

Spread of Bamboo stands in the Kinki Region

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Abstract: The Bamboo stands, which had been planted for agricultural uses, have been spreading from fields to hills and mountains beyond farmers' expectation over the last 50 years.

Bamboo stands yield bamboo shoots to be served as a vegetable dish ("takenoko in Japanese") every spring, and supply materials for bamboo crafts in various ways. Now, as bamboo products have lost their social demand, bamboo stands has been gradually abandoned. This has resulted in the wild and unfavorable spread of bamboo stands in many regions over the western half of Japan.

This paper illustrates the unfavorable spread of bamboo stands regionally in the southern Kyoto from 1985 to 1999 and the Yamashiro area from 1948 to 2000 through the observation of satellite images and aerial photographs.

Keywords: Bamboo, Satellite Remote Sensing, Land Use, Aerial Photograph

1. Introduction

Forests in Japan, which had been well managed and conserved for a long time in the past have been neglected in recent years because of poor industry management and cheap timber import^[1]. Much of the same can be argued on bamboo stands. Bamboo products have been replaced by petrochemicals, and also domestic bamboo shoot production has been decreased due to the increase of imports from neighboring China, Taiwan and other Asian

countries. Decrease of demand has caused an increase of abandoned bamboo stands. Most of the bamboo stands in Japan grow at a high speed, namely in only two or three months. This speed is remarkably different from other trees. As a consequence, abandoned bamboo stands have been spreading from fields to the foot of mountain forests beyond farmer's expectation over the last 50 years. If forests are replaced with bamboo stands, biological diversity in forests has the potential to become impaired.

The purpose of this study is to estimate by observing and studying satellite images and aerial photographs when and where bamboo stands have developed apart from farmers' intention.

2. Regional Observation of the Southern Kyoto

1) Objective region

Our objective is the southern part of Kyoto Prefecture in the center of the Kinki Region. This region is outlined in Fig.1 (27km×29km). It is famous for rich bamboo shoot production. Above all, the Yamashiro Area shown with a solid zone (4.0km×1.7km) in Fig.1 is favorably cultivated with bamboo.

2) Method

We employed the Landsat-5 TM data acquired in 1985 and in 1999, respectively. When an objective target is too large to access immediately, it is a great advantage to us that the use of satellite remote sensing enables much easier to get a solution from the both points of view on space and time than any other method. Details about the employed satellite, sensor, path and row and observation date are given in Table 1. The positioning of the objects observed through the satellite must be calibrated as exact as they are on the ground. This is so called geometrical calibration by "geo-reference". We took the Nearest Neighbor Re-sampling Method, with which a set of ground control points (as ground truth) minimized the geometrical errors of the satellite image in principle of the least square method. The ground control points were extracted from the 1:25,000 topographic maps of the area.

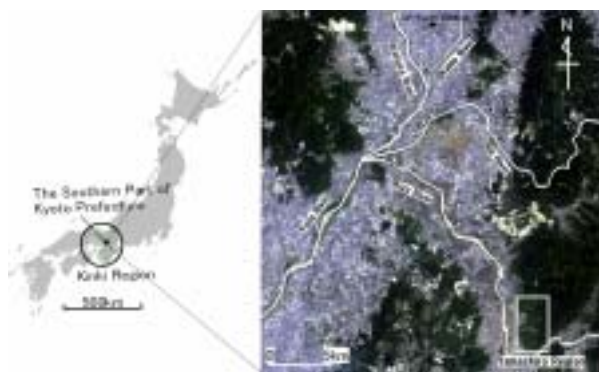
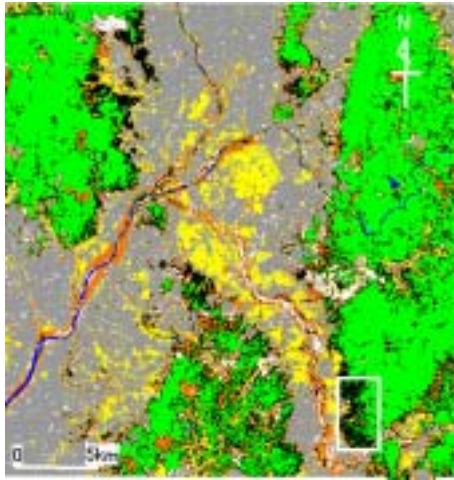


