

Accurate field survey by UAV and NDVI estimate for rice terrace

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1. Introduction

Accurate field survey has been developed by drone recently. On the other hand, the real estate owners become too old to manage rice terrace. Then, accurate field survey was carried out for Onigi rice terrace¹⁾ (Figs.1 and 2) by drone and IR images were obtained for NDVI, soil moisture, water quality, and finally water budget.

2. Methods

Aerial photographs by drone (Fig.3; Phantom3) were taken and changed to 3D images and DEM by PhotoScan Pro. Next, photographs with IR filters were taken for 3D infrared images for NDVI and NDWI²⁾. NDVI and NDWI are shown next.

$$NDVI = \frac{IR - R}{IR + R}$$

$$NDWI = \frac{R - IR2}{R + IR2}$$

where IR : digital numbers for pixels of transparent through NIR filter, $IR72$, R : digital numbers of red pixels, $IR2$: digital numbers for pixels of transparent through IR filter, $IR90$. Evapotranspiration from NDVI and soil moisture from NDWI are estimated.

Water quality is estimated by next equations.

$$\text{Water Temperature} = a \text{ } IR2 + b$$

$$pH = c \text{ } IR2 + d$$

$$\text{Chlorophyll } a = e \text{ } B + f$$

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where B : digital numbers of blue pixels, a , b , c , d , e , and f : coefficients and constants determined by experiments. Moreover, transparency, turbidity, total nitrogen, total phosphorus, ammonium nitrogen, dissolved oxygen, and COD are estimated in the same way as water quality. Surface temperatures are estimated from $IR2$.

3. Results

RGB images and two types of IR images were obtained by drone (Figs. 5 and 6). They correspond to Bands 1 to 5 for Landsat 7. At the height 30m, the spatial resolution of drone was 1.63cm, while that of Landsat 7 is 30m. Also from these images very accurate DEM was obtained. At the same time, NDVI, NDWI, water quality, and surface temperatures were estimated with spatial resolution 1.63cm.

3. Conclusions

Drone proposed accurate DEM and surface quality: NDVI, NDWI, water quality, and surface temperatures with spatial resolution 1.63cm.

References

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- S. K. McFeeters, The use of the Normalized Difference Water Index (NDWI) in the delineation of open water features, *International Journal of Remote Sensing*, **17**, 7, 1996.

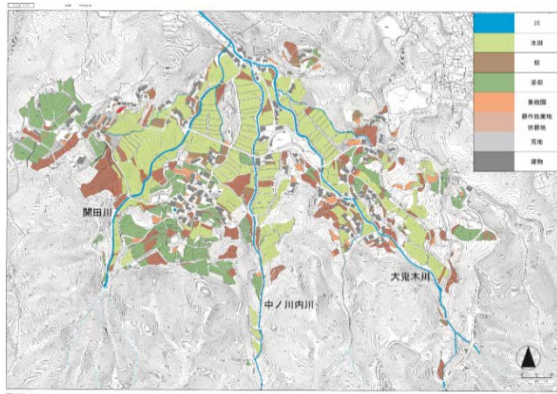
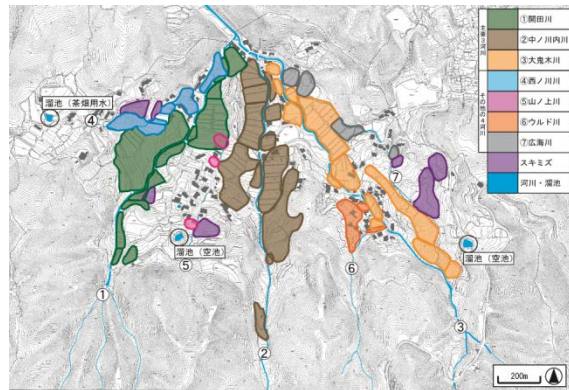
Fig. 1. Land uses at Onigi Village (2015)¹⁾Fig. 2. Rice terrace and its watershed¹⁾

Fig. 3. Drone, Phantom 3



Fig. 4. Satellite image (ASTER)



Fig. 5. Rice terrace at Onigi Village

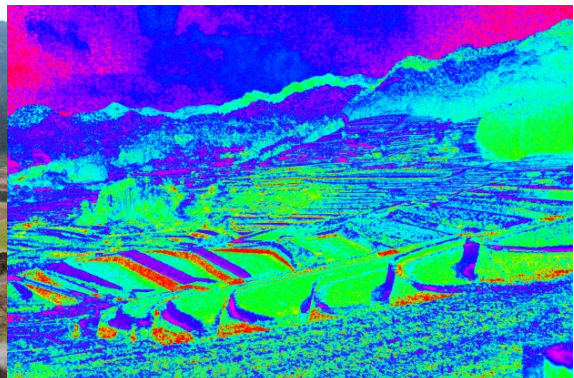


Fig. 6. NDVI of rice terrace at Onigi Village