MONITORING THE CHANGE ON WATER RESOURCES IN MA RIVER BASINS, VIETNAM USING THE MULTI-TEMPORAL LANDSAT SATELLITE IMAGES

Yun-Jae Choung (1), Soo-Young Choi (1), Nguyen Quoc Hiep (2), Nguyen Anh Hung (2)

[1] Institute of Spatial Information Technology Research, GEO C&I Co., Ltd, 435 Hwarang-ro, Dong-gu, Daegu, 41165, Republic of Korea
[2] Center for water resources software, Ministry of Agriculture and Rural Development, Vietnam
Email: chyj@geocni.com; sychoi@geocni.com; nguyenquochiep@cwrs-au.vn; anhhungbk81@gmail.com

KEY WORDS: Water resource, NDWI, river, reservoir, Landsat satellite image

ABSTRACT: Monitoring the water resource changes such as rivers and reservoirs is necessary for managing agricultural water resources and monitoring water quality. This research utilized the multi-temporal (July 1, 1986 and July 1, 2015) Landsat satellite images acquired in Ma river basins, Vietnam for monitoring the changes on the water resources through the following steps. First, the Normalized Difference Water Index (NDWI) images were separately generated using the multispectral bands of the given multi-temporal Landsat images. Then, the multi-temporal water resource features were separately extracted from the NDWI images by employing the threshold 0. Finally, the water resource changes were detected by mapping the water resource change areas using these extracted multi-temporal water resource features.

1. INTRODUCTION

Monitoring water resource changes is necessary for the sustainable water resources management. However, monitoring the water resources is difficult because the water resource shapes are occasionally changed due to the climate conditions, such as droughts and floods. The remote sensing datasets, such as the satellite images, have been widely used for managing the water resources because they can provide the multi-temporal information of the huge water resource areas with high accuracy without human access (Choung and Jo, 2016a). Choung and Jo (2016a) utilized the multi-temporal satellite images for detecting the water resource changes in Nakdong River basins, South Korea. Previous research has been limited to map the water resource change areas using the multi-temporal satellite images. This research proposed the efficient methodology for monitoring the water resource changes using the given multi-temporal satellite images by mapping the water resource change areas using these extracted multi-temporal water resource features.

2. DATASETS AND STUDY AREA

In this research, the Ma River basins, Vietnam were selected as the study area for monitoring the water resource changes. Figure 1 shows the location of Ma River basins, Vietnam, selected as the study area.

Figure 1. Location of Ma River basins, Vietnam, selected as the study area.

This research utilized the two Landsat satellite images, called as the first Landsat image and the second Landsat image, respectively, for monitoring the water resource changes in Ma River basins. The first Landsat image was acquired on July 1, 1986 by the Landsat-5 TM (Thematic Mapper) sensor while the second Landsat image was acquired on July 1, 2015 by the Ldnsat-8 OLI (Operational Land Imager) sensor.

3. METHODOLOGY

This section illustrated the methodology for detecting the water resource changes using the multi-temporal Landsat images (the first and second Landsat images). Figure 2 shows the flowchart of detecting the water resource changes using the multi-temporal Landsat images.

