# Can Citizen Scientists Generate Reliable Ground Truth Observations of Land Use?



Main Point: Based on two seasons of observations (n=694), trained citizen scientists using smartphones (i.e. GPS and camera), were able to collect land use ground truth data with 89% accuracy.

| Introduction |  |                  |                             |                  |
|--------------|--|------------------|-----------------------------|------------------|
| •            | Land use drives water related land surface           |                  | Ground Truth<br>Observation | 4                |
|              | processes like runoff, infiltration,                 | 2/3 measurements | ↓<br>↓                      | 1/3 measurements |
|              | evapotranspiration, etc; hence it is important for   |                  |                             |                  |
|              | making wise management decisions.                    | Remote Training  |                             |                  |
| •            | Satellite imagery are freely available and are often |                  |                             |                  |

#### **Methods and Materials**

- Study Area: Kathmandu Valley
- Data Collection:
  - **Who?** : CS
  - How? : Android application called

Open Data Kit (ODK)





combined with ground based observations to develop reliable land use maps (Figure 1).

- Uncertainty in ground truth observations directly
  - impacts uncertainty in subsequent land use maps.

Land Use Map Validation Good

Figure 1. Land Cover Classification Work Flow.

Objective : Evaluate if citizen scientists (CS) can collect reliable land use ground truth data.

What? : "Land-Use" form; built-in land use tutorial in the form (Figure

2)

**Collected Parameters**: GPS, Land Use Classes (Six Land Use Classes) Pictures Figure 2. Photographs of land use classes. Six land use classes were identified: agriculture non-rice, agriculture rice, built high, built low, natural forest, natural shrub.

## Results



### Summary of Quality Controlled CS Ground Truth Observations



Postmonsoon 2017
Premonsoon 2018

Figure 3. Ground Truth Data collected by CS in Post-Monsoon 2017 (a) and Pre-Monsoon 2018 (b). Land use data from 2015 used as map background. Figure 4. Analysis of Quality Controlled Ground Truth Observations taken by CS. A total number of 654 measurements were recorded in Post-Monsoon 2017 (n=454) and Pre-Monsoon 2018 (n=240). Each row represents the summation of dissimilarities between land use classes assigned by CS and quality controlled by S4W staff. Among those measurements, the number of good and bad measurements were found to be 88.9% and 11.1% respectively.

#### Discussion



- Figures 5 and 6 represent example good and bad
- CS land use ground truth observations,

respectively.

- Incorrect measurements were due to improper
- site selection (i.e near a land use transition), lack of understanding in methodology, and inadequate field training.

## **Conclusions and Recommendations**

- CS were able to observe land uses with 89% accuracy.
- Using smartphones to collect ground truth observations gives the ability to quality control and correct erroneous data.
- Future CS land use campaigns should focus on providing detailed theoretical and in-field training.
- CS land use observations should be continued annually (post monsoon) to characterize temporal and spatial patterns.

Citizen Science - scientific work undertaken by members of the general public, often in collaboration with or under the direction of professional scientists and scientific institutions. [Oxford English Dictionary]







SmartPhones4Water = Citizen Science + Mobile Technology + Young Researchers