Pixel-based and hybrid pixel/object-based land use/cover classification techniques: A comparative study

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Introduction

Pixel-based image analysis has been, and still is, the basis for thousands of successful applications in remote sensing like land use/cover (LUC) mapping (Blaschke 2010). However, several limitations of this approach have been observed, such as the salt and pepper effect and limited integration of expert knowledge and feature space optimization (Platt and Rapoza 2008; Liu and Xia 2010). While other studies have shown that object-based techniques produce more accurate LUC classification results than the traditional pixel-based techniques (Platt and Rapoza 2008; Myint *et al*. 2011), other studies have also shown that a hybrid pixel/object-based technique can outperform both individual techniques (Bhaskaran *et al*. 2010; Li *et al*. 2013).

The goal of this study is to contribute to this endeavour as it compares a pixel-based and a hybrid pixel/object-based LUC classification techniques, applied to high and medium-resolution satellite images.

Data and Methods

For the high-resolution image, a 2006 pan-sharpened QuickBird image (0.6 m resolution) of the eastern part of Tsukuba City, Japan was used (Fig. 1). For the medium-resolution image, a 2009 Landsat TM image (30 m resolution) of Bangkok, Thailand was used (Fig. 2). Five LUC categories were classified from the QuickBird image (built-up, cropland, forest, other lands and shadow) (Fig. 8), while three categories were classified from the Landsat image (built-up, other lands and water body) (Fig. 9).

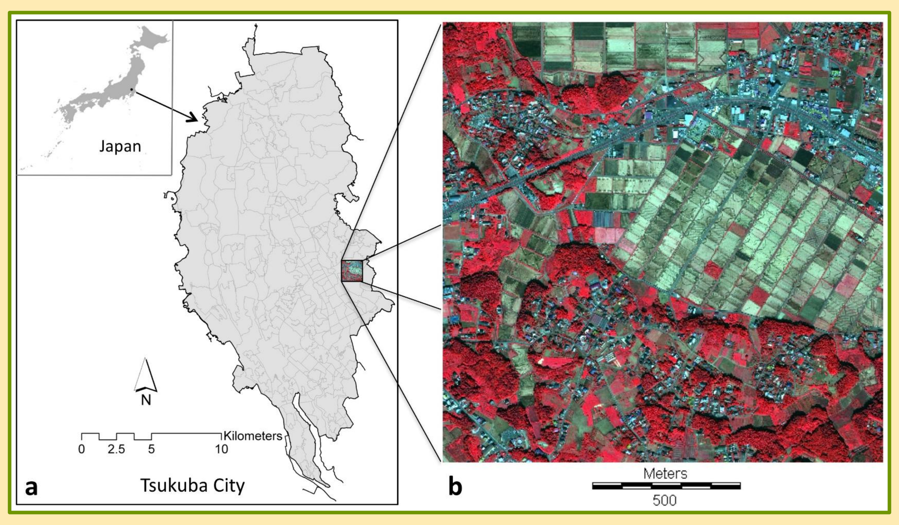

Fig. 1. (a) Tsukuba City, Japan; (b) QuickBird image (2006) (RGB: 432).

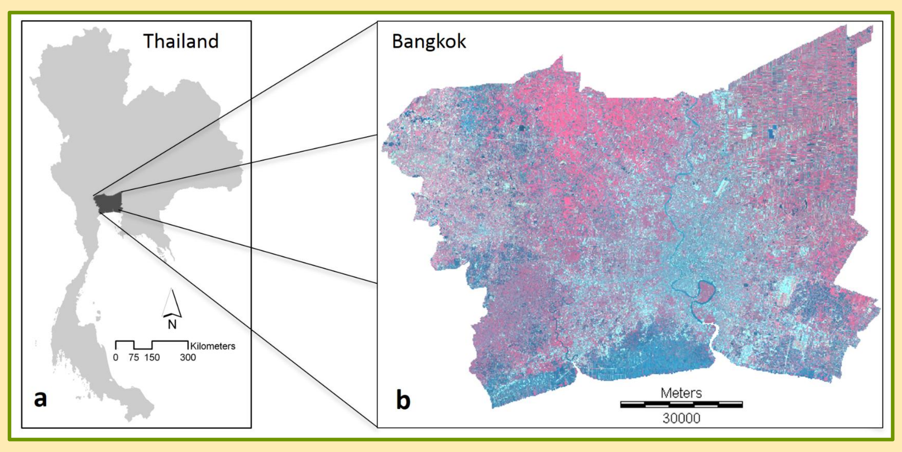

Fig. 2. (a) Bangkok, Thailand; (b) Landsat image (2009) (RGB: 432).

