MEDSCAPES PROJECT (2014 & 2015)

Development of Landscape Character Assessment as a tool for effective conservation of natural heritage in the Eastern Mediterranean

Final Report of Work Package 4: BEST PRACTICE METHODOLOGY FOR LANDSCAPE CHARACTER ASSESSMENT

Prepared by the team of Mediterranean Institute for Nature and Anthropos with contribution by all partners

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The multilateral cross-border cooperation "Mediterranean Sea Basin Programme" is part of the new European Neighbourhood Policy (ENP) and of its financing instrument (European Neighbourhood and Partnership Instrument - ENPI) for the 2007-2013 period: it aims at reinforcing cooperation between the European Union (EU) and partner countries regions placed along the shores of the Mediterranean Sea. 14 participating countries, which represent 76 territories and around 110 million people, are eligible under the Programme: Cyprus, Egypt, France, Greece, Israel, Italy, Jordan, Lebanon, Malta, Palestinian Authority, Portugal, Spain, Syria and Tunisia.

"The European Union is made up of 28 Member States who have decided to gradually link together their know-how, resources and destinies. Together, during a period of enlargement of 50 years, they have built a zone of stability, democracy and sustainable development whilst maintaining cultural diversity, tolerance and individual freedoms. The European Union is committed to sharing its achievements and its values with countries and peoples beyond its borders".

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ACRONYMS

BPM	Best-Practice Methodology
CoE	Council of Europe
DEM	Digital Elevation Model
DSS	Decision Support System
ELC	European Landscape Convention
EMLO	East Mediterranean Landscape Observatory
ENPI	European Neighbourhood and Partnership Instrument
EU	European Union
FAO	Food and Agriculture Organisation
GIS	Geographical Information System(s)
GPS	Global Positioning System
LCA	Landscape Character Assessment
LCT	Landscape Character Type
LDU	Land Description Unit
MMU	Minimum Mapping Unit
NGO	Non-Governmental Organisation
RAM	Risk Assessment Model
UK	United Kingdom
UNESCO	United Nations Educational, Scientific and Cultural Organisation
WP	Work Package

FOREWORD

It is with great pleasure that we welcome the present Manual, which encapsulates the essence of the MedScapes Project, concerning the application of the Landscape Character Assessment methodology adapted to Eastern Mediterranean specificities. First and foremost, as the result of a cross-border cooperation project funded by the European Neighbourhood and Partnership Instrument (ENPI) for initiatives between EU and other Mediterranean countries, the manual is a compilation of concerted efforts in four countries to scientifically record and map landscapes in the Eastern Mediterranean. The common goal has been to contribute towards a comprehensive mapping of landscapes in the region, through systematic and integrated use of spatial data, thus contributing towards the protection and sustainable development of our diverse landscapes. In addition to their significance regarding cross-border cooperation on landscape issues, itself an important component of the European Landscape Convention, the outcomes of the project are useful both for research and decision-making, in the sense that they foster the development of an advisory tool for drawing sustainable development strategies in the participating countries and beyond.

The European Landscape Convention was signed by the Government of Cyprus in 2001 and ratified by its Parliament in 2006. During the nine years since then, the Department of Town Planning and Housing has promoted the implementation of a step-by-step process to enable the full enforcement of the Convention in the country. One of the first important changes that resulted from the adoption of the Convention is the terminology of “landscape” itself. Whereas, previously, Cyprus had recognised a number of outstanding landscapes and landscape features as worthy of protection, the Convention specified that landscape is a concept that applies to all types of surroundings, whether these are outstanding, “everyday” or even degraded and in need of attention. It refers, in fact, to the quality of the space that surrounds us and as such should, therefore, be the object of spatial planning policies. Moreover, the Convention itself calls not only for the protection, but also for the management and **planning** of landscapes.

The next steps had to be taken in relation to the fulfilment of the Convention’s requirements. First, preparatory work was undertaken at the strategic level, in order to set down a plan of action in relation to the assessment and evaluation of the character of the Island’s landscapes, while at the same time opportunities were provided to raise stakeholder awareness on landscape issues. To achieve these goals, the Department has cooperated with the *Laona Foundation for the Conservation and Regeneration of the Cypriot Countryside*, a non-governmental organisation, which has been registered with the Council of Europe since 2005 as an observer-member of the European Landscape Convention. In 2008 came the first intermediate results, through the *Cyprus Landscape Mapping Project*, co-funded by the Government and the Foundation. A complementary study followed, turning attention to the cultural aspects of landscape, an element that had been partly missing from the first project. Despite the loss of critical time between 2010 and 2014 due to lack of funding as a result of the fiscal and financial crisis, our vision is coming to fruition through the MedScapes Project, for which this Department is an associate partner.

We therefore look forward to receiving the results of the project, which is particularly important for Cyprus, as it completes the first comprehensive assessment of its landscapes at national level. This will provide the scientific background that will enable the introduction of landscape quality objectives into spatial plans on the basis of the project's deliverables, including the landscape character maps, risk analysis model and overall decision support system. All of these aspects will be examined over the coming months by the Department's policy team with the scope of assessing their usefulness and compatibility with the planning system and the objective of enabling and facilitating the introduction of an appropriately documented landscape policy, as current policy is largely based on general principles rather than place-specific data. It is therefore extremely important to utilize *MedScapes* results, and further elaborate where necessary, a task for which the present Manual is indispensable.

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Director, Department of Town Planning and Housing

Introduction

Project Scope and Philosophy

The MedScapes Project was approved during the second call for standard ENPI projects of the period 2007-2013 according to the ENPI Priority 2: *"Promotion of environmental sustainability at the Basin level, pursued through the preservation of natural common heritage, the reduction of risk factors for the environment, the improvement of energy efficiency and the promotion of the use of renewable energy sources"*, and Measure 2.1: *"Prevention and reduction of risk factors for the environment and enhancement of natural common heritage"*.

MedScapes brings together eight (8) partners from four (4) countries for this two-year project: Cyprus, Greece, Jordan and Lebanon. Each country is represented by one non-governmental organisation (NGO) and one University. The eight project partners are:

- Laona Foundation for the Conservation and Regeneration of the Cypriot Countryside (Lead Partner);
- Open University of Cyprus;
- Royal Society for the Conservation of Nature (RSCN), Jordan;
- German Jordanian University (GJU);
- Society for the Protection of Nature in Lebanon (SPNL);
- American University of Beirut (AUB), Lebanon;
- Mediterranean Institute for Nature and Anthropos (Med-INA), Greece; and
- University of the Aegean (UoA), Greece.

The Project aims to strengthen the protection of, and reduce risk to the landscape heritage (natural heritage and the landscapes that sustain it), through the development of an integrative Landscape Character Assessment (LCA) framework for enhanced territorial planning and sustainable landscape management. The specific objective of the Project is to *develop and apply a Best-Practice Methodology (BPM) for LCA and landscape recording in pilot areas, and to promote the results as a tool for sustainable land use decision-making and landscape-scale protection of the natural and cultural heritage in the East Mediterranean context*.

A series of activities have been planned in order to achieve this objective. These activities work in a complementary manner, involving desktop research and mapping, field validation, stakeholder and community involvement, training and education workshops and material. The BPM for LCA is at the heart of the Project's outcomes, as it capitalises on the joint experience of the partners' LCA implementation in the selected pilot sites, to deliver a fully tested and regionally adapted methodology for landscape characterisation and mapping in the East Mediterranean.

PURPOSE OF THE BEST PRACTICE METHODOLOGY

The landscape characterisation methodology of the MedScapes Project has been built upon the UK's LCA, a well-established method for landscape-scale nature conservation that has been developed and employed in Northern Europe, and has recently been refined and applied in Cyprus by members of the Project Partnership. Drawing on existing practice in other regions, adding new elements based on the scientific experience and deep knowledge of the East Mediterranean of the MedScapes multidisciplinary international team, and pilot testing in the whole of Cyprus and in five (5) pilot areas in Greece, Lebanon and Jordan; these are the main steps followed in order to:

(a) draft the provisional landscape typology at Level 1 (1:250,000) and Level 2 (1:50,000) scale (outputs of WP5[1]) and, consequently,

(b) develop an applied and tested, regionally adapted, methodology for LCA in the East Mediterranean (output of WP4[2] at hand).

Both outputs aim to set a benchmark standard for landscape characterisation work in the East Mediterranean, so as to enable much greater consistency between territories of the Basin in future landscape mapping exercises and, ultimately, facilitate trans-boundary cooperation in landscape-scale nature and culture conservation.

The BPM technical manual at hand is structured in five parts:

1. **Part 1** presents the philosophy and key principles of the LCA method with reference to the concept of landscape in policy and to the particular challenges of the Mediterranean landscape that fall into the scope of the MedScapes project.
2. **Part 2** presents the first step to landscape characterisation, which is desktop mapping:
   - Chapter 2.1 provides a general description of the steps to be followed, clarifying the relation between Level 1 and Level 2 mapping;
   - Chapter 2.2 describes the datasets required to carry out the mapping process;
   - Chapter 2.3 gives some practical tips to prepare for desktop mapping;
   - Chapter 2.4 describes in detail the four steps to carry out Level 1 mapping;
   - Chapter 2.5 in turn describes the refined process that follows at Level 2 mapping.
3. **Part 3** describes the process of field survey:
   - Chapter 3.1 makes an introduction to fieldwork, presenting the main issues involved according to the level of assessment and describing the use of standardised Field Survey Sheets;
   - Chapter 3.2 gives some practical tips for good preparation before fieldwork;

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[1] WP5: *LCA Training and Implementation*.
[2] WP4: *Best Practice Methodology for LCA*.

    - Chapter 3.3 describes in detail the field survey process, pointing out the differences between Level 1 and Level 2 and giving practical suggestions for improved results at the field.
4. **Part 4** describes the step of characterisation and description, explaining the process of using the mapping and fieldwork results to define landscape character types:
    - Chapter 4.1 explains the process of defining Landscape Character Types based on the results of the desk study and field survey;
    - Chapter 4.2 provides guidance on naming Landscape Character Types and presents the full range of East Mediterranean Landscape Character Types recorded in the framework of WP5;
    - Chapter 4.3 gives guidance on how to describe landscape character providing illustrative examples from the MedScapes East Mediterranean landscape typology.
5. **Part 5** presents the uses of landscape characterisation and mapping for decision-making, with regard to stakeholders engagement, and discusses the potential applications of the MedScapes LCA method:
    - Chapter 5.1 makes reference to the Risk Assessment Model (RAM) and Decision Support System (DSS) which has been developed in the context of WP7[3];
    - Chapter 5.2 refers to the *Hima* community-based model for participatory management which has been developed, adapted and applied in the context of WP6[4];
    - Chapter 5.3 concludes with a discussion of potential applications of the project outputs at the East Mediterranean level, summarising the main lessons learnt from this joint experience and providing guidance on the way forward.

It is hoped that this BPM technical manual will facilitate the wider application of LCA throughout the East Mediterranean, providing a useful tool to practitioners, policy-makers and academics working on landscape research and policy.

[3] WP7: *LCA results integration and Risk Tool development*.
[4] WP6: *Community participative process (based on Arab Hima concept plus other models) to build on results of LCA*.

PART 1: INTRODUCTION AND BACKGROUND TO LCA

1.1 THE CONCEPT OF LANDSCAPE

During the last four decades *"landscape"* has made its way onto the scientific discourses of much different kind of disciplines, onto the policies of several countries and onto the practices of various international organisations. Particularly, soon after the signing of the European Landscape Convention (Council of Europe, 2000), landscape became a rather popular theme of interest amongst scientists, practitioners and policy makers, mainly due to the fact that it succeeds to bridge the gaps of human and natural sciences and to draw parallel lines between policies and practices in natural and cultural heritage management and governance.

Concerted efforts towards this direction led to the formation of multiple theoretical approaches, scattered across various research domains, each of them having its own merits as having its limitations. Until now, none of these approaches has managed to solve the problem of disparity that characterises the landscape concept or to provide an integrated, comprehensive and analytical framework of study (Terkenli, 2001, p. 198).

The English word *landscape* is a compound word made by *land* and *scape*, which appeared in the English language as landscipe or *landscaef* sometime after the 5th century (Calder, 1981; Jackson, 1986; James, 1934; Terkenli, 1996). The term derives from the German *landschaft* referring to a restricted administrative unit of land or region. In English, these early terms were understood similarly as fields or as natural units controlled by a group of people or a feudal landlord. Six centuries later, the word fell into disuse and it reappeared in the English language at the turn of the 16th century, when the Dutch term *landschap* was introduced, referring to the depiction in paintings of inland natural or rural scenery or area (Muir, 1999; Olwig, 1996; Tuan, 1979). By the late 19th century the term changed again and was now considered as a part of the territory comprehensive in a single view (Mikesell, 1968).

By the 1960s and 1970s, the new emerging environmental consciousness and movement provided an alternative understanding of nature and landscape; the term started becoming slightly more holistic giving rise to an appreciation that the landscape was not about just a scenic view but the result of a dynamic and all-encompassing process of our daily interactions with our surroundings. As such, these interactions need to be sustainable and appropriate to enhance the character of place and region.

Undoubtedly, the concept of landscape has evolved to take a plurality of meanings and connotations, making it a "vast, difficult, slippery and mercurial subject" (Laurie Olin, cited in Benson and Roe, 2007). In the same time it is neither understood in a similar way by various communities nor is it translatable in all languages. Characteristically, there is no precise translation of the term in Arabic.

Landscape means different things to different people. It results from the interplay of physical, natural and cultural elements of the surroundings and the way that people perceive these interactions. Different combinations of these elements create the distinctive character of landscapes in places, allowing different landscapes to be mapped, analysed and described. Landscape character is not just about the elements that make up a landscape but also embraces the aesthetics and perceptual factors that make different places distinctive. Landscapes have thus long been viewed as "multifunctional", integrating ecological, economic, socio-cultural, historical and aesthetic dimensions. This is also reflected in the statutory guidance aiming their conservation, as well as in the related methodologies developed to meet that need (Vogiatzakis, 2011).

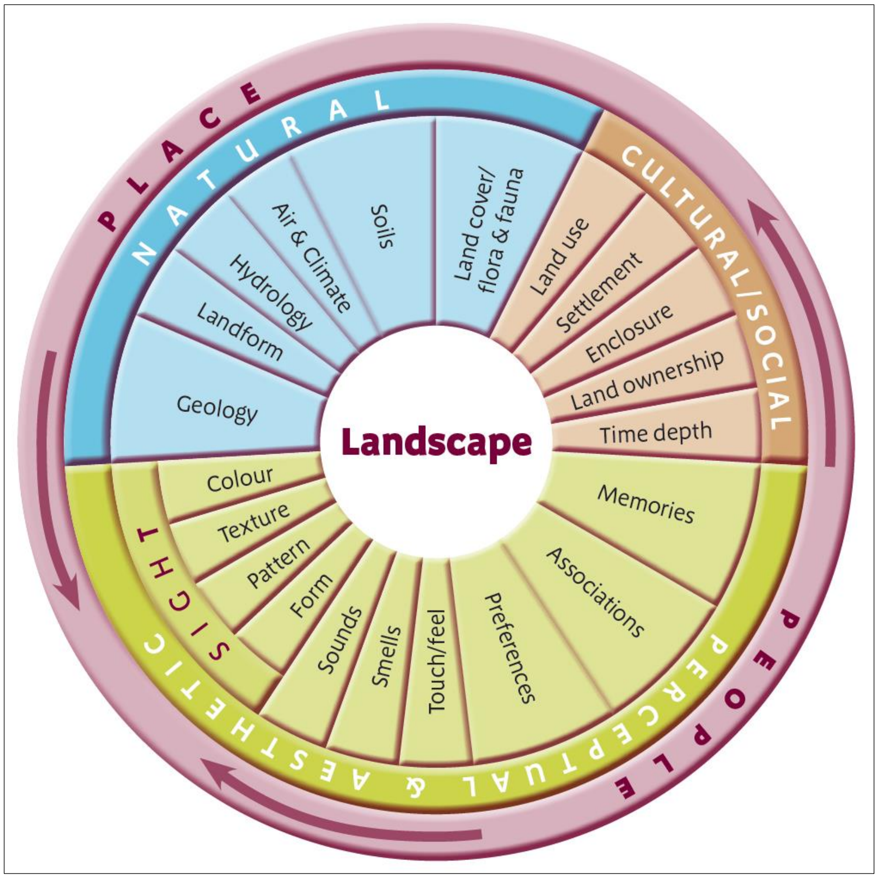

Figure 1: What is landscape?

Source: Tudor, 2014

Today, landscape is considered one of the key themes of policies for environmental and territorial sustainability. It concerns environmental, cultural, social and economic matters and also affects populations, as it represents the way in which they perceive their living environment. Landscape has been on the political agenda of European countries, resulting in innovations in Land and Spatial Policies and in specific sectors such as agriculture and cultural heritage (Peano and Cassatella, 2011). Landscapes play a leading role in the innovation of spatial policies in the international community. They are an essential component of people's surroundings, an expression of the diversity of their shared cultural and natural heritage and a foundation of their identity. They are also an economic resource for implementing sustainable development. Landscape scale approaches are fundamental to the understanding of past and present cultural, physiographic and natural evolution and are now considered to be an appropriate spatial framework for the analysis of sustainability. All the above were acknowledged by the Medscapes project partners and a recognized gap on landscape scale environmental and territorial sustainability approaches was addressed. The MedScapes project came in response to that gap, in order to facilitate the wider application of landscape assessment throughout the consortium territories and to extrapolate it in the Eastern Mediterranean context.

1.2 The Basics of Landscape Character Assessment

1.2.1 Background and Philosophy

Landscape is "*An area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors*" (ELC, Council of Europe, 2000). Our landscapes have evolved over time and they will continue to evolve; change is a constant but outcomes vary. The management of change is essential to ensure that we achieve sustainable outcomes –social, environmental and economic (Tudor, 2014).

Landscape Character Assessment (LCA) is a set of techniques and procedures used to classify, describe and understand the evolution and physical and cultural characteristics of a landscape. The implementation of LCA is important for all the countries that have ratified the European Landscape Convention (ELC). It provides a framework to identify and assess landscapes, understand landscape change, and develop landscape quality objectives in partnership with stakeholders –all specific measures of the ELC (Washer and Jongman, 2003).

LCA can operate at a range of scales, from the national and regional to the local, and has an important role to play in managing and guiding change, as it can be used, for example, to:

- describe a landscape with reference to the characteristics that combine to make a place distinctive;
- give spatial reference to baseline information via mapped landscape character areas / types;
- inform understanding of key characteristics, sense of place, special qualities etc. that can then inform judgements (decision making) regarding, for example, development management and the siting, design, scale and massing of developments from housing developments and transport infrastructure to forests, woodlands, or renewable energy projects;
- assist with the monitoring of change (Tudor, 2014).

1.2.2 The Landscape Character Assessment Process

LCA has a long history in Europe with North-West European countries leading the way on methodological aspects but also on implementation through policy and legislation (e.g. Griffiths et al. 2004). Significant progress has also been made in South Europe with regard to the description and mapping of landscape types (Pinto-Correia et al., 2002; Marušič and Jančič, 1998; Blasi et al., 2000).

Many variations of LCA have been developed and applied during the past decades. In one or the other version, the process of LCA involves the stages of ***characterisation***, ***evaluation*** and ***decision-making***[5]:

1. **Characterisation** is the process of identification, classification, mapping and description of areas of distinct character; characterisation is carried out in four main steps, and is largely based on the results of a desk study and a field survey.
2. **Evaluation** is subsequently carried out to assess the key characteristics, vulnerability and sensitivity (capacity for change) of the areas identified during the characterisation process; this is mainly done by assessing the condition and strength of character of each area.

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[5] The evaluation and decision-making stages are sometimes referred to as part of the same stage.

3. **Decision-making** is about making informed judgements about the future of landscape, taking into account the results of the characterisation and evaluation stages so as to effectively respond to the pressures affecting each of the different landscapes (character-based approach); in other words, how to accommodate change whilst at the same time retain and, where possible, strengthen regional character and local distinctiveness, by developing the appropriate landscape strategies or management guidelines.

1.2.3 LANDSCAPE CHARACTERISATION

Landscape characterisation is the first stage of the LCA process. It comprises the identification of areas of distinct ***character***, the classification and mapping of those areas and the description and explanation of their character. The rationale behind landscape character mapping is that particular combinations of physical and cultural factors occurring in different areas result in similar landscapes. The approach is based on a series of natural (i.e. landform, geology, soils) and cultural factors (i.e. land use, settlement pattern) that are used to describe the variability in the landscape at various spatial scales depending on the research scope. The data sources may include existing published sources, field survey information and the input of stakeholders to identify and describe areas of common character. The characterisation process may result in ***landscape character types*** (relatively small, generic, repeatable spatial units) or ***landscape character areas*** (larger unique spatial units).

The characterisation process is carried out through a combination of desk study and field survey. The **desk study (or desktop mapping)** relies heavily on analysis of mapping data to arrive at a simple broad brush indication of the range of ways in which each attribute could be expressed in the landscape. Simplified map overlays prepared for each attribute are then related to one another, to enable patterns to be distinguished. These, in turn, made it possible to begin to understand the relationship between the different attributes. This greatly assists in the understanding of how a particular landscape has developed and is the key in assessing landscape character (see Chapter 2). The end product of the desk study is the identification and mapping of draft areas of common character (provisional typology).

The **field survey** is a key part of the LCA process, as it provides an important ground level view that shows how the landscape is seen by people. Fieldwork is used to validate and refine the results of the desk study as well as to identify key elements or features that are not apparent from desktop mapping (e.g. natural features, data about the ecological integrity of a landscape, etc.), and it is essential to capture aesthetic, perceptual and experiential qualities of landscapes. The purpose of a detailed field survey is to collect as much information as is necessary to describe the character, identify aesthetic and perceptual qualities, assist in final decisions about division into character types or areas, update and expand the database of desk study information, and, ultimately, to contribute to the decision making process (i.e. making informed judgements about the future of the landscape). Sometimes field survey might identify issues that need to be clarified by further desk study, and this then may require more than one field survey stage to draft the character types or areas (see Chapter 3).

Based on all the information collected (i.e. incorporating field survey findings to desktop mapping results) the characterisation process is refined and finalised. The end product is a ***classification into landscape character types and/or areas*** (final landscape typology), accompanied by the finalised maps and clear descriptions of their character.

Box 1 below provides an illustration of the stages and steps of the LCA process.

Box 1: Typical Stages and Steps of LCA (adapted from Tudor, 2014 & Griffiths et al., 2004)

Stage 1 – Characterisation

Identify and map areas of distinctive character and describe their key characteristics.

Step 1 – Define the purpose and scope

Determine the scale and level of detail of the assessment and the resources required.

Step 2 – Desk Study (Desktop mapping)

Collect and review relevant background documents and spatial data to identify draft areas of common character and map draft landscape character types / areas.

Step 3 – Field survey

Validate and refine the results of the desk study, describe the character of the draft landscape character types / areas, identify aesthetic and perceptual qualities, assess condition of landscape elements.

Step 4 – Classification and description (Typology)

Finalise the classification and describe the character of each landscape character type / area.

