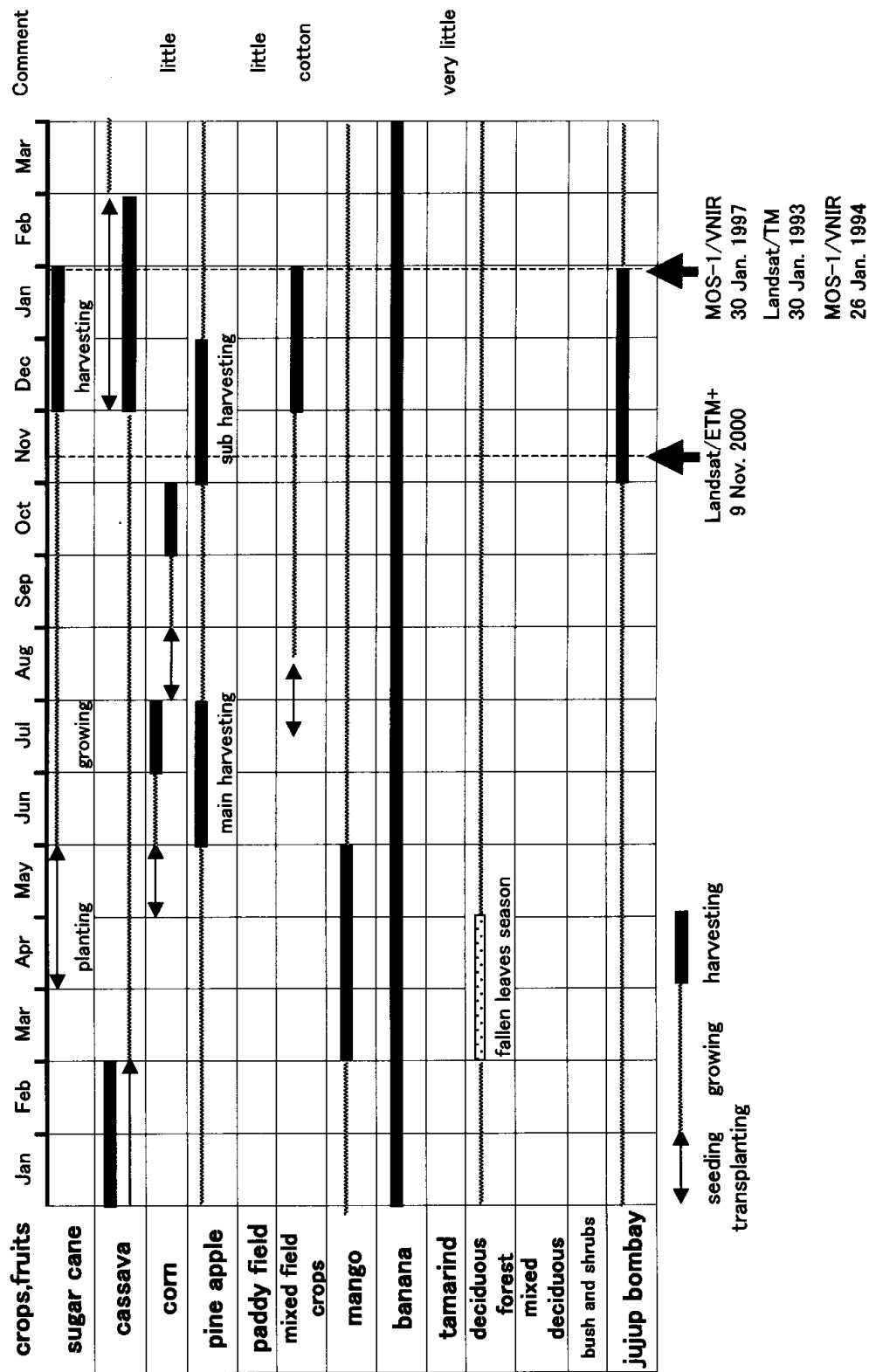


Fig.2.2. Crop calendar in upper Lam Pachi basin area

