Improving the local governance processes through exchange of good practices, pilots and training in geospatial technologies “LOCAL-SATS”

D.5.1.1 Land Evaluation of Hermel Caza for Sustainable Governance of Land Use Options

Abou Najem, Sandra (environmental expert)

P10: National centre for remote sensing – Lebanon (CNRS, L)

Dr. Darwish, Talal

Dr. Faour, Ghaleb

P9: Union of municipalities of Hermel - planning and development agency (PDA)

Dr. Mahfouz, Jalal

Eng. Mahfouz, Walaa

CNRS PDA

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1. Introduction

Local Sats Project analyzed the use of geospatial information in Lebanon and concluded the absence of policies for geospatial data use, production and sharing and stressed the weak coordination among different stakeholders in geospatial data sharing. Thus, it was obvious the need to assess the capacity of municipalities in this domain, and notably PDA, P10 in Local Sats project, as they are the development body involved in local governance. After analyzing the needs and gaps at local level, Local Sats concluded the incompleteness of national data collections, restricted access to low scale maps in paper format, absence of production of large scale geospatial information and availability of updated maps covering all themes. Therefore, it was decided in the frame of WP5 of Local Sats project that CNRS (P9) supports PDA (P10) and strengthens local capacities at the local authorities of Hermel for the use of geospatial information by providing basic and thematic GIS maps, training the staff on their use and management.

Land is the most valuable natural resource, which needs to be harnessed according to its potential and monitored for good governance. Good management of land resources is inevitable for both continued agricultural productivity to secure food security and protection of the environment. Land evaluation is done to identify productive lands, assess the problems of land degradation, control landuse and assess soil suitability for irrigation to protect productive lands for the beneficial use of coming generations.

2. Objective

Land evaluation is proposed to locate, classify and better manage the suitable for irrigation lands. Between 19963 and 2010, urban expanded at high rate notable in the last two decades reaching 14% of the total city area that can cause loss of fertile lands (Figure 1). For this reason, land capability classification helps building local stewardship and governance to conserve limited soil resources in the area.

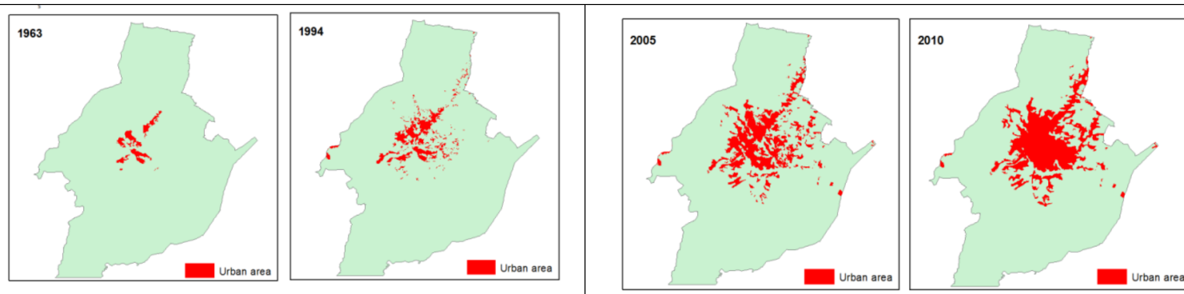

Figure 1. Historical expansion of the city of Hermel

3. Description of the study area

Hermel Caza is located in North East of Lebanon with a total area of 528.96 Km^2 (Figure 2a and b). Spatial extent of Hermel district is ranging from latitude 34° 1´ 8" to 34° 2´ 9" North and 36° 7´ 44" to 37° 7´ 53" East. The study area is characterized by an altitude that varies from 550 m to 3000 m. it lies in semi-arid zone and has extreme summers with temperatures reaching 40°C.

4. Materials and method

The land capability classification has been carried out by applying parameters like soil depth, soil texture and slope of land. This information is used as a basis for placing lands in capability classes. Land evaluation is related with soil depth and soil texture using the soil map of Lebanon 1: 50 000 (Darwish et al, 2006) and thematic maps of the study region are created in Arc GIS software. Digital elevation map (DEM) data of the study region is used to assess the terrain conditions and to get better accuracy. The Intersect tool calculates the geometric intersection of input feature classes. The features or portion of features that are common to (intersect) all inputs will be written to the output feature class (Final LCC map).

