

# Analysis of urbanization factor in river boundary using aerial image

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**Abstract** : It can be important framework data to monitor the change of land-use pattern of river boundary in design and management of river. This study analyzed the change of land-use pattern of Gab and Yudeung River using time-series aerial images. To do this, we carried out radiation and geometric correction of image, and estimated land-use changes in inland and floodplain. As the analysis of inland, the ratio of residential, commercial, industrial, educational and public area, that is urbanized element, increases, but that of agricultural area shows a decline on the basis of 1990. Also, Minimum Distance Method, which is a kind of supervised classification method, is applied to extract water-body and sand bar layer in floodplain. As the analysis of land-use, the ratio of level-upped riverside land and water-body increases, but that of sand bar decreases. These time-series land use information can be important decision making data to evaluate the urbanization of river boundary, and especially it gives us goodness in river development project such as the composition of ecological habitat.

**Key Words** : Landuse pattern, Aerial image, Inland, Floodplain.

## 1. Introduction

In Korea, extremely heavy rainfall events over the last decade have been in perceived increases, therefore flooding damages have been occurred seriously by this reason. Especially, flood disaster caused by population increase and industrialization at urban area is becoming serious.

Periodic monitoring information of sand-bar, water-body and various factors at the floodplain is necessary for systematic river management. Satellite image and aerial photo has the information of topographic features, so they are useful of analyzing

the characteristics of landuse pattern in river boundary. Because river shows linear feature, so high resolution image is necessary to analyze topographic objects as water and sand-bar. Gab and Yudeung river are selected for study region, because these regions are progressed in urbanization recently. And aerial images by national geographic institute are applied to analyze landuse pattern in this study. The object area is divided into two regions such as inland and floodplain as shown in Figure 1. And it is carried out to estimate the urbanized factors on the basis of landuse classes.

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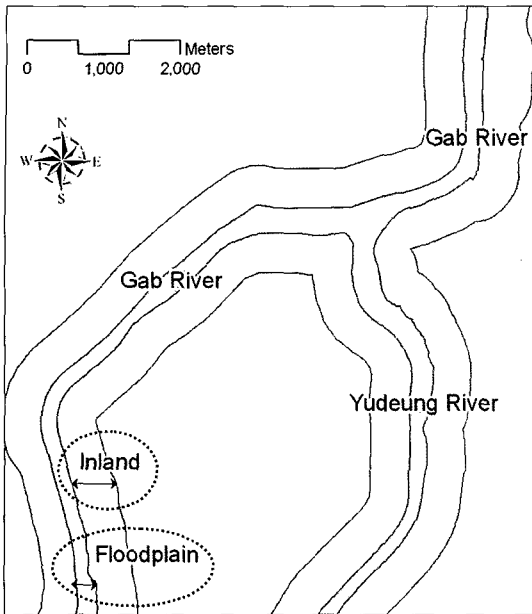


Figure 1. Study area.



Figure 2. Procedure of geometric correction.

## 2. Study Area and Data

Gab River was selected to evaluate urbanization factor using time-series landuse pattern in this study because this river was under way on rapid urbanization at a turning point of World Expo Exhibition (1983). River boundary shows linear feature, so high-resolution image is necessary to analyze landuse pattern in river boundary. This study used time-series aerial image on 1970, 1976, 1985,

1992, 1995, 2002. And this study divided river boundary into inland and floodplain. Radiation correction was done for areas that show the differences of reflection and geometric correction was processed based on 1:5,000 scale topographic map.

