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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 the problem of soil erosion in pineapple fields in a hilly area of the Tha Khoei Basin upstream of the Lam Phachi river basin. We used statistical data, farmer interviews and satellite images to survey the historical development of agricultural land and crop production and discuss the background of agricultural land development and the movement of eroded soil in pineapple fields in hilly areas. This study clarifies that (1) the development of agricultural land has been extended from flat areas to hilly areas during the last 30 years; (2) pineapple cultivation has increased, especially in sloped fields; (3) three factors spurring the rapid development of agricultural land are increases in population, the enlargement of farm size and the innovations in farming technologies; (4) the coverage of the catchment area of irrigation ponds, which have been extensively constructed throughout the area, is as high as 70% of the Tha Khaei Basin, thus having a substantial effect on soil movement in the basin.

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

1. INTRODUCTION

Almost all the land in the Tha Khoei basin of the Lam Phachi river basin was forested in 1970. Around 1975, immigrants from other areas in Thailand moved there, joining other farmers who had originated from the Ban Kha Sub-district upstream of the Tha Khoei Basin. 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 is currently used for pineapple cultivation. Hilly areas, which

are suited to pineapple cultivation, easily incur soil erosion after heavy rains. This problem has several dimensions: (1) soil is lost from pineapple fields, (2) the fertility of the soil in pineapple fields is degraded, and (3) eroded soil contaminates the 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 irrigation ponds 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 observe the pineapple field area in Tha Khoei sub-basin upstream of the Lam Phachi river basin, we analyzed four satellite data sets. The satellite data sets used in the study 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). An outline of our analysis is shown in Fig.2.1. Four data sets were geo-corrected using 1:50,000 maps. Each satellite data set was classified by unsupervised classification, ISODATA method. Images were identified for classification from ground survey data and a crop calendar (Fig.2.2). Each classified image

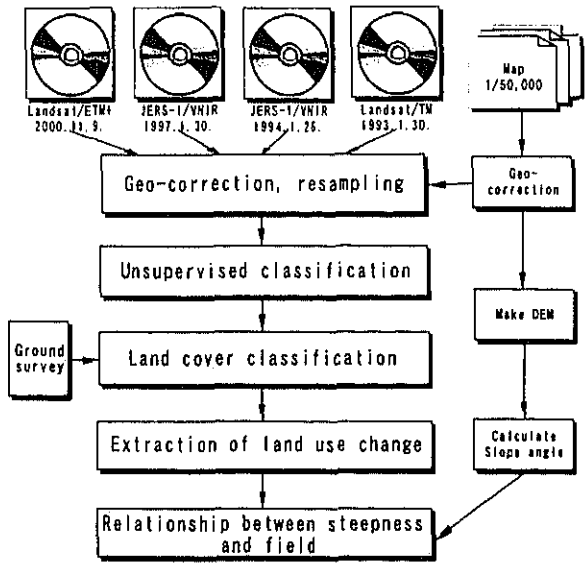

Fig.2.1 Analysis of pineapple field change using remote sensing data and GIS.