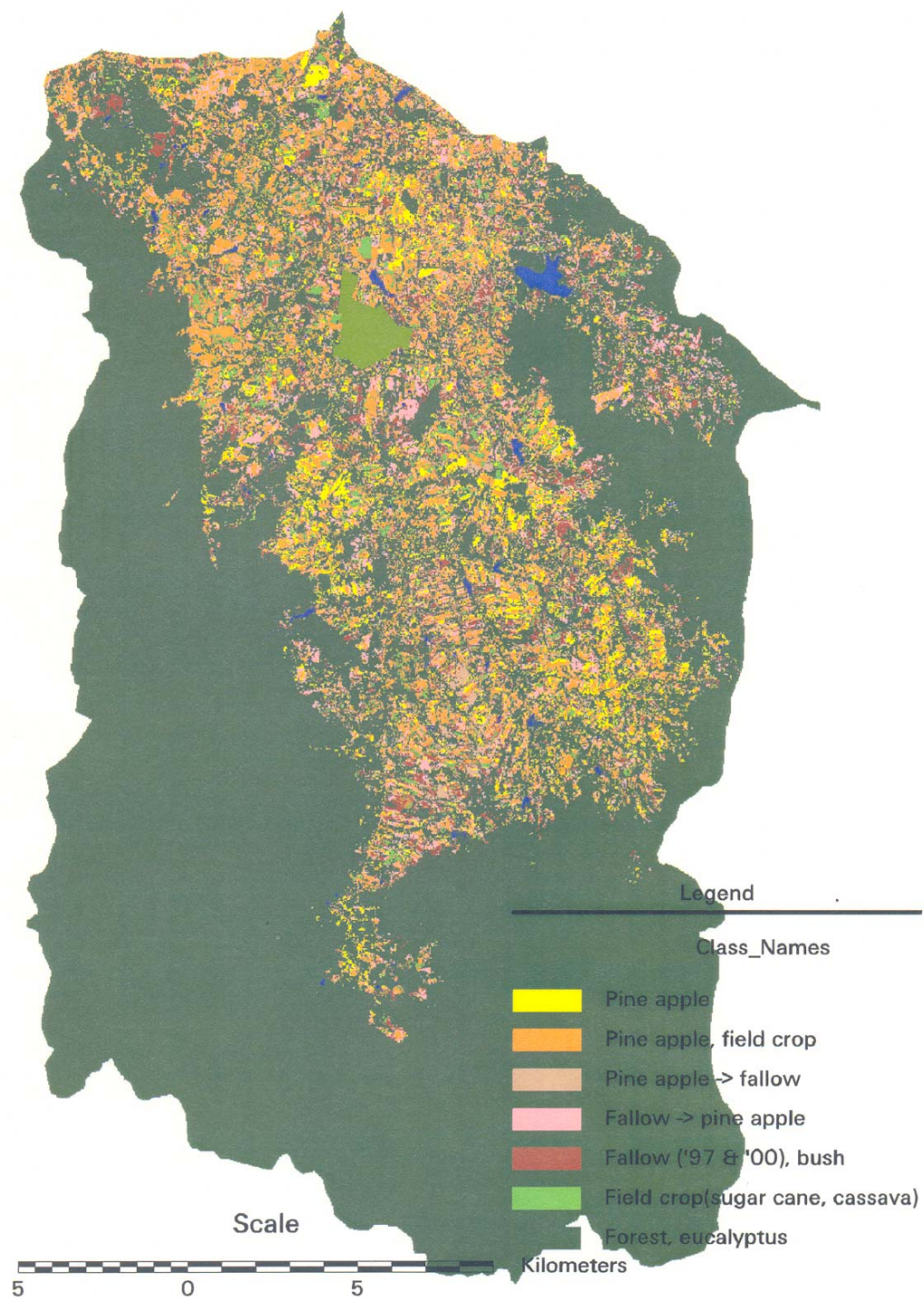


Fig.2.3. Results of land cover classification in 1997 and 2000.