## 3. Analysis of urbanization in inland

The landuse factors of inland are agriculture, forest, residence, road, river, commerce, industry, education, public facility, park and so on. Digitized mapping method was used to classify landuse pattern. Figure 3 is landuse map of inland, Figure 4 is a landuse pattern of inland and figure 5 is the unitless

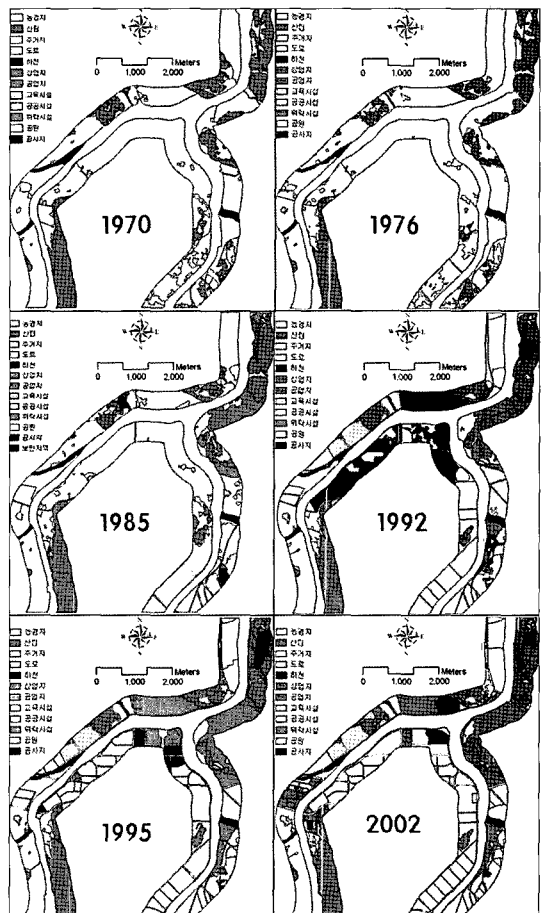


Figure 3. Landuse map of inland.

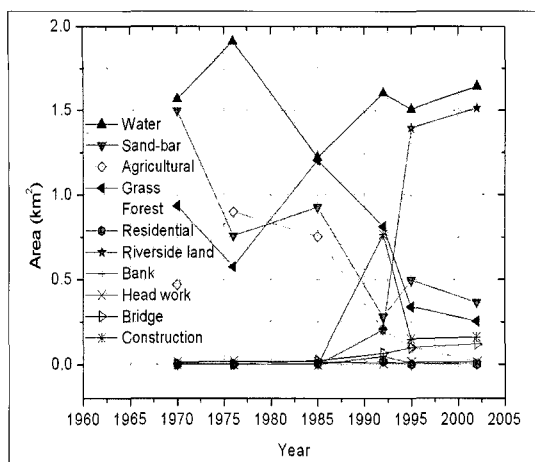


Figure 4. Landuse pattern of inland.

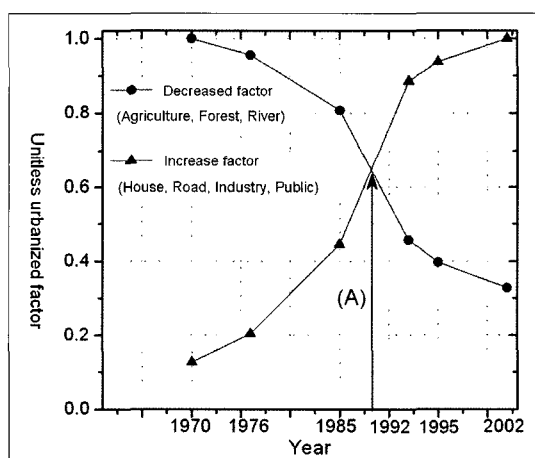


Figure 5. Unitless urbanized factor of inland.

urbanized factor of inland. As analysis of landuse pattern, the ratio of agricultural land was declined, but that of residential area was increased. As the analysis of unitless time-series landuse pattern, residence, road, industry, public facility are increased factor of urbanization and agriculture, river and forest are declined factors of that among landuse factors. In the estimation of summation of each urbanized factors, 1988 shows the turning point of urbanization in inland. So we can evaluate that the tendency of urbanization in inland is changed on the basis of 1988.

