ITS 4 LAND

innovations for land tenure

TOWARDS INNOVATIVE GEOSPATIAL TOOLS FOR FIT-FOR-PURPOSE LAND RIGHTS MAPPING

This project has received funding from the European Union's Horizon 2020 research and innovation programme, under Grant Agreement No 687828

Horizon 2020
European Union funding
for Research & Innovation

NCG

Netherlands Center for Geodesy and Geo-informatics

November 02, 2017, Delft, The Netherlands

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University of Twente (NL)

The Land Tool Evolution

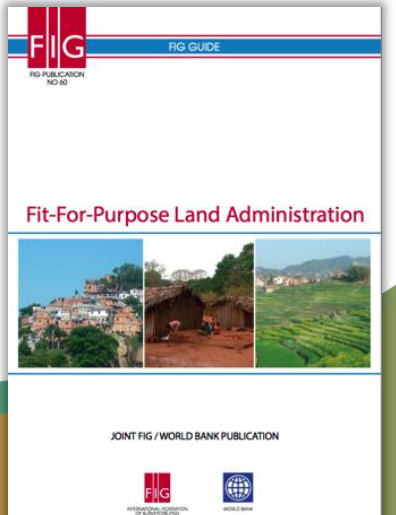
Only 30% of the world's population has access to formal land administration systems to register and protect their land rights.

Mapping cadastral boundaries using traditional, field based methods often proves to be time, cost and labour intensive.

The Land Tool Evolution

Recently there are many evidences that show that the existing ICT-based approaches for land tenure recording – do not deliver what is expected.

- **1st Generation – Conventional**
  - precise, expensive, complex procedures,
  - requiring specialists, imported, government driven (mostly)
- **2nd Generation – Pro-Poor / Fit-for-Purpose**
  - cheaper, less accurate, simpler, barefoot, para-surveyors, bottom-up, manual, participation, grass roots, diversity, scalable...?
- **3rd Generation – Socio-Technical Fusion**
  - high tech, human touch, partnerships, innovation/market focused, end-user driven, automation, artificial intelligence, robotics



Program: H2020-ICT-2015
Type of Action: Research and Innovation (RIA)
Topic: International partnership building in low and middle income countries
Acronym: its4land
Number: 687828
Duration: 48 months
Start Date: 2016-02-01
Consortium: 8 partners
Budget: 3.9 M EUR

Its4land- Aim

We’re creating seven new tools to make
land rights mapping
faster, cheaper, easier, and more responsible

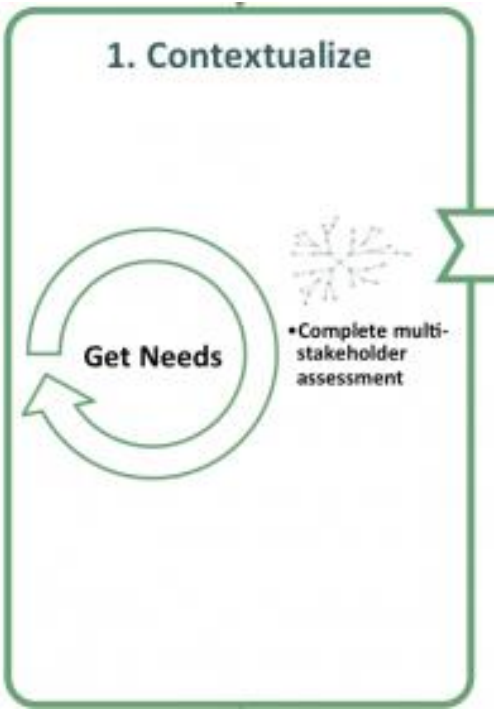
Case locations

RWANDA - developing approaches that can support updating, at scale, land rights documents and maps

KENYA - adapting tools to enable mapping of pastoralist land rights and layered disputes

ETHIOPIA - developing approaches that improve plot recordation of urban smallholder and dwellers (peri-urban and rural landscapes)

Work package - Get Needs

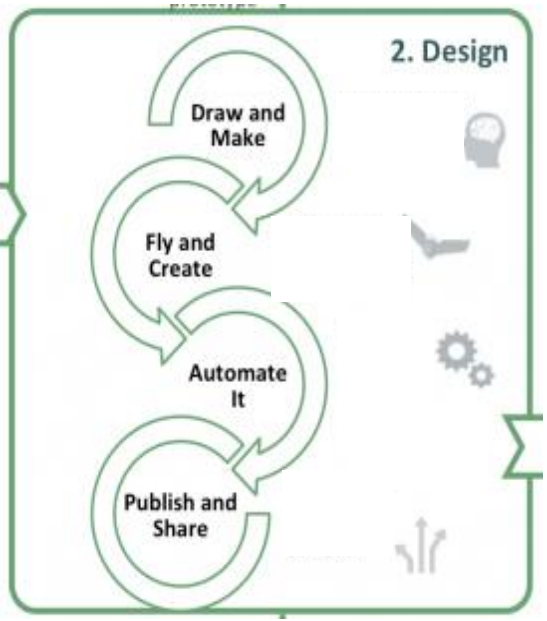


Phase1

To understand and identify the needs of stakeholders in the land sector and how its4land might meet these needs

Work package - Draw and Make

Phase 2



Implementation of a sketch based geospatial data recording to capture land tenure data from local perspective.

