Application of Open-Source GIS and live GPS tracking for land use / land cover field data collection in Kilimanjaro, Tanzania

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One of the key outputs of CHIESA project (*Climate Change Impacts on Ecosystem Services and Food Security in Eastern Africa)* is the production of accurate and up-to-date land use / land cover (LU/LC) maps of the project's study areas. These maps will be used as inputs for modeling various ecosystem services, SWAT analysis, as well as to detect historical and model future LU/LC changes.

In April 2012, researchers from University of Helsinki and Clark University conducted field work in the Southern slopes and surrounding plains of Kilimanjaro, where one of the research transects is situated. The purpose of the trip was to collect ground control points for satellite image (SPOT5) orthorectification and training areas for LU/LC classifications. GPS receivers were used for real-time navigation, collection of waypoints and tracks, and taking geotagged photographs. The satellite images were roughly georeferenced with old topographic maps before the field work.

Traditionally *in situ* data collection for LU/LC mapping has been done with either a combination of printed maps, satellite images and a hand-held GPS. Alternatively a more sophisticated solution combines handheld data collector integrated with a GPS, and propriety GIS software.

The first solution is simple and robust, and works in most situations, but the drawbacks are the difficulties of positioning and orienteering with the paper prints, and being limited to the fixed scale. Making remarks on the prints is also cumbersome. The second solution is more user-friendly and effective, but the equipment and propriety software licenses are expensive and out of reach for many researchers in the developing world.

A good compromise between the two solutions was tested and found to be very cost-effective for this study case: A normal hand-held GPS was connected with an USB cable to a PC laptop, which was running QuantumGIS free/open source GIS software. With the help of live tracking integrated in the software, the car's location on the satellite image could be seen and training areas could be digitized from the satellite image straight away. Geotagged photographs taken from different LU/LC types served as an additional reference.

Collection of ground control points was also made very easy with this setup: it could be easily verified from the satellite image, if a particular road crossing was clearly visible in the image, and had remained the same since the image was taken.

Because the study area was well covered with an extensive road network, the laptop stayed inside the car at all times, and training area sampling was stratified close to the roads. The downside of this particular setup is that it is not very portable. However, it would be possible to connect the GPS to a lightweight tablet running Android OS with QuantumGIS.

We believe the above field data collection method works well especially in developing countries, and it is very cost-effective since no expensive equipment or software is needed.