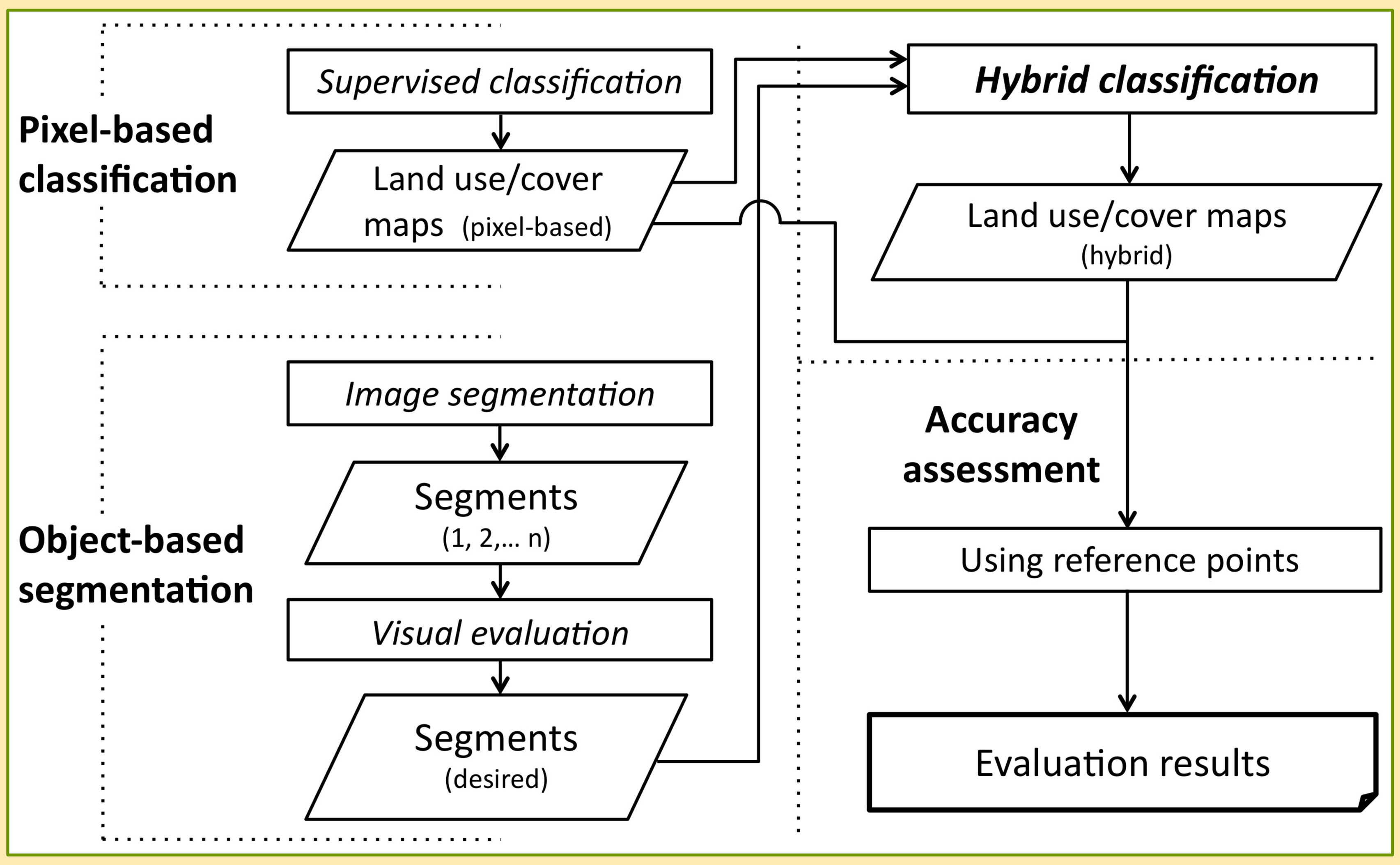

Fig. 3. Flowchart of the study.