Main components are developing:

- Domain models for representing sketch maps
- Spatial models for representing sketch maps
- Methods for their recognition and embedding within existing datasets

Task Overview: Object recognition

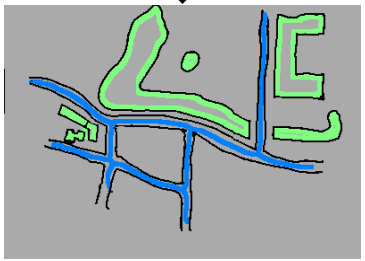
1. Symbol extraction

2. Symbol deletion

3. Image Segmentation

4. Classification

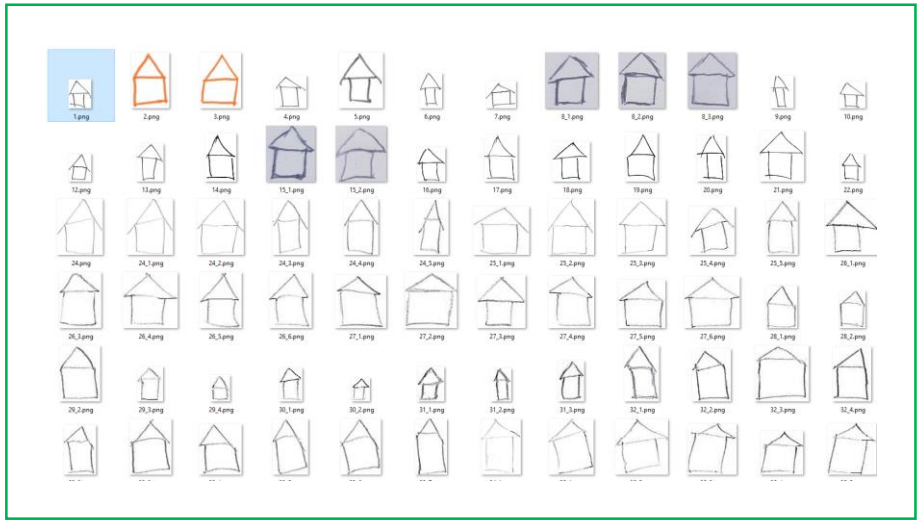
5. Vectorization



House: geom =rectangle <1,2 ,3,4…>
Graveyard :geom=polygon <1,2, 3,4…>
Forest : geom= polygon< 1,2, 3,4…>
…..

Pattern detection and contour detection

Challenge is in ensuring that all allowed symbols are recognized by the program with high probability



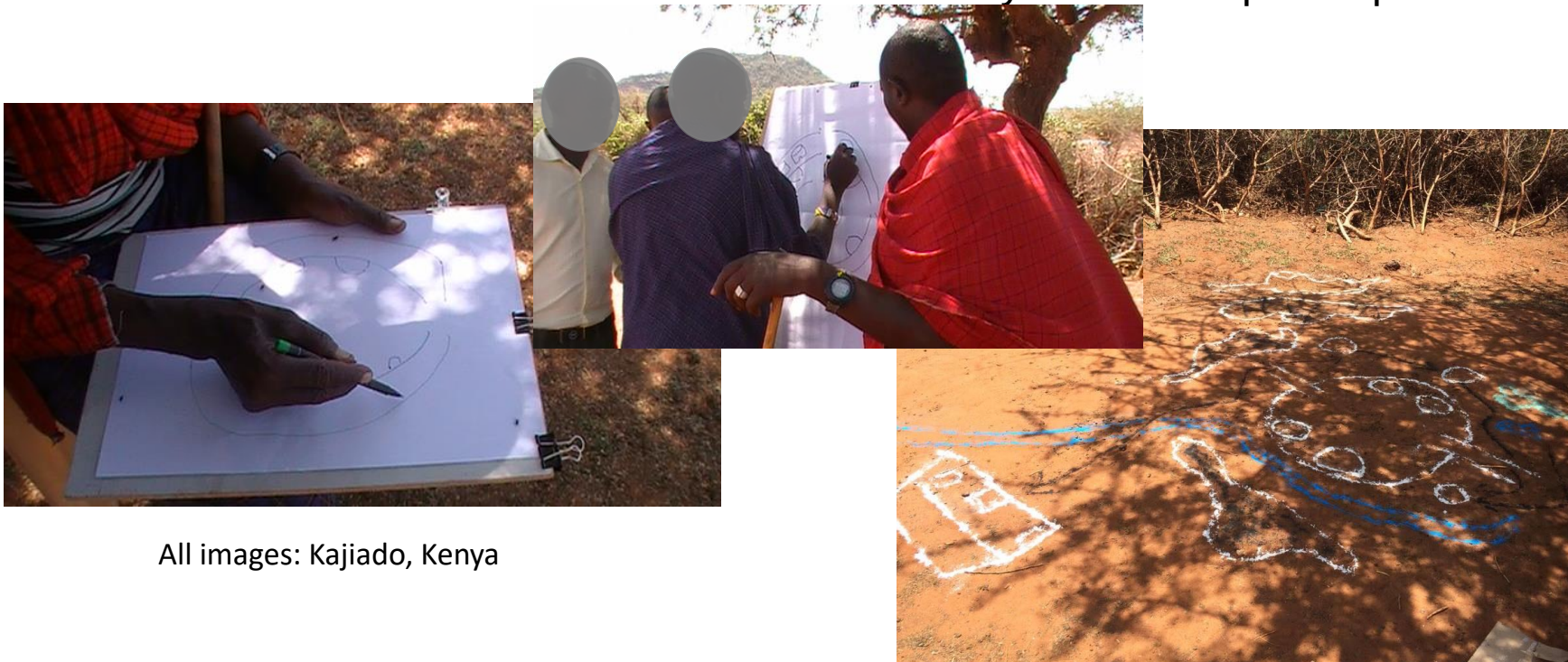
Symbol catalog of positive samples

Developing small software tools to make preparation of sample data semi-automatic.

Training also requires negatives samples

Supporting Activities

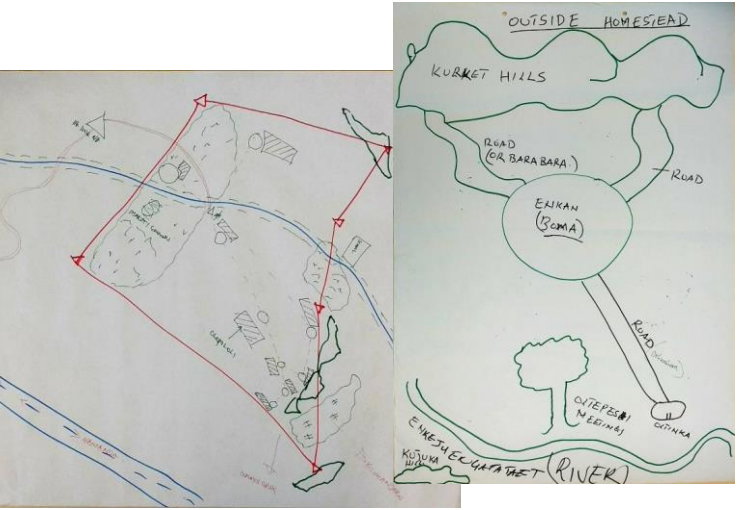
1. Field data collection with TUK and BDU in Kenya and Ethiopia resp.



