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Land resource assessment for social land concessions in rural Cambodia

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Abstract:
The paper presents the application of a land resources assessment (LRA) method to evaluate environmental, biophysical resources – their condition, trends and capability for use in rural Cambodia. The applied landscape-ecological method takes into account a range of different geo-ecological and agronomic factors. The resulting land units are systematic arrangements of various predefined categories. The capability of land units for particular land uses and the adapted treatment requires sustaining those uses without land degradation. LRA is required to serve the long-term needs of economic and environmental development, planning, land allocation and environmental impact assessment as well as land management and monitoring of land related to development projects.

Project background and methodology

A social land concession (SLC) is a legal mechanism established under the Cambodian Land Law of 2001 to legalize the transfer of state private land to individuals or community groups for social purposes, in particular for residential and agricultural land. Therefore, SLC procedures require a land suitability analysis with regards to agricultural services and resource needs. In Cambodia, social concession land for sustainable agricultural purposes will be provided to landless and poor households in the beginning of 2007. Major constraints for agricultural production by poor farmers are limited commercial inputs and a low level of technology. Without those current farming operations faces difficulties on unfavourable land or soil qualities as they are difficult to modify. Qualities to be considered for a suitability rating are e.g. soil fertility, water retention capacity, soil depth, slope and susceptibility to erosion. Land resource assessment combines several different approaches of land classification like measurements of suitability, capability, agro-ecological zoning (AEZ), land cover classifications, land utilization types (LUT) and land use potential (BELL, R. ET AL 2006) into a homogeneous appraisal or evaluation methodology. It is based on interdisciplinary assessments of the bio-physical conditions soil, water, vegetation, fauna and recent land cover and land use type.

Existing Data and SOTER method

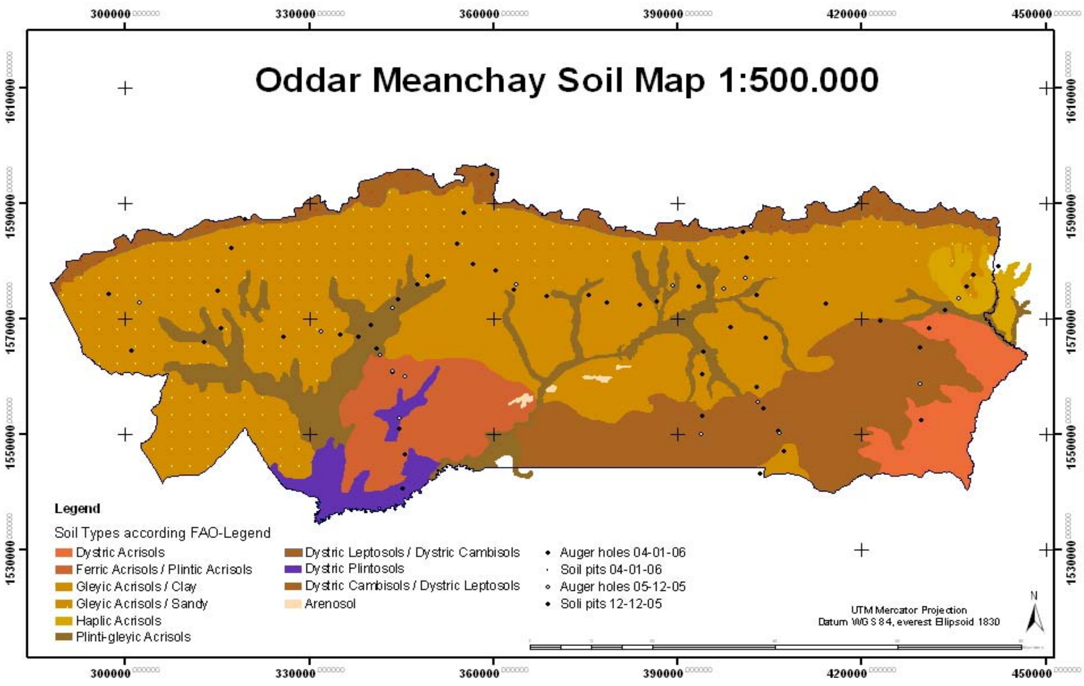
The existing environmental and soil information of Cambodia (CARBONNEL 1972) covers mostly major rice production areas in the alluvial lowlands (WHITE ET AL. 1997), while environmental conditions, especially soil data of the uplands are still very limited (CROCKER 1962). As a result land resources information in Cambodia is based on existing soil map at scale 1:1 million (IGN 1977) and MRC soil data (Agriculture Soil Unit 2002; Mekong River Commission 2002), an analysis of the SRTM90 digital terrain model (USGS 2003). The SRTM90 analysis as proposed by (DOBOS ET AL. 2005) was applied using slightly different classes. It produced four layers: elevation, slope gradient, relief intensity and potential drainage density (Fig. 3). Furthermore, the hydrological network as well as land use and land cover pattern derived from Landsat and Spot remote sensing data was used. The resulting information was verified and enhanced by field observations.