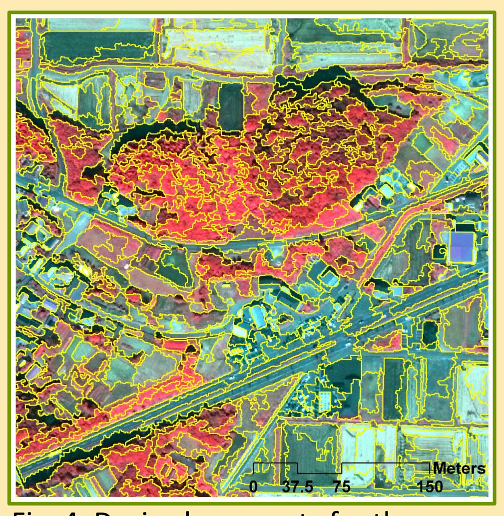
Fig. 4. Desired segments for the QuickBird image.

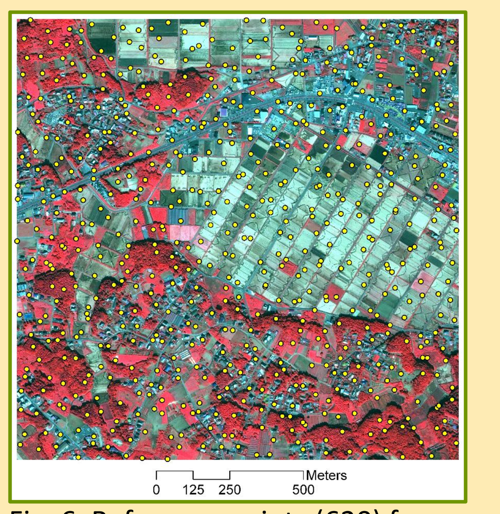
Fig. 6. Reference points (620) for accuracy assessment.

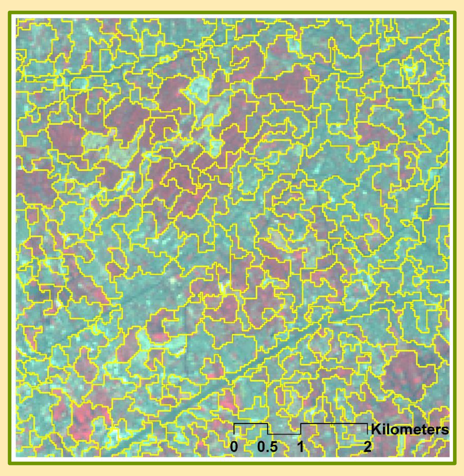
Fig. 5. Desired segments for the Landsat image.

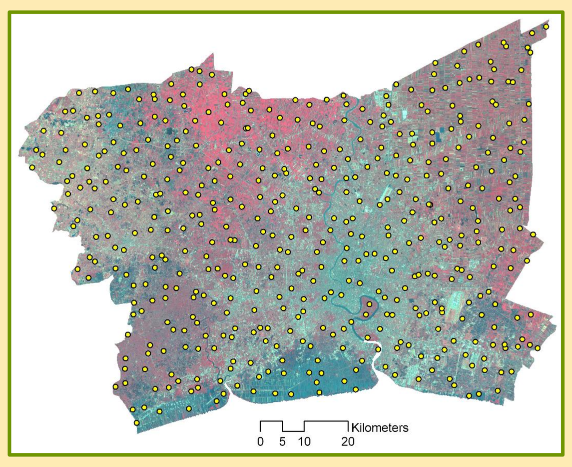
Fig. 7. Reference points (473) for accuracy assessment.