All images: Kajiado, Kenya

Supporting Activities

2. Field data collection with TUK and BDU in Kenya and Ethiopia resp.



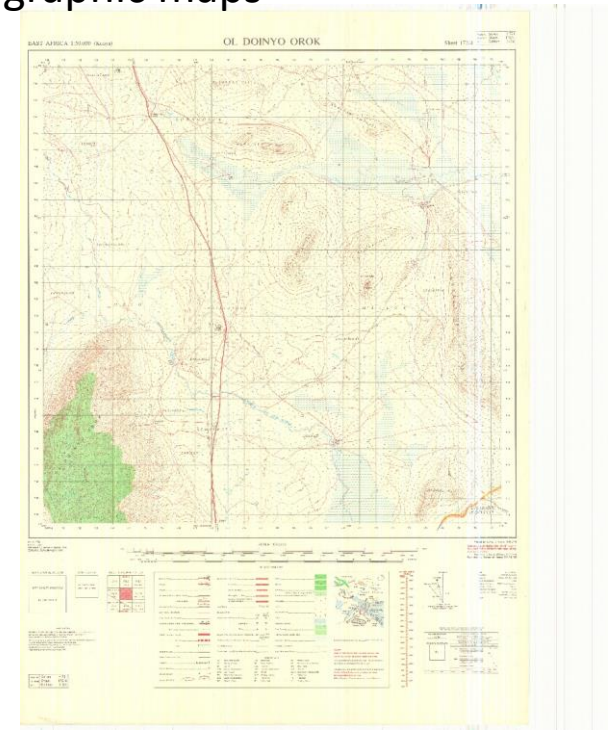
All images: Kajiado, Kenya

Data covering large geographic areas should be collected at multiple scales

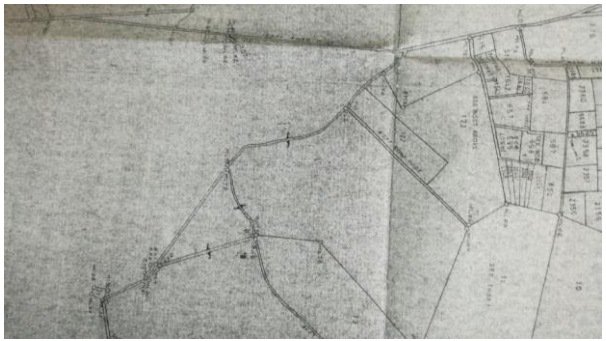
1. Large scale maps around areas of interest (highly informative regions);
2. Small scale to cover larger regions;
3. Maps can then be joined by providing cross references.