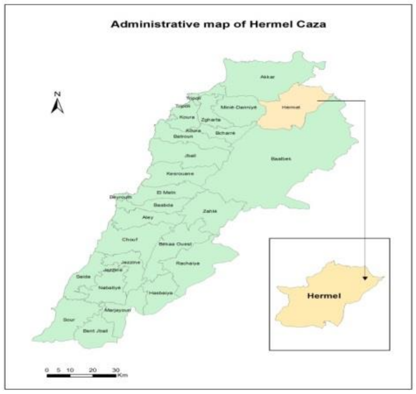

Figure 2a. Location of the Caza of Hermel

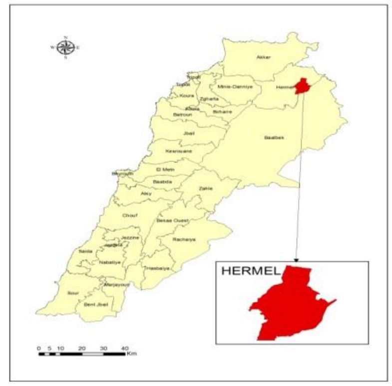

Figure 2b. Location of the city of Hermel

5. Land capability classification

United States Department of Agriculture (USDA, 1973) has provided specific guidelines for Land Capability Classification. Here, for the present study USDA's LCC system has been adopted which includes eight classes of land designated by Roman numerals from I to VIII. The first four classes are suitable for agriculture in which the limitation on their use and necessity of conservation measures requires a careful management increase from I to IV. The remaining four classes, V to VIII, are not to be used for agriculture, but may have uses for pasture, range, woodland, grazing and wildlife purposes. The criteria for placing a given area in a particular class involve the landscape location, slope of the field, depth; texture and land use /land cover (Tideman, 1990).

6. Model of land capability

The land capability model was based on five related parameters: Slope gradient, soil depth, clay content, organic matter content and CaCO3 level. Each factor was classified into high potential (given 5 points), moderate potential (given 4 points), low potential (given 3 points), very low potential (given 2 points) and non-arable (given zero point) (Table 1). A given weight for each classified factor was allocated depending on its importance for the assessment of potential soil productivity. A total of 30% was allocated to slope, 25% was allocated to soil depth and the rest three factors were equally assessed 15%. The best quality soils were classified as high and moderate production potential and they must therefore be given priority in term of soil conservation and management.

Table 1. Categories of land capability based on soil conditions

Attribute	Land Capability Class					Weight %
category	1	2	3	4	5	
	High	Moderate	Low	Very Low	Non Arable	
Land form	<5	5-8	8-15	15-30	>30	30
Soil depth, cm	>75	50-75	25-50	10-25	<10	25
Clay, %	30-40	20-30	>40	<20	Different	15
O.M. %	>5	3-5	1-3	<1	Different	15
Active CaCO3, %	<3	3-5	5-7	>7	Different	15

7. GIS information

a. Slope and Rainfall

The Caza of Hermel is characterized by the abundance of level and rolling lands on the eastern slopes and slopping and steep lands with slope gradient over 30% on the west (Figure 3). The annual rainfall does not exceed 200 mm in the North East and reach 1300 in the South West (Figure 4).