Stage 2 – Evaluation

Assess the key characteristics, vulnerability and sensitivity (capacity for change) of the areas identified during the characterisation stage.

Stage 3 – Decision-making

Make character-based informed judgements about the future of the land-scape (develop appropriate landscape strategies or management guidelines)

1.2.4 LCA Scales

A Landscape Character Assessment can be carried out at any scale from the national level down to the site level. In general terms, a national / regional assessment is carried out at 1:250,000 scale, an intermediate / local assessment in scales ranging between 1:50,000 (District/Municipality level) and 1:10,000 (Community level), whereas a site level / project-based assessment might be carried out at around 1:2,500 scale or even lower.

The two most common scales to carry out a LCA are:

- The **national / regional** (1:250,000), which is commonly referred to as **Level 1**. The MedScapes typology for the East Mediterranean, presented in Chapter 4.3, corresponds to this scale.
- The **intermediate / local authority scale** (1:50,000), which is commonly referred to as **Level 2**. The MedScapes results cover this scale too; however, no common landscape typology has been produced.

The selection of the appropriate scale ***depends on the purpose*** and intended uses of the study. These, in turn, will influence the ***level of detail*** and required outputs to be provided for the end user(s):

- Generic strategies or guidelines may only require a general description of character given by ***landscape character types*** (e.g. land management strategies); Level 1 studies, such as the one completed in the Medscapes project, are typically oriented towards this strategic level.
- If an assessment is to be used as part of a detailed assessment of development options (where the extent, nature and distribution of individual elements are important) a detailed LCA is more appropriate; Level 2 studies are partly oriented towards this level.
- Predominantly subject-based studies (i.e. cases where strategy might be informed by landscape character and detailed visual considerations) might require more detailed information from ***landscape character areas*** (e.g. renewable energy sensitivity studies, conservation area appraisals); this level is usually dealt with lower scale studies (Tudor, 2014).

Sometimes a more strategic national / regional LCA might provide the context for a more detailed LCA. For example, in England, National Character Areas[6] might give strategic context to highways planning and design that will, in turn, require more detailed Landscape Character Assessment(s) at the route / site level (Tudor, 2014). Ideally, the “proper” way to conduct an LCA is to follow this hierarchical order, where a Level 2 assessment is nested into a broader Level 1 assessment. In practice, though, practical considerations (e.g. time and resource restrictions, specific development needs, etc.) might indicate the need to focus on the finer scale, or conduct only the higher-level scale without having the possibility to make a finer scale assessment afterwards. In such cases, the content of the assessment might need to be calibrated accordingly, to incorporate elements of one level into the other.

[6] Countryside Commission and English Nature (1996), *The Character of England: landscape, wildlife and natural features* (map) CCX 41. Countryside Commission/English Nature, Cheltenham.

Important note:

The scale of the LCA will influence the need for, and choice of, appropriate datasets, as well as the design and content of the field survey. It is therefore important to define the purpose of the study beforehand, to avoid unnecessary data collection (or acquire data which is not fit for the exercise). The scoping step of the characterisation stage should respond to this question.

A key component of LCA and landscape characterisation is the use of ***Geographical Information System*** (GIS) technology. GIS greatly facilitates the storage, analysis and presentation of spatial (map based) data, allowing environmental and other information to be compared ***across both space and time***, thus enabling the user to ask questions of the data and to generate hypotheses. The use of GIS also necessitates a rigorous approach to data storage and manipulation, and hence provides the opportunity for establishing a structured database of archival quality (MedScapes LCA Training Manual, 2014).

If GIS is to be used effectively as a decision support tool it needs to be built on a structured, spatial framework for describing and evaluating the landscape. This has to be capable of operating at different levels of spatial resolution, which in turn correspond to the scales of landscape assessment.

1.2.5 The Concept of Land Description Units (LDUs)

The cornerstone of the methodology that was used in the MedScapes project, described in the present guide, is the concept of **Land Description Units (LDUs)**. LDUs are distinct and relatively homogenous units of land, each with a similar pattern of physical, ecological and historical attributes. The LDUs are the ***building blocks of the landscape*** and they form the framework on which all subsequent description, classification and evaluation is based. This means that at the end of the characterisation process, ***LDUs with similar characteristics are amalgamated to form landscape character types and/or areas***.

The LDUs are defined by a combination of **natural** and **cultural attributes**, known as "***definitive attributes***" because they define the extent of each LDU. ***Definitive attributes are derived through a process of overlay mapping of thematic layers in GIS*** (described in detail in Chapter 2), with the help of which the LDU polygons are drawn in the GIS map.

The selection of definitive attributes may vary according to the case, as discussed below. The typical method on which the MedScapes LCA process has been based uses ***four definitive attributes at Level 1:***

- ***landform*** and ***ground type*** (based on the overlay of datasets for *relief, geology and soils*) which together encapsulate the underlying natural dimension of the landscape;
- ***landcover***, reflecting surface vegetation; and ***settlement pattern***, which describes the historic structural component of the cultural landscape.

At a finer scale of resolution (Level 2) each of the Level 1 attributes is typically split into two parts, giving a total of ***eight definitive attributes for Level 2*** characterisation. This allows for a much finer grain of mapping, whilst retaining the hierarchical structure of the spatial framework[7]. The eight attributes typically used at Level 2 are:

[7] Thus an LDU defined as "forested mountain" at Level 1 might be subdivided into 2 or more LDUs at Level 2 (e.g. "precipitous mountain slope with coniferous vegetation", "bare rock escarpment", etc.).

- ***landform*** and ***geology (structure)***, hierarchically connected to the Level 1 attribute of *landform*;
- ***geology (rock type)*** and ***soils***, hierarchically connected to the Level 1 attribute of *ground type*;
- ***farm type*** and ***tree cover*** (corresponding to land use), hierarchically connected to the Level 1 attribute of *landcover*;
- ***settlement type*** and ***field pattern***, hierarchically connected to the Level 1 attribute of *settlement pattern*.

The selection of definitive attributes has been slightly modified for the Level 2 assessment of the MedScapes project, omitting or simplifying some of the abovementioned attributes. More on the subject are discussed in Chapter 2.5.

The definition of discrete LDUs provides a meaningful and structured spatial framework for gathering additional ***descriptive*** information about the landscape. ***Descriptive attributes are derived mainly through the field survey*** and include:

- character-based information (e.g. species associations, habitats, building styles, etc.), which is used to describe and evaluate landscape character;
- qualitative information relating to the significance of particular attributes, their condition and their vulnerability to change, which is used to evaluate landscape character and inform the decision-making process.

All of the above information is held on a GIS database linked to the LDU polygons.

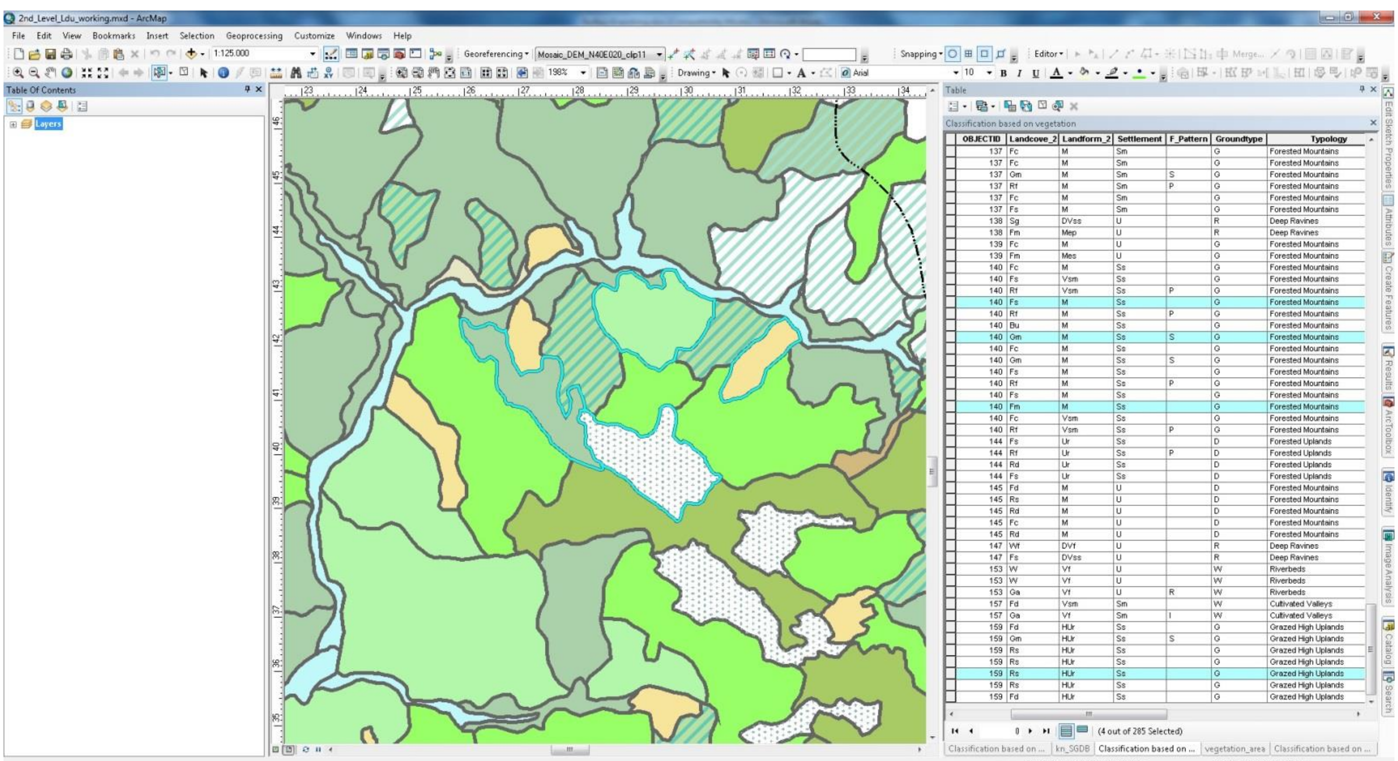

Figure 2: LDU polygons selected on the GIS attribute table and shown on the map

Source: MedScapes Epirus LCA database (ArcGIS 10 software used)

The relationship between the Level 1 and 2 definitive attributes is summarised in Table 1, which shows typical cases of definitive attributes and examples of associated descriptive attributes. Note that, according to the scope of the assessment and the availability of data, ***the study team may well decide to use as "definitive" some of the attributes shown below as "descriptive", and vice versa***. These attributes are marked in blue letters.

Table 1: Relation of LDU attributes between Level 1 and Level 2

Attribute category	**Definitive attributes**		**Descriptive attributes**
	Level 1 (Regional) (1:250,000)	**Level 2 (Local)** (1:50,000)	
Natural dimension	**Landform**	Landform	Natural features
		Geology (structure)	
	Ground type	Geology (rock type)	Hydrology (water sources)
		Soils	Classification of agricultural lands
Cultural dimension	**Landcover**	Landcover	Associated habitats Vegetation cover
		Land use	Tree cover
	Settlement pattern	Settlement pattern	Settlement types Building styles
		Field pattern	Land ownership and tenure

Source: Adapted from Tudor, 2014 and MedScapes LCA Training Manual

Important notes:

- The natural attributes (*topography, geology and soils*) are known as "permanent definitive indicators" since they are not generally subject to change through man's influence. The cultural definitive indicators (*landcover / land use, settlement and field pattern*) are always applicable to the landscape since they reflect man's influence on it, but they are not permanent definitive indicators because they are subject to change. Essentially they are identified to provide baseline descriptive information for today's landscape; however they may also give insight on the dynamics of landscape evolution if properly mapped and assessed.
- The selection of definitive attributes may vary according to the scope of work and availability of data. As shown in Table 1, some of the attributes mentioned as "descriptive" could be used as "definitive", if considered more appropriate for the assessment –and vice versa. This applies particularly to the cultural dimension, which is more flexible in its interpretation in comparison to the natural dimension. The important thing in any case is to have a representative set of definitive attributes to encapsulate both the natural and cultural aspects of landscape, which fit the scope of the assessment.

- The finer level of assessment when moving from Level 1 to Level 2 is represented by a more detailed level of detail between the associated definitive attributes. For example, an LDU characterised at Level 1 as a “valley” in terms of landform, may be subdivided (and characterised accordingly) at Level 2 into a “valley floor” and “valley sides”; similarly, an LDU characterised at Level 1 as a “forest” in terms of landcover, may be specified as being a “coniferous forest” at Level 2 –and so on.

1.2.6 Using LDUs to Produce a Landscape Typology

The final stage of the characterisation process is the definition of *Landscape Character Types* and/or *Character Areas*. Landscape Character Types are repeatable spatial land units with relatively homogeneous character which can recur in different places, while Character Areas refer to geographically discrete areas.

The process of LDU mapping and subsequent characterisation gives a complete “birds eye” view of the land, which in turn provides a structured spatial framework for gathering additional descriptive information about the visual dimension of the landscape as it is seen and valued by people on the ground. Although it is the more intangible aesthetic aspects of the landscape, such as scale, form and enclosure, that are most apparent to viewers on the ground, the fact that these aspects are almost invariably controlled by either relief, or the surface pattern of vegetation and landcover / land use, explains why the LDUs defined by the process of overlay mapping can be used as a basis for defining Landscape Character Types and/or Character Areas (MedScapes LCA Training Manual, 2014).

The LDU-based method developed by the MedScapes project ***focuses on the definition of Landscape Character Types (LCTs)***, as the spatially referenced framework on which landscape character descriptions and follow-on judgements and decisions about future policy development and land management strategies may be based. LCTs are defined by the amalgamation (i.e. groupings) of LDUs based on the classification of visually significant attributes. By contrast to the mapping of LDUs, the derivation of LCTs recognises the human perception of prominent visual characteristics and/or locally distinctive features. For this reason, the classification into LCTs is possible only when field survey has been completed, allowing to include the visual dimension of the landscape into the results of the mapping process.

The end result of the classification process is a map of LCTs, with their accompanying descriptions, which will synthesise the detailed information recorded for each LDU into much larger landscape units. This means that, for the purposes of the classification, some of the information that has meticulously been recorded during the two previous stages of the characterisation process (i.e. desktop mapping and field survey) will be “lost” for reasons of uniformity and simplicity (for example, mixed Level 1 LDU landcover characterisations might be concealed under a more generalised LCT definition focusing on the most dominant or characteristic use only). These deductions are necessary to allow the characterisation process work more efficiently. The more detailed information recorded during mapping and field survey may still be used either as part of the LCT descriptions (i.e. as additional descriptive characteristics that contribute to landscape character at least in parts of a given LCT) or later on, as part of a finer scale of LCA for the study area.

1.2.7 Basic LCA Terminology

Box 2 below summarises the main terms used in LCA.

Box 2: Commonly used terms in LCA

Landscape Character Assessment (LCA)
A set of techniques used to classify, describe and understand the evolution and physical and cultural characteristics of landscape.

Landscape mapping process
A procedure of data acquisition, processing and synthesis to produce a series of character-based overlays incorporating the key factors that contribute to landscape character.

Landscape character
A distinct, recognisable and consistent pattern of elements in the landscape that makes a landscape different from another –not better or worse.

Definitive attributes
Attributes which define spatial units on the ground based on patterns that can be delineated from map information.

Land Description Units (LDUs)
Distinct and relatively homogeneous units of land, each defined by a series of definitive attributes.

Landscape Character Types (LCTs)
Repeatable spatial land units relatively homogeneous in character. They are generic in nature in that they may occur in different areas, but wherever they occur they share broadly similar combinations of definitive attributes. LCTs are derived by the amalgamation of LDUs based on the classification of visually significant attributes.

Source: Adapted from Tudor, 2014 and MedScapes LCA Training Manual

1.3 LCA IN THE EAST MEDITERRANEAN CONTEXT

The Mediterranean Basin is a coherent geographical region which includes parts of three continents: Europe, Asia and Africa. These share several common features, including a great ecological diversity, long cultural history as well as very dynamic, diverse and heterogeneous landscapes. They also experience common pressures, such as rapid change due to urbanisation, rural depopulation, decreased rainfall, increased fire frequency, tourism expansion, social inequalities, political instability etc. Historically the area has demonstrated a tendency to adaptation to new socio-economic and environmental challenges and as such a great variety of landscapes has been created, but the rate of change may now exceed their resilience.

The main challenge of the MedScapes project has, thus, been how to incorporate and properly adapt a method for landscape assessment that has been originally developed in such a different geographical and cultural context, as the one of Northern Europe. To this end, an extensive review of the original methodology was necessary, to make the necessary amendments and additions that may better describe the specificities of the East Mediterranean landscapes.

The LCA leading team of the Open University of Cyprus (OUC) has been in charge of this delicate process, preparing the necessary material and organising a 5-day training workshop for all project partners, which resulted in the development of a common ***protocol*** to carry out Level 1 landscape mapping and characterisation in the project countries[8]. Following LCA implementation, extensive feedback by all partners and mentoring visits to each country, the protocol has been refined to ensure that all important characteristics of the East Mediterranean are finally included in the classifications and final landscape typology. The content of the finalised protocol reflects the high diversity of the Mediterranean landscape, with its distinct landforms and mixed land uses. It also encapsulates the joint experience of inadequate –either missing, outdated, or coarse and unreliable– datasets in all project countries, a particular problem that necessitated improvisations to be made; most characteristically and importantly, by widely using free, Google Earth, satellite images in all steps of the mapping process – practically using the satellite layer as an additional dataset to those typically used in most studies in Europe (described in the previous Chapter).

The final product of the Level 1 mapping and characterisation exercise has been the development of a common landscape typology for the East Mediterranean region (see Chapter 4.3). Once again, extended discussions took place with all partners to ensure consistency in the terms finally used and, thus, to produce a truly representative set of East Mediterranean landscape types, that exhibits similarities in all countries.

Similar work has consequently been carried out at Level 2, where another protocol has been developed, to guide the process of Level 2 desktop mapping and field surveying, expanding the Level 1 classifications into a much more detailed, hierarchically nested, system of classification. Time and resource restrictions did not allow the development of a common landscape typology at this level, however all partners have produced a provisional typology for their study areas, and this work may certainly be used and refined in the context of other similar initiatives in the future.

[8] The MedScapes LCA Level 1 protocol is the main source for drafting Chapter 2.4, which describes the process of desktop mapping at Level 1. Similarly, the Level 2 protocol is the main source of Chapters 2.5 (Level 2 desktop mapping) and 3.3.3 (Filling in the Field Survey Sheet).

PART 2: DESKTOP MAPPING

2.1 GENERAL DESCRIPTION OF THE MAPPING PROCESS

As mentioned in Chapter 1.2, the first stage in the characterisation process is essentially a desk based exercise involving the preparation and analysis of simplified map overlays in order to define Land Description Units (LDUs). Each task in the process of LDU mapping involves a step by step procedure of data acquisition, processing and interpretation to produce a series of map overlays incorporating the key factors that contribute to landscape character.

The ***natural dimension*** of the landscape is mapped first, not only because it provides a context for analysing the historical evolution of the landscape, but also because the baseline attributes used to map the natural dimension have “real” boundaries which can be readily extracted from existing published maps. The two definitive attributes for Level 1 characterisation are ***landform*** and ***ground type***:

- **Landform** (referred to as “physiography” in other guidance documents) is an expression of the shape and structure of the land surface as influenced both by the nature of the underlying geology and the effect of subsequent geomorphological processes. The attribute of landform at Level 1 is used to define the *relative relief, topography and geological structure* of each LDU.
- **Ground type** is an expression of the soil forming environment and its influence in determining the surface pattern of vegetation and land use. The attribute of ground type at Level 1 is used to describe the nature of the soils / underlying bedrock of each LDU (*soil types*), so as to reflect variations in the process of soil formation related to drainage and soil fertility.

Cultural attributes on the other hand do not usually have such clearly defined boundaries; however, due to the constraints that have historically been imposed on land utilisation by slope, soil fertility and drainage it is often possible to map cultural patterns at the landscape scale using the LDU framework. The two definitive attributes for Level 1 characterisation are ***landcover*** and ***settlement pattern***:

- **Landcover** is the physical material at the surface of the earth. The definitive attribute of land-cover at Level 1 is used to describe the general type of vegetation (natural or man-made) covering the surface of each LDU (*broad landcover classes*)[9].
- **Settlement pattern** is an expression of the structural component of the cultural landscape reflected in the historic pattern of settlement. The definitive attribute of settlement pattern at Level 1 is used to describe the clustering of settlements in each LDU (*settlement density*).

The mapping exrcise is carried out in ***four subsequent Steps***. Each step builds on the outcomes of the previous one in order to define and refine the LDUs. In other words, the LDUs derived at the end of Step 1 according to their landform are subsequently divided (and potentially refined) in Step 2 according to their ground type; the LDUs derived at the end of Step 2 are then further divided (and potentially refined) in Step 3 according to their landcover. The final, fourth step, is used only to describe the LDUs derived at the end of Step 3.

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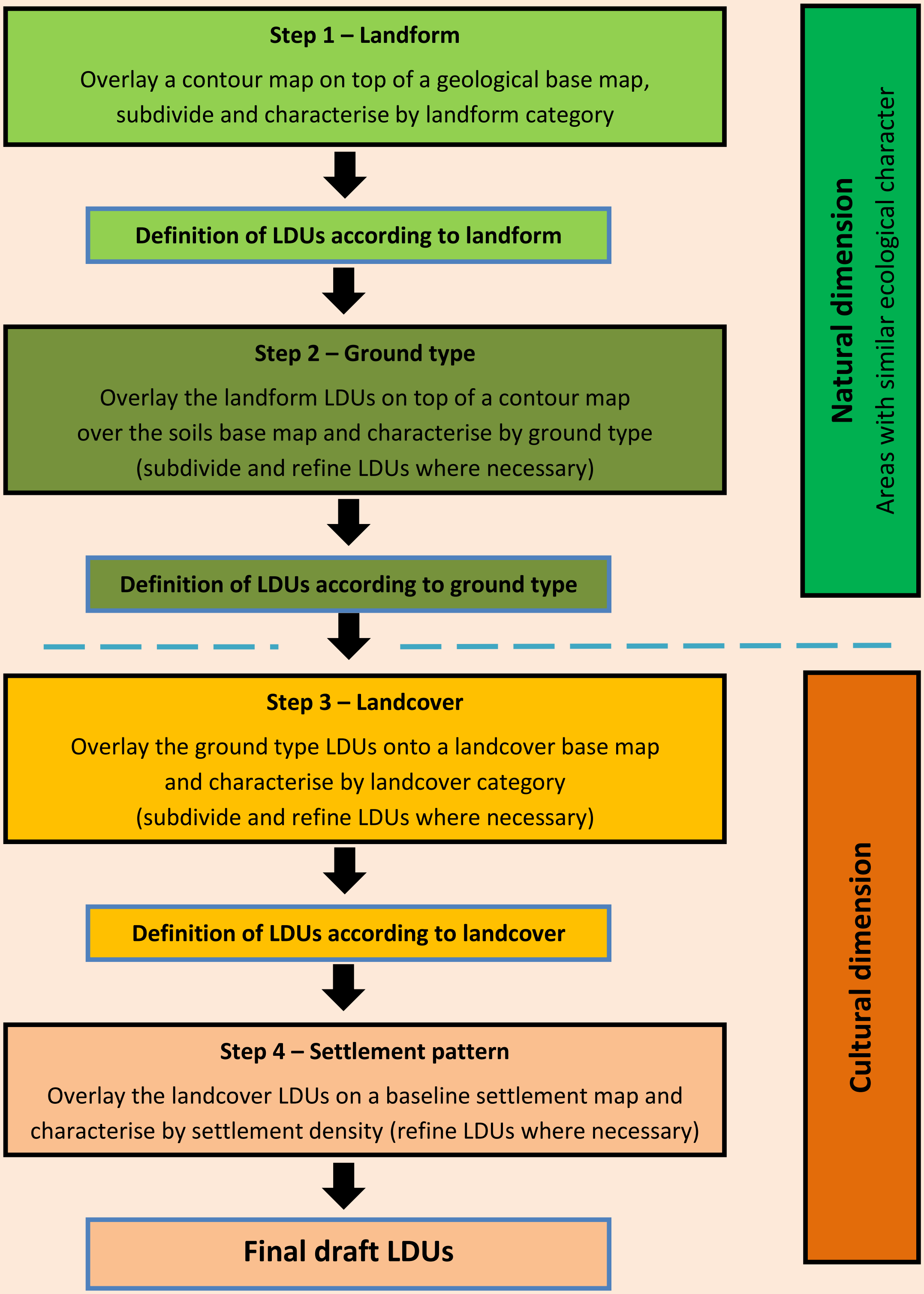
[9] Landcover is an attribute that actually links the natural and cultural dimension of the landscape, since it includes areas with predominantly natural vegetation and areas largely (or exclusively) shaped by human practices. In the Mediterranean context, where virtually all land has diachronically been shaped and transformed by human interventions on the natural environment, landcover is clearly more relevant to the cultural dimension.