Supporting Activities

Topographic maps

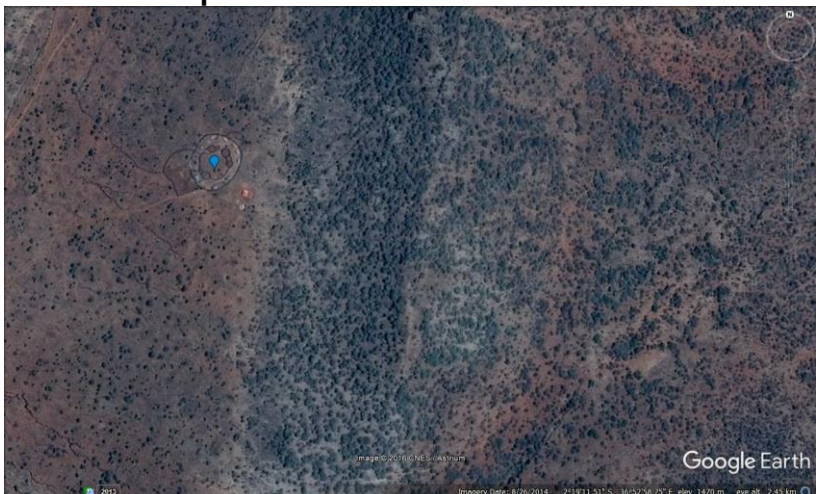


Cadastral maps



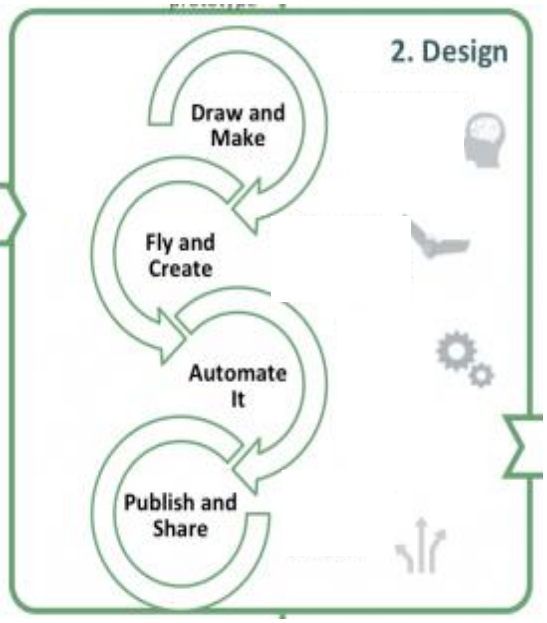
3. Base data format specification

Aerial imagery



Work package - Fly and Create

Phase 2

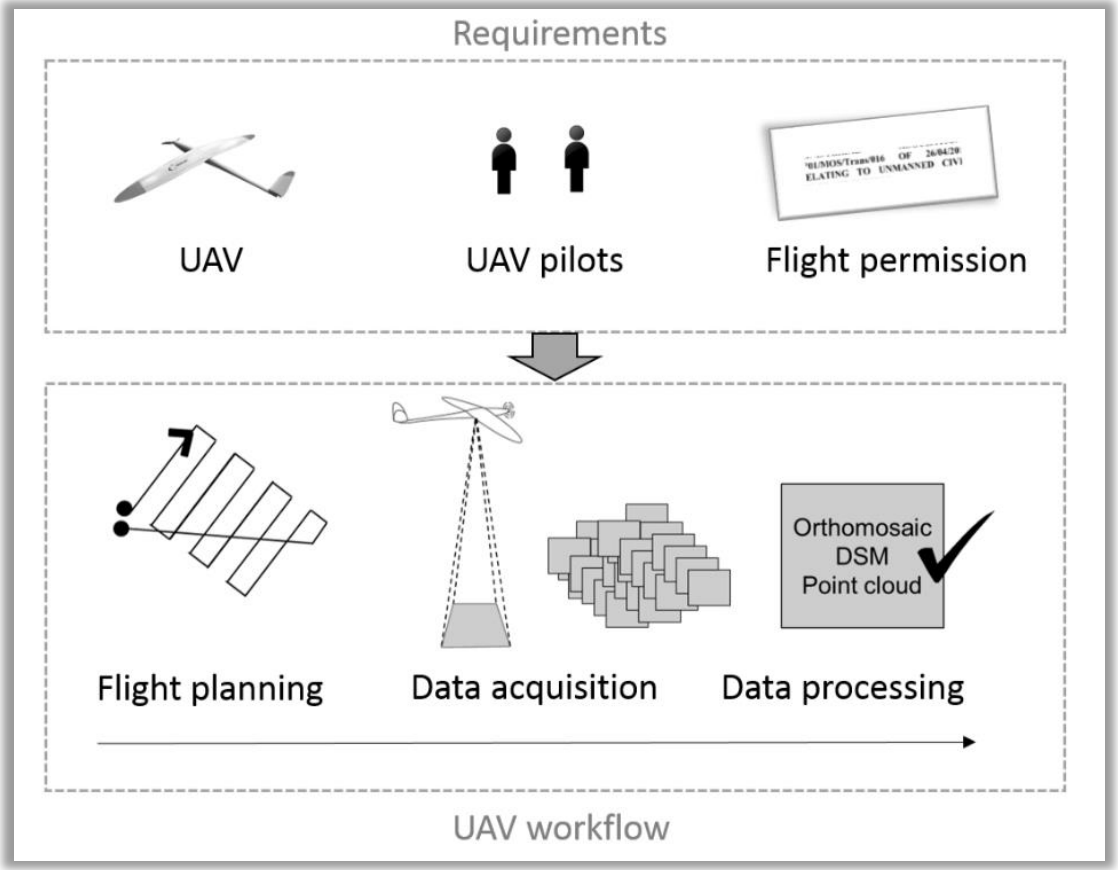


To design, test and validate a UAV driven land administration workflow

UAV selection
(same or not/price/purpose)

- Regulations
- UAV registration
- Pilot certification
- Pilot training
- No clear rules for license certification

Work package - Fly and Create



Stöcker, C.; Bennett, R.; Nex, F.; Gerke, M.; Zevenbergen, J.: Review of the current state of UAV regulations. In: Remote Sensing. 2017, *9*, 459;

Progress: Synthesis on the current state of UAV regulations

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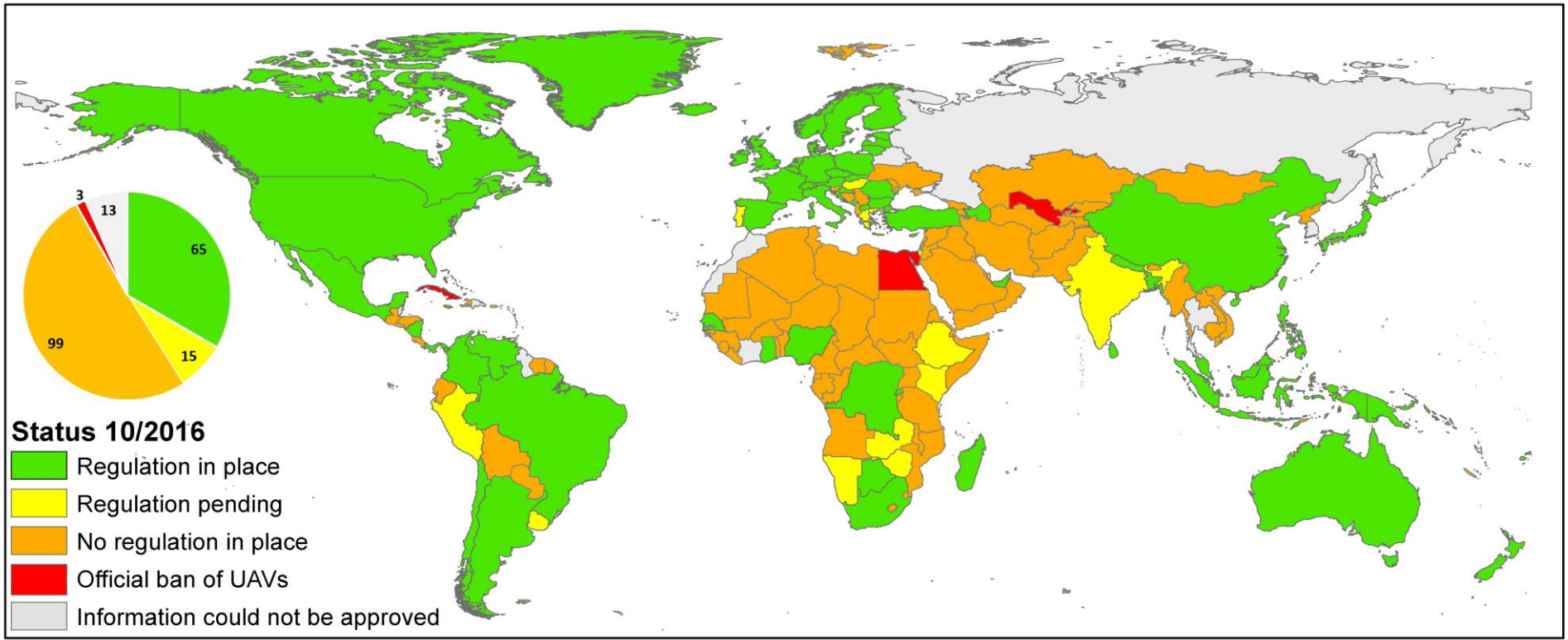
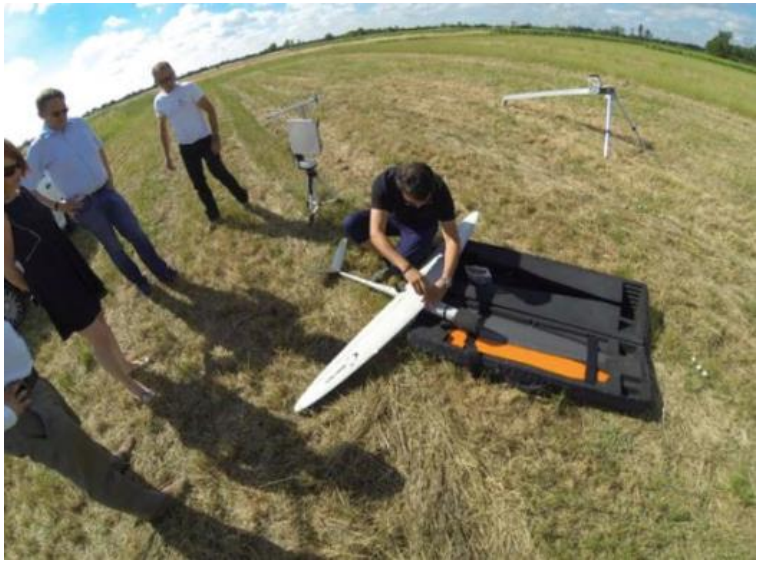
Global Drone Regulations Database