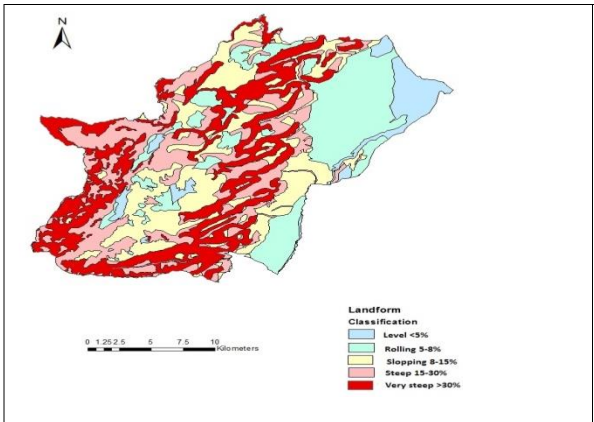

Figure 3. Land form and slope gradient of Hermel Caza

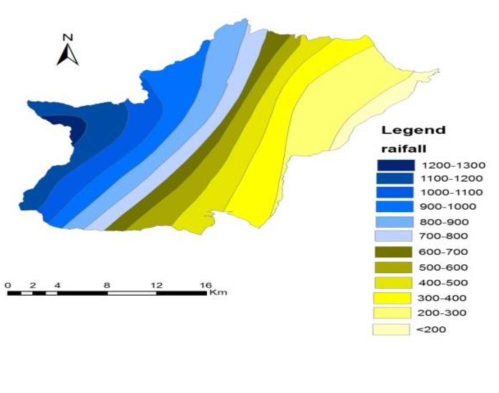

Figure 4. Rainfall map of Hermel Caza

b. Soil resources

The area of study consists of 31 soil cartographic units, among which 19 units are pure consisting of single soil type and 12 units consisting of association of two soil types (Figure 5). The dominant soil type in the area is the shallow and gravely Leptosol followed by the Luvisols with different depth. The majority of soils are not deep, eroded, gravely and stony. The soils are mainly clay and contain moderate and low amount of active $CaCO_3$.

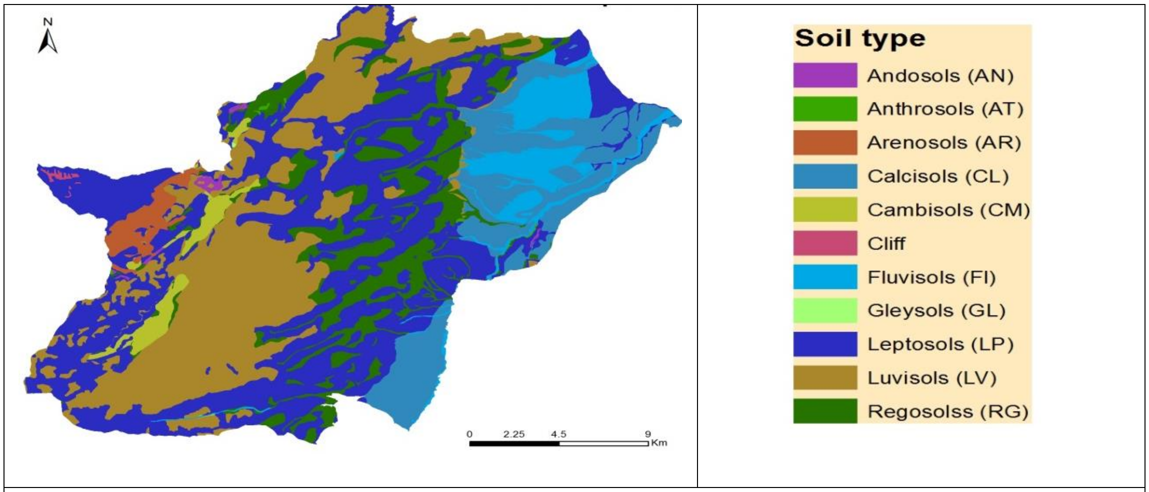

Figure 5. Soil types of Hermel

c. Soil depth and Clay content

The area of study is characterized by the dominance of moderately deep and shallow soils. Based on prevailing soil depth, this factor was classified into four classes with high effect on LCC for soils having depth >75 cm, moderate effect for soils having a depth of 50-75 cm and low effect for soils having depth <50 cm. Soils having depth less than 10 cm were considered as non-arable (Figure 6). The clay content of >30% and < 40% was attributed the best effect on LCC due to clay positive impact on soil structure and cation exchange capacity (Figure 7). A large part of the study area is characterized by clay and loamy soils. Soils with prevalence of silt and or sand, located to the west of the area of study, constitute a significant part of the soil types of Hermel Caza.