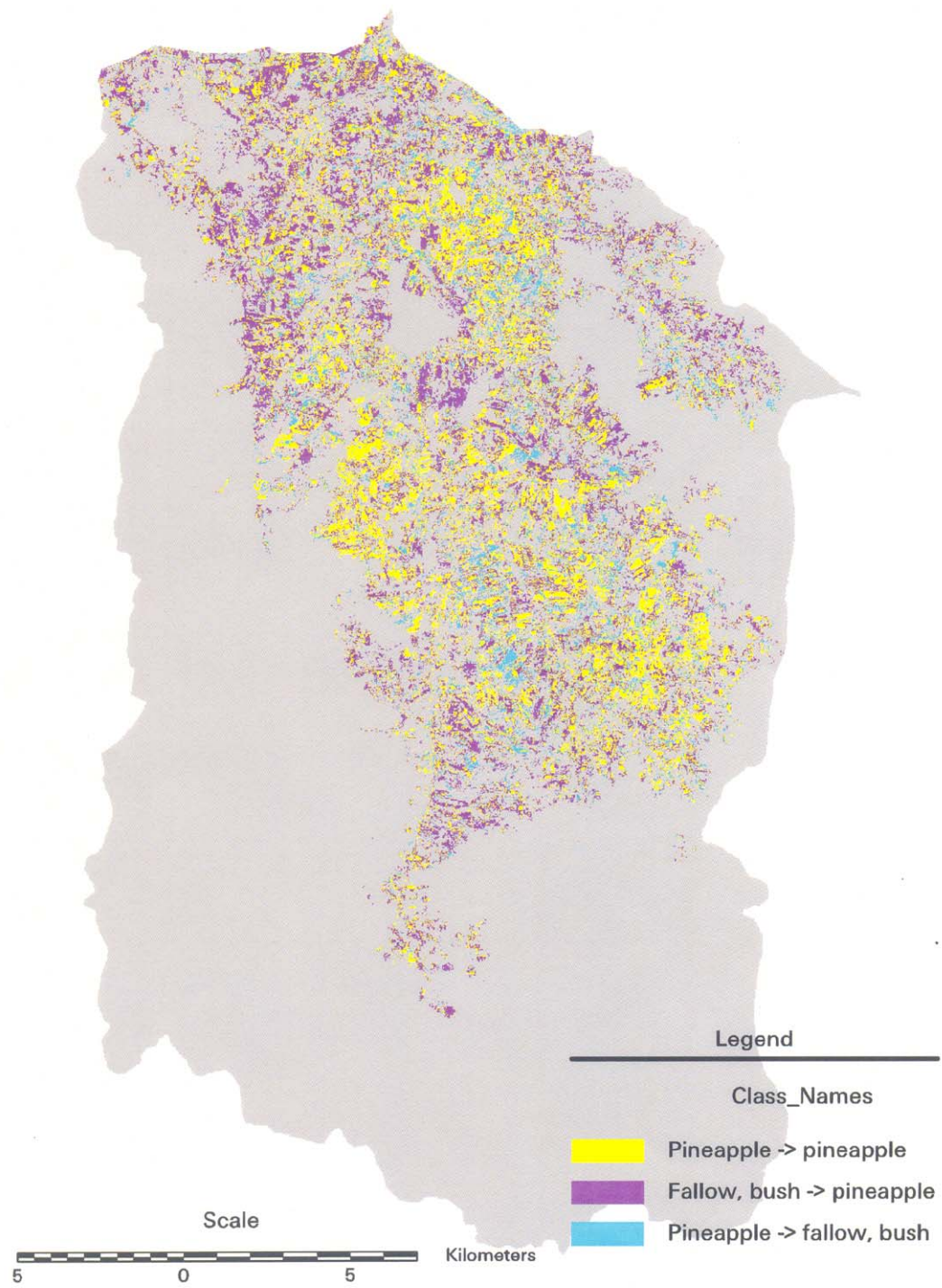


Fig.2.4. Distribution of pineapple field in 1994 and 2000

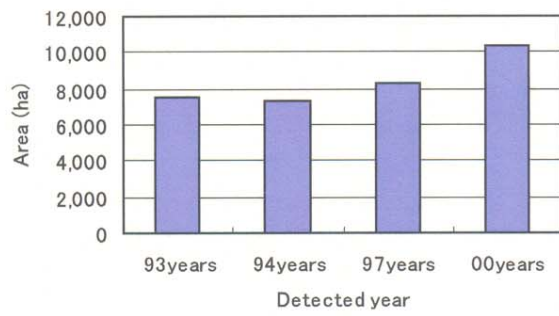


Fig. 2.5. The change of pineapple field area

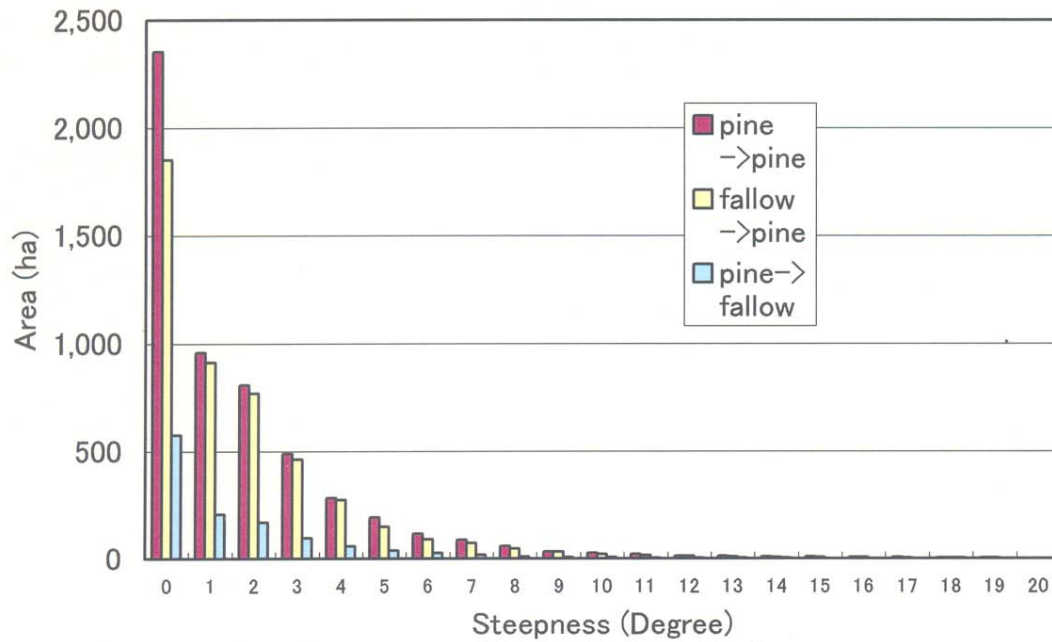


Fig.2.6. Steepness of pineapple fields

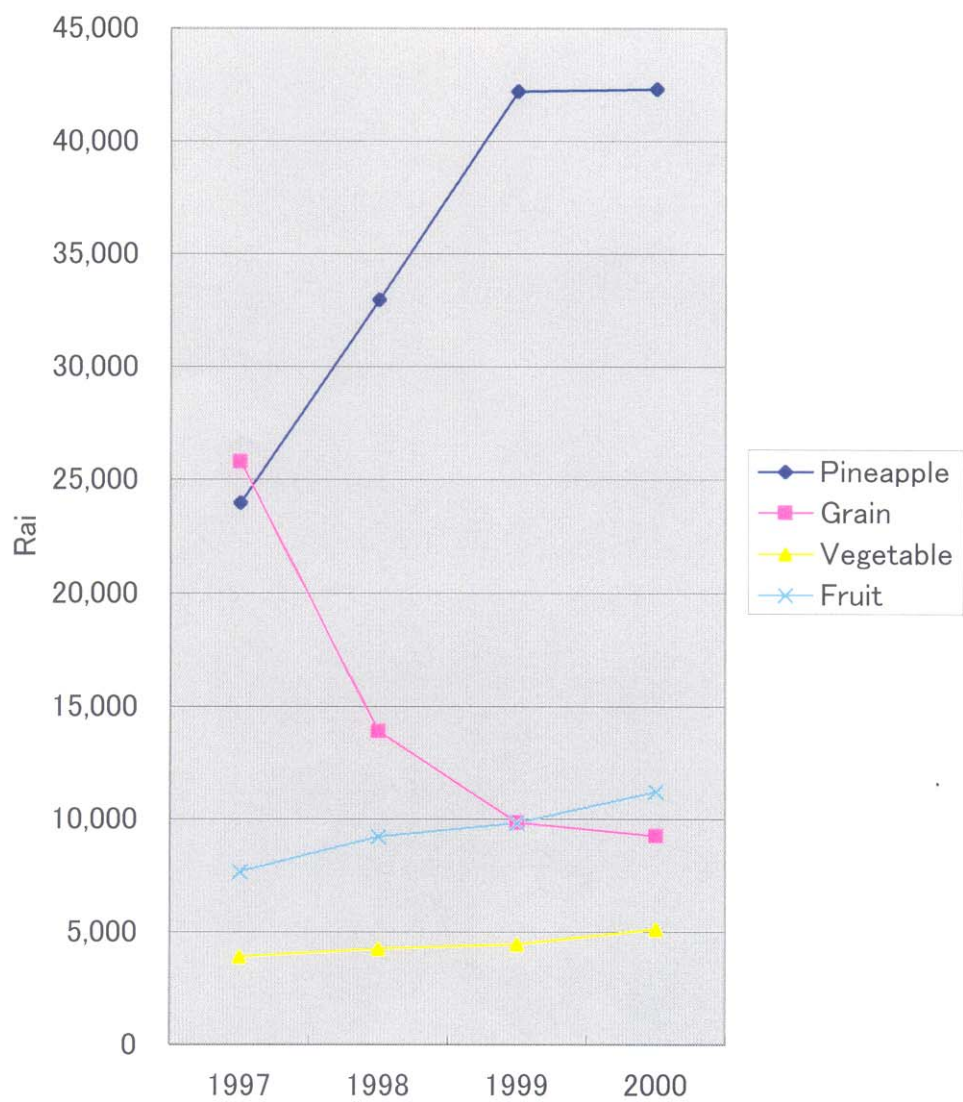


Fig. 2.7 Change of crop production in Ban Kha Sub-district

later, this rapid increase suggests that pineapples are cultivated in a lot of hilly areas.

3. CHARACTERISTICS OF PINEAPPLE CULTIVATION

3.1 Good conditions of land for pineapple cultivation