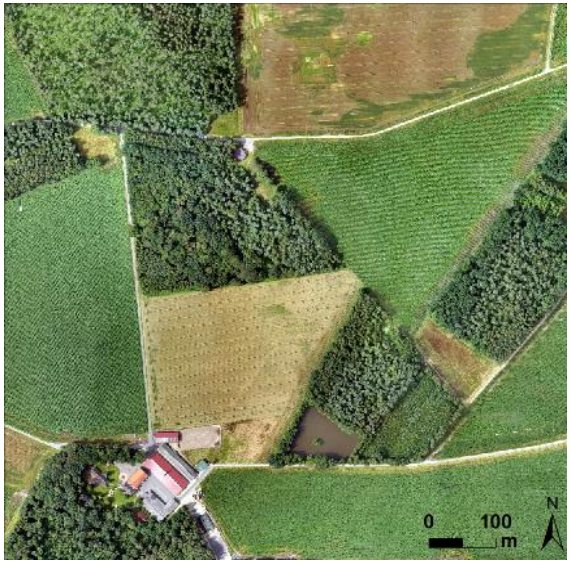


Progress

- Selection of a suitable UAV
- Purchase, shipping and import UAVs
- Pilot training for 8 trainees (UT, HL, BDU, TUK, INES, ESRI)

- Fixed wing UAV, 60 min of endurance
- Payload:
  - Industrial grade RGB camera
  - IMU/GNSS Applanix APX-15

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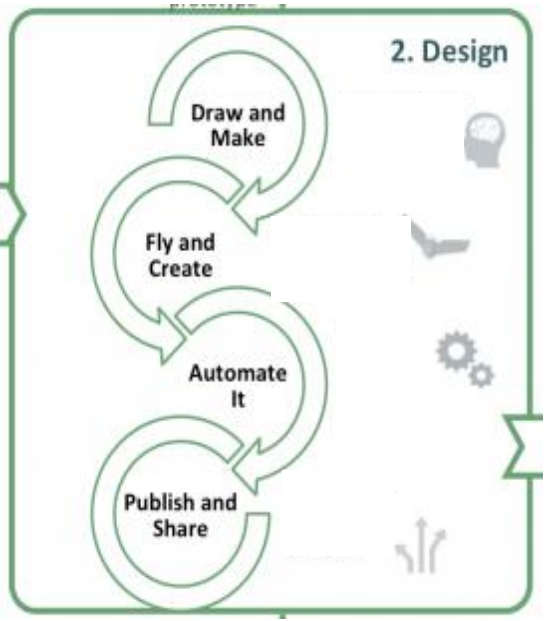
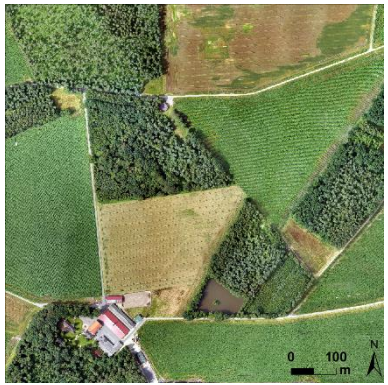
Work package - Automate it

Phase 2

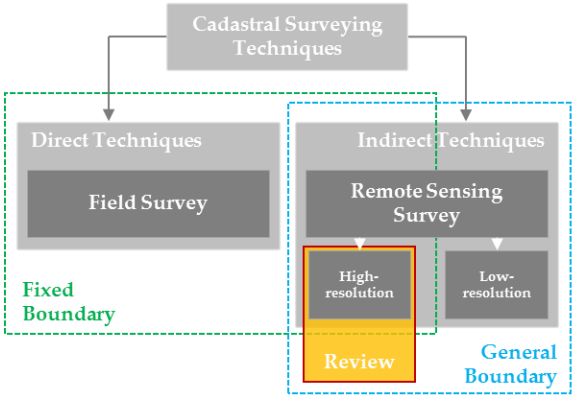


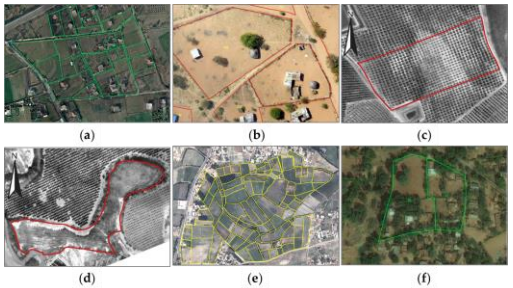
To design and implement a tool that enable automated delineation of visible cadastral boundaries from UAV data.