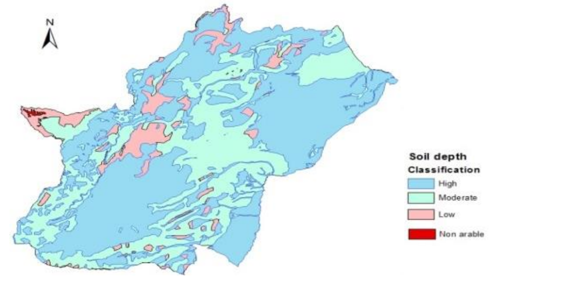

Figure 6. Classification of soil depth

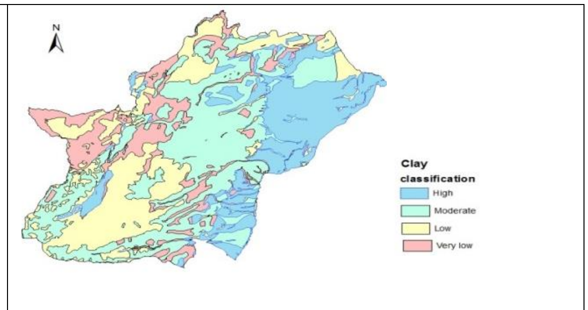

Figure 7. Classification of clay content

d. Organic Matter and Calcium carbonate content

Mountain forest soils are rich in organic matter whereas level plains are subject to cultivation and plowing and showed lower level of organic matter (Figure 8). The mountainous soils are characterized by low CaCO3 content which matches the prevailing climatic conditions and leaching of CaCO3 from the soil (Figure 9). Therefore, the soils of the low lands are characterized by enrichment in CaCO3 which affects the productivity of calcifuge crops.

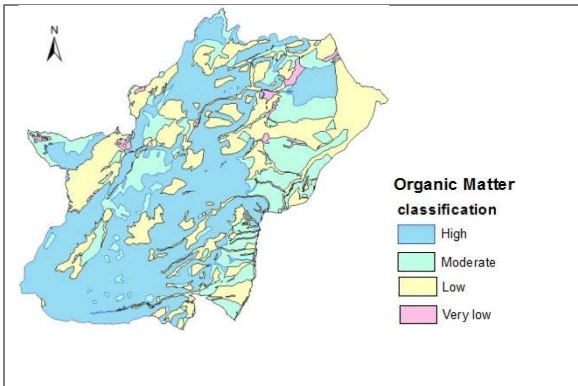

Figure 8. Classified organic matter content

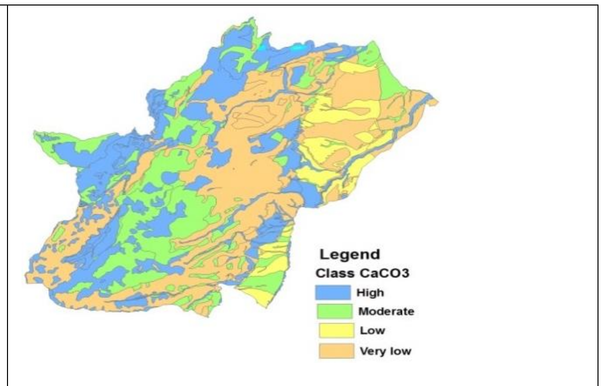

Figure 9. Classification of CaCO3 effect of LCC.

8. Field work

The field survey undertaken was an integrated and qualitative survey using the Global Positioning System (GPS).