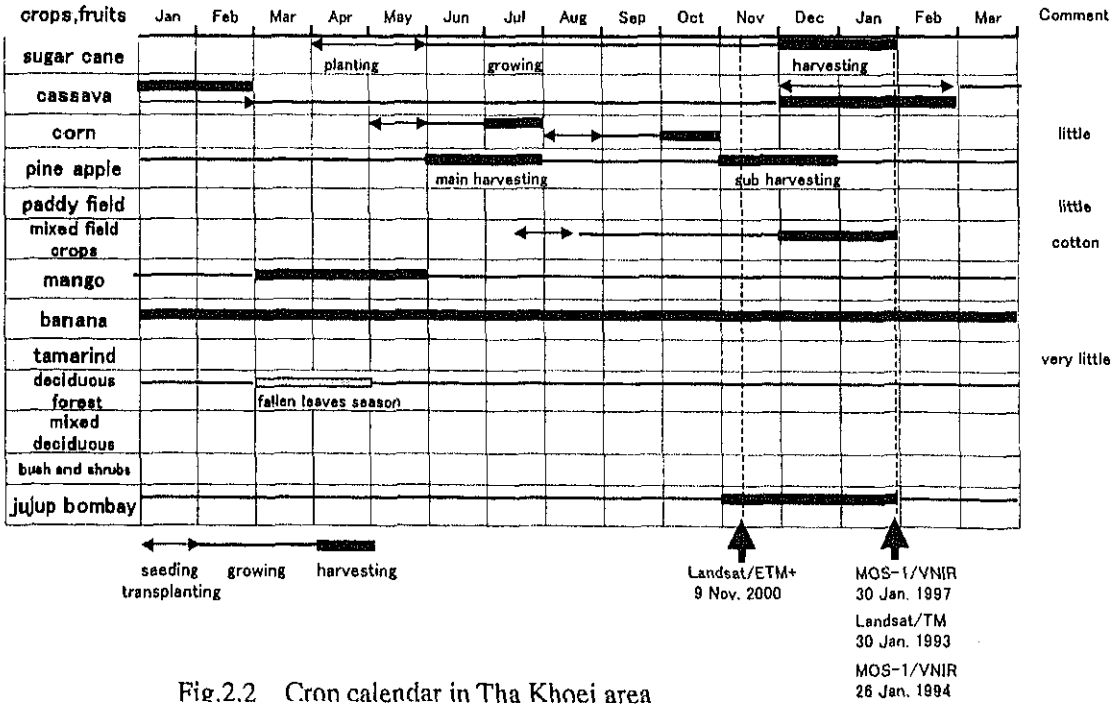

Fig.2.2 Crop calendar in Tha Khoei area

was overlaid and land use change was extracted. Furthermore, pineapple fields and slope angle images made from 1:50,000 scale topographic maps were overlaid and the relationship between slope steepness and pineapple fields was analyzed.

In this area, the main field crops are sugar cane, cassava and pineapple. The most important crop is pineapple. The cropping calendar for these crops and others is shown in Fig.2.2. Satellite data sets employed in the study were acquired in the dry season.

(2) Estimation of pineapple field

As shown in the crop calendar, on November 9, the date of the first satellite images, sugar cane and cassava are in their growth periods, and would not be clearly distinguished from the pineapple fields. By late January, the time frame of the other satellite images, these crops can be distinguished from the pineapple field because they are bare after harvesting. Fields that were cultivated in pineapples during all 4 data collections were estimated by overlaying all these classified results. Classified images analyzed from satellite data sets in 1997 and 2000 were overlaid on a land use change image (Fig.2.3), and classified images in 1994 and 1993 were overlaid an image.

Finally, the four classified images were overlaid and the map of land use change in pineapple fields was created. Fields where pineapples were grown in both 1994 and 2000 are seen in the center of the basin area (Fig.2.4). The areas planted with pineapples in 1993 and in 1994 were approximately the same; pineapple fields increased from 1994 to 1997 and from 1997 to 2000(Fig.2.5). Fields that became pineapple fields between 1994 and 2000 are seen in the circumference part. Fields recently changing over to pineapple cultivation show a tendency of spreading out from the circumference. Fields at 0% slope angle that were pineapple fields in both 1994 and 2000 are more numerous than fields at 0% slope angle recently changing over to pineapple cultivation; this can be seen by overlaying DEM made from the topographical map of 1:50,000 on a map of classified pineapple fields (Fig.2.6).

