The land use optimisation via control of soil erosion and improvement of soil properties

COHEN Working package: Land use optimization

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Area of Expertise:

1. Soil Erosion: soil erosion, modeling, monitoring and measurement (catchments, field, remote sensing), erosivity of different land use practices, soil stabilization - amendments and management, soil erosion factors, connectivity, effect of landscape structure on soil erosion
2. Geomorphology and Physical Geography of agricultural landscape in different environments, human -environment interactions in past, present, and scenario for future; geomorphometry, GIS, geomatics
3. Soil sciences: soilscape in different scales, analysis of soil properties in field and laboratory, soil degradation and management

I hold PhD in Physical Geography, Geoecology and Geomatics. My scope are human-environment interactions, soil erosion and soil erosion mitigation in agricultural areas in different environments. Currently I am AgreenSkills Fellow at LISAH (Montpellier, France). I study the interactions between soil erosion rates and land use management and examine possibilities of soil erosion mitigation by different management practices selected with regard to the prospects of ongoing environmental changes. I participate in the Connecteur COST action ES1306. Due to my interest in the delivery of citizen-oriented management solutions, I actively work in its two working groups “Usable Indices for Connectivity” and “Transitions of connectivity research towards sustainable land and water management”. They are both targeted on requirements of stakeholders, communication of scientific approach and developing of common, widely acceptable solutions for improving sediment connectivity in (among others) agricultural landscapes.

I currently develop methodology for testing different soil erosion and mitigation scenarios by using various modeling platforms (including OpenSource). The results are validated to long-term observation and thus the best performing model can be selected. This methodology will be further developed within COHEN project, where the citizen observation would be included. This is an innovative approach, of high scientific and management relevance (if executed correctly), combining top down (geoaspatial analysis and modeling) and the bottom-up (information provided by citizens) within the decision making process for management.

Working package Land use optimization:

Outline :

The intensification of agricultural production is widely connected to soil degradation, loss of soil fertility and functions and following increasing demand on use of agrochemicals (pesticides, fertilizers) in order to maintain the production.

The land use optimization in connection to pesticides use might focus on:

1. short term goals of pesticides reduction: e.i., by disease monitoring and precise (GPS localized, real demand based) application of pesticides
2. long-term goals by improvements of agricultural practices and resilience of agricultural landscape, that will lead to overall increase in soil fertility, minimize the sediment transport and optimize soil water management.

Long-term approach :

A. Land use optimization is based on:

1. geospatial database including freely available DEM, imagery (e.g. UAV obtained within the project?), land use and soil properties maps, land management and ownership databases, climate predictions (datasets)
2. freely available modeling tools (soil erosion and hydrological models, connectivity indices in order to select proper land use management and calibrate its functioning under different environmental conditions)

From these sources, continuously upgradable geospatial database should be ideally created (that can include every future change in the landscape structure or management), within which the solution for best management can be automatically generated from the models and chosen after the expert assessment (that can be also automatized until certain extend).

B. The geospatial database resolution have to be improved by citizen observations in order to provide best decision making practices. The contribution of CO is following:

1. providing sub-grid information (information not obtainable due to grid resolution), - GPS localized, about the soil management, soil roughness, soil cover, cracks, crust; rill formation, degradation of terraces, gullying, or another factors influencing hydrological and sediment connectivity and soil degradation (via smartphones photographs / sms providing approximate spatial extend e.g. in m, or feet, or steps, by GPS tracking, and simple scale for height/depth – best in comparison with a standard sized tool of every day use -e. g., axe, spade)
2. providing up to date information about changes

C. combination of approaches A and B, can provide sufficient information about the possible change in management

and allow introduce simple agricultural management practices (terracing, soil protection, grass strips, cover crop) attainable and known by poor farmers, innovatory through the expert detailed geospatial and scenario analysis that provides assessment about their performance in soil protection. Different management option can be proposed to different types of decision makers, if required. The participatory approach within CiO should assure the acceptance, understanding and support of observation, management and its maintanance trough time.

