Identifying Riparian Water Landscape Change Detection Using Digital Photogrammetry Technique

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Abstract

Han River water landscape changes between 1966 and 2002 were detected by interpreting IKONOS images, aerial photographs. Digital photogrammetry technique was used in this process. Most of water landscape change are disappearance of sandbars and meandering streams in 1966. It is mainly due to the stream straightening for housing site development.

1. Introduction

Han River water landscape has changed significantly during the past half century. It is mainly due to the stream straightening for housing site development. In order to restore Han River function, the first and most important requirement is to inventory data layers for adequate detail and accuracy (Roy Welch and M. Remillard, 1996). Aerial Photographs are very useful to identify and detect hydrologic changes. Digital photogrammerty is the science and art that get geometric, radiometric, symmetric information from digital images. It is an important technique for acquiring high-quality digital ortho-photo map from aerial photograph. This study aims to detect changes of Han River between 1966 and 2002 and provide basic and reliable data for urban environmental restoration.

2. Study Site

The study site is Han River located in Seoul City, South Korea. The Han River is 497.5km long with watershed area of 26,219 ㎢. Its water courses cover extensive regions of the middle part of country including Gangwon-do, Chungcheongbuk-do, and Gyeonggi-do provinces (Seoul Metropolitan City). From the 1960s, the water landscape of Han River has significantly changed. It is mainly due to the urbanization.

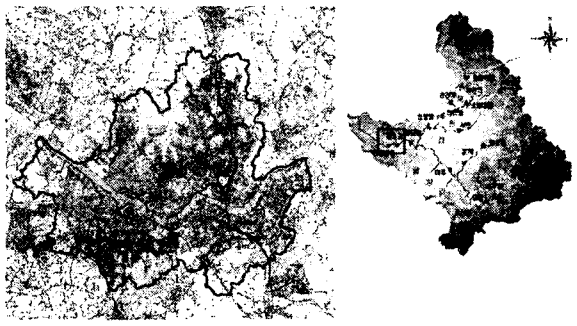

Figure 1. Study Site (Han River in Seoul City, Left), Han River Watershed Area (Right)

3. Study Methods

Aerial photographs taken from 1966 and IKONOS satellite images from 2002 were used to detect river changes. Table 1 shows the data, hardware, and software used in this study.

Table 1 the data, hardware, and software used in this study

Input Data	Aerial photograph(1966)	1:33,000 Scale
	IKONOS Image(2002)	1m spatial resolution
	Digital Road Map(2002)	1:1,000 Scale
	Digital topographic map(1998)	1:5,000 Scale and 1:25,00 Scale
	Seoul Biotop Map(2000)	Seoul Development Institute
H/W	UltraScan5000	± 5 micron accuracy
	Desktop PC	Pentium 2.3GHz
S/W	Leica Photogrammetry Suit V. 8.7	Leica
	ArcView GIS V. 3.2	ESRI

Aerial photographs taken from 1966 were scanned to digital images by using Ultrascan 5000 scanner at 30 micrometer per pixel. Each digital image from scanned aerial photograph was ortho-rectified by performing Bundle Adjustment technique. 150 GCP's were acquired from 1:1,000 scale digital road map and 1:5,000 topographic maps. Vertical coordinates of GCP's were referred to 5m*5m resolution DEM which was produced from 1:25,000 topographic maps. All digitally ortho-rectified images were mosaicked to a unique image which is generally called digital ortho-photo map. Leica Photogrammetry Suite (LPS) V. 8.7 was used in this process. Finally, Han River in 1966 was extracted from digital ortho-photo map by using on-screen digitizing technique. ArcView V. 3.2 was used in this process. On the other hand, Han River in 2002 was extracted from Seoul Biotop Map (2000) and some changed area between 2000 and 2002 was corrected by referring to IKONOS (2002) image. Finally, quantitative analysis of Han River changes between 1966 and 2000 were derived. Figure 2 shows the study procedure.

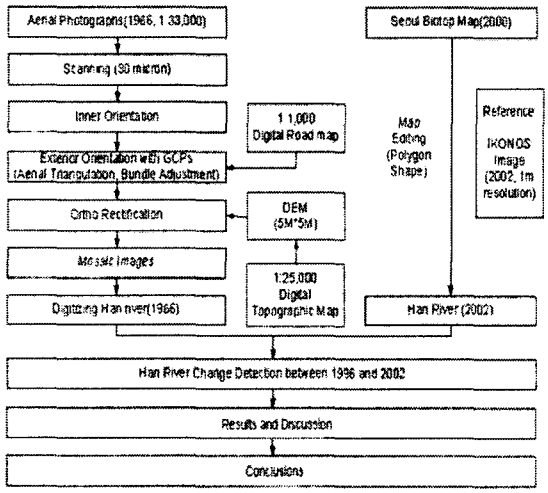

Figure 2. Han River Change Detection Work Flow

4. Results and Discussion

Figure 3 shows Han River Digital ortho-photos in 1966 (left) and Han River in 2002 and mapping process from Seoul Biotop Map (right). Aerial Triangulation results by using Bundle Adjustment technique show that overall RMSE is 7.9m. It is mainly due to the registration error of GCP's and images. Some areas are changed so that GCP's can be hardly selected. And topographic changes between 1966 and 2002 also might increase the RMSE.