Note: The segmentation and hybrid classification procedures were accomplished using IDRISI GIS and Remote Sensing software.
Desired segments' parameters: QuickBird image (similarity threshold = 30); Landsat image (similarity threshold = 10); other parameters were the same for both images (window width = 3; relative weights of the input band files = equal; weight mean factor = 0.5; weight variance factor = 0.5). The majority rule algorithm was used in the SEGCLASS module for the hybrid classification .

Results

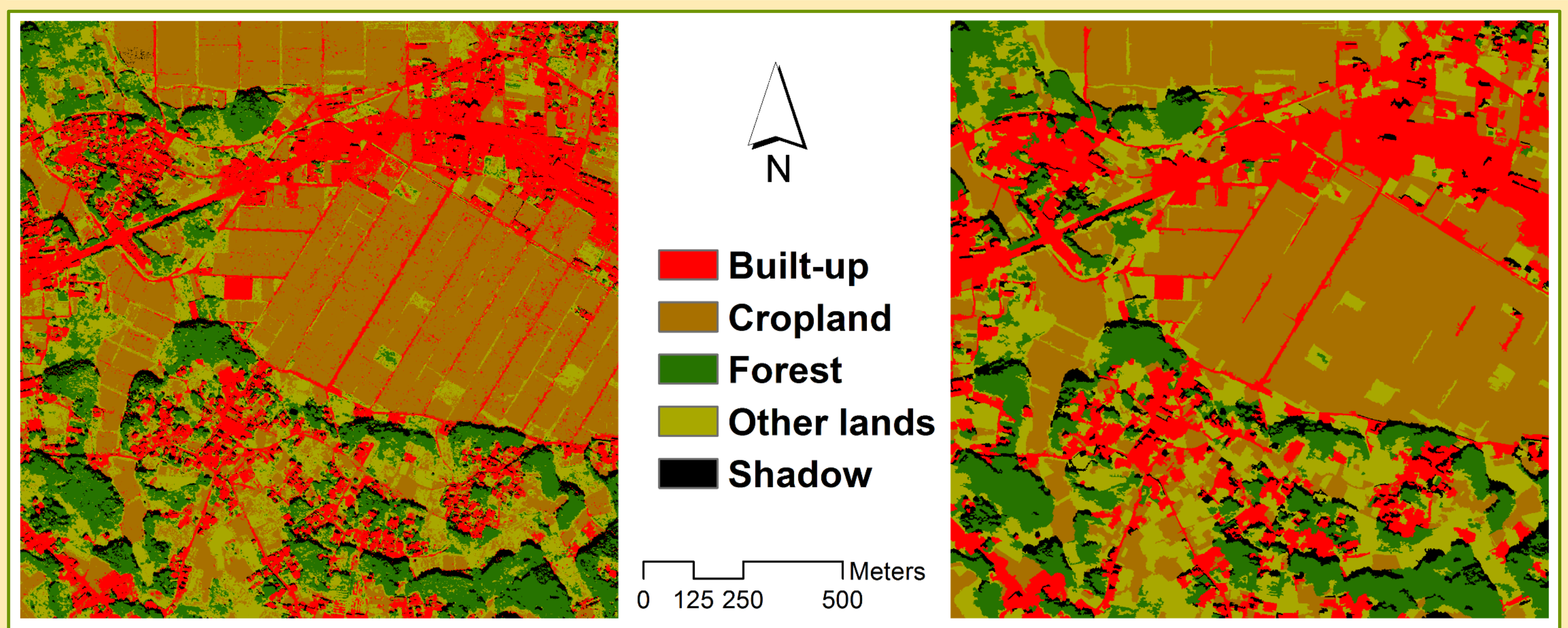

Fig. 8. QuickBird image: Pixel-based (left) and hybrid (right) classified LUC maps.