Box 3: The steps and outcomes of desktop mapping



The draft Level 1 LDUs defined at the end of the mapping process will be refined and finalised when the field survey process has been concluded (see Chapter 3) and, subsequently, they will be amalgamated to produce the Level 1 Landscape Character Types of the study area (see Chapter 4).

If a Level 2 assessment is to follow, Level 2 mapping will be closely related to –indeed derived from– the Level 1 map. This means that the ***Level 2 mapping process will not start from scratch*** but it will be a more detailed version of Level 1, and the Level 2 LDUs will be derived by modification and subdivision of the final Level 1 LDUs. The process to be followed is similar to that for Level 1, following the same steps described in Box 3 above; what changes is the scale and level of detail. In brief, the Level 2 LDUs:

- are smaller than those of Level 1[10],
- are mapped in more detail, therefore they have more complex (i.e. less generalised) boundaries,
- contain more information in terms of the number of descriptive categories available to characterise the main definitive attributes[11].

Important note:

The definition of LDUs is done **manually**, by digitising polygons on screen. This means that the person who carries out the mapping exercise will have to make a **subjective interpretation** of the underlying data to produce LDUs. Although time consuming, especially for large datasets, this allows the user to have full control over the mapping and characterisation process.

Automated processes and clustering techniques (e.g. by using GIS queries) should be avoided for LDU definition, as they produce very generic results that do not make sense on the ground; on the contrary, such tools are useful as references to guide the manual mapping process (as explained in Chapter 2.4).

The element of subjectivity, which unavoidably enters the process, is not a drawback, provided that clear mapping rules have been set from the onset.

2.2 Required and Available Datasets

Before the process of mapping can begin, all of the relevant, readily available information for the study area needs to be collated as a series of digital map layers stored in a database within the GIS software. Although it is commonly accepted that a scientifically sound typology should be based on detailed information on the distribution, quality and quantity of the necessary attributes, in many cases such information may only be derived from heterogeneous datasets of differing quality. Quality is compromised by, for example: modernity, spatial scale, and area coverage. What is important to know is that some datasets are more easy to find in a usable (i.e. GIS vector) format than others. Particularly in the countries of the East Mediterranean, ***the most common problem is the difficulty to obtain digital datasets related to mapping of the cultural dimension of landscape***.

[10] See Chapter 2.3 for specific suggestions.

[11] For example a simple Level 1 landform category of "valleys" is broken down to "valley floor" or "valley sides" at Level 2; a land cover category of "agricultural land" is detailed as "arable land" or "olive groves", and so on. Detailed guidance is provided in Chapter 2.5.

Satellite imagery is a particularly helpful source of information for landscape mapping and characterisation. Access to satellite images (e.g. orthophotomaps) used to be limited and very costly; the emergence of free and easy-to-use software such as Google Earth helps to overcome this limitation today. Using Google Earth greatly helps to cover limitations posed by missing or low quality datasets, especially in the cultural aspects, but also to test and refine LDU mapping "on the ground", since it allows easy transfer of datasets with the GIS software through the .kml export option. All MedScapes mapping teams have extensively used Google Earth throughout the whole mapping process, positively commenting on its value; the inclusion of Google Earth as an additional "dataset" in the characterisation process is one of MedScapes' innovations.

Figure 3: Using Google Earth as an additional data source for LDU definition

Source: Symons, 2015 (Google Earth background)

Below is a summary table of datasets that can be employed to carry out a proper LCA at Level 1. Most of the basic datasets will usually be available in GIS vector format in all countries. Some other basic datasets (usually the soils, perhaps also the geology), as well as the ancillary data might not be available at all (requiring extensive fieldwork or review and collation of other sources) or be available only in hard copy / raster format. Other useful sources on the other hand, such as Google Earth and DEMs, are free and readily available for use / download on the internet.

Table 2: Required datasets for Level 1 and Level 2 LCA mapping

Definitive attributes		Basic data	Ancillary data
Natural dimension	**Landform**	• Topographic contour map (contour lines of 50m for Level 1 and 20m for Level 2) • A simplified geology map (both Levels)	• Digital Elevation Models (DEMs) • Google Earth • Landform maps (where available)
	Ground type	• National soil maps 1:250,000 (both Levels)	• European or other regional scale soil maps (if national maps are not available) • Specialised soil survey maps (where available) • Soil quality classification maps (where available)
Cultural dimension	**Landcover**	• A recent landcover map (CORINE or equivalent) reflecting surface vegetation (simplified in broad landcover classes for Level 1; expanded in detailed land uses for Level 2)	• Vegetation maps (where available) • Google Earth • Recent satellite images (Landsat, MODIS etc.) if landcover maps are not available (using standard image classification techniques)
	Settlement pattern	• Location of settlements as points-features centroids (latest data available) for both Levels	• Google Earth • Information on settlement type and building styles (usually for Level 2) • Historical data and maps (ancient settlements) • Water sources (spring supplies, groundwater, rivers etc.) as supplementary information for possible explanation of pattern • Cadastral maps where available (showing farm type and land tenure for Level 2)

Source: Adapted from Medscapes WP5 Final report

Important note:

As has been proven in the MedScapes project, the two most important datasets to carry out the LCA mapping exercise are the contour and landcover maps. The project team should thus gear its efforts to secure good topographic and landcover maps, having in mind that the unavailability or poor quality of other datasets (soils, geology, settlement and field pattern data) can largely be substituted by the combined interpretation of topography, landcover and satellite data.

2.3 Preparation for Desktop Mapping

To carry out landscape mapping successfully, you have to set the framework properly prior to start digitising. Below are some key points that have to be considered beforehand.

1. Know your area!

Normally, you will already be pretty much familiar with the study area where the assessment will be carried out. However it is practically impossible to have a complete view of the landscape beforehand. Today's technology provides the opportunity to "visit" places all over the world without having to move from your chair. Take a virtual tour to your study area and familiarise yourself with how the landscape you are about to map looks like. This will help you identify the broad patterns of relief and landcover, which are essential for the mapping and characterisation process.

2. Decide on the level of assessment and the scope of your exercise

First of all, you need to define the scope of your exercise, so as to decide which datasets you will need. A typical example is contour data; if you only plan to carry out a Level 1 LCA, 50m contours (which are easier to find) will be sufficient; Level 2 on the other hand should better be carried out using 20m contours –particularly in areas with intense relief, so commonly found in the Mediterranean.

Ideally, the assessment will be carried out at both Levels 1 and 2, which allows to gradually build the process following the hierarchy presented in Chapter 1.2.5. If though, for time and resource restrictions, a two-level work is not feasible, then the assessment will have to be carried out at an intermediate level; that is, to cover the basic parameters used in Level 1 (as detailed in Chapter 2.4), but incorporating some more detailed aspects normally included in Level 2 (as detailed in Chapter 2.5). This has partly been the case in the MedScapes project, where the difficulty to fully carry out a Level 2 assessment (except for the case of Cyprus) has led the project teams to modify their Level 1 assessments.

Irrespective of the level of assessment, the purpose of the exercise will affect the selection of your definitive attributes, therefore the associated datasets required. For example, a full landscape typology at the national level will require at least the datasets presented in Chapter 2.2 above. In contrast, a study which is specifically designed to inform spatial planning policy, could be sufficiently carried out with good topographic, landcover / land use and settlement data, without needing high quality geology and soil datasets to produce a meaningful classification –in this case though, the analysis of the cultural dimension would probably need to be elaborated to include settlement patterns or building styles or more detailed landcover data so as to properly map the intensity and dynamics of human activities.

3. Decide on the classifications you will use

Once you have established a fairly clear view of the area under study and decided on the definitive attributes and datasets you will use per level of assessment, draft a provisional classification system for each step of the mapping process (i.e. develop a "mapping protocol"). Of course you can always come back later to make amendments to your protocol, but having set the scene correctly from the first place will allow you to win valuable time during the mapping exercise.

Recognising this need, the LCA leading team of MedScapes organised a four-day training workshop during which the basics of LCA have been presented to all mapping teams. A very interesting exchange of opinions during training pointed out the need for partial differentiations in the method; the leading team made the appropriate modifications and produced the Level 1 protocol, to guide the mapping process in the project pilot sites. LCA implementation in the study areas further indicated cases that had not been foreseen in the Level 1 protocol and had to be added afterwards, also setting the scene to develop the Level 2 protocol. Detailed classification suggestions for both Levels are presented in Chapters 2.4 and 2.5.

4. Gather, organise and reference your data

Make sure you have access to all the data you will need. As these will most probably originate from different sources, the first thing to do is georeference all layers in your national projection system and visually check them on screen to assess their quality and identify potential inaccuracies or incompatibilities between them. Some of the data sources might not be available in vector format (for example soil data), therefore you will have to make some manual corrections to make them fit as much as possible to your spatial framework. Other datasets might not be available at all, and you will have to create them from scratch. Such a case could be the contour data; contours can be easily created in GIS using a Digital Elevation Model (DEM) that can be downloaded for free on the internet, so as to avoid the tedious and extremely time consuming process of digitisation from printed maps.

5. Be ready to make some compromises and improvise!

Most probably, some of your datasets will be of poorer quality than others, especially those that originate from printed maps (for example soil maps or historic maps). In this case, you will have to use them mainly for reference, to help you characterise LDUs, avoiding their use for boundary definition; before getting frustrated, keep in mind that some datasets can be substituted by others, without significantly compromising your end result (for example, a combined interpretation of the geology and landcover maps can help you characterise ground type even if your soils basemap is of poor quality). Vector data that has been originally produced in very rough scales (1:250,000 or even higher) can also be compromising the quality of your map; this again refers to the soils layer, but also to the landcover data when it comes to Level 2 mapping. In this case, the satellite layer might come very handy, helping to distinguish landcover patterns on the ground –in some cases soil changes too.

6. Set up the project team properly and consult specialists to help you out where needed

Don't forget that the key for successful landscape mapping is to be able to properly interpret your datasets and make the required simplifications in each step. The person who carries out on-screen mapping has to be familiar with the GIS environment and the basic datasets (that is, at least the topography and landcover layers), but also to have some experience in satellite imagery. Apart from that, you should be ready to consult people that will help you out with the "tough" tasks of the exercise, particularly with the classification and interpretation of geology and soils. In addition, consulting local people, who have a good empirical knowledge of the study area, will help you better understand the character of the landscape and make the "right" decisions in mapping.

7. Set your basic mapping rules

The practical aspects of digitisation are also important to carry out landscape mapping successfully. The basic mapping rules will help you digitise your LDUs at the proper level of detail according to the scale of assessment, saving valuable time during on-screen mapping.

The LCA protocols developed in MedScapes have set out the following simple, yet very significant, rules for the Minimum Mapping Unit (MMU) and zooming scale.

Table 3: Basic mapping rules for Level 1 and Level 2 LCA

	Level 1	Level 2	Notes / comments
Minimum Mapping Unit (MMU)	5 km^2	1 km^2	At Level 2 the MMU can be decreased to 0.25 km^2 for important/sensitive ecosystems. No limit has been set for Level 1 exceptions. N.B. extent should take account of 3D surface in case of steep or vertical landforms (applies mostly at Level 2).
Scale of map	1:250,000	1:50,000	This may refer to either the scale of the information used or the scale of digitisation.
Scale for digitisation	Down to 1:200,000	Down to 1:40,000	When digitising check accuracy of boundaries where possible against satellite imagery. Zoom in where necessary to sample and confirm (e.g. land use / landcover), then zoom out to digitise[12].

Source: MedScapes Level 2 LCA protocol.

2.4 Carrying out Level 1 Mapping

The present Chapter gives a detailed description of the tasks to be taken to carry out on-screen mapping at Level 1. Practical tips and suggestions are provided for each step of the process. The suggested categories for LDU subdivision and characterisation in each step inlcude the whole range of landscape types recorded in the MedScapes project upon completion of Level 1 mapping. Given the wide territorial coverage of the project, these suggestions should cover most cases in the East Mediterranean region. Similarly, of course, they are not relevant for all countries and areas of the region.

2.4.1 Level 1 - Step 1: Landform

Landform[13] is an expression of the shape and structure of the land surface. One definitive attribute is used at Level 1 to define the principal landform of the LDU (informed also by the geological structure).

Data required:

- The principal dataset required is a topographic contour map (50m or 20m contours). Ancillary data such as Digital Elevation Models (DEMs), Google Earth and landform maps where available can be used. DEMs can be used to produce the required contours.
- A simplified geology map, reclassified to show broad rock types (see Table 5 below).

Data processing, key wording and suggested classification:

The definition of landform types is based on a mix of basic geographical terms (i.e. mountains, hills, plains, etc.) and descriptive terms (i.e. uplands, lowlands, etc.), brought together using the topographic concept of “average slope” (measured in % percentages). The key topographic terms to help you understand and apply the suggested classification of Table 4 below are:

[12] Zooming in very closely to digitise is always tempting. Try to avoid this, especially in Level 1 when a Level 2 assessment is planned to follow. Keep in mind that Level 2 mapping is also used to refine Level 1 LDUs.

[13] Landform is also referred to as “Physiography” in other guidance documents.

- Flat (topography): 0-2% average slope
- Gently undulating: 2-5% avg. slope
- Undulating: 5-10% avg. slope
- Rolling: 10-50% (or 10-20% if the “steeply rolling” characterisation is also used)
- Steeply rolling: 20-50% avg. slope (theoretically it might not be used at Level 1)
- Steeply sloping: >50% avg. slope (or 50-100% if the “precipitous” characterisation is also used)
- Precipitous: >100% avg. slope (theoretically it might not be used at Level 1)

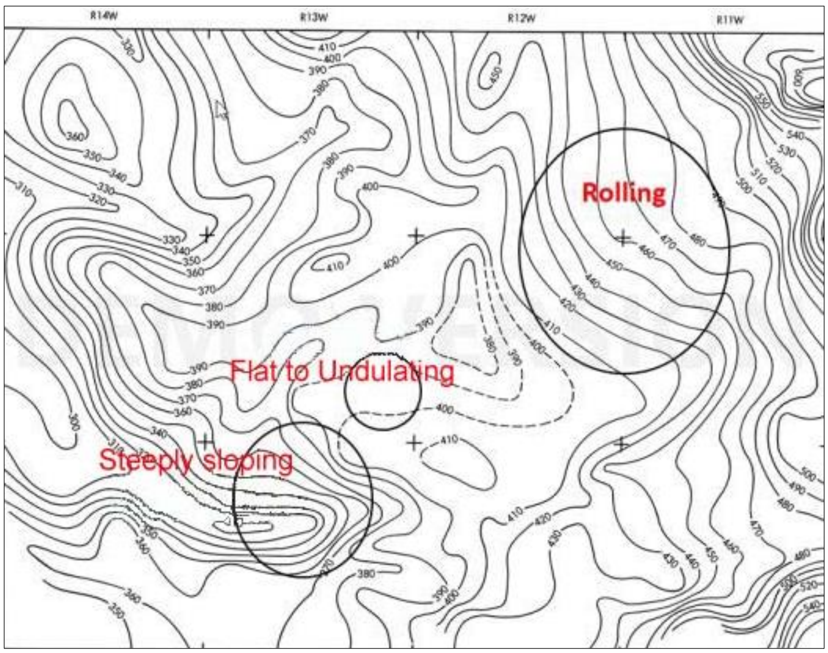


Figure 4: Examples of different slope ranges on a simple contour map

Source: MedScapes Level 1 LCA protocol

It is important to note that the above descriptions refer to ***average slope percentages*** (%), not degrees. Practically speaking, this means that the “steeply rolling” and “steeply sloping” classes describe areas with slopes ranging between 11^{o} to 26^{o} and 26^{o} to 45^{o} respectively, whereas the “precipitous” class describes areas with slope >45^{o}. All of these areas are widely found in the Mediterranean region, which is typically characterised by its intense relief; therefore, a more detailed approach that uses all the above mentioned classes could be useful even for Level 1 assessments in the Mediterranean[14]. That said, the more generalised approach may still produce satisfactory results, partuclarly if a Level 2 assessment is to follow. The suggested landform classes presented in Table 4 are based on this more generalised approach that has been used in the MedScapes Level 1 exercise giving good results in most cases.

[14] This is a decision to be taken at the early stage of the mapping process, depending on the overall character of the area and the scope of the assessment, particularly the possibility or not to carry out a Level 2 assessment afterwards.

Table 4: Suggested landform classes for Level 1 LDU subdivision and characterisation

Class	Description and notes	Code
Plains	Areas with flat (0-2%) to gently undulating (2-5%) topography, lying at the base of rising slopes. They may appear at any altitude.	**PL**
Lowlands	Areas of land generally lying < 200m above **sea** level*. These can be further characterised as **u**ndulating (5-10%) or **r**olling (10-50%).	**Lu** **Lr**
Hills	Somewhat elevated tracts of land (generally between 200-600m above **base** level*), characterised by rolling topography (10-50%).	**H**
High Hills	Similar characteristics to Hills, but standing on higher ground (generally between 400-900m above **base** level*) usually having steeper topography (>50%). High Hills have a mountainous "feel" but are below 1000m.	**HH**
Uplands	Elevated and often extensive tracts of land generally lying between 600-1200m above **base** level*, with variable but mostly moderate relief (typically rolling topography, between 10-50%). Like hills, uplands could have different kinds of relief but it is not suggested to further characterise them as undulating or rolling at Level 1 (this should probably be done at Level 2).	**U**
High Uplands	Similar characteristics to Uplands, but lying on higher ground, which extends into the sub-alpine zone (generally between 900-1750m above **sea** level*). High Uplands are usually found between mountainous areas.	**HU**
Mountains	Elevated and often extensive tracts of land generally lying > 1000m above **base** level*, typically showing peaks, ridges and steep to precipitous slopes. Note that the term Mountain should not be used for a landscape that is not "mountainous" in character, even if it stands >1000m above **base** level; if it doesn't have peaks, ridges or precipitous slopes it should better be classified as Uplands, High Uplands, Plateau or Eroded Plateau.	**M**
High Mountains	Strongly elevated extensive tracts of land, which lie above the alpine zone limit (i.e. generally >1,750m above **sea** level). High Mountain massifs have very variable relief, which ranges from rolling to precipitous, often with escarpments, peaks and ridges. They are likely to have been shaped by glacial and peri-glacial processes in the past, and they have very variable relief and wild, open vistas; they are characterised by sparse alpine vegetation and may have permanent snowfields. Non-extensive mountain peaks which rise above the alpine zone limit should not be further subdivided and characterised as High Mountains, but remain part of the Mountain.	**HM**

Class	Description and notes	Code
Plateaus	Extensive areas with flat (0-2%) to gently undulating (2-5%) topography, found on some altitude (i.e. >200m. above **base** level*). The essential characteristic of a Plateau is that it stands higher than all or most of its immediate surroundings with land falling away from its edge (i.e. it usually stands on top of a mountainous or hilly surrounding); this means that if the land around is rising up then the area is a Plain at some elevation, not a Plateau. Although a Plateau usually has slope angles less than 5%, it may be dissected by small valleys with steeper slopes; in any case, extensive areas of Plateau surface are still evident between the valleys.	**P**
Eroded Plateaus	Extensive areas of elevated land, undulating (5-10%) to rolling (10-20%, but not more), often with dendritic drainage patterns. An Eroded Plateau is a further stage of erosion of an elevated Plateau at which little or nothing remains from the original Plateau surface. An Eroded Plateau resembles a “lowland” relief but it lies at some altitude, with only the alignment of the hill tops and ridges giving a clue to a former pediplain.	**PE**
Valleys	An elongated hollow between hills or mountain ridges, usually with a permanent or seasonal river in the bottom. A stretch of a land deposited by a river (present flood-plain or past river terraces) and enclosed or flanked by erosion slopes. Where the whole valley system stands out in the context of an area with more gentle relief (usually a Plateau or Uplands) the whole valley (including the slopes) should preferably be mapped as a single landform unit, since this is how it looks from a distance or from the edge. In places where the valley sides “blend-in” with the surrounding hill or mountain slopes, it makes more sense to map the valley as the valley-floor only (flood-plain and river terraces), since this will be the thing that stands out visually, ecologically and culturally.	**V**
Deep Valleys (Gorges)	Valleys at least as deep as they are wide, with vertical or near-vertical slopes on large parts of the valley sides, often including cliffs and rock outcrops.	**DV**
Escarpments	Extensive area at any altitude with precipitous topography (>100%), often including cliffs and rock outcrops. At Level 1 escarpments with cliffs that are part of an enclosed valley system will not be subdivided from the valley, but the whole system will rather be characterised as a Deep Valley.	**E**

* Altitude variations refer to relative relief (i.e. difference of altitude from the **base** level) with the exception of “High Uplands” and “High Mountains”, where absolute relief (i.e. difference of altitude from **sea** level) is taken into account. “Lowlands” are also based on absolute relief, except if the base level is under sea level, where relative relief is taken into account. See more at the discussion section in the end of Step 1.

Source: Adapted from MedScapes WP5 Final Report

Figures 5 and 6 below show some "real life" examples of distinct landforms and other issues described in Table 4, to help better understand the key points involved in landform mapping.