Landscape and ecological field observations, assembled in a standardized soil and terrain resources database (SOTER, 2000) provide the basis for a suitability assessment. The World Soils and Terrain Digital Database (SOTER) is a geographically referenced system, capable of providing accurate, useful and timely information on soil and terrain resources (VAN REEUWJIK, 2002). The database is structured as a comprehensive framework for the storage and retrieval of uniform soil and terrain data that can be used for a wide range of applications at different scales. It presents adequate data to extract information at a resolution of 1:1 million, both in the form of maps and as tables. SOTER provides standardized resource maps, interpretative maps and tabular information essential for the development, management and conservation of environmental resources, for soil mapping on reconnaissance level as well as for the development of national environmental and soil databases at scales from 1:1 million to 1:100 000.

Preliminary results

A preliminary suitability analysis in two provinces was based on the existing soils map and updated MRC soil data. Additional soil and terrain data was gathered from the digital terrain model SRTM90, the hydrological network as well as land use and land cover pattern derived from Landsat and Spot remote sensing data. Based on 41 auger samples and 10 full pit analyses a soil mapping process on reconnaissance level was started in Oddar Meanchey. Laboratory analyses of field samples have taken place in the Soil lab of the Ministry of Agriculture which probes major physical and chemical soil analysis. The suitability assessment combines results from soil fertility, water retention capacity, soil depth, slope and susceptibility to erosion, providing five suitability classes according FAO (1974). This derived map (Fig. 1) provides a quick and comprehensive overview of land resources and conditions for decision makers in the process of land allocation.

Figure 1. Soil Map of Oddar Meanchay Province, Cambodia



In the Southeast of the country an area forming the transition between quaternary basalt flows and older crystalline rocks was mapped in detail using Spot images and contours derived from the DEM completed with more than 50 field observations (Fig. 2). The following terrain-soil units are distinguished (Fig. 3):