#### 4. Analysis of urbanization in floodplain

The landuse factors of floodplain are river, sand bar, agriculture, grass, forest, residence, bank and bridge. Water and sand-bar show complicated shape, so it is difficult to digitize the boundary and it takes times a lot. This study used minimum distance method as kind of supervised classification method to classify water and sand-bar automatically. Figure 6 shows time-series landuse map in floodplain and figure 7 is the graph of landuse pattern in same

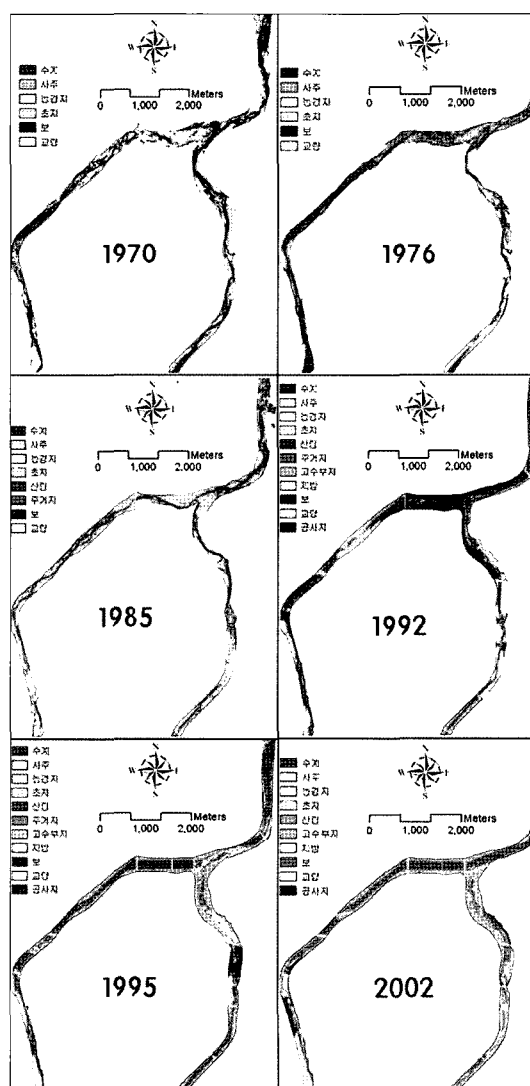


Figure 6. Landuse map of floodplain.

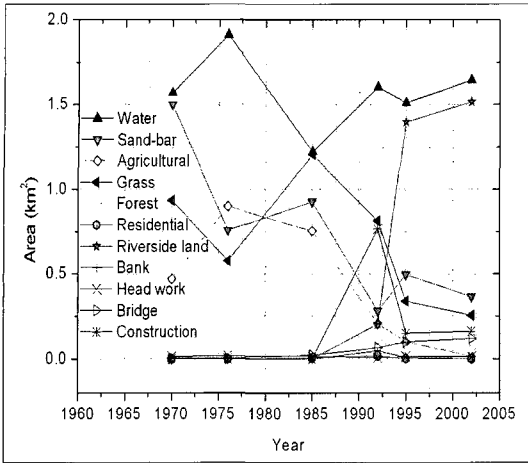


Figure 7. Landuse pattern of floodplain.

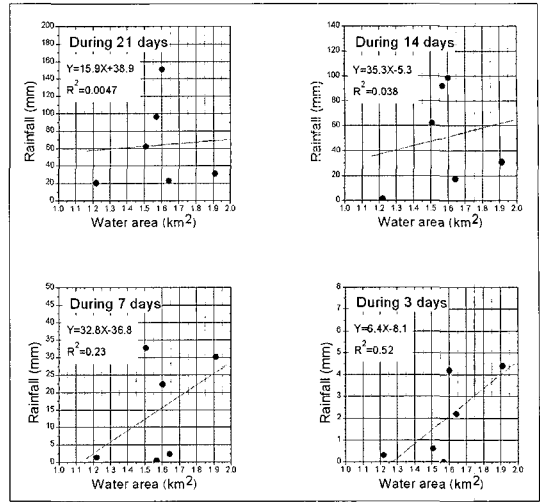


Figure 9. Relationship between rainfall and water area.