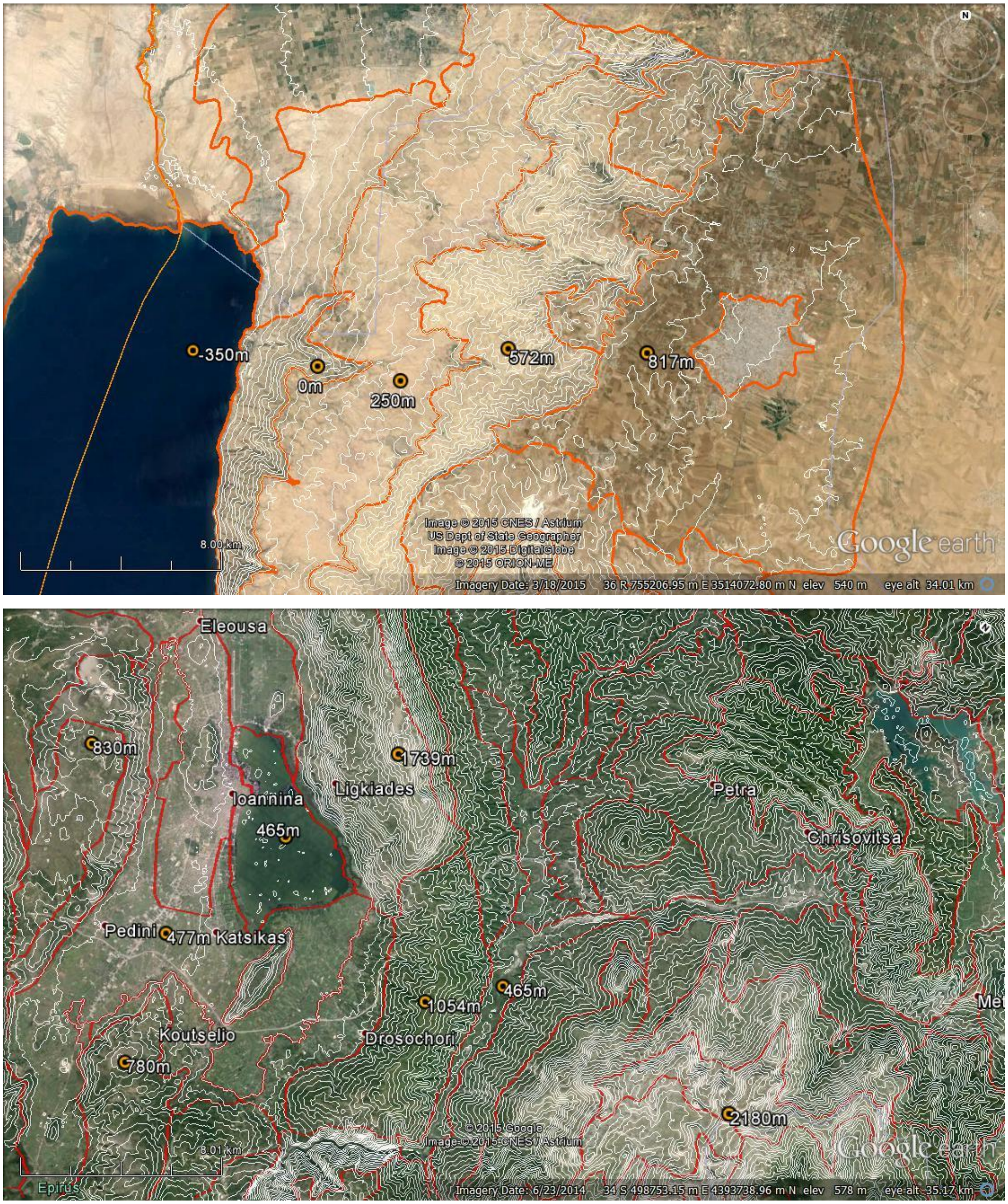


Figure 5: Examples of relative relief patterns on the satellite image

Base level ranging from 350m *below* sea level (Dead Sea, Jordan) to 465m *above* sea level (Ioannina Lake, Epirus).

Source: Symons, 2015 (Google Earth background)

Figure 6: Relief difference between a plateau and an eroded plateau

Examples from Jordan showing how a plateau (left) and an eroded plateau (right) look in reality and on the contour map (above).

Source: Symons, 2015 (Google Earth background above)

Geology in the MedScapes approach ***is not used to characterise LDUs***, but only to inform LDU boundary defintions[15]. Even so, you should be able to produce a simplified map that shows the main geological variations of the study area. If there is no geologist in the study team, don't lose unnecessary time trying to interpret a complicated geological map; contact a specialist and seek his advice to define the basic rock types of the study area and, most importantly, to make the necessary reclassifications (groupings) to produce your simplified map. The same applies for the soil types layer (Step 2), which is largely

[15] Geology is used as a definitive attribute only at Level 2.

related to the geology, so it is preferable to do both tasks in one session, making sure that both layers are compatible to each other[16].

The number of classes you will have in the end depends on the geology of the area; as a general rule though, it should range between 6-9 broad types. Table 5 below gives some suggestions that could assist your work. Note that the classification presented below will also be used at Level 2, this time for characterisation purposes.

Table 5: Suggested classification of geology (rock types)

Rock Type	Code
Alluvium/fen peat	**W**
Clay/mudstone	**C**
Soft sandstone/sandy drift	**S**
Mixed soft rock	**M**
Limestone & Chalk	**L**
Flysch	**F**
Igneous/Metamorphic rocks	**I**
Other hard rocks	**P**

Source: Adapted from MedScapes Level 2 LCA protocol

Steps to be taken

Step 1: Add the topographic map (contour lines should be at 20m or 50m). Start with topography layer only and identify main landforms (steeply sloping to precipitous; rolling; undulating; and flat to gently undulating).

Step 2: Bring in the geology layer and overlay both layers on-screen.

Step 3: Define significant relief variations based on the significant change of form (frequency of contour lines and variation of line shapes). Then define new polygons and integrate large units by combining contour lines with geology to define Level 1 landform.

Step 4: Create an attribute called *Landform* in the GIS database (attribute table of the shapefile) and insert a definitive code for each LDU using the codes of Table 4.

[16] As proven throughout the MedScapes project, geology and soils (ground type) are not as important as they were initially thought to be for the characterisation process; this is why they have been used only as *descriptive* attributes. Even so, they help to acquire a better understanding of the character of the study area, enabling to better interpret variations of the two main *definitive* attributes: landform (topography) and landcover. Therefore, it is worth consulting a specialist even for a day's work (and mentoring); this will most probably pay out during the whole mapping and characterisation exercise that follows!

Advice and suggestions

- ✓ Pan through your study area before digitising, to capture the whole picture.
- ✓ Decide which is going to be your base level. This is easy in insular and coastal areas (such as Lesvos and Lebanon), where the sea will be your base level. In mountainous areas (such as Epirus), your base level will most probably be a flat area (plain or lake) which stands amidst higher and steeper grounds. In areas located lower than the sea, your base level will be something similar, such as the Dead Sea in Jordan.
- ✓ Once you have decided on your base level, the interpretation of landform classes shown in Table 4 will become much more apparent than it seems at first glance. For example, you will immediately know if "lowlands" exist or not in your area (and where they generally are), which is roughly the absolute altitude above which you will be looking for "hills", "high hills", "mountains" and "uplands", and so on. Finer interpretations, such as "high uplands", may come through later on, after the basic landforms have been identified.
- ✓ Digitise using a fixed scale for the layers; 1:250,000 could zoom in to 1:200,000. Don't go below!
- ✓ Creating a slope raster layer from the DEM will assist you to identify the main variations of relief when digitising; classify the slope raster into % ranges corresponding to the relief classifications used in Table 4 (you can also use generalisation filters to reduce "noise", but be careful not to over-generalise). Use appropriate colour schemes to make the interpretation of relief classes easier for the eye (see examples in Figure 7).
- ✓ Digitise using free form and start mapping with the prominent / distinct landforms; then see what's left (e.g. flat areas with hills dispersed inside).
- ✓ Remember that the priority is to define overall landform, you don't have to overanalyse at this stage; therefore do not use the suggested altitude and slope categories 100% strictly, keeping in mind the keywords "average" (for slopes) and "generally" (for altitudes).
- ✓ Most importantly, don't try to extract the landform classes by creating automatic queries in the GIS!
- ✓ Draw polygons following the contours as much as possible, avoiding cutting contours vertically.
- ✓ Use geology as a means to interpret the contour map: Geology is used to guide and confirm the definition of polygons where relief changes are observed; if landform does not change above two geological types, do not subdivide LDUs.
- ✓ Geology should only be used to subdivide a landform unit if the geology itself makes a strong visual impression when checked against the satellite image (e.g. dominant colour or repeated rock outcrop features) (see Figure 8).
- ✓ Geology is more useful as a guide to define the polygons in cases of river valleys.
- ✓ Geology is not a descriptive attribute at Level 1: Characterise with the same code polygons that have common landform yet different geology; their difference will show in the next step, of ground type characterisation.
- ✓ Landform boundaries should ideally follow clear "breaks in slope" that are related to geological boundaries; where there is no obvious break in slope (e.g. the transition between the dip slope of an

escarpment and an adjoining vale) a "best fit" line (i.e. a line that has been adjusted to match the surface landform) should be defined to reflect the geological boundary.

✓ Contours are "heavy" datasets, that slow down the process of panning around the map (especially if you are using 20m contours), therefore it might be useful to "crop" your data for the study area only (this suggestion could apply to all datasets). If you do so, remember to use a sufficient buffer zone around the boundaries of your area, so as to be able to properly map the outlying polygons[17].

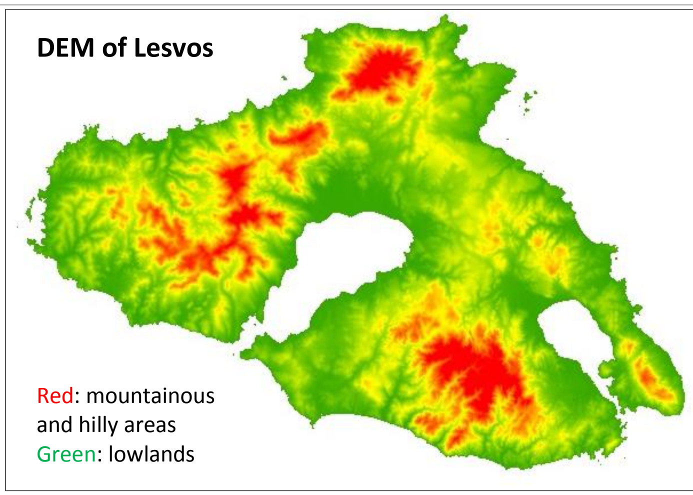


Figure 7: Ancillary sources for landform mapping; a DEM showing main landforms and a slope raster map showing main topographic variations

Source: MedScapes Lesvos Level 1 report and Epirus LCA database

[17] Don't forget that landscape knows no administrative boundaries! One of the most interesting aspects of the final mapping work is to see how the landscape of your study area fits with the adjacent ones; this is also helpful in case where the neighbouring community decides to undertake a similar exercise in the future.

Figure 8: Changes in geology making a strong visual impression on the satellite image

Source: Symons, 2015 (Google Earth background)

Discussion:

- The initially suggested landform classes (presented at the LCA training workshop) gave more emphasis on the geological aspect rather than on the topography of the landscape. This practice may be more suitable for the UK (where the LCA is based) and Northern Europe, but it has shown not to work so well in the Mediterranean context; consequently, the landform classes used for landscape characterisation in the project have been adapted in the LCA Level 1 protocol to reflect the topography of the landscape, using geology only as a supplementary attribute. It is also worth noting that the MedScapes method produced some additional landform classes to those originally proposed, to describe the Mediterranean landscape character; these are "deep valleys" (Epirus, Lebanon, Jordan), "high mountains" and "high uplands" (Epirus, Lebanon), "eroded plateaus" and "escarpments" (Jordan).
- Landform classes, as presented above, are strongly related to altitude and relief patterns. Practice has shown that altitude and relief should not be interpreted in absolute terms, but rather in relation to the surrounding topography. This is why most of the suggested altitude categories refer to the base level of the study area and not sea level in general. This allows to maintain a homogenous approach in areas which stand on a generally high altitude (as in Epirus, where the base level roughly corresponds to the two big plains of Ioannina and Konitsa at 400-500m above sea level) or in areas standing below sea level (as in Jordan, where the Dead Sea [420m below sea level] has been considered to be the base level of the study area [see Figure 5]). However, there are cases where

absolute relief has to be taken into account, particularly if a systematic, national level, typology is to be produced. This applies to "lowlands", which by definition are found in low altitudes near the coast, "high mountains", which are characterised by the dominant factor of alpine vegetation formed >1,700m above sea level, but also "high uplands", which stand on higher ground than "uplands".

- Further to the previous point, practice has shown that absolute interpretations of altitude and slope do not work for landform characterisation. To this respect, automated processes to create landform LDUs should definitely be avoided as they fail to capture the character of the landscape.
- The topographic classification presented here seems a bit overanalytic at first glance. However, practice has shown that if the classification has not been properly and clearly decided from the onset of the mapping process, it will result in significant loss of time to amend LDUs afterwards.
- "Rolling" topography has a very broad definition (10-50%) at Level 1. Normally, further distinctions can be added at Level 2 (i.e. rolling 10-20% and steeply rolling 20-50%). However, due to the generally intense relief variations found in the Mediterranean, the study team may decide to use the more detailed classifications for Level 1 too. In any case, since slope angles are most likely based on assessment of the 50m contours, in the field you will find some steeper areas than these averages.
- One of the most tricky aspects of mapping has to do with valley boundaries definition. As mentioned already, the proper way to do that is by finding the clear break of slope. This, in practice, is the point beyond which a standing person loses sight of the valley bottom; therefore, despite all theoretical suggestions and advices, this can usually be identified only on the spot rather than on a 50m contour map. In addition, as reported from both Greek case studies, a dilemma has arised as to whether settlements should be mapped as part of the valley or inside the adjacent mountain / hill (this is important to know because it affects the settlement characterisation to be made later on, in Step 4). Field survey might also be necessary to determine this; in this case LDUs might have to be refined after fieldwork and the algorithm of Step 4 should be re-run to finalise the LDU characterisation. In both cases, the significance of field survey has been proved for proper landscape characterisation.

2.4.2 Level 2 - Step 2: Ground Type

Ground type is an expression of soil formation. One definitive attribute is used at Level 1 to describe the nature of the soils / underlying bedrock to reflect variations in the process of soil formation related to drainage and soil fertility.

Data Required:

- Soil maps (preferably national level maps at 1:250 000 scale).

Data processing and suggested classification:

Ground type is mostly ***used to characterise, rather than subdivide, LDUs***, using soil type data to reflect the nature of the underlying bedrock in relation to the vegetation patterns observed on the earth's surface; in other words, ground type is used as a ***descriptive*** attribute, which provides information to (a) refine the geology (that has not been used to characterise LDUs in Step 1) and (b) better understand the landcover and vegetation patterns you will come across next, in Step 3. Step 2 will allow you to distinguish LDUs that have the same landform but different geology (a difference that didn't show in Step 1).

Table 6 below provides a brief overview of indicative soil classes that cover the two essential parameters of soil drainage and fertility[18]. For most projects this should be enough to help characterise LDUs according to ground type; however, it remains with the study team to consult local experts and attempt to classify soil types differently if the scope of the assessment demands a more refined approach. Soil type classification will in any case resemble the geology classes, as ground type is derived from the underlying geology (an example is shown in Figure 9 below).

Table 6: Suggested soil classes for Level 1 mapping

Class	Notes	Code
Impoverished soils	Impoverished sandy and coarse loamy soils Podzolic soils Brown podzols	**D**
Shallow soils over chalk & limestone	Lithomorphic soils -shallow soils formed directly over rock, or soft unconsolidated sediments Rankers (humic and mineral) Rendzinas Sand rendzinas Alluvial rendzinas	**R**
Deep Brown soils	Brown soils -free draining, brownish or reddish, loamy soils Brown earths (calcareous and non-calcareous) Brown sands (calcareous and non-calcareous) Brown alluvial soils (calcareous and non-calcareous) Argillic brown earths (calcareous and non-calcareous) Paleo-argillic brown earths (calcareous and non-calcareous)	**B**
Heavy clay soils	Free draining, brownish or reddish, loamy soils Pelosols (Typical and Argillic)	**G**
Alluvial (wetland) soils		**W**
Terrestrial raw soils	Un-vegetated coastal sand dunes	**T**
Raw gley soils	Mud flats or salt marsh	**Rg**
Volcanic soils		**V**
Organic soils		**O**
Arid, semi-arid soils		**S**
Mixed soils		**M**

Source: MedScapes WP5 Final Report

[18] A more detailed overview of soil types with reference to the vegetation patterns they sustain and common international soil type classifications is presented in Appendix 1.

Steps to be taken

Step 1: Create a new LDU layer (named *LDU_Step2* for example) and make any modifications based on ground type definition to the new layer (this will allow you to track down the process of LDU definition and characterisation at the end of the process).

Step 2: Characterise according to ground type the LDUs (polygons) resulting from Landform (Step 1), refining boundaries or subdividing where necessary.

Step 3: Create an attribute called *Groundtype* in the GIS Database (attribute table of the shapefile) and insert a definitive code from Table 6.

Advice and Suggestions

- ✓ Avoid further LDU subdivision unless it seems really necessary; soil changes will normally show on the vegetation patterns of Step 3 (Landcover) allowing you to make the required subdivisions.
- ✓ On the contrary, you may use this step to refine landform LDU boundaries, provided that the soil layer is more accurate than the geology.
- ✓ Soil changes are sometimes evident from satellite imagery, as well as on the ground (in fieldwork).
- ✓ Thus, if you decide to subdivide or refine polygons based on ground type, (a) remember to consult your satellite layer and (b) try to seek (where possible) a “best fit” line that reflects a change in land-form (e.g. the contour line defining the edge of a river floodplain) or in landcover (see also Step 3).

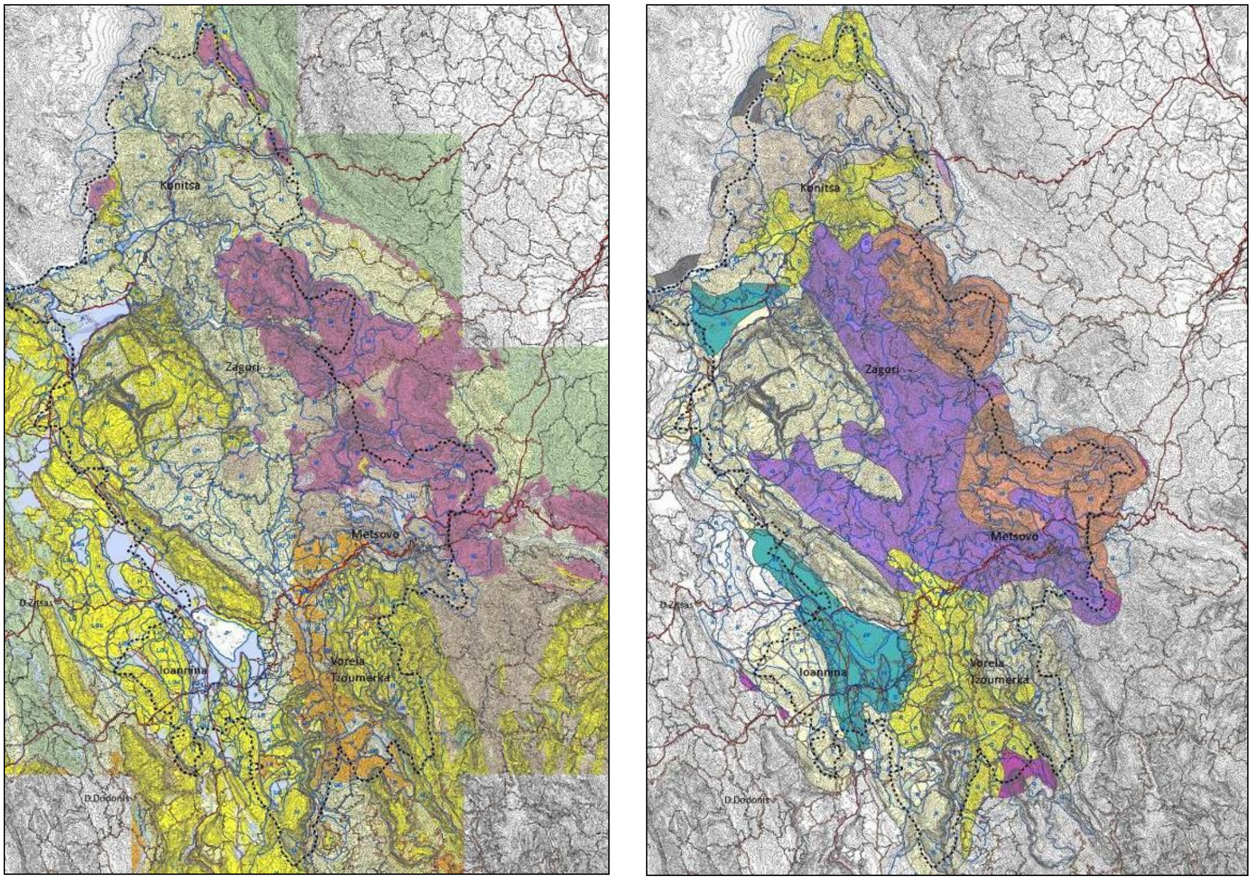


Figure 9: Similar patterns of geology and soil type in Epirus

Left: Geology layer, dominated by limestones (yellow), flysch (beige) and serpentines (scarlet)

Right: Soil type layer, dominated by leptosols (beige), luvisols (purple) and cambisols (orange)

Source: MedScapes Epirus Level 1 report

Discussion:

- The attributes of geology and soils seem to have limited usefulness in the characterisation process, as commonly reported from all MedScapes partner teams. The relevant datasets are usually available at a coarse scale[19] and they often exist only in raster / hard copy format; furthermore, their interpretation is difficult and time consuming, requiring extensive reclassification and expert knowledge. Hence, it is advisable to put more emphasis on the landform, landcover and settlement attributes, using geology and soils mainly as supplementary / explicatory information; this methodological shift in comparison to the original method applied in Northern Europe will enable the LCA process work more efficiently and effectively, particularly in the East Mediterranean context.

[19] For example, the European soils database, which provides a common framework for the whole of Europe, is very rough in detail to be considered as a valuable source of information, whereas alternative sources that can be found nationally (or locally) have different classifications.

2.4.3 Level 1 - Step 3: Landcover

Landcover is the physical material observed at the surface of the earth. Land covers include grass, trees, bare ground, water, etc. One definitive attribute is used at Level 1 to define the principal landcover pattern of the LDU according to a broad, simplified classification.

There are two primary methods for capturing information on landcover: field survey and analysis of remotely sensed imagery. In Europe, the Corine Land Cover database provides a consistent and reliable source of information which is readily available in vector format. In the Middle East, other sources of information (e.g. landcover or vegetation maps from the pertinent Ministries of Environment or of Agriculture) should be sought in order to avoid conducting primary data analysis.

Satellite imagery (Google Earth, Cadastral Service base maps, etc.) is in any case a useful source of ancillary information, as it allows for an informed interpretation and refinement of landcover in cases where the landcover base map fails to depict the “real” landcover of the area due to its outdated or coarse data[20]. Vegetation maps, if available, are also useful sources, as they may provide more detailed and refined information than the Corine database.