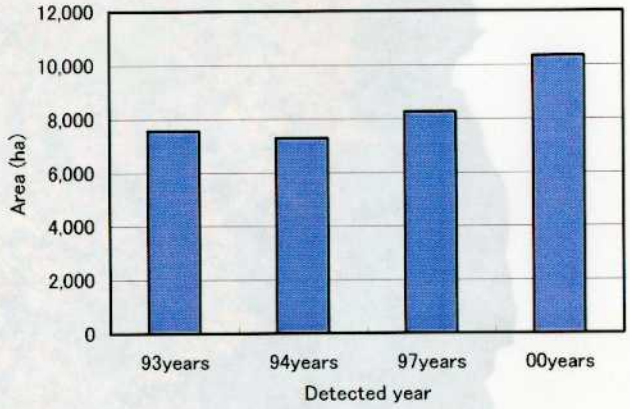

Fig. 2.5 The change of pineapple field area

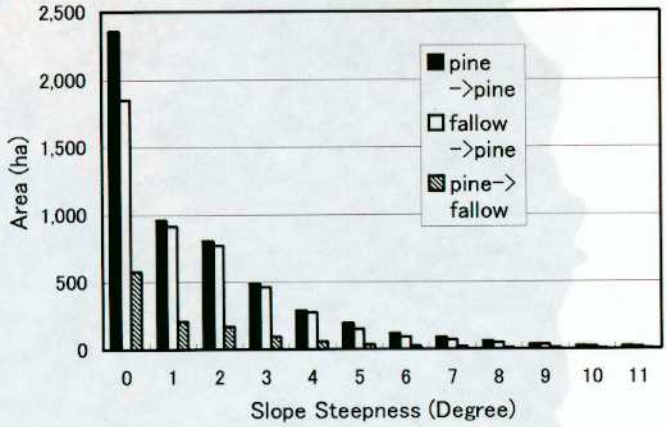

Fig.2.6. Slope Steepness of pineapple fields

2.2 Analysis by interview to a farmer

An interview [with] a farmer living near the gauging station K 25A in Ton Ma Ka village, Ban Kha Subdistrict, indicated that he and his several colleagues immigrated there from Nakhon Pathom Province in 1975 and developed forests into agricultural land in the flat part of this area, and that they had been developing fields in the sloped areas since about 1990.

2.3 Crop production

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

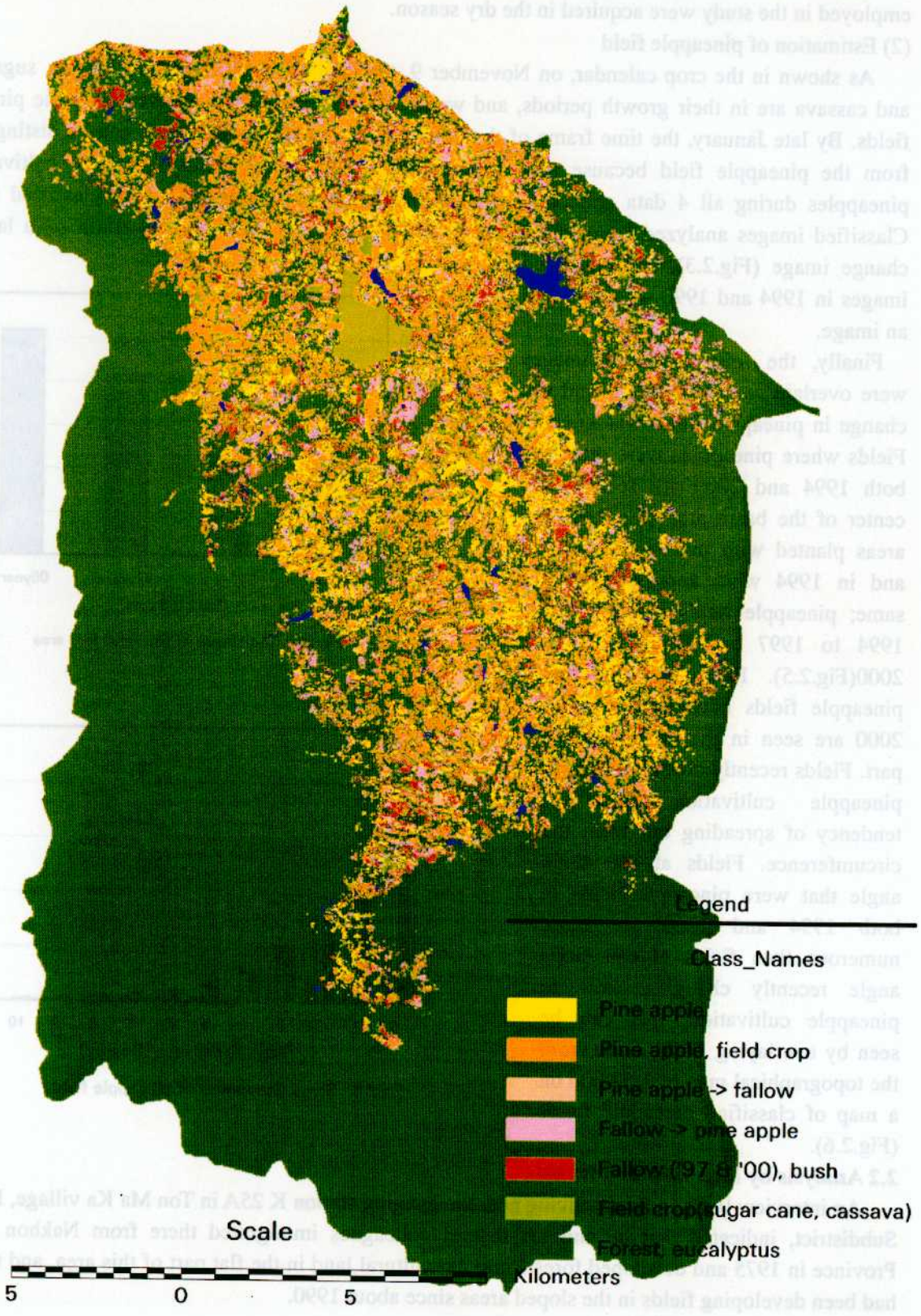

Fig.2.3. Results of land cover classification in 1997 and 2000.