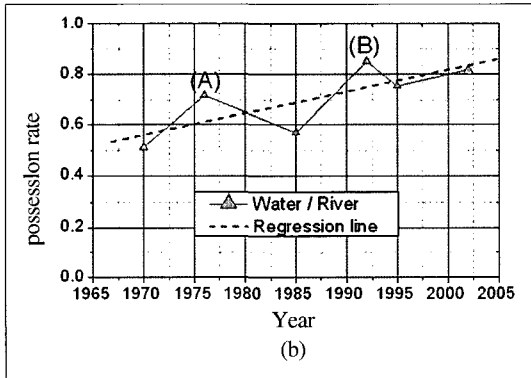
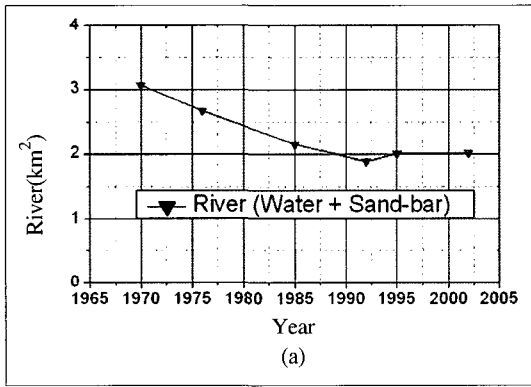


Figure 8. River area (a), Possession rate of water to river (b).

region.

Among landuse factors of floodplain, riverside land as recreational space is increased, but the area of river is decreased as urbanization of river. Also, the area of water-body is increased and sand-bar is

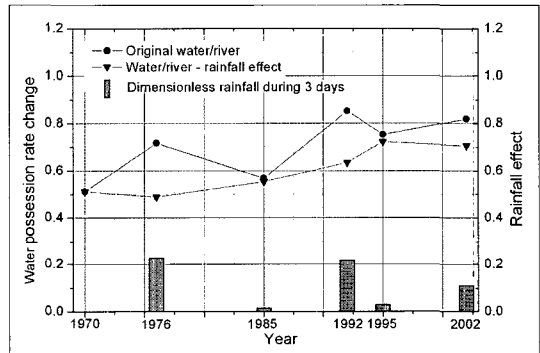


Figure 10. Water area considering rainfall effect.

decreased because of the influence of bank or facilities constructed to keep water in urbanized river.

Figure 8(a) is the area of river (water + sand-bar) and it shows that the slope of graph decreases as times go by. And Figure 8(b) is the possession rate of water to river and it shows the slope of graph increase as times go by. But 'A' and 'B' are described in Figure 8(b) show the peculiar cases that the possession rate strayed out of urbanization tendency. Therefore it means that rainfall data is necessary to interpret result more accurately.

Figure 9 is the investigation result about relationship between rainfall and water area. From those investigation results, it is clarified that the

rainfall effect during 3 days is most considerable. In conclusion, figure 10 is the result to the exclusion of rainfall effect from the urbanization tendency depicted in Figure 8(b). The slope from 1992 to 1995 shows steep in figure 10, so we can evaluate the tendency of urbanization in floodplain is changed from 1992 to 1995.

## 5. Conclusion

As the analysis of landuse of inland by digitized method based on time-series aerial images, agricultural area shows a decline, but commercial and industrial areas are increased on basis of 1992. Also, this study analyzed unitless landuse pattern considering maximum area by each class to reflect landuse change of inland that is important to estimate urbanization. Residence, road, industry and public facility are classified as increased factor of urbanization and agriculture, forest and river are classified that of urbanization. Also, the tendency of the both factors is inversed on basis of 1988. It can be assumed landuse pattern of Gab and Yudeung river changed into the urbanization on the basis of 1988. In the analysis of river area that reflects urbanization of floodplain, river area is declined as times go by. It means the area of landuse class that reflects urbanize factor as riverside land and bridge, is increased. Also, ratio of water-body to river area is increased and it means Gab and Yudeung river changed into the

urbanization as times go by.

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