Land evaluation, key factor of successful agricultural development

Rokhaya Daba FALL[A], Ibrahima DEME[A], Papa Nékhou DIAGNE[A]

[A] Institut national de pédologie, Tel +221 33 832 65 65, Fax: +221 33 832 85 17, farodaba1@hotmail.com

Abstract
For the first time, in 2008, Senegal arable land areas have been re-estimated. In most west SAHEL countries, the arable lands for less than 20% of the national territory. This research using two methods, provides new results for arable land superficies for the Senegalese territory that are over three times larger than the previous estimations. Both methods use GIS tools and thus differ from basic maps used in the analyses: the first goes through 149 Soil and Terrain data base units while the second method considers firstly, pedoclimatic zones overlaid with hydrological data. Adequate methods and techniques are recommended for land conservation and productivity improvement, depending on identified soil quality. To refine conceptual notions and update data continuous land and water resources assessment is needed in order to guide land use in terms of soil capability.

Key Words
Soil, Arable Land, Evaluation, Geographic Information System, Agriculture.

Context
Nowadays, to successfully implement agricultural development, one should have a clear vision of sustainable land management. Rules, methods and techniques to manage land in a region or nationwide territory are specific to environmental and socioeconomic characteristics of addressed zones. Thus land evaluation is a key factor of success.

To face the global crisis several countries have been involved in defining new agricultural development politic that takes into account in one hand effects of global economic and financial difficulties, and on the other awareness of global climate change. To give a scientific basis to Senegal's new agricultural planning that aims to extend agricultural land and intensify production, authors of this research explore two methods of reevaluating available land resources available to increasing agricultural production objectives.

Materials and tools
As defined in the framework and directives for land evaluation (FAO 1976, 1984), land evaluation is "the assessment of land performance when used for a specified purpose, involving the execution and interpretation of surveys and studies of land forms, soils, vegetation, climate and other aspects of land in order to identify and make a comparison of promising kinds of land use in terms applicable to the objectives of the evaluation". This requires matching relevant kinds of land use with land qualities, while taking local economic and social conditions into account.

Several countries have adopted means, principles, statements and rules capitalized in cited FAO documents. Two different methods have been experienced by the authors. The following table summarizes materials and tools used for both methods.

Method 1	Method 2
SN SOTER map (ISRIC, INP 2008);	morpho-pedological map (1/500000) (1985).
SN SOTER database (ISRIC&INP,2008)	pedoclimatic zones map (RDF 2009)
Isohyets Map of Senegal from 1971 to 1990 , (CSE,	Overlaid hydrographic and isohyets Maps (RDF 2009)
map of localities in Senegal (DAT)	Map of localities in Senegal (DAT)
map of senegalese protected areas (DEFCCS/CSE)	Map of senegalese protected areas (DEFCCS/CSE)
field survey (INP)	field survey (INP)
Questionnaires	Questionnaires

Methodology
A difference between the methods is constituted by the evaluation units. The first method analyzes one by one the 149 Soil and Terrain data base units elaborated in cooperation with ISRIC from the digitalized morphopedological map of Senegal (1/500 000). The second method builds new units based on underlying pedoclimatical zones and hydrological maps.
GIS tools have been used for both methods to allow their computerization in order to ensure continuing follow up. After classification of each unit, calculation of available land has been done by extraction of existing forest areas and habitation.

Method 1 Results
Category A corresponds to very suitable and irrigable land .Land belonging to category A is located in the lower valleys, watercourses, fossil valleys, basins and depressions. These soils are reserved for crops of rice and market-gardening.

Category B corresponds to suitable land without rainfall constraints. Land belonging to category B is located at sites with rainfall greater than 700 mm and has good water retention and availability.

Category C corresponds to suitable land with the possibility of water stress. Land belonging to category C is located between 400 and 700mm isohyets. Agricultural activities conducted therein may suffer water stress.

Category D corresponds to suitable land with rainfall constraints. Lands belonging to category D is subject to constraints of rainfall and requires occasional irrigation

63.10% of the Senegalese national territory consists of land suitable for agriculture. Habitat occupies 1.58% and classified forests and protected areas, 22.66% of this land. Thus 47.81% of the country is estimated to be available arable land.

Method 2 Results
By considering the possibility of the soil to provide water for agricultural use, Potential Evapo-Transpiration PET and Water Retention Soil Capacity (WRSC), the second method generate with 6 classes of arable land and one class of unsuitable inapt land. Table below gives main characteristics of classified lands.

Unsuitable land	Laterite, rocks, soil with more than 80% rocks depth limited to less than 20cm; saline soil; sulfated acid soil; alkaline soil. Non fixed dunes; sandy soils located in arid areas with high PET
class 01	Soils with particular disposition regarding their WRCS located in low PET zones generally Valleys with clay/silt soil; depressions on planes and plateau with good WRCS; plains and plateaus in high rainfall zones;
Class 02	Soil without physical and hydrological constraints include plains and plateaus in soudano-sahelian zones; sandy silt valleys in sahelo-soudanian and sahelian zones.
Class 03	Soils without main constraints located in the sahelian zone
Class 04	Starting from class 4 soils presenting constraints that can be overcome depending on possible investment or particular care. From 4 to 6 constraints are increasing but do not reach the criteria to be unsuitable. Discharge are < 80% and rock surface <30%, salinity, acidity and alkalis allow natural vegetation survival.
Class05	
Class 06	

Conclusion
Difference between first and second methods can be explained by :

1. Accuracy of the second method, which takes into account all specific possibilities to use land for any agricultural activities.

2. The first method is more general, it considers global climatic data through a unique set of three isohyets lines. It provides a global view of rainfed agriculture suitability.

Evaluation methods have to be adapted to socio-economic conditions and physical data availability. The second method represents an adequate foundation for successful agricultural development including all possible activities that can take part to solve the economic, financial and food crisis. These two fields for research should continue to be explored for the country and the regions