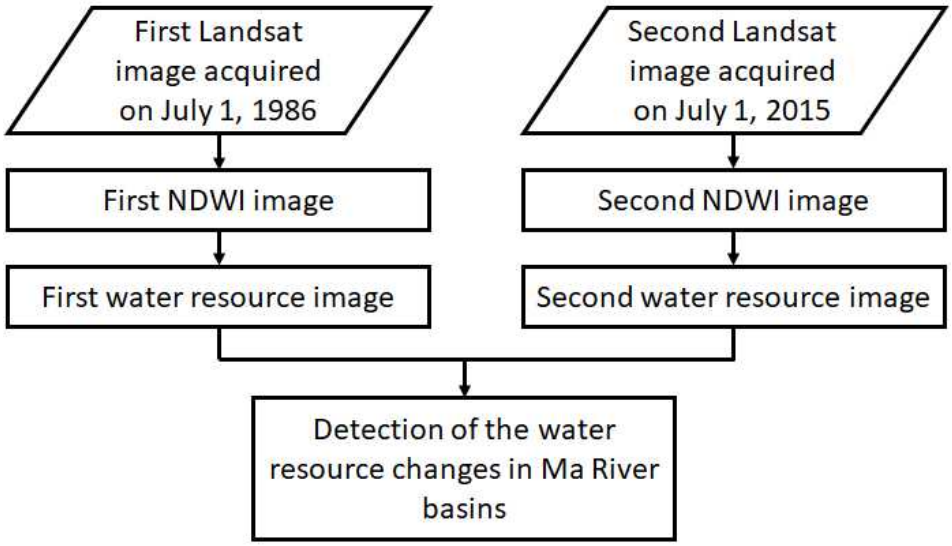
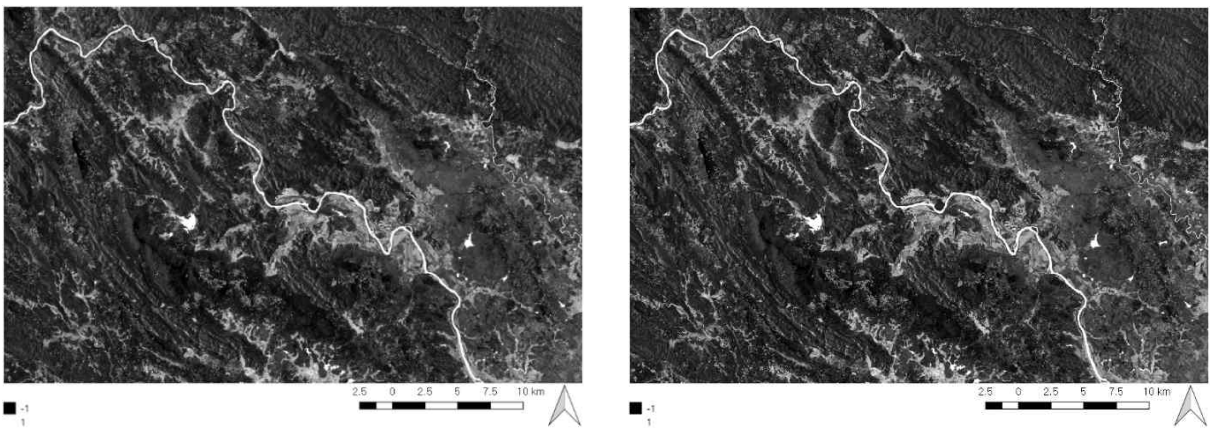


Figure 2. Flowchart of detecting the water resource changes using the multi-temporal Landsat images.

In the initial step of the proposed methodology, the NDWI (Normalized Difference Water Index) images were separately generated from both the first and second Landsat images through the below equation (McFeeters, 1996; Xu, 2006; Choung and Jo, 2016b).

NDWI = (Green - Nir) / (Green + Nir) (1)

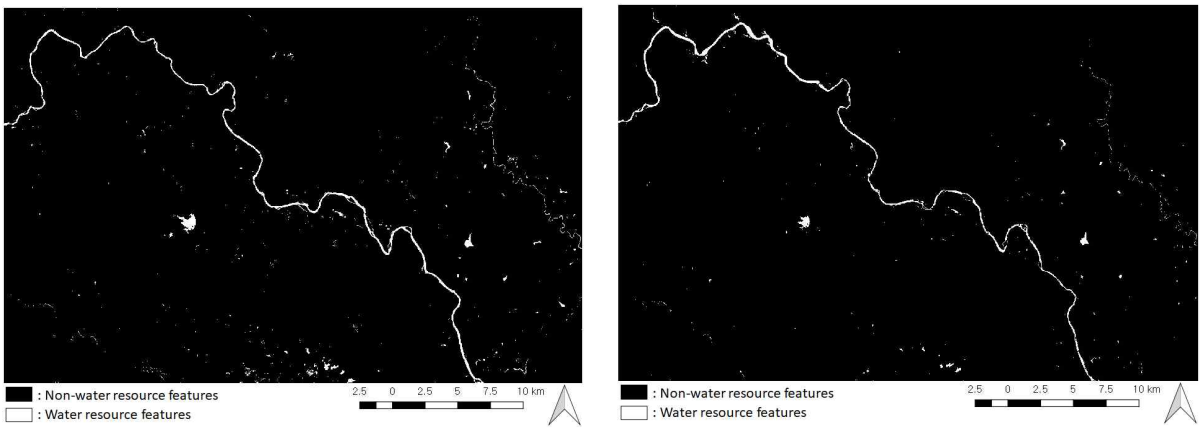
, where Green represents the green band while Nir represents the near infrared band of the given first and second Landsat images. Figure 3 shows the NDWI images (called as the first and second NDWI images) generated from the first and second Landsat images, respectively.