gPb-ucm – 1000 pixels – 1m
GSD – 1 tile – bdry 2

To review background information





remote sensing

MDPI

Review

Review of Automatic Feature Extraction from High-Resolution Optical Sensor Data for UAV-Based Cadastral Mapping

Sophie Crommelinck *, Rohan Bennett, Markus Gerke, Francesco Nex, Michael Ying Yang and George Vosselman

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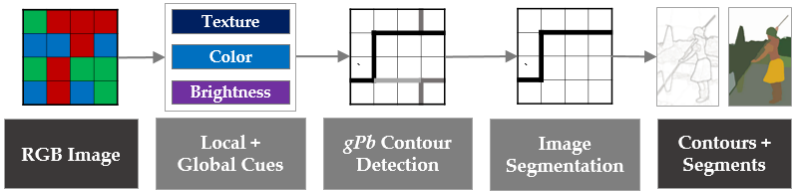
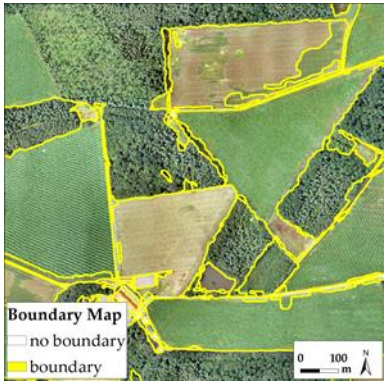
Academic Editors: Farid Melgani, Gonzalo Pajares Martinsanz, Richard Müller and Prasad S. Thenkabail
Received: 30 June 2016; Accepted: 11 August 2016; Published: 22 August 2016

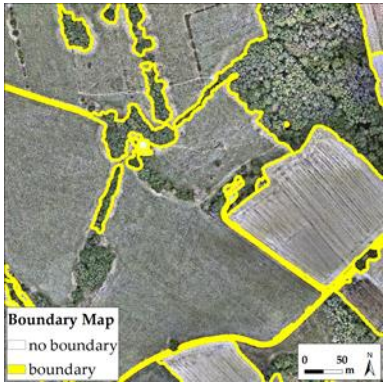
Abstract: Unmanned Aerial Vehicles (UAVs) have emerged as a rapid, low-cost and flexible acquisition system that appears feasible for application in cadastral mapping: high-resolution imagery, acquired using UAVs, enables a new approach for defining property boundaries. However, UAV-derived data are arguably not exploited to its full potential: based on UAV data, cadastral boundaries are visually detected and manually digitized. A workflow that automatically extracts

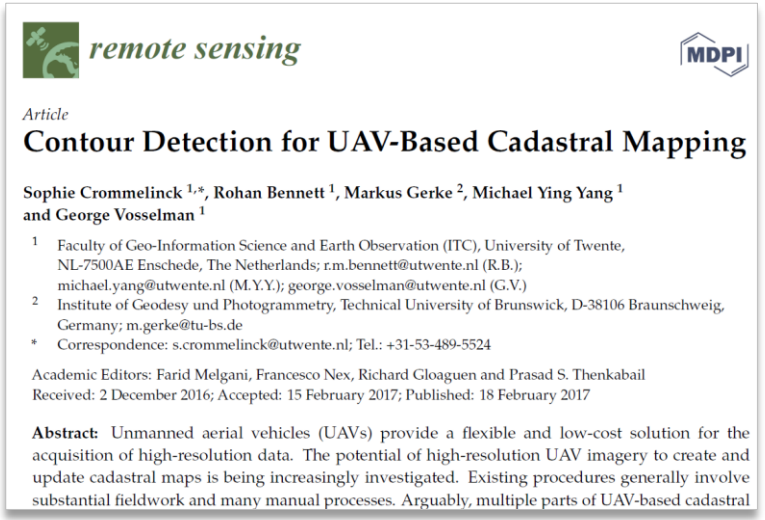
To automate Feature Extraction for UAV-based Cadastral Mapping

Globalized Probability of Boundary *(gPb)* Contour Detection









remote sensing

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Article

Contour Detection for UAV-Based Cadastral Mapping

Sophie Crommelinck [1,*], Rohan Bennett [1], Markus Gerke [2], Michael Ying Yang [1] and George Vosselman [1]

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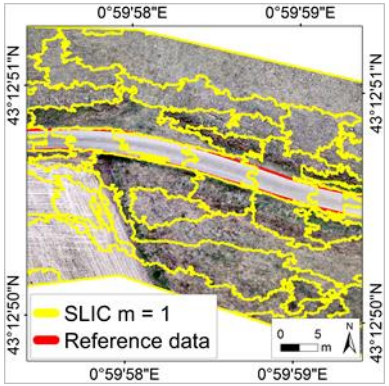
Academic Editors: Farid Melgani, Francesco Nex, Richard Gloaguen and Prasad S. Thenkabail
Received: 2 December 2016; Accepted: 15 February 2017; Published: 18 February 2017

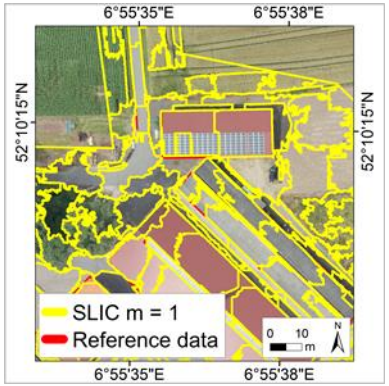
Abstract: Unmanned aerial vehicles (UAVs) provide a flexible and low-cost solution for the acquisition of high-resolution data. The potential of high-resolution UAV imagery to create and update cadastral maps is being increasingly investigated. Existing procedures generally involve substantial fieldwork and many manual processes. Arguably, multiple parts of UAV-based cadastral