Data Required:

- Core information: Recent landcover map (CORINE or equivalent), reflecting surface vegetation.
- Recent satellite images (Landsat, MODIS etc.) if landcover maps are not available (using standard image classification techniques); these are useful to have in any case.
- Vegetation maps, if available, as additional sources for landcover verification.

Data processing and suggested classification:

The aim at Level 1 is to map broad landcover patterns so as to describe the physical cover on the earth’s surface. More refined classifications are used at Level 2 (see Chapter 2.5), where the aim is to describe land use (which involves the management and modification of natural environment by humans)[21].

Table 7 below provides a general landcover classification that is suitable for Level 1, with reference to the relevant CORINE classes[22]. Note that the suggested classifications of Table 7 may be used in combination (mixed landcover characterisations) if an LDU cannot be sufficiently described by a single dominant landcover pattern[23].

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[20] For example, the CORINE database dates back to 2000 (with some amendments in 2006) and presents some inaccuracies due to the inherent limitations of the satellite imagery analysis on which it is based.

[21] This hierarchical process has worked quite well in MedScapes; nevertheless, as pointed out in previous sections, the study team may decide to expand the landcover classification to include characteristic vegetation patterns of the Mediterranean, particularly if a Level 2 assessment is not planned to follow. This will usually refer to agricultural lands, where additional classes may be added to describe, for example, permanent crops (such as “vineyards” or “olive groves”) or “terraced cultivations”.

[22] For suggestions on landcover classification for Lebanon and Jordan, please refer to Appendix 3.

[23] This can be the case when significant patches of cultivated land appear inside LDUs with forests or scrubs (reported from Epirus) or rangelands occur in combination with agricultural lands or bare lands (reported from Jordan); mixed landcover characterisations have been used in Lebanon, Jordan and Epirus.

Table 7: Suggested landcover classification for Level 1 mapping

Class	Description*	Notes**	Code
Artificial surfaces	Urban; Industrial, commercial and transport units; mine, dump and construction sites; artificial non-agricultural vegetated areas. Corresponds to the general landcover class 1 of Corine. Will be further divided at Level 2.		**A**
Agricultural areas	Arable land, permanent crops, horticultural crops, enclosed pastures, mixed agriculture. Corresponds to the general landcover class 2 of Corine. Will be further divided at Level 2.		**G**
Forests	Natural forests (including dense sclerophyll maquis); Artificial forests (plantations). Corresponds to the landcover class 3.1 of Corine, but may also include areas from Corine classes 3.2.3 and 3.2.4. Will be further divided at Level 2.	Mediterranean forests may be dense or open in structure with tree cover as low as 10%, often mixed with scrub and dwarf scrub. Dense maquis is indistinguishable from low forest without exhaustive field checking, therefore it should probably be mapped as Forest at Level 1 and be further subdivided at Level 2.	**F**
Scrubs	Includes more open maquis, garrigue and other mixed scrub (except +/- pure stands of dwarf shrubs). Corresponds to the landcover class 3.2.2 of Corine, but may also include areas from Corine classes 3.2.3 and 3.2.4. Will be further divided at Level 2.	Typically sclerophyl shrub species attaining 1m+ in height. Larger shrub species cover at least 10% of the ground, trees are scattered or absent, with <10% tree cover.	**S**
Rangelands and rough grazing	Dwarf scrub, hedgehog scrub, phrygana, often mixed with annual grasses and herbs, typically grazed by free-ranging goats and/or sheep. May correspond to landcover class 3.2.1 of Corine, but could also include areas from other Corine classes (mostly 3.3.3).	Vegetation usually is < 0.5m in height, consisting of aromatic, xerophytic and drought-adapted shrub species. Vegetation cover ranges from 5% to 100% (depending on climate and grazing intensity); of this, dwarf shrubs form >20% and larger shrubs are <10%.	**R**
Bare land	Land with exposed bedrock, boulders, rocks, gravel, etc. with virtually no vegetation nor any specific clear use. Corresponds to landcover class 3.3.1 of Corine, but may also include areas of class 3.3.3.	Total vegetation cover < 5%, no trees or shrubs. Note: Truly bare land is actually scarce (even in arid areas); most of it is sparsely vegetated rangelands (rough grazing areas).	**B**

Class	Description*	Notes**	Code
Wetlands and Water Bodies	Inland wetlands like marshes and peatbogs; Coastal wetlands like salt marshes, salines and intertidal flats. Inland waters like water courses and water bodies; and Marine waters like estuaries and coastal lagoons.	Depending on the case, Wetlands and open Water Bodies (lakes, reservoirs, lagoons) could be separated, using codes WE and WA respectively, keeping the code W only for water courses (rivers).	**W**

Source: Adapted from MedScapes WP5 Final Report

* This column provides suggestions for the required layer groupings when using the Corine landcover database, to facilitate the mapping and characterisation process. Unfortunately though, Corine maps are not always reliable to properly distinguish maquis forests from shrublands, and shrublands from rangelands (either because of the scale of digitisation or due to the fact that the Corine maps date back to the year 2000). Therefore, the process of subdividing and characterising LDUs should preferably be assisted by satellite imagery too.

** The figures in this column are indicative, as it is not practically possible to measure them with precision; they are provided to give an idea of the main differences between each class, to facilitate the characterisation process.

Steps to be taken

Step 1: Create a new LDU layer (named LDU_Step3 for example) and make any modifications based on landcover definition to the new layer (this will allow you to track down the process of LDU definition and characterisation at the end of the process).

Step 2: Overlay the provisional LDU boundaries (polygons derived from Steps 1 and 2) onto a simplified landcover base map (e.g. CORINE), subdivide and characterise using the broad landcover categories presented in Table 7.

Step 3: Create an attribute called *Landcover* in the GIS Database (attribute table of the shapefile) and insert a definitive code from Table 7.

Advice and suggestions

✓ Keep in mind that polygons are based on landform, which remains until the end a dominant factor / attribute on landscape variation:
  - The broad classifications of Level 1 do not always allow to properly describe the landcover of an LDU with a single characterisation. As mentioned above, in such cases it is preferable to use mixed characterisations (e.g. Forest / Agricultural) rather than trying to make additional LDU subdivisions that do not conform with the landform, as these will not make any sense on the ground.
  - Two LDUs of urban areas with different landform should remain separate.
  - As an exception only, you may merge small LDUs for which you were not certain if they should have been subdivided in Steps 1 and 2 (ex post correction).

- ✓ Keep the contour layer visible on screen. This will help you decide if you will subdivide or not an LDU based on landcover; it will also help you find a “best fit” line in cases when you are not certain of where to draw the new boundary (e.g. following the contour line that defines the edge of a river floodplain).
- ✓ Clear differences in landcover may also help you refine LDU boundaries; similarly with the previous suggestion, avoid adjusting LDU boundaries if there is no clear break of slope.
- ✓ The landcover layer will also assist you to cross check and correct, if deemed necessary, ground type characterisations (and subdivisions, if you made any) of Step 2.
- ✓ Remember that landcover maps are not always accurate, or updated. When in doubt, bring in the satellite layer and check for any inconcistencies, so as to make the proper characterisation.
- ✓ In case when the satellite image reveals that a formerly uncultivated area is now cultivated, map and characterise as “agricultural” (present landcover / land use dominates landscape character).
- ✓ Similarly, if a formerly cultivated area is now abandoned but still shows clear evidence of former agricultural use (such as boundary walls, terraces, rows of untended trees), map and characterise as “agricultural” (land use of recent past still determines visual landscape character) unless the evidence of former use is no longer readily visible due to succession to scrub or forest.

Discussion:

- Landcover is an expression of the type of vegetation (natural and man-made) covering the land surface. Depending on the scope of work, landcover could be analysed in different ways, either placing emphasis on general variations or expanding the classification to include particular, characteristic anthropogenic uses of the land. The second option could be more suitable for the Mediterranean context, which is characterised by the dominant presence of human induced activities virtually everywhere; however, the final decision depends on the scale of the assessment and the possibility or not to carry out an LCA in both Levels 1 and 2; this has been the case in MedScapes, where it has been decided to keep a simple, broad classification at Level 1 and expand the landcover analysis to more detailed land uses in Level 2.
- Nevertheless, some adjustments had to be made in the course of the project, to include important vegetation types of the region. The landcover class of “Rangelands and rough grazing” has been added to the final MedScapes Level 1 protocol, in order to provide a common characterisation for low vegetation areas that are used for grazing –so commonly found in the Mediterranean. Such landcover may occur either as a result of grazing (i.e. in Uplands and High Uplands), or as a natural result of climatic conditions (i.e. in the alpine zone of the High Mountains). The former case has been initially characterised as “Bare Soil” in Jordan and as “Natural Grassland” in Lesvos, Greece; the latter case has been initially characterised as “Alpine Fields” in Epirus, Greece. In any case, experience has shown that truly bare land is actually scarce (even in arid areas); most of it is sparsely vegetated rangelands (rough grazing areas). Some examples are presented in Figure 10 below.
- Distinguishing “forests” from “shrublands” may be quite difficult in some cases, also as a result of outdated data (which sometimes characterise as “shrubs” areas that actually appear as forests on the ground). This is a case where recent landscape dynamics can be indirectly observed, and it may be a good way to start recognising dynamic / changing parts of the landscape, where focus should be given at the next stages of the LCA process (see management and decision making).

- The use of vegetation maps in Greece has been a very useful source of information, as it provided detailed spatial information for the types of forests and shrubs, the agricultural uses and, quite importantly from a landscape management perspective, the abandoned agricultural uses. Such kind of detailed information is evidently very helpful to carry out Level 2 LCA, however it proved quite useful at the scale of Level 1 too.
- In all cases, the use of satellite imagery has proved very useful to confirm patterns and boundaries that could not be properly picked up by the (often outdated and/or inaccurate) landcover maps; ideally, satellite images at different seasons and years (now available in Google Earth) should be consulted to make the best possible interpretation of landcover.

Figure 10: Examples of different rangeland types in the project countries

Source: Symons, 2015

2.4.4 Level 1 - Step 4: Settlement Pattern

Settlement Pattern is an expression of the structural component of the cultural landscape reflected in the historic pattern of settlement. As with each of the previous steps, one definitive attribute is used at Level 1 to describe the broad pattern of settlement density.

Data Required:

- Core information: Location of settlements as points - feature centroids (use latest data available).
- Supplementary information for possible explanation of settlement pattern (causal factors):
    - Historical data and maps (ancient settlements).
    - Water sources (springs, groundwater patterns, rivers and streams).

Data processing and suggested classification:

Settlement pattern analysis is the least well developed part of the characterisation process mainly due to the difficulty in obtaining coherent and useable map data. Typically, the LCA method uses a combination of settlement density (or clustering) and settlement type (or dispersion / compactness), possibly including farm type data too, to describe the character of the cultural landscape. The MedScapes partners have decided to use only settlement density as a definitive attribute for Level 1 mapping, to produce a first, broad, description of the cultural pattern of the landscape (in addition to the landcover analysis of Step 3), considering that settlement compactness is not a property of the landscape but of every village (i.e. the pattern of the houses within villages), but also due to the unavailability of settlement type data. In this sense, Step 4 has been used ***only to characterise and not subdivide LDUs***[24].

Table 8 below presents the suggested classification for settlement pattern characterisation. Once again, depending on the scope of the exercise, you may choose to merge some of the suggested classes to fit better the character of your study area (as has been for example the case in Lesvos, shown in Figure 11).

Table 8: Suggested settlement classes for Level 1 mapping

Class	Description	Code
Unsettled	Areas with no settlements	**U**
Settled - Closely spaced	The distance between the 3 neighboring centroids of settlements is between 1-2 km	**Sc**
Settled - Medium spaced	The distance between the 3 neighboring centroids of settlements is between 2-3 km	**Sm**
Settled - Sparsely spaced	The distance between the 3 neighboring centroids of settlements is >3 km	**Ss**
Urban	Cities, and other large built up areas greater than 10 sq.km in extent	**Ur**

Source: MedScapes Level 1 LCA protocol

[24] Some MedScapes partners chose to make limited LDU subdivisions based on settlement pattern, but that has not been the rule.

Steps to be taken

Step 1: Measure clustering of settlements: Use ***Nearest Neighbour Analysis*** (ArcToolbox -> Spatial Statistics -> Average Nearest Neighbour) selecting the ***kernel density estimation method*** which allows the average distance of each settlement (centroid of settlement) from the 3 nearest surrounding settlements to become a mapable parameter.

Settled areas will then be distinguished in areas of ***closely-spaced*** (1-2km), ***medium-spaced*** (2-3km) or ***sparsely-spaced*** (>3km) settlements. Areas without settlements will be characterised as ***unsettled***.

Step 2: Overlay onscreen the kernel density layer with the LDUs resulting from the previous step, of landcover mapping. Characterise each LDU according to the observed settlement density but don't subdivide further; if necessary to subdivide in exceptional cases, remember to create a new LDU layer first.

Step 3: Create an attribute called *Settlement* in the GIS Database (attribute table of the shapefile) and insert a definitive code from Table 8.

Advice and suggestions

- ✓ An alternative classification, which has been used by the Lesvos team, is to have two sub-categories for "settled areas" (instead of three as suggested in Table 8 above): "Settled" and "Sparsely Settled". In this case, the average distance threshold is suggested to be set at 5km.
- ✓ The use of the algorithm will allow you to make a first characterisation of settlement pattern, but it should always be checked on the ground and refined afterwards according to the perceived character on site. As a general rule, "settled" areas are those where you will see several settlements when you look around, whereas in "sparsely settled" areas you will only see one or two settlements when you look around.
- ✓ Similarly, it is very likely that a remote LDU which only contains one settlement should probably be characterised as "unsettled" although the algorithm will, obviously, indicate it as "sparsely settled".
- ✓ In any case, note that the "urban" characterisation will not result from the nearest neighbour analysis, but it will be given to LDUs characterised as having "artificial" landcover in Step 3.
- ✓ As mentioned above, settlement pattern has only been used to characterise and not subdivide LDUs. As an exception, it could be used to subdivide an LDU only if it is a large one (e.g. over 100 sq.km) and if there are clearly two parts of the polygon with quite distinct settlement patterns (see an example from Jordan in Figure 12 below).

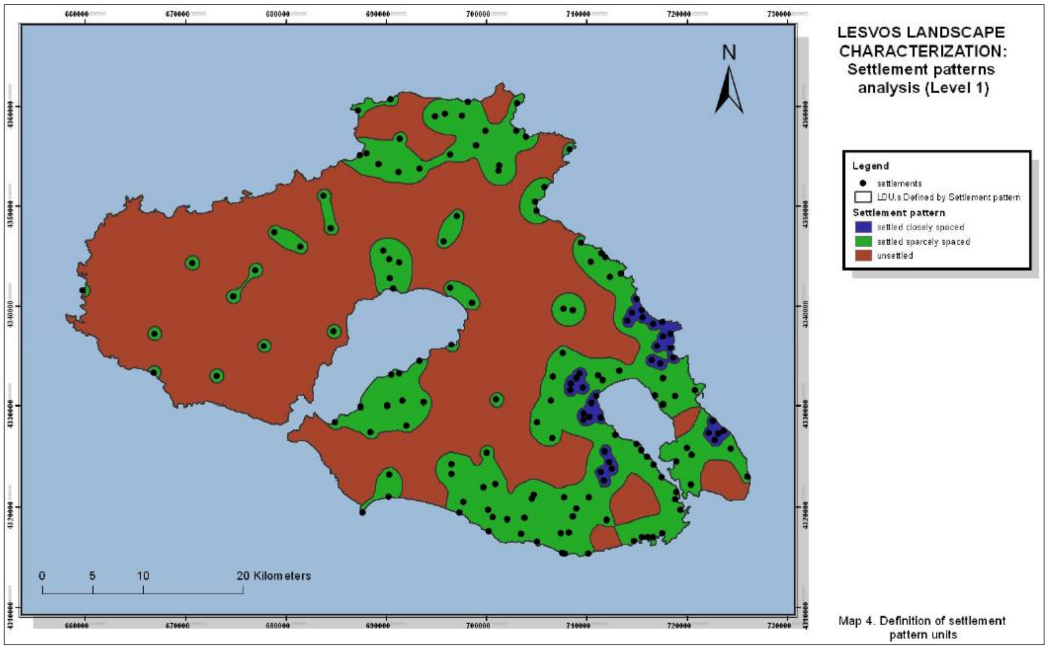


Figure 11: Settlement density map of Lesvos

Source: MedScapes Lesvos Level 1 report

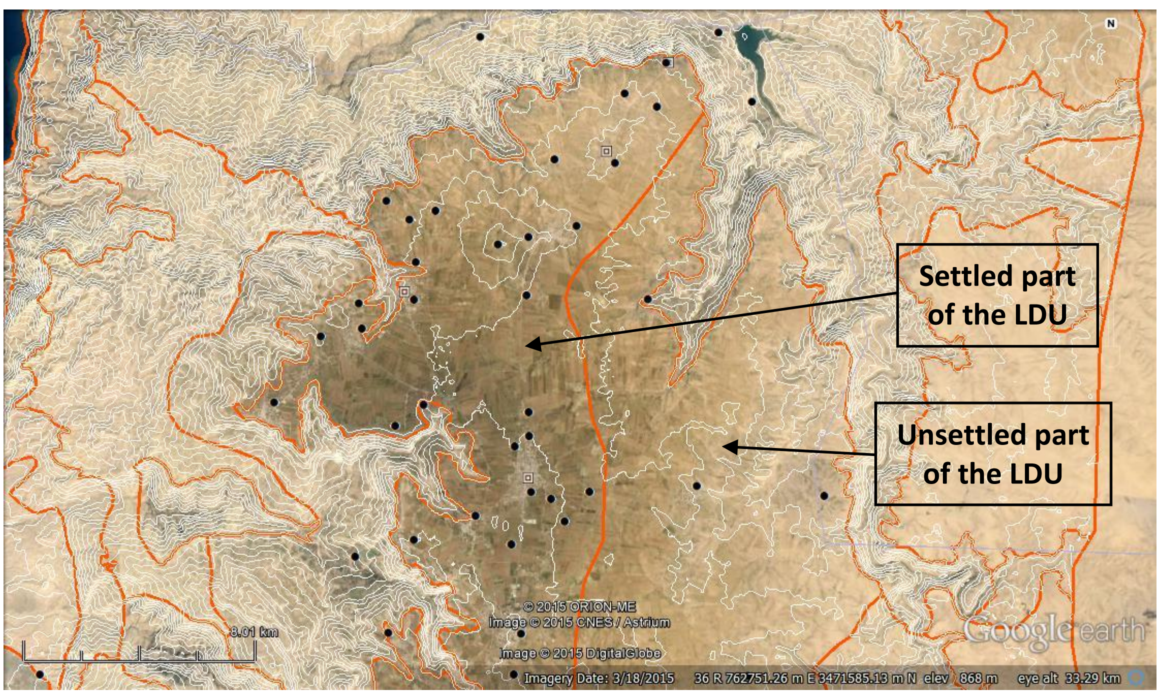


Figure 12: LDU subdivision in Jordan based on settlement pattern

* Settlements shown as black dots

Source: Symons, 2015 (Google Earth background)

Discussion:

- The attribute of "settlements" is probably the most puzzling and challenging case of the assessment in both levels. Mapping settlement density, as done in MedScapes, provides some basic information to understand the patterns of human presence on today's landscape, but is not enough to capture the character and historic depth of the cultural landscape. Supplementary information for possible explanation of settlement pattern (causal factors) could be sought and, potentially, mapped, using historic data and maps (e.g. ancient and abandoned settlements), mapping spring supplies, etc.
- Field survey showed that the criterion of settlement density used during the desk study was not adequate to describe the actual sense of place at the Level 1 scale. Two examples are: (a) Epirus, where the sense of place in some LDUs with closely spaced settlements did not correspond to a settled area (e.g. the area near Pramanta in South Tzoumerka), whereas, at the opposite, the intensity of human land use was more evident in some LDUs with sparsely spaced settlements (e.g. Fourka and Aetomilitsa in Konitsa); (b) Lesvos, where sometimes a settlement found at the boundaries of more than one LDUs, gave the impression of a settled landscape, when the statistical method (kernel density estimation) characterised the same area as unsettled. These remerks point out that the kernel estimation method should better be used only as a guide for the characterisation process.
- Recording settlement types (i.e. compact or dispersed structure), or even building styles, as a definitive (or at least descriptive) attribute in the characterisation process is definitely a good option to overcome the abovementioned limitations (see also the suggestions of Table 1 in Chapter 1.2.5). The Cypriot team, who had already conducted a Level 1 LCA in the past, used this approach to refine and revise the outputs of their Level 1 mapping during the MedScapes project. Unfortunately though, most of the above data can hardly be found in vector GIS format, thus requiring extensive deskwork and considerable fieldwork. In this sense, this process would generally fit more into Level 2.
- A practical problem, as reported from both Greek case studies, is whether settlements should be mapped as part of the valley or inside the adjacent mountain / hill. The problem is that landform definition comes first, without taking into account the settlement aspect, but when Step 4 takes place, LDUs have already been defined. It is therefore possible that in several cases, LDU boundaries might need to be refined in order to properly reflect the "settled" or "unsettled" character of an area. Field survey will probably be necessary to determine this, making the proper refinements afterwards (either manually, or by re-running the nearest neighbour analysis), in an iterative process of desk and field work.
- As can be seen from the above remarks, field survey is indispensable for proper characterisation of the cultural component of the landscape.

2.5 Carrying out Level 2 Mapping

The present Chapter gives a detailed description of the tasks to be taken to carry out on-screen mapping at Level 2. The descriptions and practical advices provided below assume that the Level 2 assessment is taking place after the Level 1 exercise has been finalised and concluded. In this respect, the Level 1 final LDU map is used as the basis to define the Level 2 LDUs and all proposed classifications are derived from their Level 1 counterparts. Needless to say, that the final Level 1 LDU map is the final outcome of the Level 1 assessment, when field survey and final landscape characterisation have been concluded. For purposes of consistency, the details of Level 2 mapping are presented in this chapter.

As with Level 1 suggestions of the previous Chapter, the suggested categories for LDU subdivision and characterisation at Level 2 inlcude the whole range of landscape types recorded in the MedScapes project, and should thus cover most cases in the East Mediterranean region.

The **key points** involved in mapping at Level 2 are:

- Firstly, ***re-examine ALL the Level 1 LDU boundaries against the topographic map at the scale of Level 2*** and see if they need refining. Some will need to be made more detailed / complex when seen at 1:50,000 provided the data layer is sufficiently detailed (and reliable) to do that. Check also against satellite imagery at the same scale, as this may also provide data to refine the Level 1 boundaries (see Figure 13 below). When done, ***save the refined LDUs as a new layer in the GIS database*** (named *LDU_2* for example).
- Then, ***subdivide the refined Level 1 LDUs according to more detailed classifications*** provided in chapters 2.5.1 to 2.5.4 below. As with Level 1 mapping, the dominant attributes that are used in Level 2 to define and characterise LDUs are *Landform* (more detailed categories which are nested into the Level 1 classes), *Land use* (detailed landcover data which describes the management and modification of the natural environment by humans) and *Settlement* (which is now expanded to include Farm Type structure). Note that no LDU thus formed should be less than 1 sq.km (except in special cases).