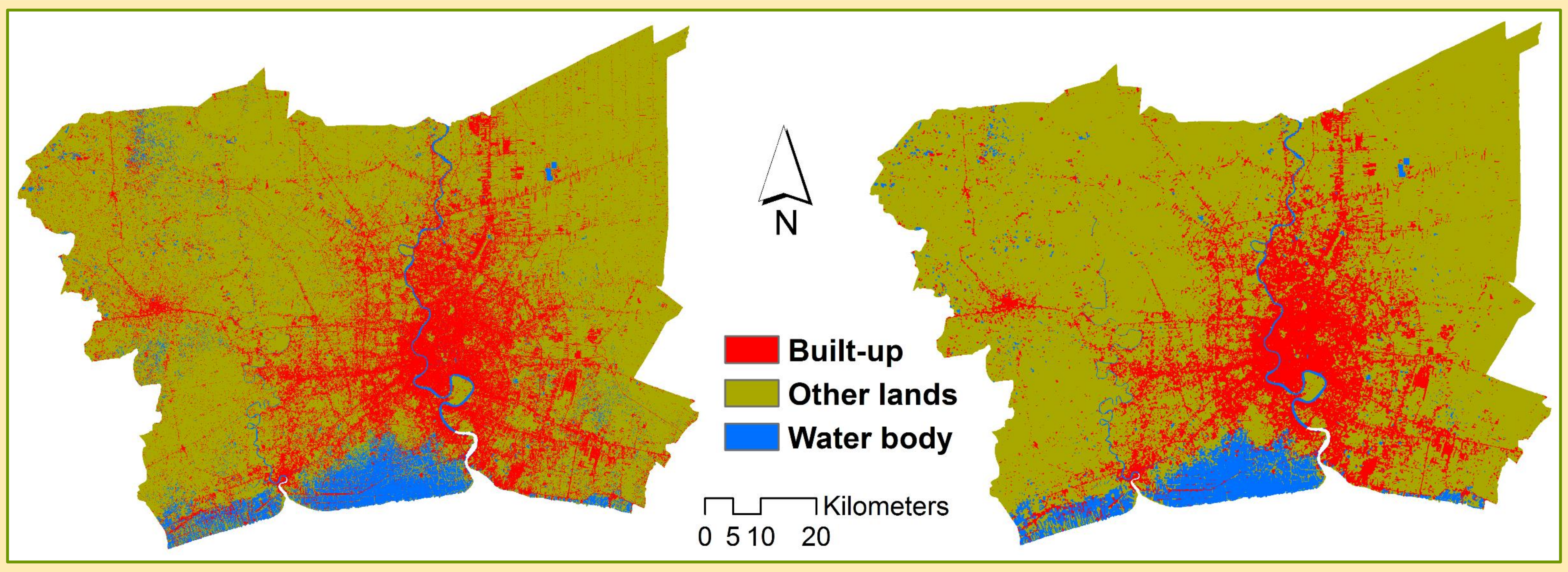

Fig. 9. Landsat image: Pixel-based (left) and hybrid (right) classified LUC maps.