To automate Feature Extraction for UAV-based Cadastral Mapping

Simple Linear Iterative Clustering *(SLIC)*

UAV-g 2017





SLIC SUPERPIXELS FOR OBJECT DELINEATION FROM UAV DATA

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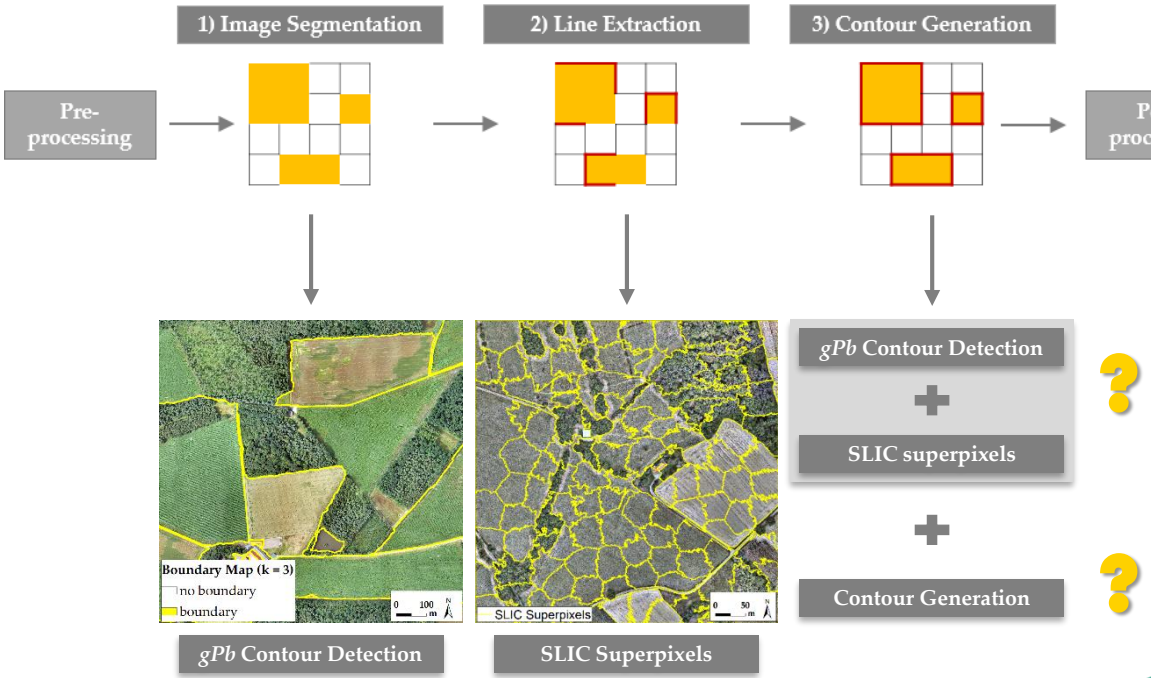
Commission #, WG #/#

KEY WORDS: UAV Photogrammetry, Image Segmentation, Object Detection, Contour Detection, Image Analysis, Land Administration, Cadastral Boundaries, Cadastral Mapping

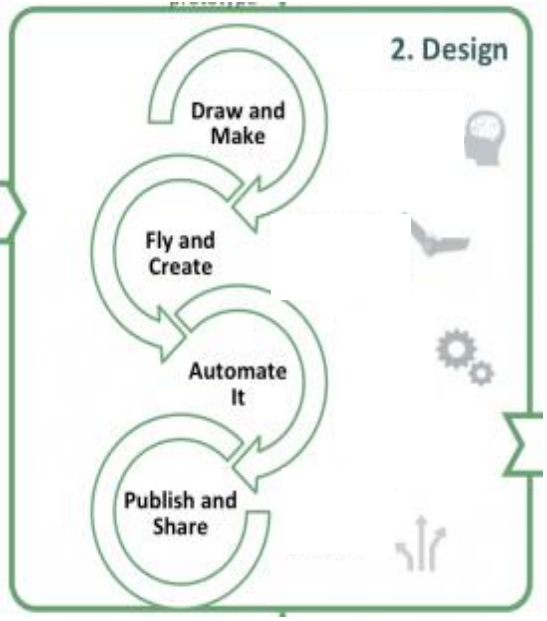
ABSTRACT:

Unmanned aerial vehicles (UAV) are increasingly investigated with regard to their potential to create and update (cadastral) maps. UAVs provide a flexible and low-cost platform for high-resolution data, from which object outlines can be accurately delineated. This delineation could be automated with image analysis methods to improve existing mapping procedures that are cost, time and labor intensive and of little reproducibility. This study investigates a superpixel approach, namely simple linear iterative clustering (SLIC), which has, to the best of the authors' knowledge, never been applied to UAV data. The approach is investigated in terms of its applicability to high-resolution UAV orthoimages and in terms of its ability to delineate object outlines of roads and roofs. Results show that the approach is applicable to UAV orthoimages of 0.05 m GSD and extents of 100 million and 400 million pixels. Further, the approach delineates the objects with the high accuracy provided by the UAV orthoimages at completeness rates of up to 64%. The