Fig.1. Study Region

Table 1 Details on satellite data

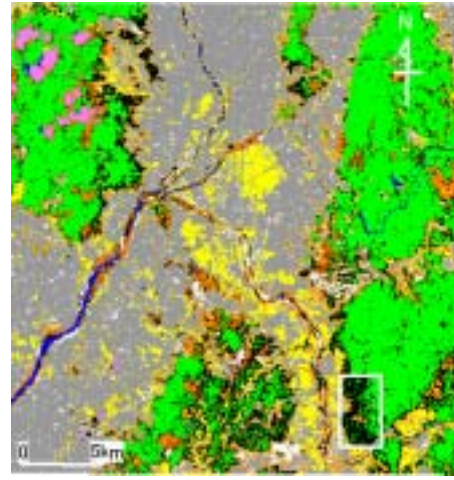
Satellite	Sensor	Path &/Row	Observation Date
Landsat5	TM	110/36	1985/6/5
Landsat5	TM	110/36	1999/6/12



June 5, 1985

Bamboo
 Forest
 Paddy field
 Grass
 Water
 Commercial
 Bare soil

Fig.2(a) Land cover classification in the Southern Kyoto area on June 5, 1985.



June 12, 1999

Bamboo
 Forest
 Paddy field
 Grass
 Water
 Commercial
 Bare soil
 Cloud

Fig.2(b) Land cover classification in the Southern Kyoto area on June 12, 1999.

The Supervised Maximum Likelihood Classifiers is one of the best fitting methods of land cover classification to estimate where the bamboo stands are distributed through satellite images^[2]. Conventional approaches of land cover classification with the remote sensing have typically relied on statistical classifiers such as the Supervised Maximum Likelihood Classifiers (SMLC) or the Unsupervised Clustering Techniques (UCT). Using SMLC, the objective region was classified into seven categories, (1) Forest; (2) Bamboo stand; (3) Rice field; (4) Grass; (5) Commercial; (6) Water; and (7) Bare soil. Field (as agriculture land) and grove are included together into Grass classification as well as riverside grass.

3) Result

The classified results are shown in Fig.2 (a); (b) and Fig.3 according to time elapse. These figures show that bamboo stands have increased 0.1% in the past 15years in the whole area inversely to the decrease of commercial areas. It is shown in Fig.2 that bamboo stands have increased in the southeastern part of the objective region during the period from 1985 to1999. This result means that the bamboo stands have spread from hills to mountains while some of them have disappeared due to urban development.

3. Yamashiro Area

1) Study area

The Yamashiro Area that is shown with solid zone (4.0km×1.7km) in Fig.1 and 2 is favorably cultivated with bamboo shoots. We see that the bamboo stands in this area have existed much previously than 1985. Consequently, we can see by observing aerial photographs how bamboo stands have spread in this area

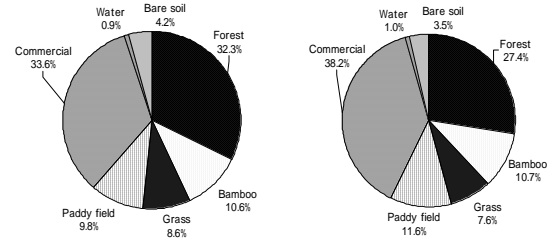


Fig.3 Change of land cover classification in the Southern Kyoto area.

Table2 Details on aerial photograph data

Observer of Aerialphotograph	Date	Scale
Armed Forces of the United States	1948	1:10000
Geographical Survey of Japan	1961	1:10000
Geographical Survey of Japan	1974	1:10000
Geographical Survey of Japan	1985	1:10000
Geographical Survey of Japan	2000	1:12500

while land use has changed in these 50 years or so. Details on the scale and the observation date are given in Table2. These analog data are converted into digital form by using a scanner. We extracted bamboo areas from the digital data obtained through visual observation on the screen of a PC. The area has two geological conditions in the altitude from 0 to 200 meters. Namely, one of them is that terrace deposit is distributed from 0 to 50m. Another is that granite appears from 50m to 200m. The granite is subject to weathering place by place.

2) Method

We analyzed an annual change of bamboo stands in the Yamashiro Area from 1948 to 2000 by observing aerial photographs. This study area is classified into six classes, namely (1) Forest; (2) Bamboo stand; (3) Farm land; (4) Water; (5) Residential area; and (6) Bare soil. The residential area includes roads and public facilities.