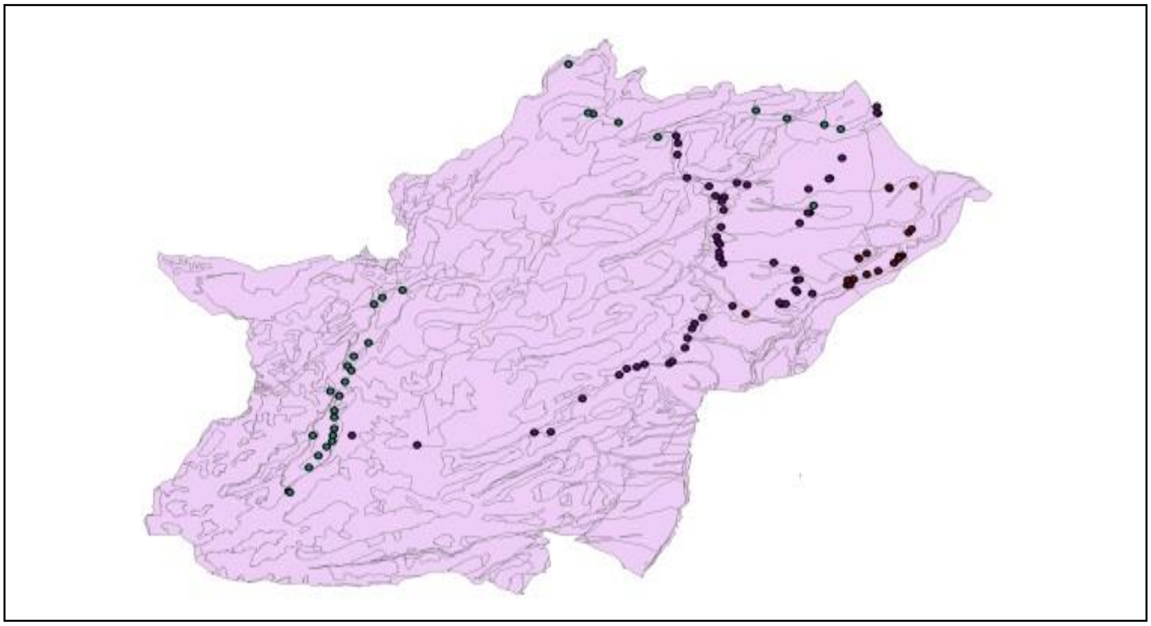

Figure 9. Locations of visited fields

9. Land capability

The results of the land capability model showed a restricted area of prime productivity soils spread on the north east and central south part of the Caza (Figure 10), not exceeding 47.9 Km2 (9% of the area) (Figure 10). The moderate capability class is 149.9 Km^2 (28.3% of the area) while the low and very low productivity lands are 126.5 and 174.4 Km2 constituting 23.9% and 32.9% respectively. The area of non arable lands is estimated at 30.3 Km2 (5.7% of the area).