Field with permeable soil and low level of ground water is good for pineapple cultivation. Sloped fields have the latter condition. Our survey shows that pineapples are cultivated in fields with a gradient of 3°, 4°, 6°, 8° and 10°.

3.2 Farming work operation of pineapple cultivation

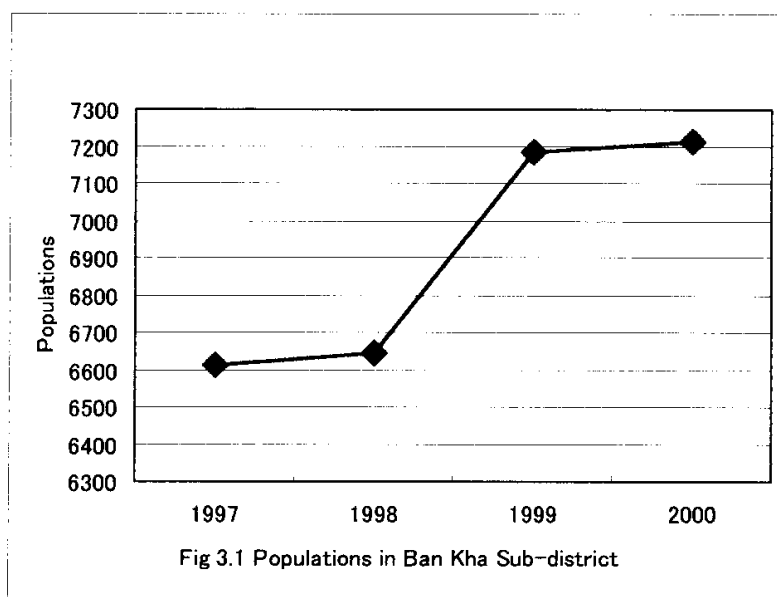
Farming work in pineapple cultivation basically has a cycle of three years. Plowing, planting, fertilizing, spraying pesticide or herbicide and harvesting are operated in the first year and fertilizing, spraying pesticide and herbicide, and harvesting twice of a year in both the second and third year. Plowing and planting are operated after the second harvesting in the third year or in beginning of the first year of next cycle, because pineapple production often decreases over three years if not plowing. In the other words plowing and planting are operated once of three years. The field of the first year, second year, third year, means the field experienced a rainy season, two rainy seasons, three rainy seasons, respectively. Pineapple cultivation, however, is sometimes continued over three years without plowing in some fields or any crops are not cultivated in some fields after pineapple cultivation of three years.