3) Result

Fig. 4(a) to (e) show the land use maps in Yamashiro area in 1948, 1961, 1974, 1985 and 2000, respectively. In the northern part of this study area, bamboo stands have already existed widely since 1948. In contrast, in the southern area to be observed, the bamboo stands that barely existed in 1948 have spread continuously year by year until 2000. Fig.5 shows the annual changes of land use in the study area from 1948 to 2000. As of 2000, the bamboo stands have increased three times more than those in 1948. Whereas the total area of forests had remained roughly constant between 1948 and 1961, they have trended to decline after 1961 and have become smaller than bamboo stands as of 1974. Similarly farmlands have continued declining after 1948 and have become smaller than the half of 2000's.

According to several interviews with local farmers, it was confirmed that bamboo shoots have been cultivated on farmland as agricultural crops during the decade of 1950s. Imported bamboo has turned over domestic one because of low price. The productions of domestic bamboo stands were abandoned in 1970s. It is shown in Fig.5. Uncultivated bamboo shoots have spread in wild from fields to hills beyond farmers' expectations while the need for them has declined.

4. Conclusion

The result of our study clearly shows that bamboo stands have spread in the southern Kyoto between 1985 and 1999. Also we recognized how bamboo stands had spread from fields to hills and mountains in the Yamashiro Area from 1948 to 2000.

Our conclusions are as follows:

1) While the bamboo stands near residential areas have become less useful due to the lack of demand, they have survived on hillsides and spread into mountains without human cares over the past several decades.

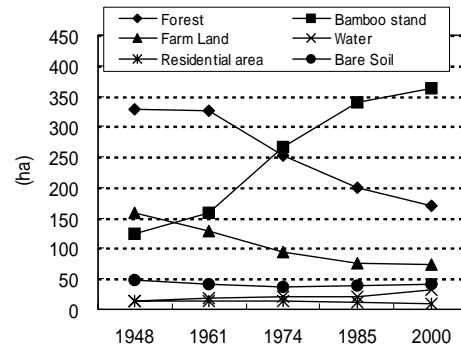


Fig.5 Change of land-use in Yamashiro region by observing through aerial photographs.

2) As of 2000, the bamboo stands in mountains have increased three times more than those in 1948. The result of satellite remote sensing shows the aggressive spread of bamboo territories visually in a comprehensive manner.

3) The TM image with the resolution of 30m is not enough to be analyzed a land use problem in city fringes in detail. The application of satellite images with a high resolution shall accelerate our study.

Acknowledgement

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Reference

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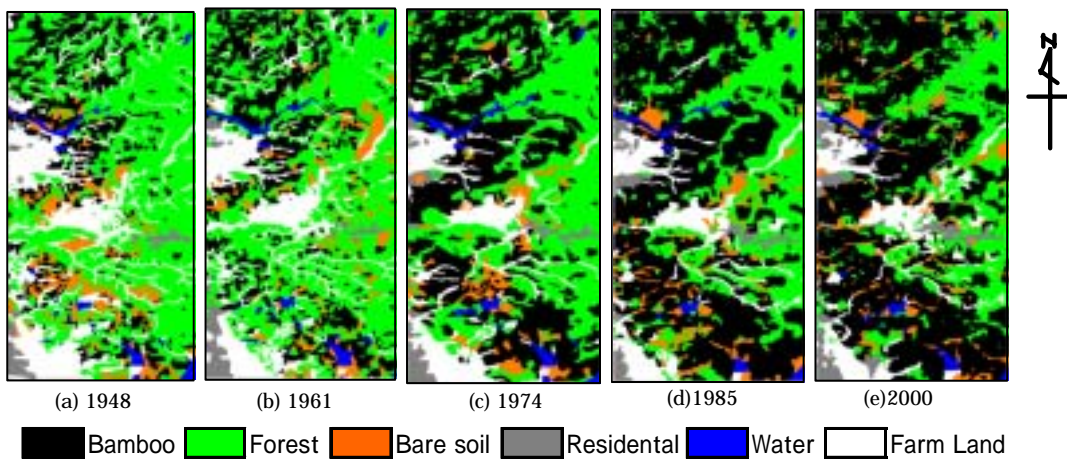


Fig.4 Yearly changes of land-use in Yamashiro region by observing aerial photographs(4.0km×1.7km).