Deliverables:

Short-term (1-3 years): Participatory approach within Living Lab will ensure community understanding of long-term land use optimization: its importance for health and environment and healthy climate smart agriculture. The system for land use optimization via living lab will be created as upgradable for the future, with possibility of free use for the decision making. The optimization management practices will be put in use and evaluated by citizens.

Medium -term (3-7 years): The management practices set within the project under proper maintenance will ensure the first observable increase in the quality of soil properties, decrease the soil erosion and pesticides transport in solutes and with sediment. The community based approach of land use optimization will provide further improvements of the system proposed within the project, and as a such improve its complexity and applicability in other regions

Long-term (7-15 years): The positive effect of proposed practices on soil properties will decrease the necessity to use agrochemicals and improve soil fertility. The maintenance of the project activities will allow to adjust the management if needed via simple citizen observations and system developed within the project and contribute to climate adaptation.

Application to COHEN project steps of workpackage LUO:

1. *Pre-**Pretest*** :

   1.1 What is currently available for supporting the accessibility of agricultural/health services?

   - analysis of (all levels of) stakeholders and their motivation, ownership and decision making competences in agriculture is needed

   1.*2 Survey on the inventory including the analysis of the agricultural/health-situation, the ICT-situation, the cultural situation, the socio-economic situation and of a frequently used information and communication-channel*.

   - the analysis of existing small to large scale managements and development plans, available spatial datasets (including ongoing research, longterm monotored areas etc) for agricultural optimization is needed

1.3 *definition of* *'questions-LUO-0'* to determine the currently used technology, methods and awareness of land use, -precondition is *LUO*-SCA-*0* (geospatial analysis)

2. report LUO-0 with first CiO and pilot mitigation strategies: based on geospatial analysis, modelling and scenario analysis (LUO-SCA-*01*), Pretest and UWA-0 reports. Only easy simplest available management solution based on (low grid resolution observation and first CiO) would be implemented.

3. **questions and report LUO-1:**

   3.1The questions LUO-1 can hardly target the improvement in agriculture according to long-term impact of this optimization approach. The changes, rather than improvements can be observed, from longterm point of view. Is more sufficient to scope on the variability (spatial and temporal) of some parameters (which can not be predicted/observed differently or their observation is too expensive) in remote regions (last mile)

   3.2 LUO-SCA-*1* (is improvement of LUO-SCA-*01*) should target the inclusion of different types of CiO (and connected analysis / indices) to database on which the geospatial analysis, modelling and scenario analysis are based.

   3.3 The inclusion of CiO into all stages of land use optimization (analysis, proposal of measures, calibration on diferent environmental conditions, decision making-selection, monitoring of maintance and performance) is required and should start in this stage.

4. **questions and report LUO-2:**

   4.1 The question should target the reliability and spatial precision of monitored managements and the willingness of opting for more complex mitigation approaches

   4.2 LUO-SCA-2 is integration of real and theoretical CiO into the mitigation management proposals, different levels of mitigation can be proposed for different levels of decision making.

5. **questions and report LUO-3:** L

   5.1 question can target the impact on agriculture of the optimized risk mitigation strategies. The awareness of maintenance and reliability of provided info should be checked.

   5.2 The understanding of decision making processes for further optimization measures (that might have been proposed but not implemented within the project) should be ensured

Question to the project team:

1. in which stage geospatial CiO for agriculture are available?

2. geospatial info for agriculture by last mile & no internet access?

3. can be a citizen observation requested in order to provide better management solution?

4. optimization decision making (somewhere was written citizen should chose the solutions)

5. the land use optimization is site (area specific). This has to be taken into account, when explaining the transferability fo reaserach to other areas (even database of the same quality can require update of management parctices)

6. how to deal with selectivity of observation, imprecisision and subjectivity