Figure 13: Example of LDU boundary refinement at Level 2

Source: MedScapes WP5 Final report

2.5.1 Level 2 - Step 1: Landform

Landform at Level 2 is split into two attributes:

- The attribute of *Landform*, which is used to characterise, refine and subdivide LDUs.
- The attribute of *Geology (structure)*, which is only used descriptively, to characterise LDUs according to their geological period and to broad differences in lithology.

Data required:

- Level 2 should ideally be carried out using a more detailed topographic map, showing 20m contours.
- A satellite image layer, as used for Level 1.
- The geological map used at Level 1, reclassified this time to show broad differences in lithology according to the geological period (see Table 10 below).

Steps to be taken:

Step 1: Create a new LDU layer (named *LDU_2_Step1* for example) and make any modifications based on Level 2 landform definition to the new layer.

Step 2: Add the Level 2 contour map and overlay onscreen the refined LDUs.

Step 3: Start by looking at each LDU. Can it be subdivided into two or more polygons with different land-form patterns according to the descriptions in Table 9 below? Are the polygons so formed > 1 sq.km in surface extent? If so, digitise new boundaries using cut polygon command and characterise accordingly.

Step 4: Create an attribute called *Landform_2* in the GIS Database (attribute table of the shapefile) and insert a definitive code ***for all Level 2 LDUs (new or unmodified)*** from Table 9.

Step 5 (optional): Bring in the simplified geology map (reclassified according to the suggestions of Table 10), create an attribute called *Geology_S* in the GIS database and insert a definitive code from Table 10 to characterise your LDUs accordingly.

Advice and Suggestions

- ✓ As with Level 1, a slope raster will provide much help; remember to reclassify your slope raster into the more detailed % ranges used in Table 9 (once again, you can use generalisation filters to reduce "noise", but be careful not to over-generalise).
- ✓ Landform changes will often show on satellite imagery, so check boundaries against imagery base-layer in GIS.
- ✓ Landform changes may also be associated with a change in the geology, so it might be useful to check against the geology layer in some cases.
- ✓ Level 2 is more detailed than Level 1; this does not mean that all Level 1 polygons should be split at Level 2! Subdivide only when necessary, remembering that all landform units should ultimately make sense on the ground.
- ✓ Do not forget to characterise all your LDUs in the new (*Landform_2*) field of the attribute table, even if their boundaries remain unmodified.
- ✓ Do not try to make LDU subdivisions in narrow valleys where it is very difficult to pick up the valley floor and sides by the contour map and slope raster. This can be done more easily (and accurately) in the land use step which follows –or it could not take place at all.

Data processing and suggested classification:

Level 2 mapping will require a more detailed approach to topographic variations, using the full range of average slope percentages presented in Chapter 2.4.1. These are: *Flat*: 0-2% avg. slope; *Gently undulating*: 2-5%, *Undulating*: 5-10%; *Rolling*: 10-20%; *Steeply rolling*: 20-50%; *Steeply sloping*: 50-100%; and *Precipitous*: >100%. Table 9 below provides a detailed landform classification for Level 2, showing the relationship with Level 1 landform classes. Note that Level 2 classes are nested into their Level 1 counterparts; minor exceptions to this rule are explained and commented below.

Table 9: Suggested landform classes for Level 2 mapping and their relation to Level 1 classes

Level 1 classes	Level 2 classes and descriptions	Code
Plains	**Coastal plain**: Low-lying flat land close to sea level (or other base-level such as extensive lake or inland sea)	**PLc**
	Pediments: Very extensive flat plains (<2% avg. slope) in semi-arid or arid lands representing the base level from which hills, uplands, buttes, mesas, etc. rise and onto which their erosion products are deposited.	**PLp**
	Alluvial fans: Areas of pediment, coastal plain or valley floor formed of mixed alluvial sediments sourced from a seasonal torrent or glacial-meltwater river spreading out in a fan-shape from the point where the confined river channel reaches the open plain. Typically low-moderate slope angle around 5%.	**PLaf**
Lowlands	**Lowlands**, **g**ently **u**ndulating: As at Level 1, avg. slope 2-5%	**Lgu**
	Lowlands, **u**ndulating: As at Level 1, avg. slope 5-10%	**Lu**
	Lowlands, **r**olling: As at Level 1, avg. slope 10-20%	**Lr**
	Lowlands, **s**teeply **r**olling: As at Level 1, avg. slope 20-50%	**Lsr**
	Lowland marine terraces: Somewhat elevated (generally <200m above base level) relatively flat shelf representing former marine depositional or erosional surface. May show raised beach deposits and are backed by relict sea-cliffs.	**Lt**
	Delta: A complex of outwash deposits and wetlands formed where a river meets the sea or other major water body: usually continuously growing into the sea (accreting).	**Lde**
	Depressions: Extensive areas at lower elevation than the surrounding plain, typically developing wetland, salt-marsh or salt-flat systems.	**Ld**
Hills and High Hills	**Low hills:** As at Level 1, lying mostly between 200-400m above base level; further characterised as **u**ndulating to **r**olling or **s**teeply **r**olling (see Lowlands).	**Hlu** **Hlr** **Hlsr**
	High hills: As at Level 1, lying mostly between 400-900m above base level; usually **r**olling to **s**teeply **r**olling.	**Hhr** **Hhsr**
	Badlands: Extensive ranges of hills, often steeply rolling or precipitous, characterised by relatively soft lithology and deeply dissected into gullies, small ravines and steep-sided valleys, with very little regolith (soil or unconsolidated surface materials).	**Hb**
	Buttes: Flat-topped hills with very steep or vertical sides that are as high (or higher) than they are wide.	**Hbu**
Uplands	**Uplands**: As at Level 1, further characterised as **r**olling (10-20% avg.slope) to **s**teeply **r**olling (20-50% avg.slope).	**Ur** **Usr**
	Upland terrace: A gently sloping shelf or terrace located inside an uplands area. Note: Upland terraces are often settled (i.e. villages and their surrounding agricultural areas usually develop on these pockets of land with smoother relief).	**Ut**

Level 1 classes	Level 2 classes and descriptions	Code
High Uplands	**High Uplands**: As at Level 1, further characterised as **r**olling (10-20% avg.slope) to **s**teeply **r**olling (20-50% avg.slope).	**HUr** **HUsr**
	High Upland terrace: A gently sloping shelf or terrace located inside a high uplands area. Note: High upland terraces might be settled (less often than upland terraces though).	**HUt**
Mountains	**Mountains**: As at Level 1, not fitting to the other classes below.	**M**
	Mountains, steeply sloping: Mountainous parts with average slope 50-100%.	**Mes**
	Mountains, precipitous: Mountainous parts with average slope >100%.	**Mep**
	Hogback mountain: Ridge with rocky crest and +/- equal slope angles on the two faces. Steep bedding planes, so scarp and dip slopes are +/- equal.	**Mh**
High Mountains	**High Mountains**: As at Level 1, not fitting to the other classes below.	**HM**
	High Mountains, steeply sloping: High mountainous parts with avg.slope 50-100%.	**HMes**
	High Mountains, precipitous: High mountainous parts with avg.slope >100%	**HMep**
	Glaciated mountains: Sculpted by past and/or present-day ice and snow fields to form amphitheatre-shaped cirques. Ridges eroded by cirques from two sides form sharp arêtes; further erosion from other directions can reduce that to a pinnacle.	**HMg**
Plateaus	**Plateaus**: As at Level 1, generally extensive in area. **Mesas**: Individual flat-topped hills, always wider than high.	**P** **Pm**
	Undulating (or gently undulating) plateaus: As above, but avg.slope >2%. Note: If eroded by small valleys, the original plateau surface is partially or mostly preserved between them and clearly visible.	**Pgu** **Pu**
Eroded Plateaus	**Eroded Plateaus**: As at Level 1. **Cuestas**: Similar, but with gently dipping strata creating alternating steep scarp and gentle dip slopes with a parallel drainage pattern.	**PE** **PEc**
	Plateau edges: Similar to the above but forming a fringe around the margins of a plateau.	**PEe**
Valleys	**Valley floor**: River (or dry river bed), active floodplain and raised river terraces (former floodplain levels); flat to undulating topography.	**Vf**
	Valley sides: Average slope <50%; usually fully vegetated.	**Vsm**
	Valley side escarpments: Average slope >50%; Often with cliffs, usually with sparse vegetation, bare rock, scree or boulder scree.	**Vss**
	Ravines: Valleys at least as deep as they are wide, with vertical or near-vertical slopes on at least part of the valley sides. Note: Use only for steep valley parts not characterised as "Deep Valleys" in Level 1.	**Vr**
	Alpine glacial and periglacial valley features[1]: Depositional valley-slope and valley-floor features derived from past alpine glacial and periglacial processes (e.g. moraines, solifluction lobes, rock-glaciers).	**Vg**
Deep Valleys	**Deep Valley floor**: As at Level 1, similar characteristics to Valley floor.	**DVf**
	Deep Valley sides: As at Level 1, similar characteristics to Valley sides.	**DVsm**
	Deep Valley side escarpments: As at Level 1, similar characteristics to Valley side escarpments.	**DVss**
Escarpments [2] (at any altitude)	**Steeply sloping escarpments**: Average slope between 50% and 100%, maybe with some even steeper patches and rock outcrops.	**Es**
	Precipitous escarpments: Average slope > 100%, often including vertical or near-vertical cliffs and rock outcrops.	**Ep**

Level 1 classes	Level 2 classes and descriptions	Code
Coastal landforms [3]	**Sand dune systems**: They are formed behind the beach or sometimes further inland. They may be mobile or stable, bare or vegetated.	**Cd**
	Sea cliffs: They could be mapped as a landform unit if they are extensive or repeated features. Note: Remember that "extent" here will include the vertical dimension too.	**Cc**
	Beaches: They could be mapped as a landform unit if they are extensive or repeated features.	**Cb**
	Spits etc: Coastal features deposited by the sea, by longshore or onshore movement of sediment.	**Cs**
	Tidal mud and sand flats: Marine or estuarine deposits at sea level.	**Cm**
	Tidal rock shelves: Wave-cut platforms at sea level, washed by tides and waves. They could be mapped as a landform unit if they are extensive or repeated features.	**Cr**
	Coastal lagoons: Enclosed or mostly enclosed water bodies ranging from fully marine to brackish, depending on fresh water inflow. They maintain a good connection with the sea either through a channel or through porous beach sediments.	**Cl**
	Salt lakes and salines: Fully enclosed coastal water bodies with little or no hydrological connection to the sea, so they are at least seasonally hypersaline or dry.	**Csl**
	Mixed coastal landform: It should be applied to a combination of smaller coastal landforms and features that together make an extensive area.	**C**

Source: Adapted from MedScapes WP5 Final Report

Notes: Cases where a Level 2 landform unit is not nested inside a Level 1 LDU:

1 "Alpine glacial and periglacial valley features" usually appear inside Level 1 "Mountains" or "High Mountains".

2 "Escarpments" can be picked up at Level 2 either as distinct landform units (appearing inside any Level 1 landform class) or as special parts of a Level 1 "Mountain", "High Mountain" or "Valley". The choice remains with the team.

3 "Coastal landforms" are generally too narrow and small in extent to map at Level 1. At Level 2 their importance and sensitivity means they could be mapped even if they are smaller than 1 sq.km. (e.g. down to 25 ha). Areas smaller than that could be recorded as features in a bigger coastal landscape unit.

Table 10 provides suggestions for Level 2 characterisation based on geology (structure). Note that this information is only used descriptively and does not affect the characterisation process if omitted.

Table 10: Suggested geological structure classes for Level 2 mapping

Class	Code
Quaternary drift	**F**
Mesozoic (soft) rocks	**M**
Alpine (folded) rocks	**A**
Tertiary volcanic rocks	**V**
Other igneous rocks	**I**
Other class	

Source: MedScapes LCA Level 2 protocol

2.5.2 Level 2 - Step 2: Ground Type

Ground type at Level 2 is used only descriptively, to characterise LDUs according to rock and soil type. It uses two attributes: *Geology (rock type)* and *Soils*. Both attributes are derived from the Level 1 classifications, as presented in Table 5 (Chapter 2.4.1) and Table 6 (Chapter 2.4.2) respectively. Similarly to the previous attribute, of geology (structure), the attributes of Step 2 can be omitted without affecting the overall characterisation process.

As an exception (similarly to what has been pointed out in Level 1), an LDU subdivision based on a geological boundary could be made if a polygon has major geological boundaries associated with a significant change of rock-outcrop colour or soil colour that is visible on the satellite imagery (provided that the polygons formed would be each > 1 sq.km). In any case, this would most probably coincide with a noticeable change of landform, land use or field pattern, therefore it could be picked up in Steps 1, 3 or 4, respectively.

2.5.3 Level 2 - Step 3: Land Use

Land use involves the management and modification of the natural environment by humans; as such, it is considered an integral part of the cultural dimension of the landscape. The aim at Level 2 is to ***map land uses***, by analysing in detail the broad landcover classes of Level 1. Land use data is derived from the principal landcover dataset, which is reclassified in more detailed classes. The detailed land use classes of Level 2 are nested in the main landcover classes of Level 1.

Data required:

- The landcover map (CORINE or equivalent), used at Level 1.
- A satellite image layer, as used for Level 1.
- A more detailed vegetation map, if available, would be particularly useful at Level 2.

Steps to be taken:

Step 1: Bring in the CORINE landcover layer (or other base map) and reclassify according to the Level 2 suggested land use classifications shown in Table 11 below.

Step 2: Look at each LDU derived from Step 1 against the land use layer. Can it be subdivided into two or more polygons with different land use pattern according to the descriptions of Table 11? Are the polygons so formed > 1 sq.km in surface extent? If so, digitise new boundaries using cut polygon command and characterise accordingly.

Step 3: Check in detail the satellite image for accuracy of the land use boundaries, but also to identify land uses not shown on the CORINE map. Such cases will typically refer to agricultural areas around settlements, as well as cultivations and/or rough grazing areas lying amidst larger forested areas. Abandoned cultivations or newly cultivated areas can also be picked up from the satellite image.

Step 4: Create an attribute called *Landuse* in the GIS Database (attribute table of the shapefile) and insert a definitive code ***for all Level 2 LDUs (new or unmodified)*** from Table 11.

Advice and Suggestions

- ✓ Land use classes at Level 2 are numerous. Make your base map readable by using clear colour codes to distinguish between different land use categories. The colour palette of CORINE is a good example that you can follow (see Appendix 2).
- ✓ At the finer scale of Level 2, satellite imagery will in many cases be as useful as the CORINE (or equivalent) base map. As also pointed out in Level 1, it is useful to consult satellite images from different seasons and years.
- ✓ Step 3 may also help to refine LDU boundaries derived from Step 1. Before doing so, check the contour map to avoid unnecessary boundary refinements (for example a landcover map inaccuracy in regard to a clear break of slope).
- ✓ Land use characterisation at Level 2 will allow mapping all those cases for which you were not sure whether they should have been picked up at Level 1 (particularly in the areas around settlements).
- ✓ Do not forget to characterise all your LDUs in the new (*Landuse*) field of the attribute table, even if their boundaries remain unmodified.

Data processing and suggested classification:

Table 11: Suggested land use classes for Level 2 mapping and the relation to Level 1 landcover classes

Level 1 classes	Level 2 classes	Descriptions and comments *	Code
Artificial surfaces	**Built-up areas**	Urban areas, residential and commercial within the urban envelope.	**Au**
	Amenity parklands, sports fields etc.	Non-agricultural urban vegetated areas with tree cover <10% (otherwise class as Forest plantation).	**Ap**
	Industrial areas	Factories, chemical plants, refineries , power stations, etc. Generally outside the urban envelope.	**Ai**
	Mines and other bare land sites	Mine, dump and construction sites consisting mostly of bare ground.	**Ab**
	Transport infrastructure	Airports, highways and interchanges, railway yards, ports, marinas.	**At**
Agricultural areas	**Arable land, non irrigated**	Cereals and other grains (e.g. sesame, buckwheat), legumes, root crops and other field crops that are watered exclusively by rainfall. Includes many aromatic, plants (e.g. zaatr), fodder crops and fallow land but excludes permanent pastures.	**Ga**
	Arable land, irrigated	Field crops irrigated on a regular, usually seasonal (but ongoing) basis (not just at establishment), using a	**Gai**

Level 1 classes	Level 2 classes	Descriptions and comments *	Code
		permanent infrastructure (irrigation channels, pipe network). Includes horticultural crops, flowers and plant nurseries, whether open field or under plastic or glass. Most of these crops could not be cultivated without an artificial water supply.	
	Tree crops, sclerophylls	Parcels planted with typical Mediterranean sclerophyllous tree or shrub crops: single or mixed species, fruit trees associated with permanently grassed surfaces. Includes olive, carob, almond, pomegranate, date. Produced with or without the help of irrigation.	**Gs**
	Tree crops, broad-leaved	Tree crops with broad, relatively soft leaves, typical of the temperate climatic zone (e.g. chestnut and walnut groves). In a Mediterranean context these will be found at higher altitudes. Produced with or without the help of irrigation.	**Gb**
	Vineyards	Production of grapes for wine or table, with or without the help of irrigation.	**Gv**
	Enclosed pastures	Fields with dense cover predominantly of grass, not under a rotation system. Mainly used for grazing, but the fodder may be harvested mechanically. Includes areas with hedges (bocage).	**Gp**
	Mixed agriculture	Combinations of the above where no single type of agriculture forms >50% of the land cover.	**Gm**
Forests Include natural forests and artificial forests (plantations)	**Forestry plantation**	Plantation forests are managed for amenity or timber / firewood production; they may often be non-native species and generally are poor in wider flora and fauna. Do not include cases of native tree-planting intended to support regeneration and enrichment of natural forest.	**Fp**
	Natural forest, coniferous	Mediterranean conifer forest is often open in structure with tree cover as low as 10%, of which at least 60% consists of conifer species (e.g. pine, juniper, fir) often mixed with scrub and dwarf scrub. Includes all conifer forests with a natural character (structure, tree species, flora and fauna) *even if trees were planted.*	**Fc**

Level 1 classes	Level 2 classes	Descriptions and comments *	Code
	Natural forest, broad-leaved, deciduous	As above, but at least 60% of tree cover consists of broad-leaved, deciduous species (e.g. chestnut, beech, deciduous oak, plane, alder).	**Fd**
	Natural forest, sclerophyllous, evergreen	As above, but at least 60% of tree cover consists of sclerophyll tree species (e.g. sclerophyll oak, wild carob, wild olive).	**Fs**
	Natural forest, mixed	As above, but neither conifers, deciduous nor sclerophyll species form more than 60% ot the tree cover.	**Fm**
Scrubs Include maquis, garrigue and other mixed scrubs (except +/- pure stands of dwarf shrubs).	**Scrub, maquis**	Maquis scrub has >10% cover of larger shrub species (0.75m+ in height) of which >60% is tall scrub of 1.5m+ in height.	**Sm**
	Scrub, garrigue	Garrigue scrub has >10% cover of larger shrub species (0.75m+ in height) of which >60% is scrub of <1.5m in height.	**Sg**
	Scrub, mixed	>10% cover of larger shrub species (0.75m+ in height) but not fitting above two categories.	**S**
Rangelands and rough grazing Dwarf scrubs, hedgehog scrubs, phrygana, often mixed with annual grasses and herbs , typically grazed by free-ranging goats and/or sheep	**Dwarf scrub rangelands**	Vegetation cover >5%, *of which* >20% is Phrygana, hedgehog scrub or other dwarf scrub cover (mostly <0.75m in height) and <10% is taller scrub. Constrained from further development by grazing and/or occasional burning; or in rare cases by local climatic factors (e.g. proximity to the sea).	**Rd**
	Steppe (and pseudo-steppe) rangelands	Vegetation cover >5%, *of which* <20% is dwarf scrub, the rest being grasses and other low herbaceous vegetation (including xerophytic species). Larger scrub species are +/- absent. Constrained from further development by grazing, burning, cold or arid climate or a combination of these.	**Rs**
	Forested rangelands	Dwarf scrub or steppe rangelands with forest patches that cannot be separated to form distinct forests.	**Rf**
Bare land	**Bare rock**	Land with exposed bedrock, boulders, etc *with virtually no vegetation* nor any specific clear use.	**Br**

Level 1 classes	Level 2 classes	Descriptions and comments *	Code
	Bare, unconsolidated materials	Land with exposed regolith (gravel, sand, and other alluvial materials) *with virtually no vegetation* nor any specific clear use.	**Bu**
	Salt flats	Land with exposed regolith (gravel, sand, and other alluvial materials) *with virtually no vegetation* and *impregnated with salt*. May be dry or moist.	**Bs**
Wetlands and Water bodies	**Water bodies**	Sub-divisions are given under Landform (see Valleys and Coastal landforms)	**WA**
	Inland marshes	Marshes and peat-bogs in which open water (if present) is patchy and forms <50% of the surface.	**WEm**
	Coastal and other saline-marshes	Marshes with saline or brackish ground water and usually a muddy or sandy substrate. Vegetation includes halophytic plant species (e.g. Glasswort *Salicornia*).	**WEs**

Source: Adapted from MedScapes WP5 Final Report

* Figures in this column are indicative, as it is not practically possible to measure them with precision; they are provided to give an idea of the main differences between each class, to facilitate the characterisation process.

2.5.4 Level 2 - Step 4: Field Pattern

The purpose of Step 4 in the MedScapes Level 2 approach is not to characterise settlement pattern (i.e. to subdivide polygons derived from the previous Steps on the basis of settlement density); this process should have already been done at Level 1 and does not work well at the finer scale of Level 2. Instead, the aim here is ***to distinguish field patterns*** that provide insight to the cultural and historic dimension of the landscape[25].

Data required:

- The satellite image layer, used in the previous steps.
- Cadastral maps, if available, would be particularly useful.

Steps to be taken:

Step 1: Bring in the satellite layer and examine all LDUs with agricultural land use to decide if there is more than one type of field pattern according to the descriptions shown in Table 12 below. If the polygons so formed are each > 1 sq.km in surface extent, then digitise new boundaries using cut polygon command and characterise accordingly.

[25] Recording settlement types (i.e. compact / nucleated / dispersed) and/or building styles (i.e. traditional, modern, etc.) could also be part of Step 4 characterisation at Level 2.

Step 2: Create an attribute called *F_Pattern* in the GIS Database (attribute table of the shapefile) and insert a definitive code ***for all Level 2 LDUs with agricultural land use (new or unmodified)*** from Table 12.