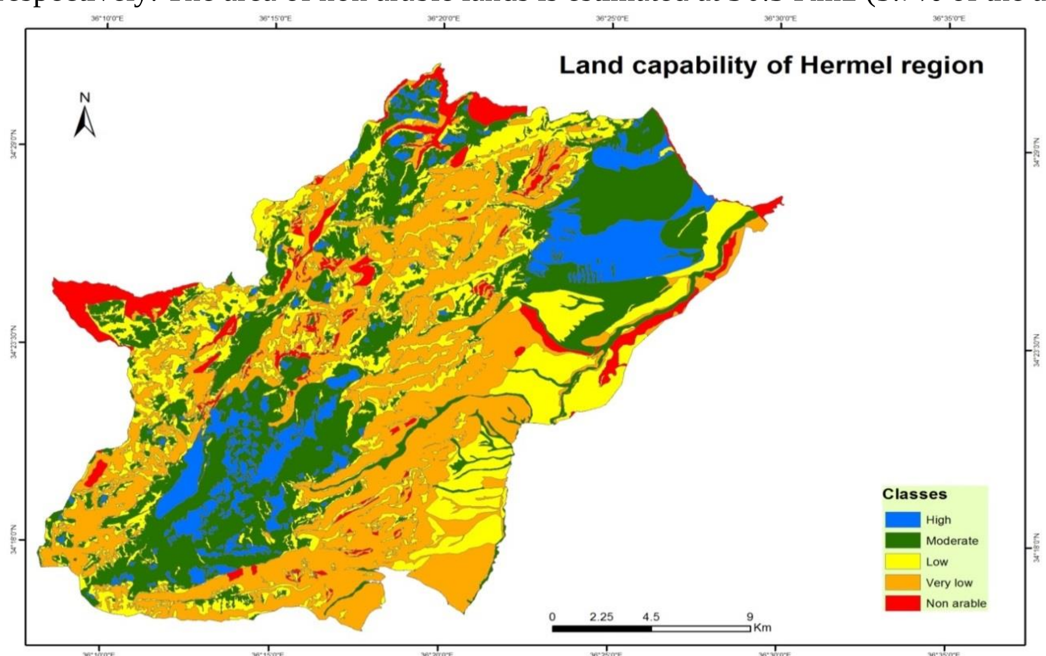

Figure 10. Land capability map of Hermel Caza

10. Assessment of historical urban expansion on productive lands starting from 1963

After 2000, a large chaotic urban expansion was observed notably in 2005 and 2013 (Figure 11). The weak control on the implementation of the land use planning project developed in 2002 resulted in the loss of more than 3.9 km2 and 6.5 km2 of class 1 and class 2 respectively, corresponding to 80% and 83 % of their area respectively. Such alarming picture shade light on the prospected urban and agricultural expansion in the Caza of Hermel with the need to sustain the remaining productive lands for future generations.

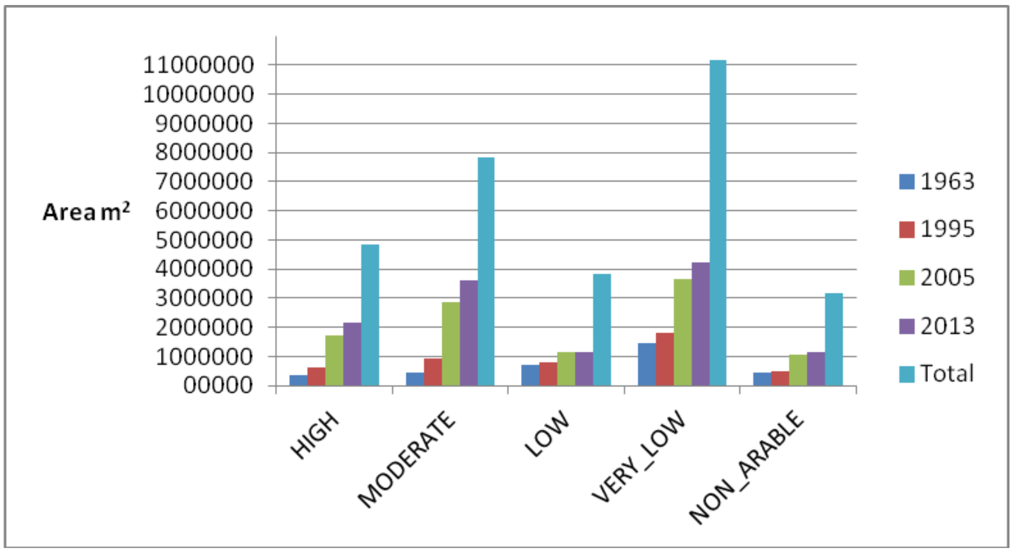

Figure 11. Urban expansion on arable lands in the Caza of Hermel between 1963 and 2013.

11. Impact of planned city development on limited soil resources

Fortunately, future urban expansion including public institutions, tourism and industry are planned on low productivity lands (Figure 12). Agricultural expansion is previewed on productive arable lands.