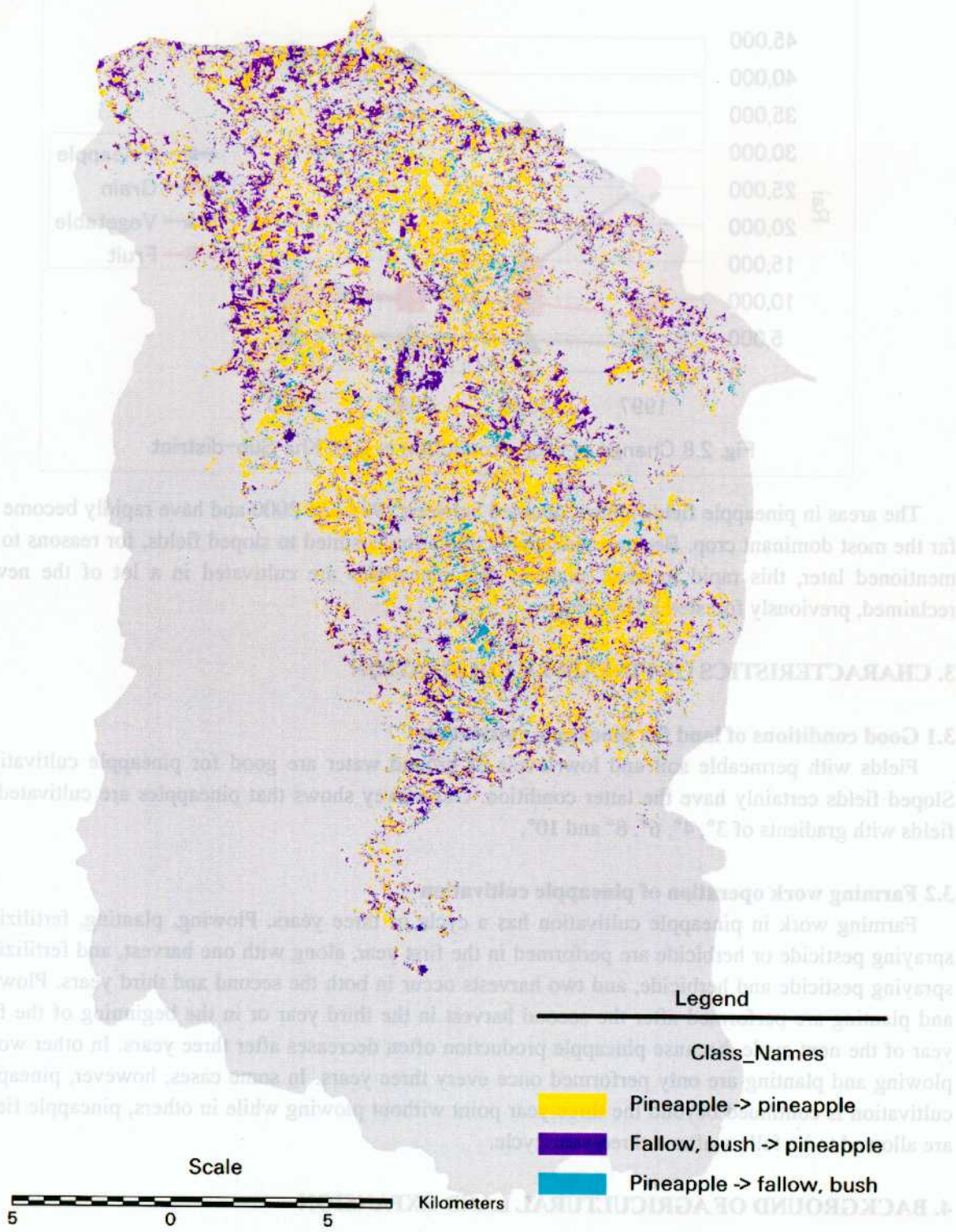

Fig.2.4. Distribution of pineapple field in 1994 and 2000

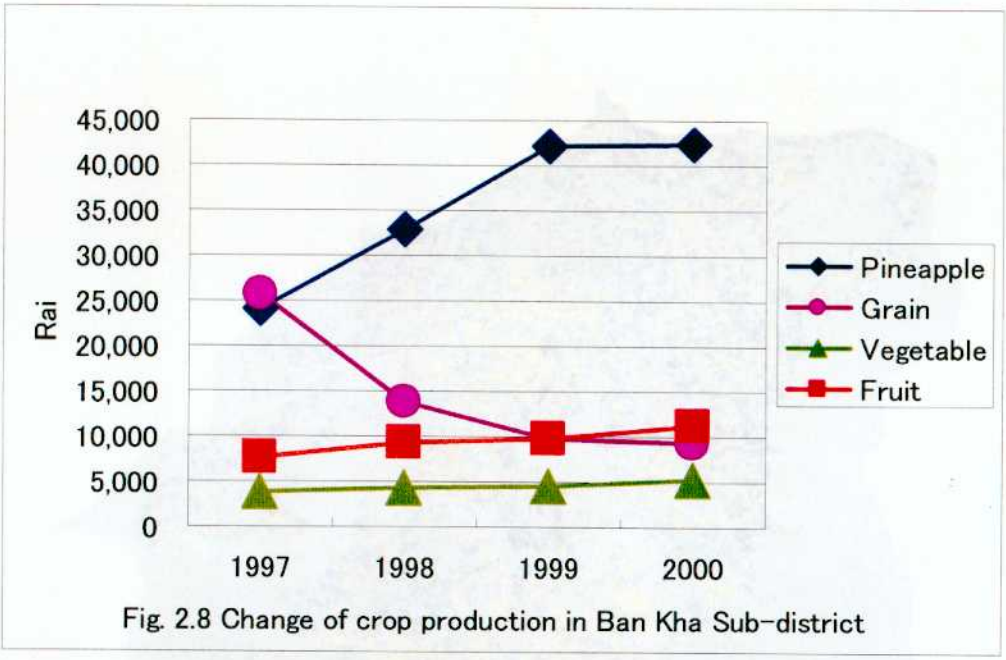

Fig. 2.8 Change of crop production in Ban Kha Sub-district

The areas in pineapple fields almost doubled between 1997 and 2000 and have rapidly become by far the most dominant crop. Because pineapple cultivation is suited to sloped fields, for reasons to be mentioned later, this rapid increase suggests that pineapples are cultivated in a lot of the newly reclaimed, previously forested hilly areas.

3. CHARACTERISTICS OF PINEAPPLE CULTIVATION

3.1 Good conditions of land for pineapple cultivation

Fields with permeable soil and low levels of ground water are good for pineapple cultivation. Sloped fields certainly have the latter condition. Our survey shows that pineapples are cultivated in fields with gradients of 3°, 4°, 6°, 8° and 10°.

3.2 Farming work operation of pineapple cultivation

Farming work in pineapple cultivation has a cycle of three years. Plowing, planting, fertilizing, spraying pesticide or herbicide are performed in the first year, along with one harvest, and fertilizing, spraying pesticide and herbicide, and two harvests occur in both the second and third years. Plowing and planting are performed after the second harvest in the third year or in the beginning of the first year of the next cycle, because pineapple production often decreases after three years. In other words plowing and planting are only performed once every three years. In some cases, however, pineapple cultivation is continued beyond the three-year point without plowing while in others, pineapple fields are allowed to lie fallow after a three-year cycle.

4. BACKGROUND OF AGRICULTURAL LAND EXPANSION

As for the background of the rapid development of agricultural land, three important factors emerge. They are the increase in population, the enlargement of farm size and progress in 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.