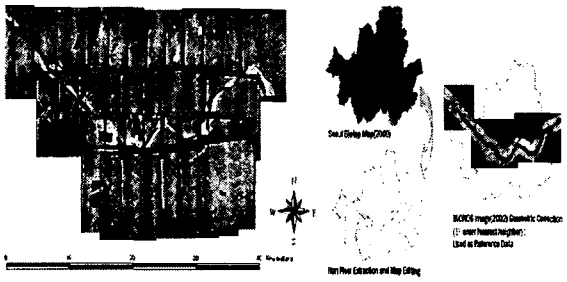

Figure 3. Han River Digital ortho-photos in 1966(left) and Han River in 2002 from Seoul Biotop Map (right)

Han River and tributary change results need more verification. Some tributaries were hardly detectable in spite of 1m*1m resolution images while Han River change between 1966 and 2000 is very clear. So, quantitative analysis of Han River change between 1966 and 2000 were performed in this study.

Table 2 shows area of Han River water landscape change between 1966 and 2002. The area of disappeared sandbars are 26.2㎢ while water area increased by 10.3㎢ between 1966 and 2002. Overall Han River water landscape area decreased (12.9㎢) between 1966 and 2002 mainly due to the disappearance of sandbars. At Bamseom and Eungbohng, a little portion of sandbars(0.04㎢) remained in 2002.

Table 2. Han River water landscape change between 1966 and 2000 (unit: ㎢)

Water landscape area	Water area	Sandbar and Other	Total area
2002	29.3	0.04	29.3
1966	19.0	26.2	45.2
Changed area	(+)10.3	(-) 26.2	(-)12.9

Water landscape has changed significantly at Jamsil Island and Mapo Sandbar by urbanization. Flood-control programs during the past half century resulted in the straightening of many streams (Brinford and Buchenau, 1993). Original hydrologic network and meandering streams in 1966 are destroyed and straightened in 2002. Many water courses are disappeared during this period.

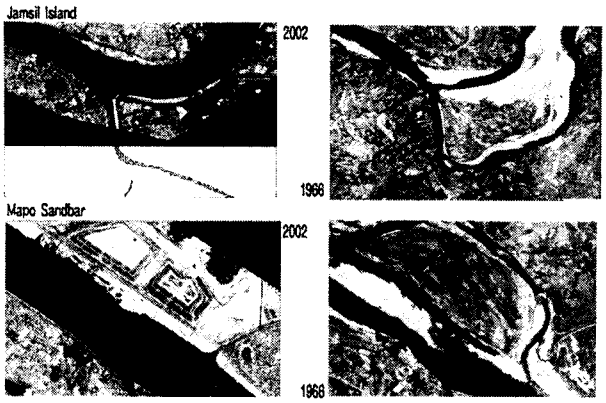

Figure 4. Jamsil Island (up) and Mapo Sandbar (down) water landscape change between 1966 and 2000

Most of sandbars disappeared (99.8%) by urban development. Figure 5 shows the land use change in 1996 water landscape area. The main reason of land use change is housing site development like Jamsil Island, and Yeouido. Most of sandbars and crop field disappeared during this period.

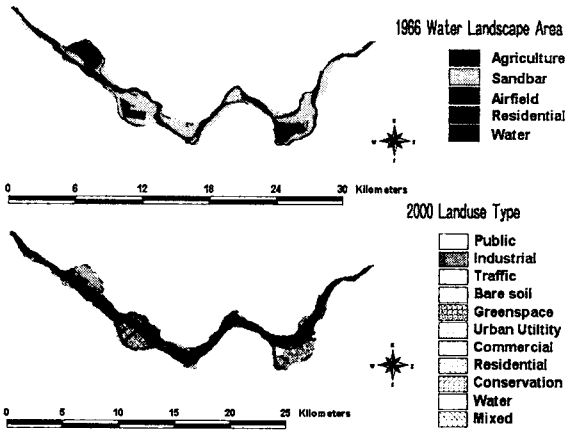

Figure 5. Land use change in 1996 water landscape area

5. Conclusions

Han River water landscape change between 1966 and 2002 were performed by using digital photogrammetry technique and on-screen digitization change detection technique. Results are as follows.

1. Han River water landscape area decreased in total area(12.9㎢) between 1966 and 2002 mainly due to the disappearance of sandbars and other area which covers 26.2㎢.

2. Jamsil Island and Mapo Sandbar water landscapes have changed significantly between 1966 and 2002. It is mainly due to urbanization.

References

Nam, Young-Woo, and T. Y. Seo, 1995, LAND AND CITY, BeopMun Inc.

Lee, In-Sung et. al., 2000, Seoul Metropolitan Biotop, Seoul Development Institute.

Welch, Roy and M. Remillard, 1996, Digital Photogrammetry and Addendum to the Manual of Photogrammetry; GPS, Photogrammetry and GIS for Remote Mapping Applications, ASPRS, pp.183-194.

Brinford, Michael W. and M. J. Buchenau, 1993, Ecology of Greenways; Riparian Greenways and Water Resources, University of Minnesota, pp.69-104.

http://english.seoul.go.kr/today/about/about_05han_01.html