To automate Feature Extraction for UAV-based Cadastral Mapping



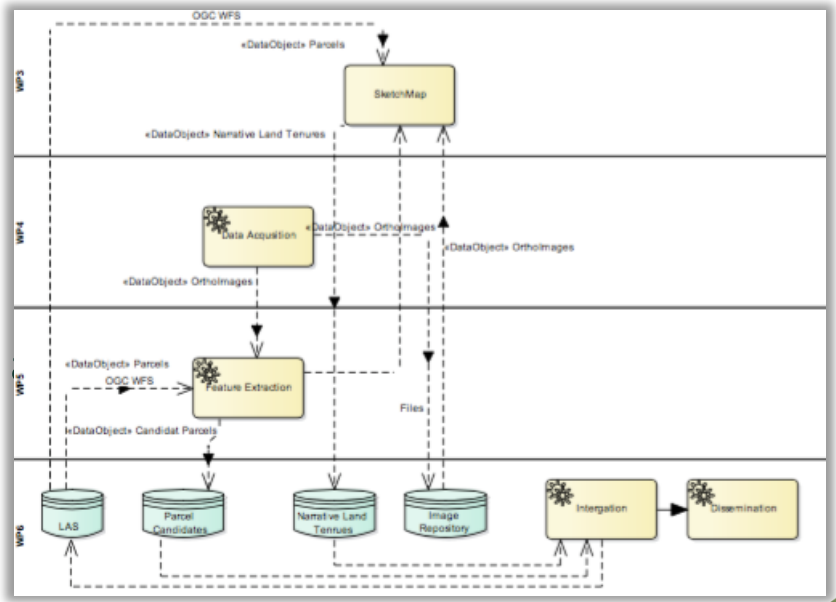
Work package - Publish and Share



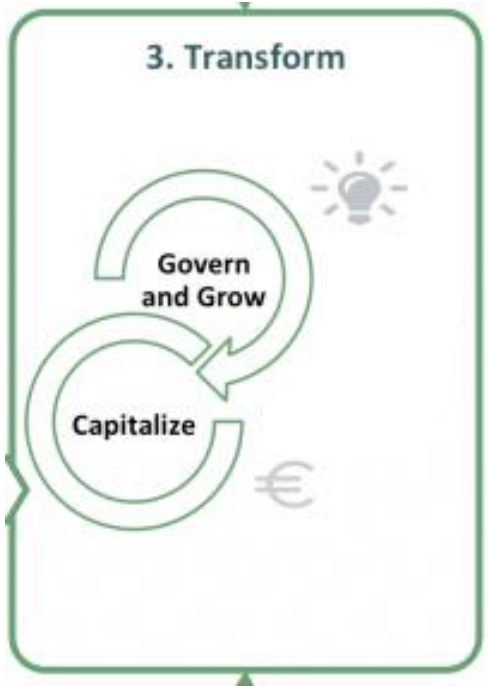
Phase 2

To prove a concept for the integration of data, workflows, publication and sharing land tenure information obtained as result from the other technical WPs.

Integrate results into a Land administration system - LAS



Work packages
Govern and Grow and Capitalize



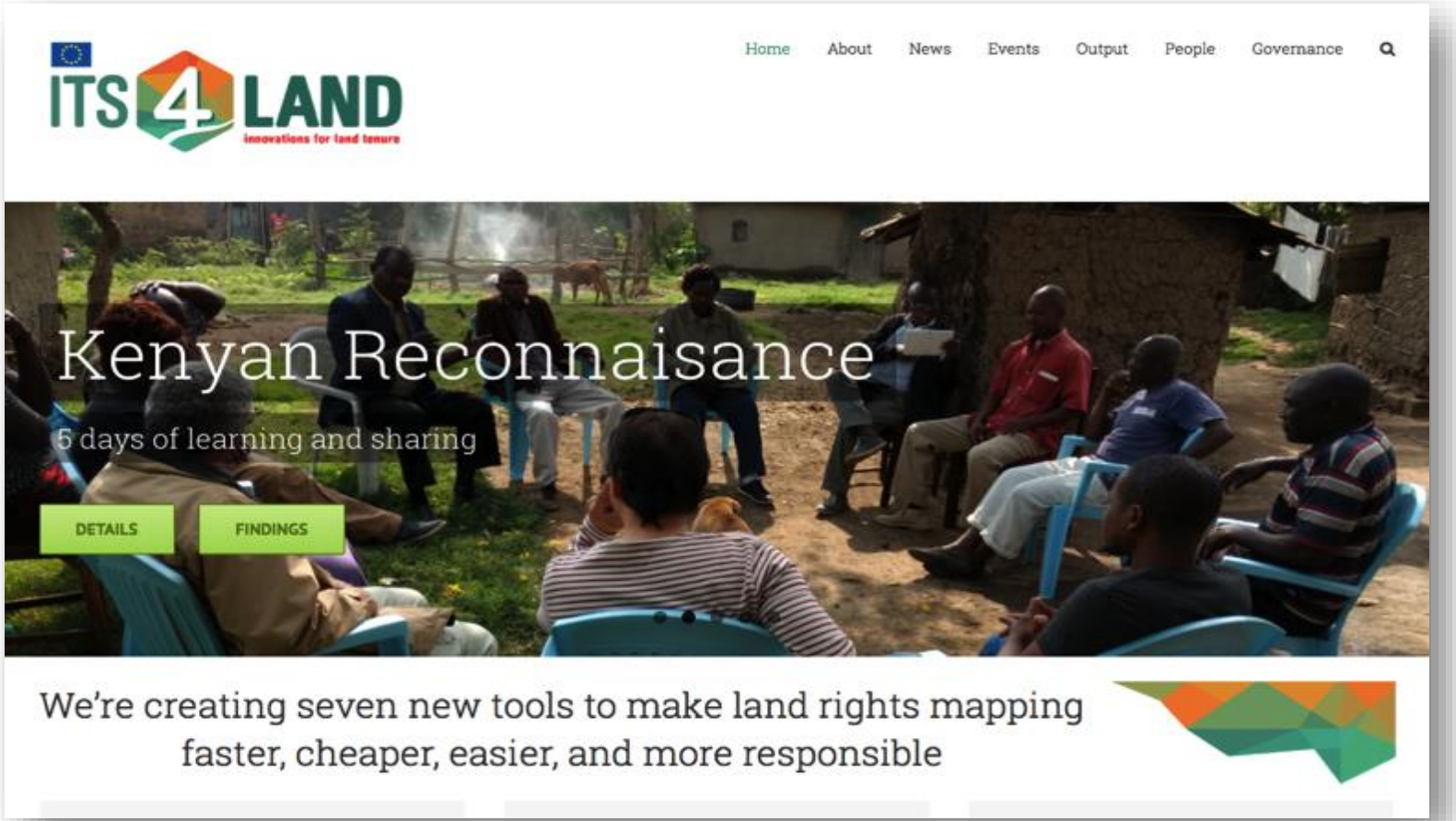
Phase 3

To understand how these technologies can be adopted and sustained

To develop a sustainable business model for commercialization of the integrated suite of land tenure recording tools within the end-user markets.

Scaling (100 / 10 000 000 parcels)

Website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Kenyan Reconnaisance
5 days of learning and sharing
DETAILS
FINDINGS
We're creating seven new tools to make land rights mapping faster, cheaper, easier, and more responsible

Thank you for your attention.