

# STUDY OF LAND USE CHANGE - A JAPANESE EXPERIENCE.

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## 1. Introduction

In 1990, a three-year priority research project called "GIS for Environmental Change in Modern Japan" was launched in Japan. It consisted of 6 research groups, and the writer led one of them, which focused on land use change of in Japan. The main objectives of this group were to reconstruct land use in Japan over the last century and a half, to produce a land-use trend database, and to analyze the data in order to show and explain changes in land use. Some of the group's results may be seen in an atlas entitled "Land Use Change in Modern Japan". In fact, many of some forty research topics included in the above priority project were related to land use change in one way or another, and the project as a whole made a wide-ranging contribution to a better understanding of land use changes during Japan's modernization period.

The present paper intends to show the nature and significance of the above project by presenting some findings drawn from the writer's own study carried out as part of it. These findings are based on land use databases from circa 1900, 1950 and 1985, which were produced by using 1:50,000 topographic maps.

## 2. Data Provision

The production of the 1:50,000 maps, which were used by the writer, was started in 1892 by the Japanese government. They have been repeatedly revised since then, thus making them an invaluable source of information on land use change in Japan. Land use data of the past are often fragmentary and inconsistent, and the task of reconstructing past land use maps is complicated and laborious.

Each of the over 4,000 maps covering the whole country during those three periods is first coloured according to land use or land cover type identified from symbols and other clues on the maps, then digitized and recorded in laser form for each of the grid squares drawn on the maps. The size of a unit cell is roughly 4cm x 4cm (or 2km x 2km on the ground). The data files thus produced are assembled into LUIS, or Land Use Information System. LUIS has a number of programmes which are easily operated by menu-selection procedures. It enables us to produce various kinds of maps of the past and present, as well as to calculate the area of each land use for each prefecture.

## 3. Land Use Change in Japan, An Overview

Some of the findings of the study are shown below. A special reference is made to the case of the Tohoku district located in northern Honshu, where relatively cool climate and remoteness from the economic centres of the country hindered development before the Second World War.

### 3.1. Settlement

Settlement areas occupied 1.7% of the country at the beginning of the century, but that figure has tripled to 5.0% at present. The rate of increase was 51% between 1900-1950, but jumped to 108% between 1950-1985, as against a declining rate of increase in the population.

In the case of the Tohoku district, there are high correlations between population P (ten thousand) and settlement area A (km<sup>2</sup>) of prefectures, as seen below:

circa 1900  $A=1.729P - 47.006$  ( $r=0.87$ )

circa 1950  $A=0.922P - 7.570$  ( $r=0.79$ )

circa 1985  $A=2.118P + 6.220$  ( $r=0.97$ )

In fact, population is in nearly direct proportion to settlement area circa 1950 and 1985. The change in population density in settlement areas is easily seen by comparing the coefficients in front of Ps.

The expansion of settlement areas in the Tohoku district was slow before 1950, but accelerated rapidly afterwards, surpassing the national average. In 1910 and 1950, 50% of settlement areas were located at an altitude below 50 metres. However, that percentage decreased to the current 45%, while there was an evident increase in the 100-300 metres rank.

The proportion of roads in urban land use, which includes settlement, road and railway, changed as follows:

	circa 1900	circa 1950	circa 1985
Japan	56%	53%	44%
Tohoku District	72%	72%	57%
Hokkaido	79%	72%	52%

This shows that the proportion of roads in urban use has been declining. In the Tohoku district, the area of roads has no correlation with population as calculated by prefecture. This is probably because road construction is done publicly from a broader point of view.

### 3.2. Agricultural Land

Agricultural land occupies 17.5% of Japan, a slight increase since the beginning of the century. There has been a large overall increase in Hokkaido, while former agricultural heartland was invaded by urban expansion. Paddy field increased greatly in Hokkaido, but the increase was offset by urbanization in other parts of the country. Dry field, which includes grassland, also increased sharply in Hokkaido. Orchard showed the largest increase, a rate of 1200% in 85 years, supported largely by government policy.

In the Tohoku district, agricultural development progressed just as in Hokkaido. The increase in paddy field after 1950 is particularly notable. However, much of that increase was observed in the relatively cooler Kitakami region, which suffered from serious cold-weather damage to rice in the summer of 1993. This suggests a need to investigate the rationality of rice-field development in this disaster-stricken region.

### 3.3. Forest

Forest area as a whole has not changed very much since the beginning of the present century, with about two-thirds of the country covered by it. It increased notably in the western part of the country, but significantly decreased in Hokkaido, where agricultural development has progressed steadily during that period. Broad-leaved forest, which is largely semi-natural, dropped markedly, giving way to mixed forest, agricultural land, and urban land. Much of the newly-formed mixed forest is the result of small-scale plantations of coniferous trees in former broad-leaved forest. The elimination and fragmentation of broad-leaved forest has resulted in the destruction of wild habitat, and some rare species of birds and mammals are under the threat of extinction. The area covered by coniferous forest changed only slightly as a whole, but in large part of western Japan, it decreased notably. In the Setouchi area, for example, abandoned pine forests were invaded by broad-leaved trees, and became mixed forest.

In case of Tohoku District, forest experienced a moderate increase both before and after 1950. The greatest change in forest was the sharp decline in broad-leaved forest and the increase in

mixed forest at altitudes of 300-700 metres after 1950.

#### **4. Concluding Remarks**

It is fortunate that Japan has produced such high-quality topographic maps covering the whole country for over a hundred years. It will be of great use to the forthcoming LUCC project if we can gain access to historical maps of similar quality which may exist in other parts of the world.