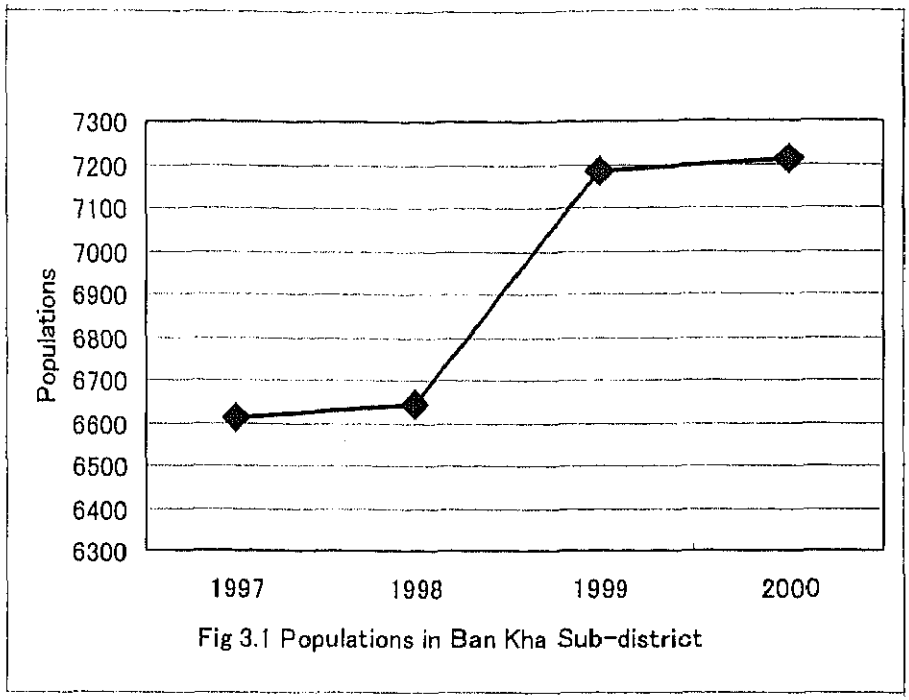

Fig 3.1 Populations in Ban Kha Sub-district

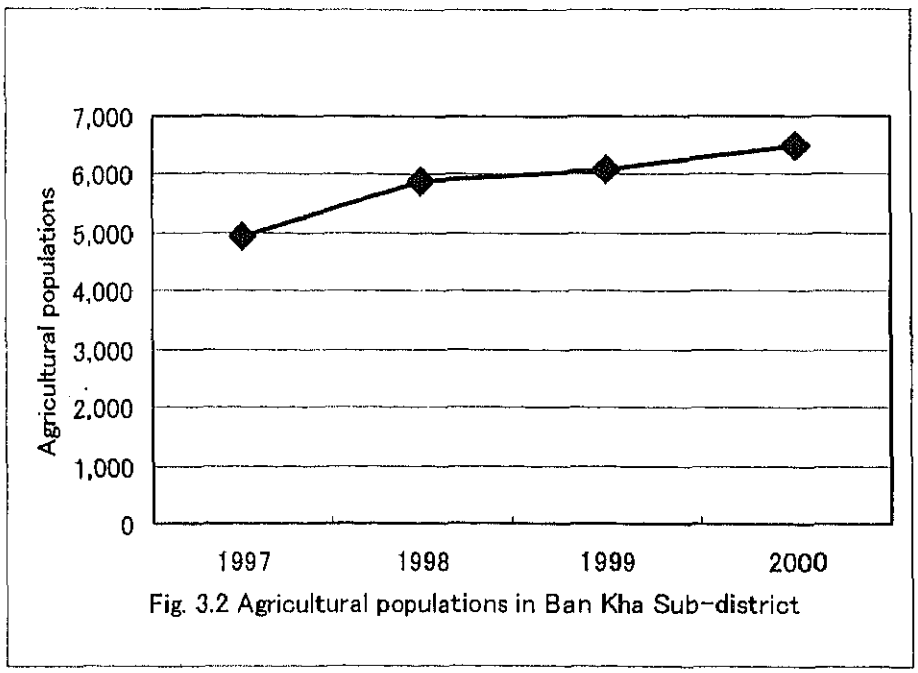

Fig. 3.2 Agricultural populations in Ban Kha Sub-district

Our interview with the farmer indicated that the 10 families including his who lived there in 1975 had increased to 17 families in 2000. An interview with the sub-head of the village indicated that some farmers moved out and some farmers moved in this area, resulting in the increase 3 families during 10 years.

Statistical data and the interviews suggest that increasing population led to expanded development of agricultural land.

(2) The enlargement of farm size

According to the farmer, he had 24 rai under cultivation in 1975 and had extended his fields to 39 rai in 1997 and 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

In 1975 the farmer his colleagues] reclaimed forest into agricultural land using saws; in 1990, they did it with chainsaws and tractors. Innovations in reclamation technology may also be listed as one of the factors in the development of agricultural land.

The farmer now cultivates pineapples using such materials as herbicide and fertilizer and by hiring a contractor with a large tractor to plow, whereas he used fewer inputs and a smaller tractor in 1975. The innovation of farming work technologies seem to have supported the enlargement of his farm size.

5. RETENTION EFFECT OF POND ON ERODED SOIL

5.1 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 the pond shown in Fig. 5.3 and accumulates at its bottom. Figure 5.4 shows that eroded soil flowed from the road of the foreground side to the weed-grown side where eroded soil flowed into the pond.

The pond thus has the effect of retaining eroded soil.

5.2 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. Catchment areas of ponds were read from the topographical map and were calculated by GIS (Fig. 5.5).