Data processing and suggested classification:

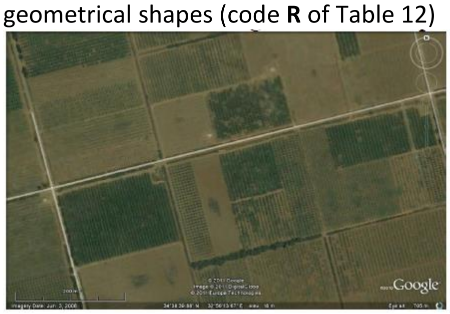
Table 12: Suggested field pattern classes for Level 2 mapping

Class	Code
Regular or semi-regular fields with mostly rectilinear boundaries (+/- rectangular fields)	**R**
Irregular fields with straight boundaries	**I**
Sinuous boundaries (always irregular)	**S**
Terraces, wide	**Tw**
Terraces, narrow	**Tn**

Source: MedScapes LCA Level 2 protocol

Figure 14 below shows some examples of characteristic field patterns from Cyprus. The main types to be found are (Symons et al., 2013):

1. Irrigated cultivations: Nearly always regular or semi-regular fields with mostly straight boundaries and rectilinear or geometrical shapes (code **R** of Table 12)



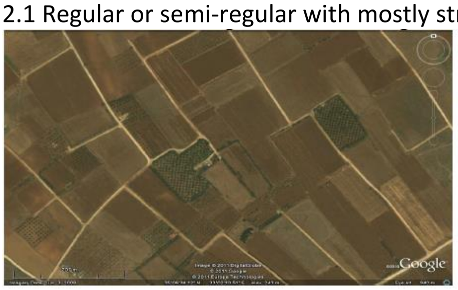
Regular (Phassouri)

Semi-regular (Morphou)

Semi-regular (Kissonerga)

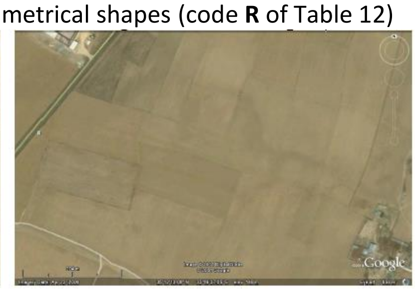
2. Dry cultivations: Found in a much wider range of situations (and consequently of field patterns) as follows:

2.1 Regular or semi-regular with mostly straight boundaries and rectilinear or geometrical shapes (code **R** of Table 12)



(Astromeritis)

(Paralimni)



(Mesaoria)

2.2 Irregular fields with mostly straight boundaries but varied shape and size (code **I** of Table 12)


(Mouth of Kourris River)


(Polemi)


(Potima Bay)

2.3 Irregular fields with sinuous boundaries (code **S** of Table 12)


(Akamas)


(Polemi)


(Amargeti)

2.4 Terraced fields (wide or narrow) (codes **Tw** and **Tn** of Table 12)


Wide (Stroumbi)


Narrow (Pachna)


Narrow (Lofou)

Figure 14: Field pattern examples from Cyprus

Source: Symons et al., 2013

PART 3: FIELD SURVEY

3.1 GENERAL DESCRIPTION

The **field survey** is a key, and essential, part of the Landscape Character Assessment process. It can be resource intensive, but provides a unique opportunity to record and analyse the landscape out on site. Field survey provides an important ground level view that shows how the landscape is seen by people. It can also identify key elements or features that are not apparent from the desk study, and it can help to record aesthetic and perceptual qualities of the area.

The field survey needs to be carefully designed to meet the objectives of the project, particularly in relation to the scope and scale of the assessment. The key matters to consider when planning the field survey include:

- The scale at which the work is carried out; local (i.e. Level 2) assessments (depending upon their purpose and geographical extent) may need more detailed survey work than strategic (i.e. Level 1) studies. It is therefore crucial to decide at which Level (1, 2 or both) the survey will be carried out in order to be properly designed.
- The emphasis of the assessment; this might require the field survey to describe and analyse some aspects of the landscape in greater detail than others. For example, if the area includes free range and/or transhumance grazing, particular attention should be paid at recording the intensity of grazing and habitat / species associations as descriptive attributes (to record evidence and causes of change).
- The required outputs from the assessment; these will normally include written descriptions and photographs, but may also include maps, copies of the field survey sheets, as well as annotated sketches.

The LDUs provide the spatial framework within which to collect additional field survey information to complement the desktop mapping results. Irrespective of the level of the assessment, the purpose of the field survey is:

- To validate the information of the desktop mapping phase and refine the draft characterisation maps (e.g. to verify the boundaries and content of each LDU, to decide if additional LDU subdivisions or merges are required);
- To observe and understand how all the factors identified from desktop mapping interact and are perceived and experienced, helping to understand and describe the distinct character of each landscape;
- To identify other factors and features that are not evident from the desk study (for example, the intensity of management in agricultural areas, forests and rangelands; settlement types, development patterns and pressures), and record aesthetic and perceptual aspects;
- To assist in final decisions about the division into character types and/or areas and develop draft descriptions of character;
- To update and expand the database of desk study information, by adding the required descriptive information;
- To contribute, if required, to the process of decision making about the future of the landscape (e.g. concerning land management strategies, the location and extent of future development, or land restoration requirements).

Field survey for Level 1 assessment mostly focuses in ***validating*** the information of desktop mapping, and ***does not necessarily require the preparation and completion of detailed field survey sheets***. Navigating through the LDUs to capture the character and sense of place, take some characteristic photos, check and refine LDU boundaries, and decide if any modifications are required (e.g. additional LDU subdivisions or LDU merges), is the main task of the work. Of course, if time and resources allow, the preparation and completion of a simple field survey form (at least for a sample of LDUs) will assist the team to conduct more systematic work, improving the results of Level 1 mapping and facilitating the subsequent process of landscape characterisation and description. An example that has been developed and used by the Lebanese team in the MedScapes project is shown in Figure 15 below.

Field Survey Sheet Level 1					Team Names:	Location:			
						Date:	LDU #:		
Visual Character			in what way do the following contribute to local character and sense of place?						
Landform									
Dominant valley with moderate slopes									Dominant Prominent Apparent Insignificant
Geology/ Soil									
Dominant fertile calcareous soil									Dominant Prominent Apparent Insignificant
Land Use									
Dominant agricultural areas on valley sides with fruit trees on terraces; scrubland prominent near the hilltops; apparent industries such as water factory at valley base									Dominant Prominent Apparent Insignificant
Settlement									
Traditional Building style materials									Dominant Prominent Apparent Insignificant
Organization of Elements									
Scale:	intimate	small	medium	large	**Views:**	Filtered	framed	open	exposed
An open valley landscape, with fertile calcareous soils that dominantly support agricultural lands with settlements clustered at hillsides. The landscape is dominantly cultivated with soil terraces supporting fruit trees, and there are apparent tall shrublands. **Issues:** High cultivation of land and minimal abandonment of agricultural lands. **Threats:** industries along the river.									

Figure 15: Simplified field survey sheet used by the Lebanese team for Level 1 assessment

Source: MedScapes Lebanon Level 1 report

A Level 2 assessment, on the contrary, definitely requires ***more detailed work*** to be carried out. Information ***should be recorded on a standardised field record sheet***, which encourages surveyors to make systematic observations and record them in a consistent way. The field record sheet should have space:

- To include a brief written description, to capture the overall impression of landscape character.
- To incorporate more detailed information about the elements that make up the landscape (such as land use, habitats and settlements) and the way that they interact together.
- To include remarks about the aesthetic and perceptual aspects of the landscape (scale, sense of place, vistas and views, etc.).
- To assess the strength of character and landscape condition, which are essential components of landscape evaluation (i.e. the next stage of the LCA process), supporting the decision making process (i.e. the final stage of the LCA process).

Field work is a time consuming and resource intensive process. Depending on the scope of work (Level 1 or Level 2), accessibility of the study area, human and financial resources and time constraints, it may last from a few days to several weeks[26]. As has been shown in the MedScapes project, multiple field survey visits might be needed in order to improve the final results. The aim should, in any case, to carefully plan the field survey process beforehand, to avoid losing unnecessary time and resources. To this end, it is vital to know from the start if a Level 2 assessment is planned to follow the Level 1 exercise:

- If the answer is "yes", then fieldwork for Level 1 could be restricted to a general validation exercise, to help refine the desk study results, identify and describe the landscape character types (in which case a sample of LDUs could be visited and recorded).
- If the answer is "no", then the Level 1 field survey should be more comprehensive, modified to include elements of the detailed approach normally required for Level 2; that is, to use a standardised field sheet to record descriptive information in a larger number (if not the whole) of LDUs.

The detailed field sheet that was developed and used for Level 2 field survey in the MedScapes project is presented in Figure 16 below.

[26] For example, the Level 1 field reconnaissance and validation process for Cyprus (conducted before the MedScapes project, in 2008) has been carried out by a group of local and foreign specialists in 6 days; the extended MedScapes Level 1 field survey process in Lebanon, which has been carried out by smaller groups of specialists, lasted a whole two months.

FIELD SURVEY SHEET	*Location* :	*Date* : / /	*Code:*

Visual Character - in what way do the following contridute to local character and sense of place?

LANDFORM	Dominant Prominent Apparent Insignificant	**NATURAL FEATURES**	Prominent Widespread Localised Insignificant
WOODLAND/SCRUB COVER	Dominant Prominent Apparent Insignificant	**SPECIES ASSOCIATIONS**	Prominent Widespread Localised Insignificant
LAND USE Fruit trees	Prominent Consistent Variable Insignificant	**FIELD PATTERN**	Prominent Consistent Variable Insignificant
SETTLEMENT & BUILDINGS Tranditional building style/materials	Prominent Consistent Variable Insignificant	**OTHER FEATURES**	Prominent Widespread Localised Insignificant

Organisation of elements

Scale:	*intimate*	*small*	*medium*	*large*	**Views:**	*filtered*	*framed*	*open*	*exposed*

Ecological integrity - how well does the countryside function as habitat for wildlife?

"Naturalness" of LDU	Mostly Natural	Semi-natural		+/- even mixture of natural and cultivated	Mostly cultivated
Overall habitat continuity	+/- continious	linked patches		separate patches	fragment
No.of main habitat	1	2		3	4
Dominant type	herbaceous/grass	dwarf scrub	low scrub	tall scrub	woodland
Intensity of management	low	medium		high	very high

Cultural integrity - assess impact of recent change & note significance of any incongruous feautures

Change of use:	widespread localised insignificant
Survival of cultural pattern	intact modified fragmented
Visual impact of change	high moderate low

Photographs:

Figure 16: Field survey sheet template used to conduct Level 2 assessment in MedScapes

Source: MedScapes Final WP5 report

Chapters 3.2 and 3.3 below give an overview and useful tips to efficiently plan and conduct fieldwork for LCA, incorporating the experience gained by the partner teams through the project. The suggestions refer to both levels of assessment, pointing out aspects and details which apply to Level 2.

3.2 Preparation for Field Survey

3.2.1 Preparation of the Required Maps

Having the proper maps with you before going to the field is the first, and most significant, thing to facilitate your work. Two sets of information are the most important for field survey:

1. The LDU boundaries derived at the end of the desktop mapping phase; and
2. A good road map of your study area that will help you navigate through during fieldwork; the road map should include topographic data, such as contour lines, local placenames, mountain peaks with altitude reference, rivers and streams; it should have a detailed inventory of roads (classified to show arterial roads, local roads, and non-paved roads), bridges trails and footpaths; it should show all cities and villages; and it would be good to have colour variations to represent broad altitude categories (for example 0-500m, 500-1000m, 1000-1500m, 1500-2000m, and above).

The best thing to do is to have both pieces of information on the same piece of paper, so that you know exactly where the boundaries of each polygon lie on the ground. So, once you find a good road map, scan and insert it to your geodatabase, making the best possible georeference. Overlay the LDUs and print it a few times –preferably twice per surveying team. This will be your main reference document throughout the field survey. Of course, the LDU boundaries alone will not help, if not accompanied by a description of their definitive attributes. It is up to you to decide if you will show the codes of definitive attributes for each LDU as legends inside the map (so as to have all information in the same document), or if you will only show their numbers and print the table of definitive attributes separately (so as to avoid overloading your map, especially if it has much information on its own). A good example, used at the MedScapes LCA training course in Cyprus, is shown in Figure 17 below.

Additionally, you could also print a series of maps for each of the main definitive attributes, to help you check if you have made the proper characterisations. All maps should include the main road network of the area as reference; apart from that, the landform map should show the LDUs and contour lines (50m or 20m according to the level of assessment) on top of the geology layer; the ground type map should show the LDUs on top of the soils layer; the landcover / land use map should show the LDUs on top of the landcover or land use layer; the settlements map should show the LDUs and settlement locations only.

Needless to say that you should carry with you during fieldwork the printed road maps too!

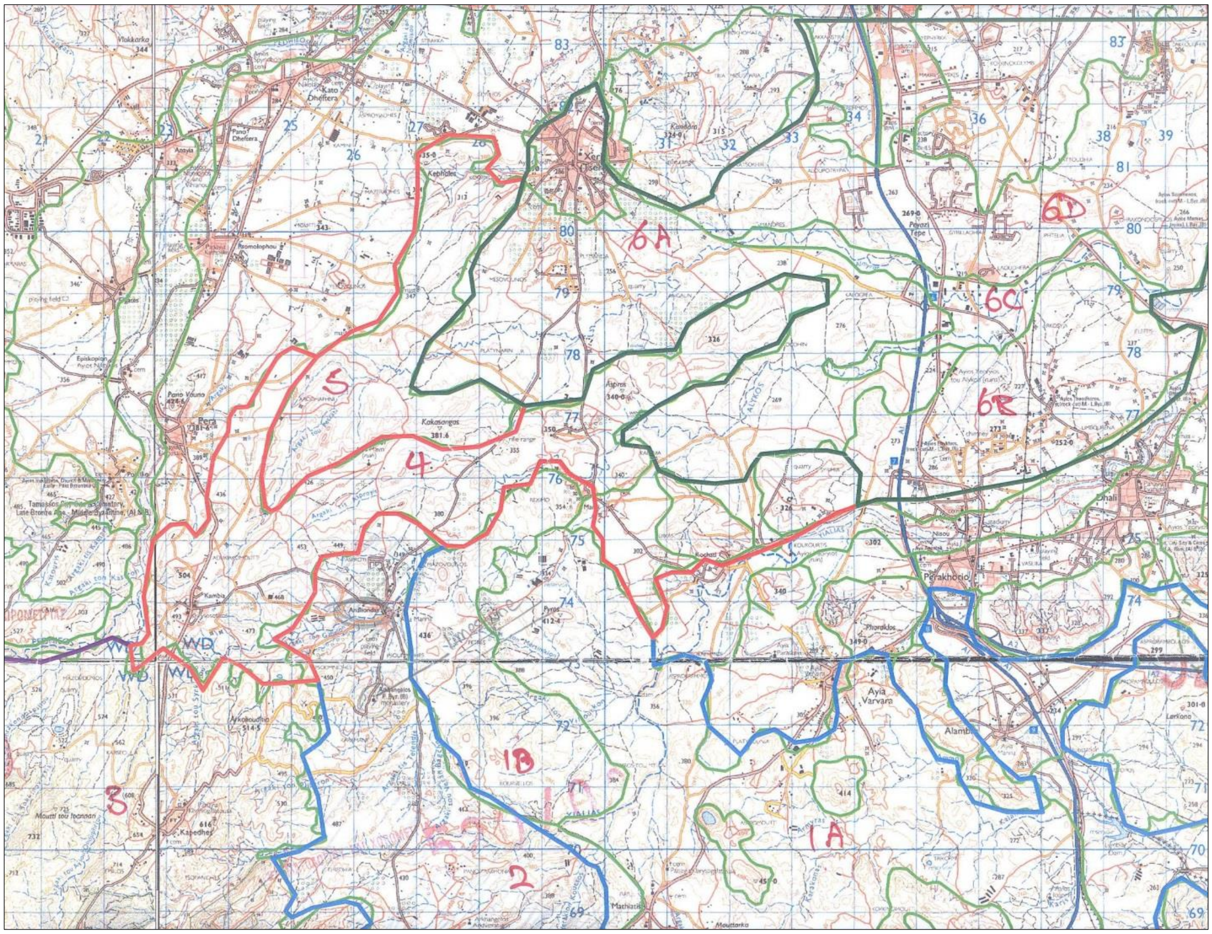


Figure 17: Road map with overlaid LDU boundaries and codes used for the MedScapes LCA training

3.2.2 Preparation of Field Survey Sheets

Field Survey Sheets are required for Level 2 fieldwork (or if you decide to conduct a more detailed assessment at Level 1). The Field Survey Sheet should be designed to reflect the scope, scale and level of detail required for the assessment. Generally, it should have space to include:

- Information on the location (grid reference and/or local placename), date, time, weather conditions and name of the surveyor;
- A viewpoint number and information concerning photographs taken at that point;
- A checklist and/or written description of the main landscape elements, features and characteristics which contribute to local character and sense of place; these should include natural factors (such as landform, geology, soils, drainage, etc.) and cultural features (such as land use, farming practices, building styles, historic features, landmarks, etc.), with notes about their importance in the landscape;
- A checklist of aesthetic and perceptual factors and space to record experiential qualities and visual criteria (such as pattern, scale, texture, colour, complexity, enclosure, etc.);
- Information on where, why and how LDU boundaries have been refined or modified in the field.

The purpose of the assessment may also demand the collection of information to guide specific future decisions. In this case, the Field Survey Sheet should also have space to include:

- Observations about the condition, sensitivity and management needs of the landscape, for example in relation to new development or land use changes;
- Evidence of recent change and assessment of its causes;
- An annotated sketch.

In terms of format, Field Survey Sheets may be printed (which is easy to use in the field) or stored on a mobile device, such as a tablet or PDA; the latter is less practical to use but can record and upload data electronically to a digital database linked to a Global Positioning System (GPS). Mobile devices can also give access to digital maps and underlying information in the field. There are nowadays numerous applications that can be installed on GPS-bearing android and/or iOS devices that can be of great use during fieldwork. A combination of both would probably be the ideal case; recording information manually in the printed sheet on site and storing / uploading descriptions, photos and any other material on a laptop or tablet upon returning to the hotel afterwards.

The Field Survey Sheet that has been used by the MedScapes partners is shown in Figure 16.

3.2.3 Setting up the Field Survey Team(s) and Involving Specialists

Surveys are usually best carried out in pairs. This can help with the practicalities of navigating and recording at the same time, and also encourages a consensus to be reached about reactions to the landscape. The field survey team(s) should ideally be multidisciplinary, including specialists from both the natural and social sciences (ecology, geology, forestry, architecture, landscape architecture, planning / land management, archaeology), preferably with some experience on the field. Given that your team will usually not cover the whole range of disciplines required and that resources will most likely be limited, you should try to find and employ specialists that are missing from your field survey team(s).

Considerable advantages will definitely be gained by involving people with local knowledge (for example specialists that are based or have been working for some time in the area). Depending on budget availability and local acquaintances, you should seek to employ a local specialist for the field survey, as this can reshape your view of the landscape, helping you to better understand and interpret what you are about to see and experience on the ground.

If the survey is going to be carried out by more than one team, it is advisable to review work at regular intervals so as to maintain consistency of interpretation and judgements among the teams. The use of standardised procedures, such as the Field Survey Sheets, will provide much help in this respect.

3.2.4 Prepare a Survey Route

The field survey must cover the ground in sufficient detail to allow well informed decisions to be made about the identification of discrete landscape types, providing the information for meaningful descriptions of character and confirmation of boundary definitions. The aim should be to move through the study area systematically, visiting all (or a representative number) of LDUs and recording information about them. At Level 1, a sampling of LDUs would be enough to capture and describe landscape character. At Level 2, the aim should be to cover all LDUs (at least those which are realistically accessible, excluding for example high mountains or areas where security issues might be raised), so as to acquire a complete view of landscape character and variations, and produce a full systematic record of fieldwork information. Of course, time and resources allowing, a full coverage of LDUs would be ideal for Level 1 too (as has been the case in MedScapes), even for validation purposes only.

What is needed beforehand is to prepare an outline survey route, with potential survey points, and any requirements for access on foot, cycle, by boat, or onto private land, estimating potential time implications. Below is an example of field survey route planning from Mujib, Jordan.

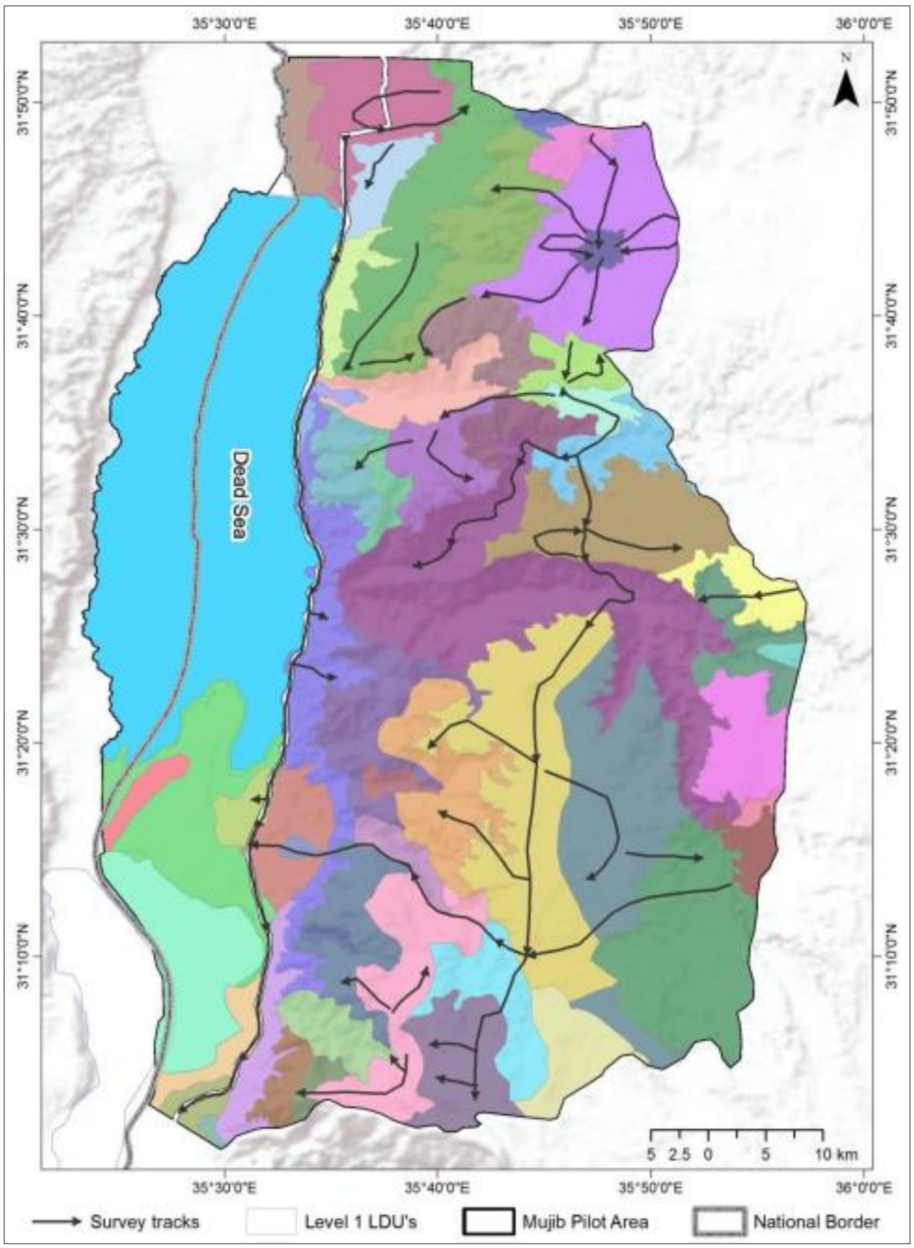


Figure 18: Field survey route planning penetrating all LDUs of the study area

Source: MedScapes Mujib Level 1 report

3.2.5 Prepare Useful Equipment

Portable equipment includes the conventional and electronic means which are necessary in order to record, take notes and pictures on site. The essential pieces of electronic equipment are a high resolution digital camera (ideally, but not necessarily, equipped with a GPS), a GPS unit to mark your survey and photo capturing spots and a laptop computer with you GIS database and LDU maps to make necessary amendments on site (that is, during fieldwork or later, in the hotel). Additionally, a video camera would be useful to capture the whole range of experiential qualities of the landscape (sounds, textures, etc.) and a tablet or PDA would be useful if you are the type of person who prefers taking notes digitally rather than on paper. And, of course, don't forget to take with you the battery charger for your camera; it is strongly recommended to have two of them with you, in case your battery runs out on the road!