Figure 2. Contours (V.I. 5m) and soil observations points

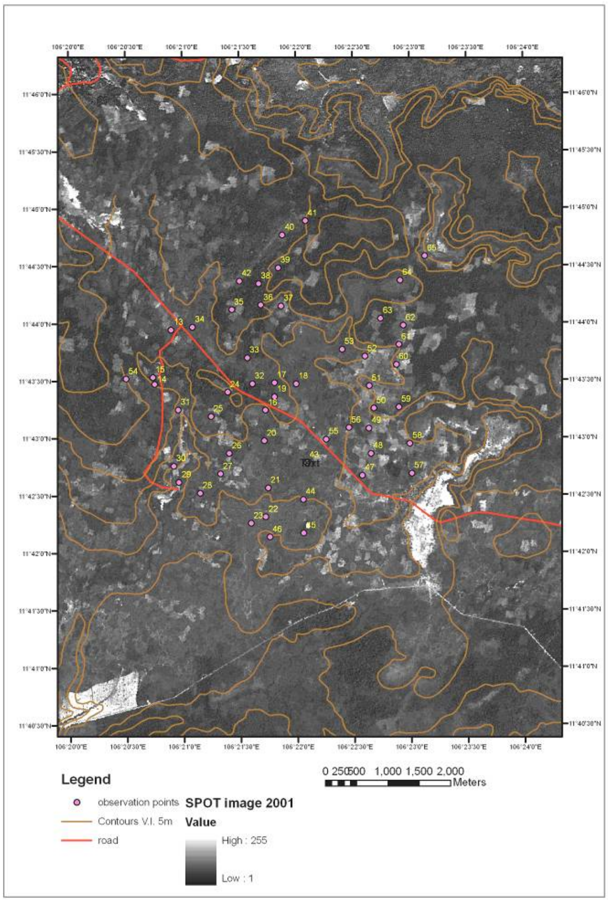
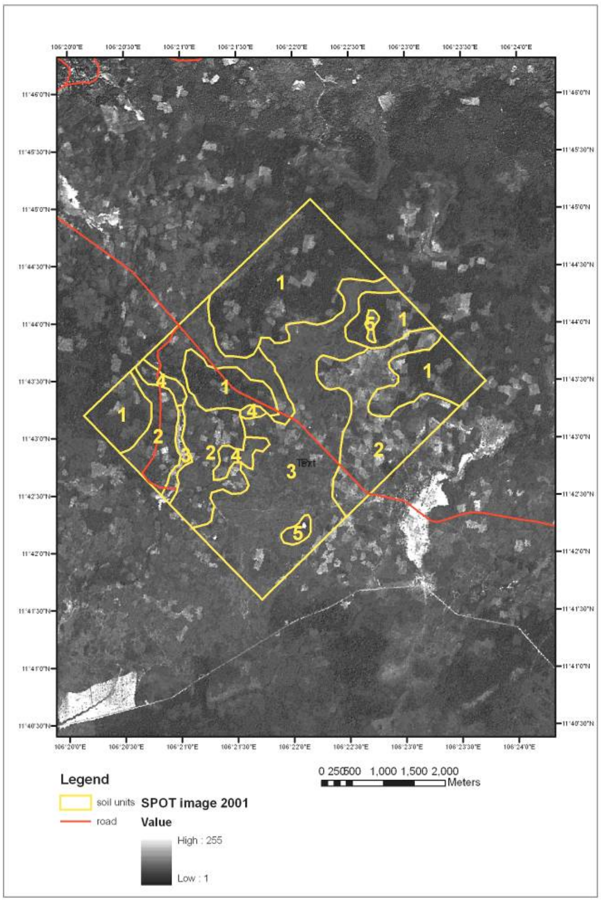


Figure 3. Terrain-soil units



Determined soil types

1. Deep, dark yellowish brown, gravelly sandy clay loam to (sandy) clay, with a loamy sand topsoil (Ferric and Plinthic Acrisols) on the higher positions in the terrain, originally covered by evergreen forest. The rather low water holding capacity might create moisture shortages at the end of the rainy season. Soil fertility is low. They are best used for tree crops (cashew) as these deep rooted plants can exploit a larger soil volume than annual crops.
2. Deep, grayish brown to light brownish gray, slightly gravelly, sandy clay loam to sandy clay with a loamy sand topsoil (Haplic Acrisols). Their soil moisture is somewhat better but fertility is still very low. They could be used for annual crops, other than rice, but require substantial inputs
3. Deep, grayish brown to very pale brown, gravelly to non gravelly, mottled sandy clay loam to (sandy) clay with a loamy sand topsoil (Gleyi-Plinthic Acrisols) in the lower positions of the landscape. They have water logging problems during the rainy season and are therefore considered unsuitable for most crops, except rice. Fertility is a constraint.
4. Deep light gray to gray, slightly gravelly, mottled, loamy sand to sand (Gleyic Arenosols). These soils have water logging problems in the rainy season and have on top of this extremely low soil fertility. Not suitable.
5. Ironstone outcrops ands very shallow, very gravelly sandy soils (Leptosols) without vegetation or with poor grassland vegetation are unsuitable for any agricultural activity.

In third SLC area has been selected in Kratie province, where a detailed soil survey as well as and agro-ecosystem analysis took place during the first month of 2006. Around 70-80% of this larger SLC area of 4.500ha is covered by different types of Acrisols according to their position along the toposequence. Different depths of subsoil development occur and are subject of a more detailed investigation in the following weeks. It seems that an ironstone layer underlies the poor sandy to silty Acrisols mostly on middle and lower positions along the straight to slightly convex slopes.

In a next step results of the three separate LRA-SLC projects at different scale level form 1:500.000 to 1:50.000 will provide necessary data for further land and economic suitability classifications, which will finally determine and propose the ecological most appropriate land use types for the selected SLC areas.

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