It was discovered that 69.2 % (43,995 ha) of the whole basin area (63,544ha) was covered by ponds. When the soil from pineapple fields flows into these ponds, sandy soil accumulates at the bottom of the pond; because sandy soil accumulates at a high rate, it can be expected that the pond's effect in preventing outflow of soil is high.

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. Three factors in the rapid development of agricultural land are the increases in population, the enlargement of farm size and the innovations in farming technologies.

4. 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 ponds' secondary function of retaining eroded soil, the construction of ponds is thought to have a substantial effect on soil movement in the basin.

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

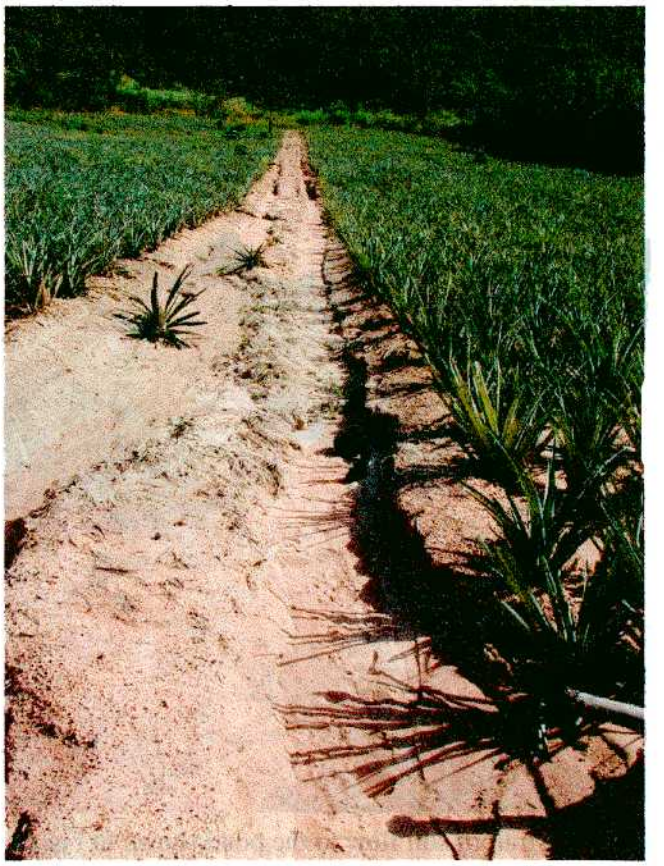

Fig. 5.2 Soil erosion in a pineapple field with a gradient of 6°

Fig. 5.3 The pond near the pineapple field in the Fig.5.2

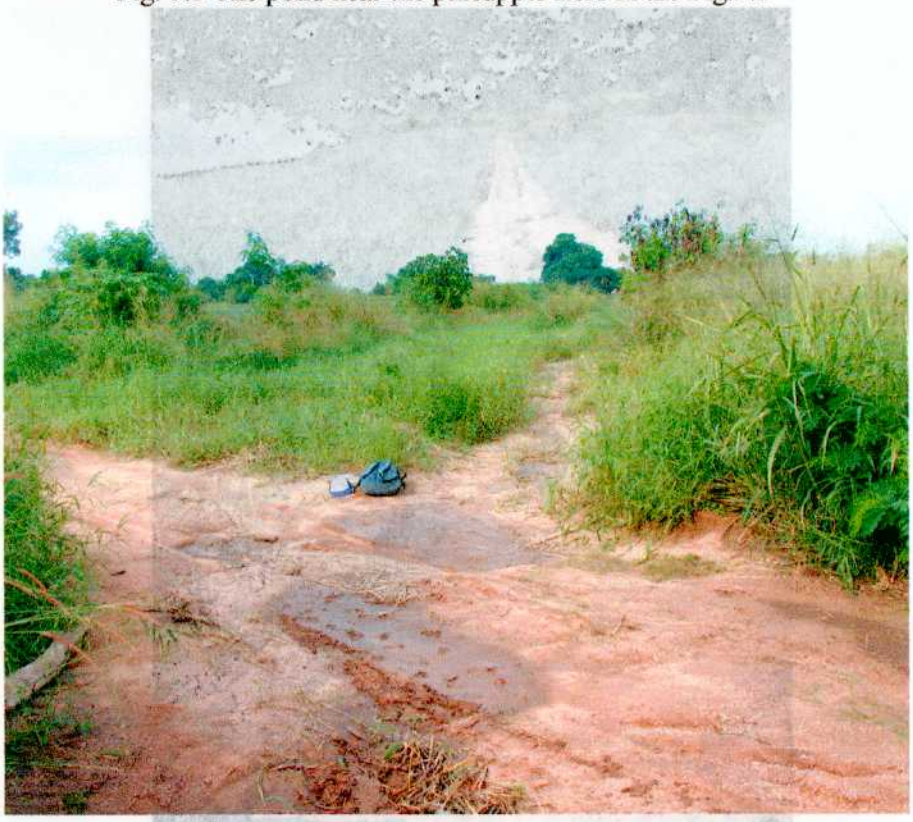

Fig. 5.4 The trail of soil flow to the pond shown in Fig. 5.3

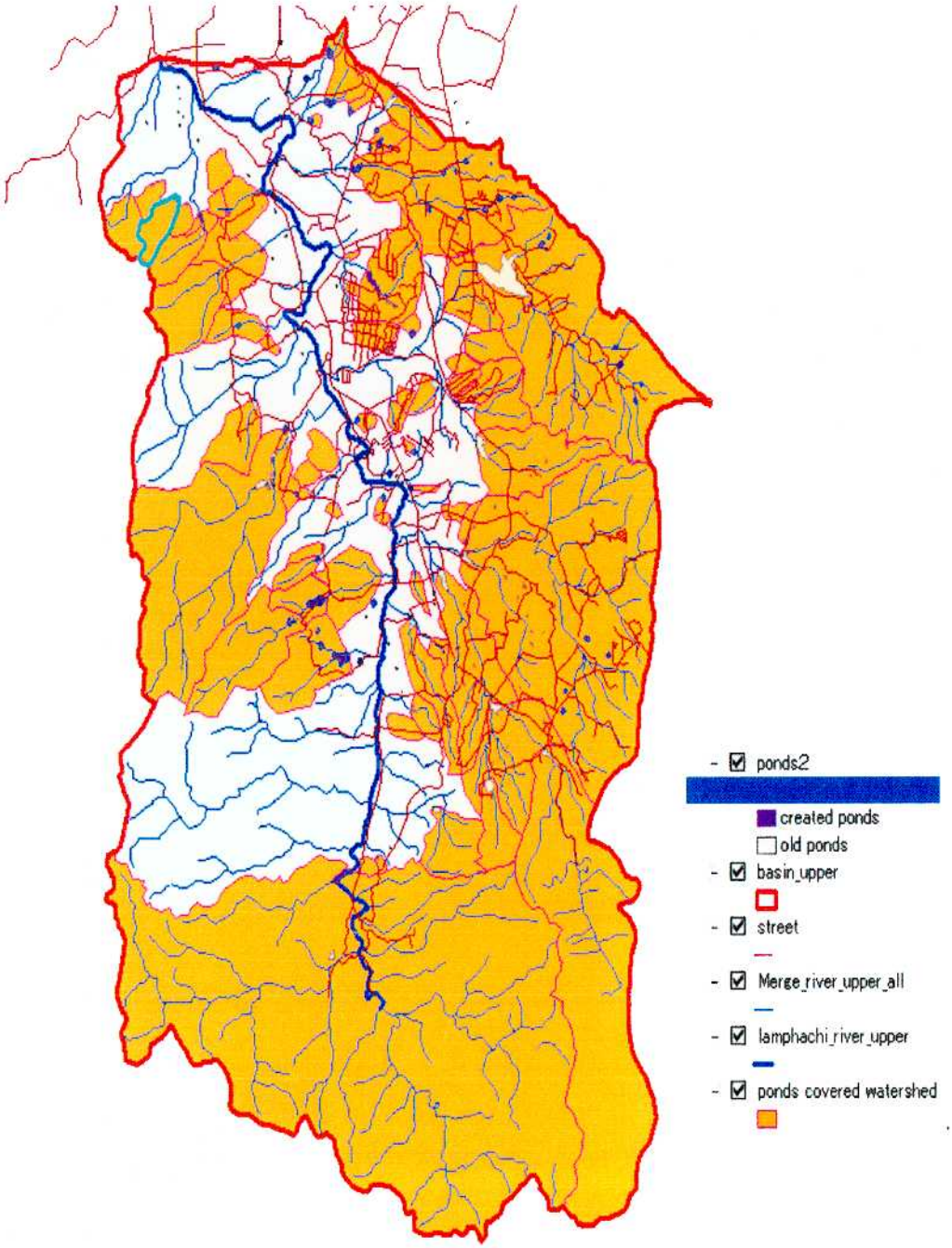

Fig.5.5 Catchment area of ponds