(a) (b)

Figure 3. First and second NDWI images: (a) First NDWI image generated from the first Landsat image; and (b) Second NDWI image generated from the second Landsat image.

After both the first and second NDWI images were generated, the water resource images were generated from the first and second NDWI images, respectively. In general, the pixels representing the water features in the NDWI images have the value higher than 0 (Choung and Jo, 2016b). Hence, the water resource images were separately generated from the first and second NDWI images by employing the threshold 0. Figure 4 shows the water resource images separately generated from the first NDWI image (called as the first water resource image) and from the second NDWI image (called as the second water resource image).



(a) (b)

Figure 4. First and second water resource images: (a) First water resource image; and (b) Second water resource image.

As can be seen in Figure 4, the various water resource features such as rivers and reservoirs were extracted from the first and second NDWI images, respectively.

4. RESULTS AND CONCLUSIONS

After both the first and second water resource images were separately generated, the water resource changes were detected by mapping the water resource change areas using these extracted multi-temporal water resource features. Figure 5 shows the water resource change areas in Ma River basins, Vietnam between July 1, 1986 and July 1, 2015.

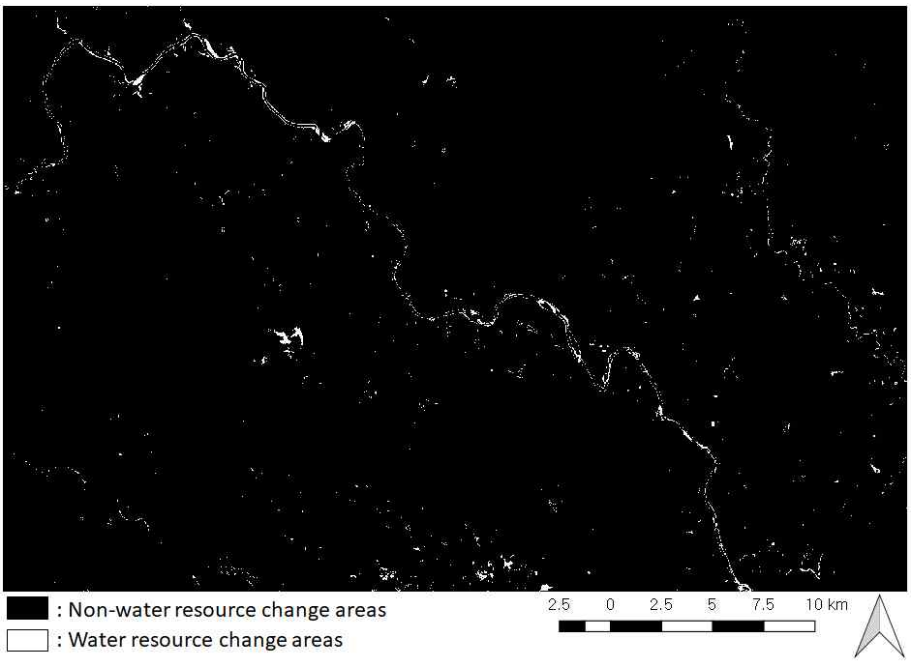


Figure 5. Water resource change areas in Ma River basins, Vietnam between July 1, 1986 and July 1, 2015.

Figure 5 showed that there are the water resource change areas in the wide areas of Ma River basins, Vietnam between July 1, 1986 and July 1, 2015.

References

Choung, Y.-J. and Jo, M.-H. 2016a. Monitoring water resource changes using multi-temporal Landsat Imagery taken in Changnyeong, South Korea. Procedia Engineering. Vol. 7, No. 1, pp. 348 – 352.

Choung, Y.-J. and Jo, M.-H. 2016b. Shoreline Change Assessment for Various Types of Coasts Using Multi-Temporal Landsat Imagery of the East Coast of South Korea. Remote Sensing Letters. Vol. 7, No. 1, pp. 91 – 100.

McFeeters, S. K. 1996. The Use of the Normalized Difference Water Index (NDWI) in the Delineation of Open Water Features. International Journal of Remote Sensing. Vol. 17, No. 7, pp. 1425 – 1432.

Xu, H. 2006. Modification of Normalized Difference Water Index (NDMI) to Enhance Open Water Features in Remotely Sensed Imagery. International Journal of Remote Sensing. Vol. 27, No. 14, pp. 3025 – 3033.