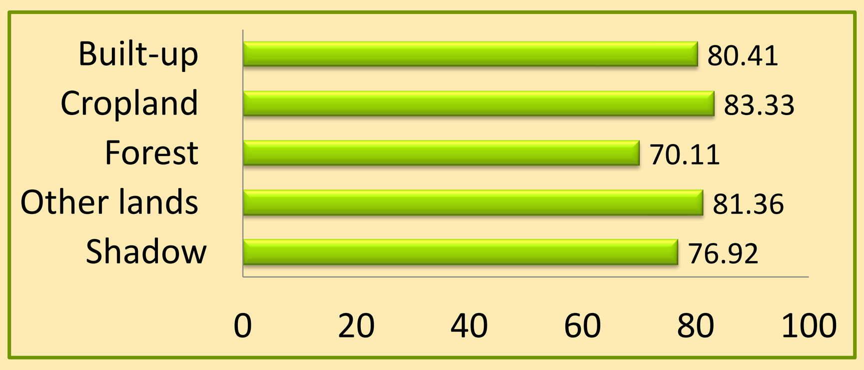

Fig. 10. Pixel-based: User's accuracy (*Overall accuracy = 80.00%).*

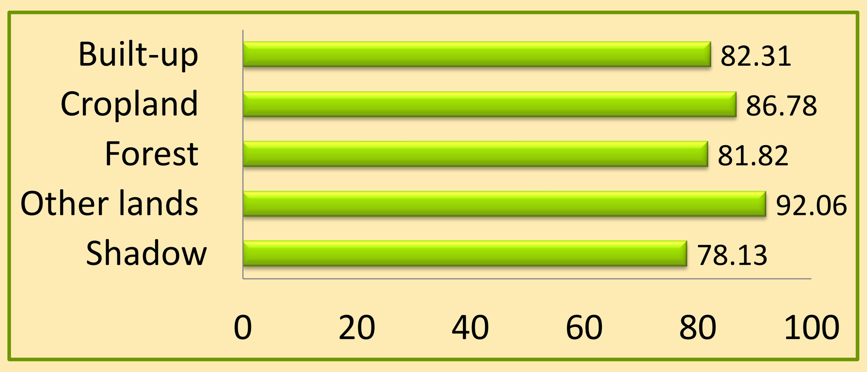

Fig. 11. Hybrid: User's accuracy (*Overall accuracy = 85.65%).*

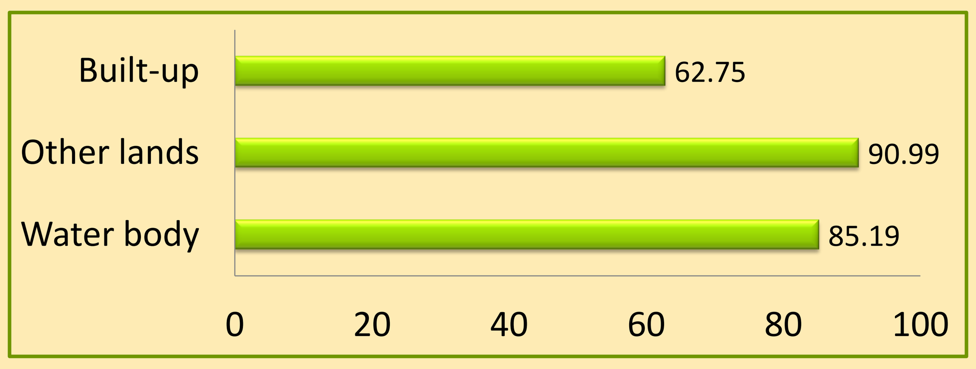

Fig. 12. Pixel-based: User's accuracy (*Overall accuracy = 84.57%).*

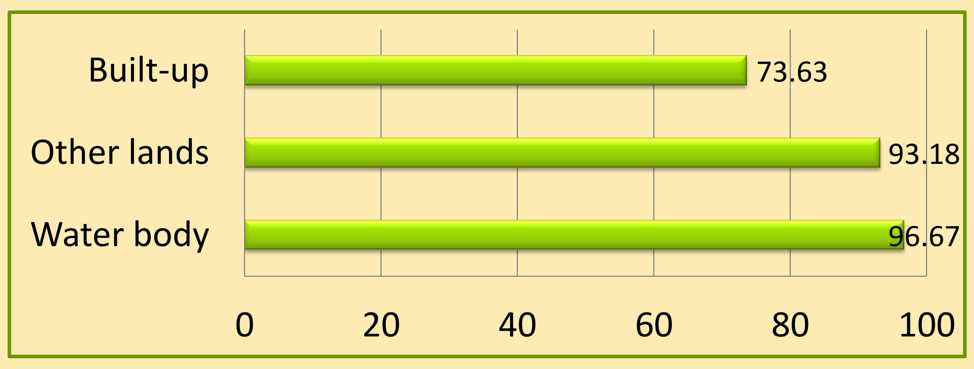

Fig. 13. Hybrid: User's accuracy (*Overall accuracy = 89.64%).*

Conclusion

While salt and pepper effect was more evident in the pixel-based classified maps, some linear features were not captured in the hybrid classified maps. In terms of overall accuracy, the hybrid technique outperformed the pixel-based technique for both the QuickBird image (high resolution) and Landsat TM image (medium resolution). Despite some limitations, the hybrid technique shows potential for a more accurate satellite remote sensing-based LUC mapping.

References

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