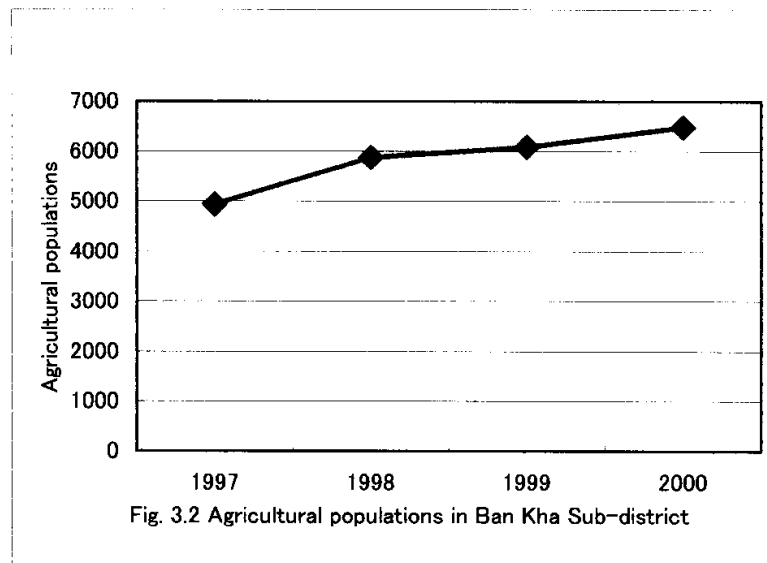
4. BACKGROUND OF AGRICULTURAL LAND EXPANSION

As for the background of the rapid development of agricultural land, there may be three factors that are the increase in population, the enlargement of farm size and the progress of reclamation technology.

(1) The increase in population

Figure 3.1 and Fig. 3.2 show the increase of population and agricultural population in Ban Kha Sub-district in the last four years, respectively.





Interview to the farmer indicated that 10 families including his in 1975 had increased to 17 families in 2000 and interview to the sub-head of the village indicated that 3 families had increased during 10 years.

Statistical data and the interview may give a suggestion that the increasing populations made the development of agricultural land expand.

(2) The enlargement of farm size

According to the farmer, his field's areas were 24 rai in 1975 and he extended his fields to 39 rai in 1997 and to 54 rai in 1999.

The enlargement of farm size may be one of the factors in agricultural land expansion.

(3) The innovation of farming technologies

The farmer reclaimed forest into agricultural land with his colleague by using saws then in 1975 and they did with chainsaws and tractors in 1990. The innovation of reclamation technology may be also listed as one of the factors in the development of agricultural land.

The farmer now cultivates pineapples by using such materials as herbicide and fertilizer and by requesting a contractor having a big tractor to plow, whereas he did by using a little materials and a small tractor in 1975. The innovation of farming work technologies might support the enlargement of his farm size.

5. RETENTION EFFECT OF POND ON ERODED SOIL

5.1 Irrigation pond for pineapple cultivation

Two ponds were found in pineapple fields. One of them was constructed for multi-purpose including irrigation in 1982 and farmers use another pond as irrigation. An irrigation pond is supposed to be important for pineapple cultivation.

5.2 Effect of pond on eroded soil retention

Soils are eroded in some pineapple fields around the gauging station K 25A. Fig. 5.1 and Fig. 5.2 show soil erosion in two pineapple fields.

The eroded soil from the pineapple field in Fig. 5.2 flows into a neighboring pond and accumulates



Fig.5.1 Soil erosion in a pineapple field with a gradient of 4°



Fig. 5.1 Soil erosion in a pineapple field with a gradient of 6°

at the bottom of it according to the farmer. The pond is supposed to have an effect on the retention of eroded soil.

5.3 Estimation of Catchment area coverage

Ponds for irrigation were read from the topographical map of 1:50,000 and the Landsat/ETM+ data observed on November 9, 2000. Catchments area of pond was read from the topographical map and was calculated by GIS.

It was found out that 69.2%(43,995ha) of the whole basin area (63,544ha) was covered as that result. When the soil of pineapple field flows into these ponds, sandy soil would be trapped in the pond, and it would be guessed that the effect of preventing outflow of soil is high. Especially, sandy soil is trapped at the high rate.

6. CONCLUSIONS

1. The development of agricultural land has been climbing up from flat areas to hilly areas during last 30 years.
2. Pineapple cultivation is dominant in the sloped fields, which are easily eroded by heavy rain.
3. As for the background of the rapid development of agricultural land, there may be three factors that are the increase in population, the enlargement of farm size and the innovation of farming technologies.
4. Many ponds distributed throughout the catchment area, most of which are for the purpose of irrigation, cover almost 70 % of the total catchment area of the Tha Khoei basin. Because of the pond function to retain eroded soil, the construction of ponds is supposed to have a substantial effect on soil movement in the basin.

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