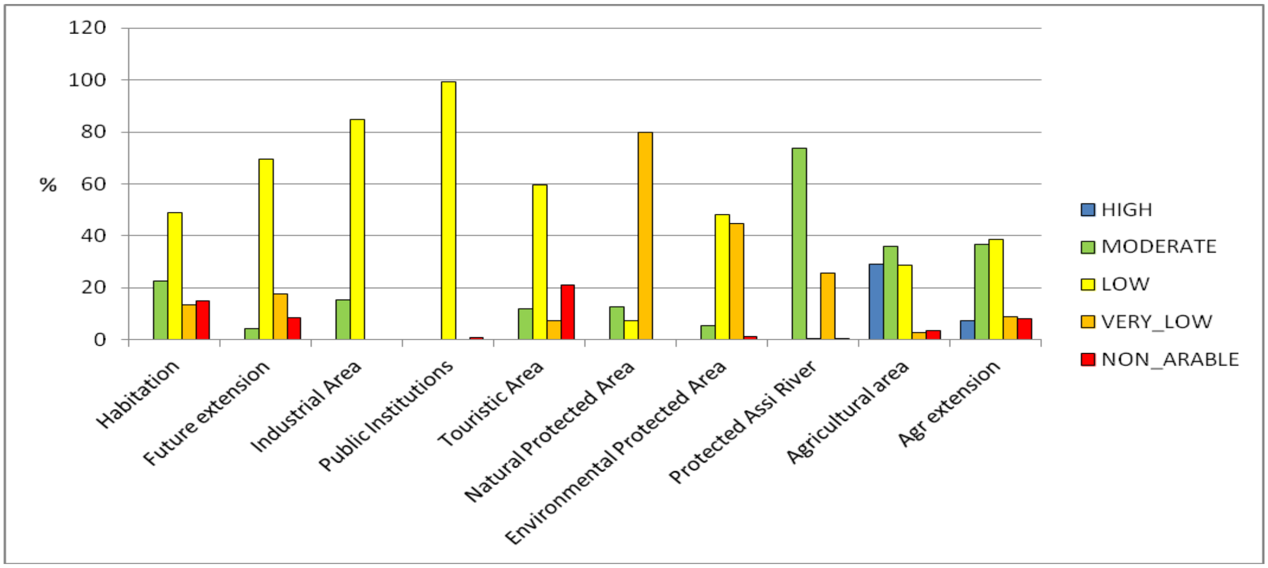

Figure 12. Planned urban development on land capability classes in the Caza of Hermel.

12. Capacity building of local authorities of Hermel

Before Local Sats project, the local authorities had no GIS trained personal that can use or produce geospatial information (Table 2). The Hermel municipality relied on low resolution cartographic information, mostly in paper format or in the form of image, which did not cover all aspects related to GIS use in the assessment and appraisal of natural resources and local governance to manage the limited natural resources. With the implementation of the project, three people were trained on GIS tools and became familiar and experts in the handling and use of GIS based information (Figure 21).

Table 2. Available capacities at the Municipality of Hermel

Theme	Available geospatial data		Available trained staff	
	Before the project	After the project	Before the project	After the project
Topography and geomorphology	Paper format JPG	Digital	No	3
Land cover land use	Paper format	Digital		
Soil	Paper format 1:200.000	Digital 1:50.000		
Climatic data	Paper format	Digital		
Land zoning	Paper format	Digital		
Use of geospatial information	Paper format	Digital		

13. Conclusion

Strengthening local capacities through GIS training and production of thematic maps related to land evaluation contributes to improved local governance. In this regard, creating an observatory for the control and monitoring of the implementation of the planned development for the Caza of Hermel supported by regular involvement of geospatial information can support local development. The created capacities for local authorities of Hermel by Local Sats project will certainly help creating a public opinion and raising awareness to hasten local governance for the protection and sustainable use of natural resources in the area.

The created geospatial database and capacities for the Municipality of Hermel by Local Sats project will certainly help decision making on land evaluation to control urban expansion and follow the implementation of rules for the construction on relevant land capability classes. The Municipality of Hermel has now the ability to propose fine tuning of the land use planning developed centrally based on small scale maps. New urban construction licenses delivered by the central Authorities are subject to the approval of the Municipality of Hermel. The municipality now possesses the capacity to carry the environmental impact assessment to control the new urban is matched with the land capability map to ensure the new construction site falls within the evaluated class to restrict the area consumed by urban and control the percent of land exploitation. Controlling land use change, land use options and urban expansion can help preventing land degradation by chaotic urban sprawl, support suitable land use generate a public opinion and raise awareness to hasten local governance for the protection and sustainable use of natural resources in the area.