Figure 19: Fieldworkers using a tablet to verify LDU boundaries and location

Source: MedScapes Lebanon Level 1 report

The conversion of the LDUs shapefile to a KML format which is compatible with Google Earth can also be very useful in order to navigate through the area, zoom in and zoom out to capture the overall picture and minor details, and, most importantly, to take instant notes on the LDUs in your laptop or tablet.

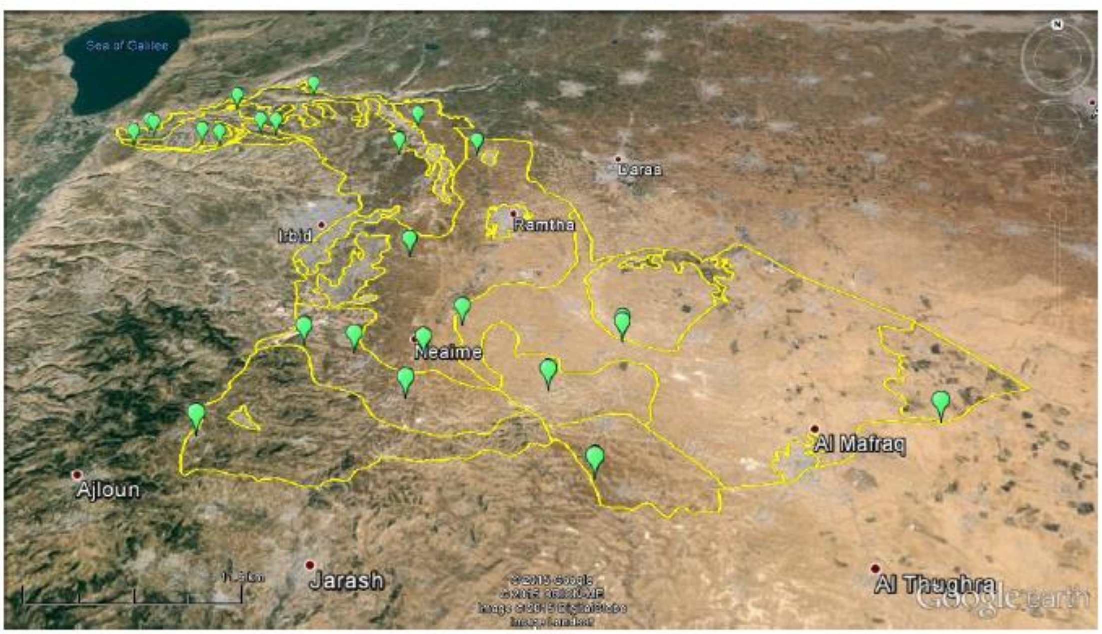


Figure 20: Exporting LDUs to Google Earth for field survey

Source: MedScapes Al Yarmouk Level 1 report

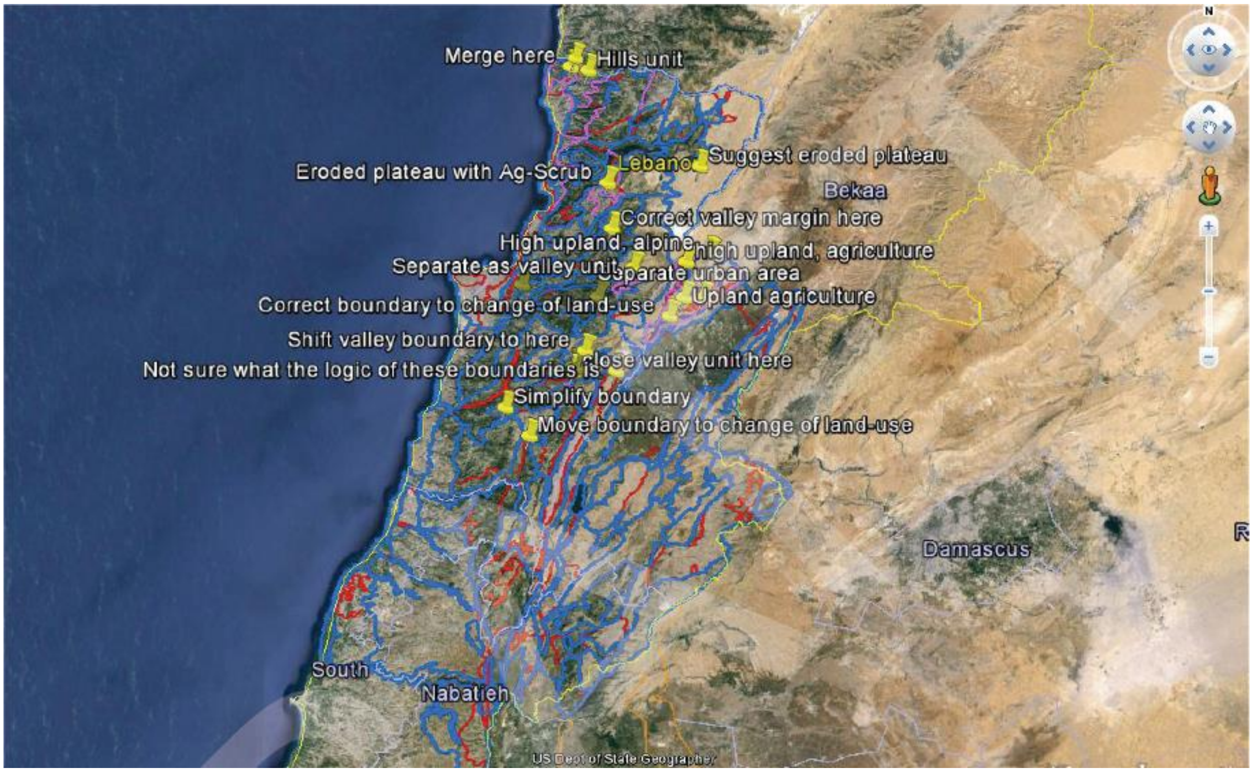


Figure 21: Making comments on a Google Earth file during field survey

Source: MedScapes Lebanon Level 1 report

Conventional equipment you will need are the Field Survey Sheets (if you plan a detailed assessment), which should be at least as many as the LDUs you are planning to survey, the printed maps prepared at the office (described in Chapter 3.2.1), transparent spreadsheets for drawing boundaries and taking notes on your maps, blank spreadsheets to take notes, a scotch tape, an eraser and plenty of pencils (ideally in different colours).

3.3 Carrying out Field Survey

3.3.1 Navigating through LDUs and Selecting Viewpoints

To have a thorough understanding of an LDU and its character, it is recommended to use three survey points. One from a distance to obtain an overall view, one from inside to have a direct view and one at the perimeter for a “border” view. It is advisable to choose first the higher elevation viewpoints so as to capture the overall character of the area, then navigate through the LDU to capture the sense of place and record landscape condition and finally complete the field survey sheets and take photographs from selected viewpoints along the main roads. You should also take photographs of all characteristics and features that contribute to the perceived character and sense of place, but also to record condition or any other aspect that you consider reporting; this will allow you to have a complete documentation of your reportings when you return to the office, helping you and your colleagues (who may not have participated in the survey, or may have been part of another survey team) to better understand the information recorded when describing landscape character.

Higher (panoramic) viewpoints can be useful for orientation and they also provide the chance to see more than one LDU at a glance, which is particularly useful to make a comparison between the scale and characteristics of different LDUs so as to conclude in uniform interpretations for all.

Figure 22: Different viewpoint locations

Left: Higher (panoramic) viewpoint outside the LDU / Centre: Inside the LDU / Right: Along the LDU boundary

Source: MedScapes Epirus LCA database

3.3.2 Verification of Desktop Mapping Results

Field survey provides the opportunity to:

- Observe how natural and cultural factors, described and mapped in the desk study stage, appear and are experienced on the ground, and how they interact with each other.
- Highlight factors that are more or less important than initially identified and considered in the desk study, perhaps requiring to amend LDU boundaries.
- Review, define and justify all boundaries in the field, considering whether they create character units that make sense on the ground.

The key points to examine in the field so as to be able to effectively correct and verify the results of the desk study are:

- **LDU boundary amendments**: Validate and adjust the boundaries of LDUs resulting from the desktop mapping by making notes or on the spot corrections, based on the perception of the overall and of the “border” view. This can be essential for the Level 1 attribute of settlement pattern, as sometimes a settlement found at the boundaries of more than one LDUs can give the impression of a settled landscape, when the statistical method (kernel density estimation) of the desk study led to the characterisation of the same area as unsettled; in this case the algorithm might need to be re-run when returning to the office. Another tricky point is mapping valley boundaries; desktop mapping by its nature cannot provide accurate and consistent results, and field survey can be crucial to amend several boundaries by observing the break-of-slope point right on the ground, improving consistency between boundary definitions.
- **LDU subdivisions and merges**: By comparison from an overall view you can make subdivisions of LDUs that seem to contain several contradicting landform or landcover / land use types;

similarly, you may decide to unify LDUs that appear homogeneous in character when viewed and experienced on the ground, compared to the overall view of the area.

- **Amending definitive attributes**: As most of the landcover / land use maps are produced through satellite images, their interpretation often fails to describe vegetation patterns accurately. Overall, border and inside views may lead you decide to amend the relevant characterisations in several cases. Settlement pattern characterisations are also often subject to modification during field survey, as noted in the first point above. To a lesser extent, this may also be the case for soil type characterisations which may be apparent on the ground, but not properly recorded at the desk study because of the rough scale of the input maps.

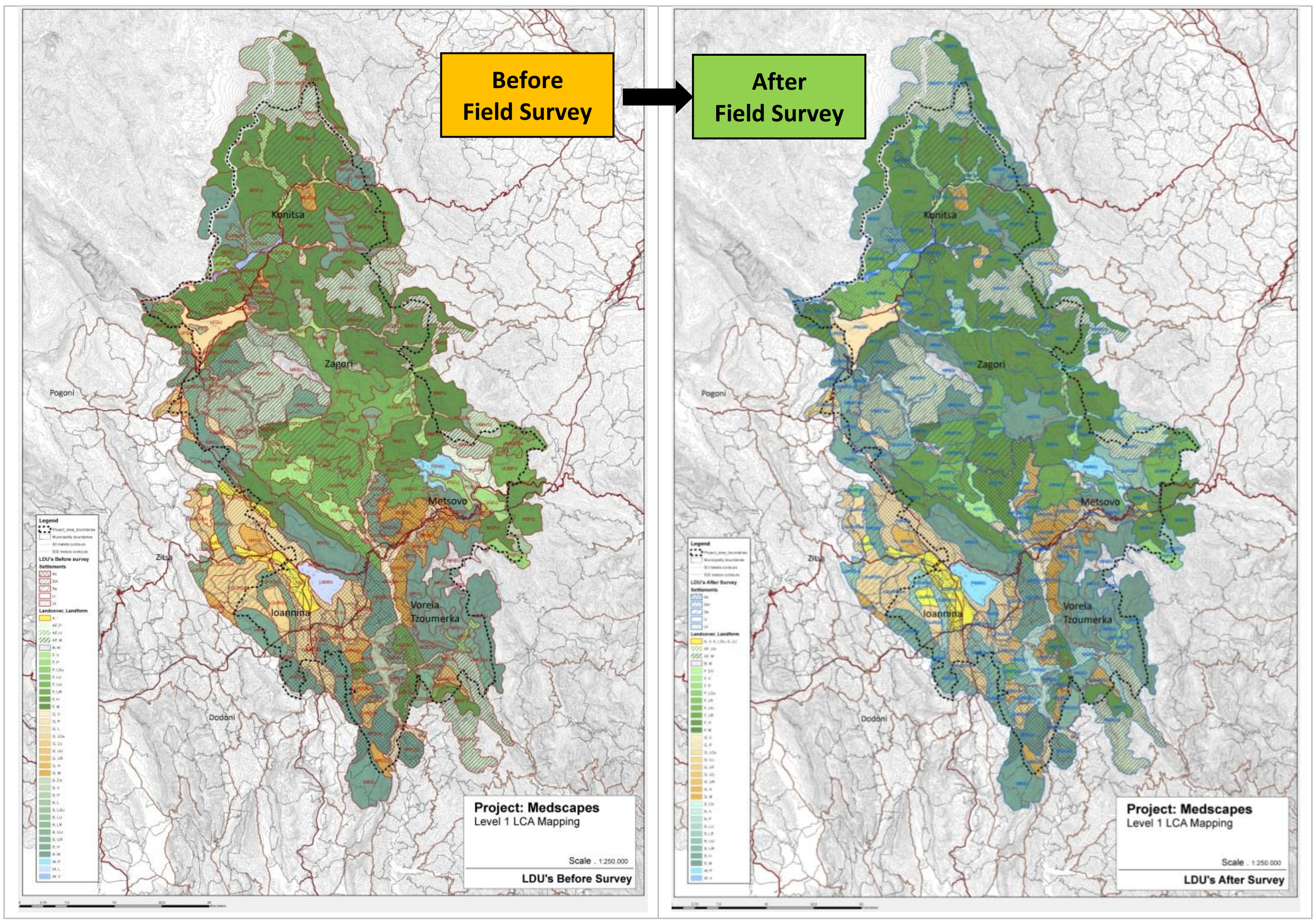


Figure 23: LDU modifications (boundary amendments, subdivisions and merges) after field survey

Source: MedScapes Epirus LCA database

3.3.3 Filling in the Field Survey Sheet to Describe LDU Character and Condition

The Field Survey Sheet for a detailed assessment is designed to capture three key bits of information that together capture ***landscape character***:

- **Dominant elements**: the key elements that occur throughout a given area and which define the character of a particular landscape.
- **Distinguishing features**: these are the associated features that although they may not occur everywhere within a given landscape, they still contribute strongly to 'sense of place'.
- **Organisation of elements**: this section should convey a clear and informed impression of the overall character and appearance of the landscape.

Furthermore, when the purpose of the assessment demands the collection of information to guide specific future management decisions, the Field Survey Sheet should also record ***landscape condition***. Condition, which should be clearly distinguished from character, is a measure of how far removed a landscape is from an "optimal" state where all the key characteristics are present and functional. Condition has both a visual and a functional dimension:

- The visual dimension reflects the degree to which the existing landscape pattern appears visually fragmented, due to the loss of existing features or the imposition of new features, which appear "out of place".
- The functional dimension embraces a range of issues related to the ecological "health" of the landscape and the extent to which present-day land use respects the inherent ecological and cultural character of the land.

The Field Survey Sheet used in the MedScapes project (see Figure 16) is designed to record all of the above information. The sections below, which are taken from the MedScapes Level 2 LCA protocol, describe the terminology used in the Field Survey Sheet, providing useful tips and advices to properly record all required information.

1. General comments

Firstly, record all components of the landscape present and then roughly estimate the proportions of each component in the LDU:

- *Dominant (D):* approx. 75-100%
- *Prominent (P):* approx. 50-75%
- *Apparent: approx.*10-50%
- *Insignificant (I):* >10%

Two landscape factors (e.g landform, woodland or land use) cannot be dominant; only ONE factor in the same unit can be characterised as dominant! If two factors are co-dominant then characterise both as prominent. *Consistent* & *Variable*; and *Widespread* & *Localized* belong to the *Apparent* category.

2. Topography

- ✓ *Undulating:* Landform that is characterised by more dramatic topography of soft hills and valleys that could be described as "gently undulating" and which cannot be described as "rolling". As a general rule undulations are between 5m and 10m in height.

- ✓ *Gently undulating*: Landform that is characterised by gentle topography of shallow hills and valleys. As a general rule undulations are not greater than 5m in height.
- ✓ *Rolling:* Landform that is characterised by pronounced topography of soft hills and valleys. As a general rule, rolling landform shows vertical variations greater than 10m in height.
- ✓ *Flat: The gentle slopes in those areas* are often hardly noticeable to the naked eye.

Figure 24: Topographic variations in the field

Source: MedScapes LCA Level 2 protocol

3. Woodland / shrub cover

Describe tall scrubs and trees, not dwarf shrubs such as phrygana (i.e. anything > 1m).

Tree cover	Coniferous, Mixed Plantation, Woodland, Trees/forest, Deciduous
Tree cover pattern	Small (<1ha), Medium (1-5ha), Large (>5ha), Clumps, tree groups, Hedgerow trees, Riverside trees, Continuous, Irregular, Regular, Linear, Extensive, Scattered trees, Linked
Species	Poplar, Alder, Willow, Oak, Ash, Birch, Pine, ect
Structure	Age of tree (old, new) or different aged trees ect

4. Landcover / Land use

Semi natural scrubland	Species distribution will generally reflect natural variations in the site and its soil
Semi natural woodland	Species distribution will generally reflect natural variations in the site and its soil
Arable	Cereals, vegetables and other
Cultivated land	
Orchard	Collection of fruit bearing trees (pears, apples), often arranged in straight avenues.
Improved pasture	Meadows and pastures that have been affected by heavy grazing, drainage or the application of herbicides, fertilizers or slurry. Limited range of grasses present and often distinguishable by a uniform, bright green, lush and even sward

Unimproved pasture	These are likely to be rare. They may be rank and neglected, mown or grazed. Species diversity is often high
Meadow	
Rough grazing	Marginal unimproved land which is often steeply sloping and used for grazing sheep. Rough grazing is often rush dominated and sometimes shows signs of scrub encroachment
Other	Mixed farming, farmlands, cows, sheep, pigs, silage bales, fen, marshland, moorland, parkland, grassland, heath, recreation

5. Scale

- ✓ The overall scale of the landscape must be assessed once the component (landform, woodland or land use) that define it (dominant) have been established.
- ✓ These include the degree of enclosure by landform or woodland and the main positions from which the landscape is viewed. Scale increases with elevation and distance. Scale is closely related to balance, proportion and enclosure.
- ✓ The landscape scale is defined by the size of the elements (e.g. size of fields and hills) within it and their relative distance.
- ✓ *Intimate Spatial Character:* A landscape of restricted views where there is a consistently small field pattern (less than 4 hectares) and the close proximity of other elements creates a strong sense of enclosure.

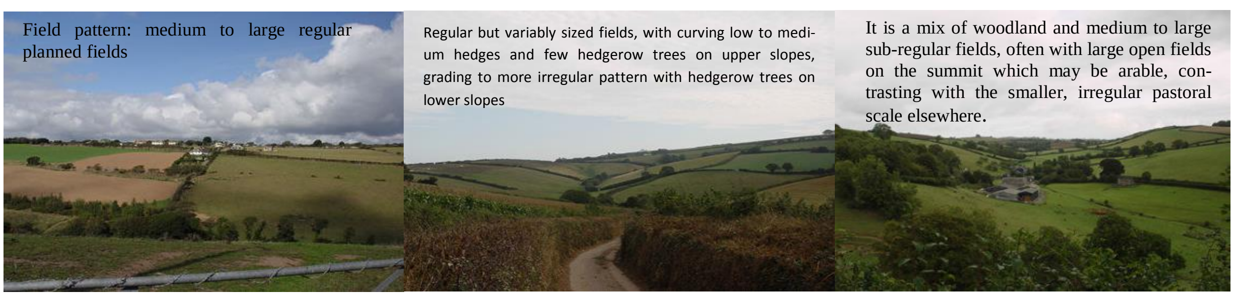


Figure 25: Field patterns and composition of elements creating an intimate spatial character

Source: MedScapes LCA Level 2 protocol

6. View

The criterion of view is assessed depending on how much you can see outside the LDU when being in it.

- ✓ *Filtered*: usually in a forested area when the view is filtered by the trees.
- ✓ *Framed*: enclosed usually by hills, or low ridge, river banks, or by clusters of trees.
- ✓ *Open*: you can see the horizon.
- ✓ *Exposed*: the area is usually susceptible to meteorological influence like wind or coastal erosion effects.

Figure 26: Different views in the landscape

Source: MedScapes LCA Level 2 protocol

7. Natural features

These may include lakes, rivers, river banks, cobbles inside the river bed, streams, rock outcrops, etc.

8. Indicator species

These refer to species that are associated to the LDU and its habitats (e.g. phrygana associated with calcareous geology, reeds associated with lotic ecosystems, *Ferula communis* associated with roads / disturbance, *Tamarix, Nerium oleander, Juncus sp., Arundo, Phragmites* etc.).

9. Field pattern

- ✓ Regular pattern of fields
- ✓ Open landscape, without field boundaries
- ✓ Recurring pattern

10. Other features

These may include artificial objects, such as antennas, stables, electric poles, but may also refer to different soil types, etc.

11. Intensity of management

- ✓ For arable lands this refers to the intensity of cultivations.
- ✓ For forests it includes forests managed for wood production, reforestation, fire breaks.
- ✓ Avoid marking “very high” unless you have information about the area (e.g. spraying with pesticides or using fertilizers with high organic loading or a deforested woodland etc).
- ✓ An example of “low” management could be a farm landscape or a wildlife park; for “medium” it could be a permanent pasture, and for “high” an intensive cultivation – all planted (e.g. cereals).

12. Description

Some tips to produce the written description are:

- At the first 2 sentences, describe the prominent elements of the landscape in relation to the associated characteristics / features; e.g. “steeply, sloppy hills”, “olive trees in cultivated areas”, etc.).
- Then describe anything else that is there (settlements, field pattern and boundaries); e.g. “landscape with nucleated settlement pattern, separated by regular pattern of medium-sized fields”.
- Finally, describe the visual character of the LDU mentioning the scale and the view; e.g. “open landscape with distance view to the coast or hillsides”.

Summary discussion:

1. Field survey is essential to complement the desk study, verify and amend the draft LDUs and provisional landscape character types; it allows character to be clearly described, and provides information on characteristics which cannot be identified from desktop mapping, but also concerning the aesthetic and perceptual aspects of the landscape.
2. Surveys should be planned to ensure that all provisional landscape character types identified in the desk study are visited, generally seeking to achieve an average of three survey points in each (outside / panoramic view; inside view; border view).
3. The scope and level of the assessment will guide the design and content of the field survey process. At the Level 1 scale, a field validation visit may be enough to complement the desktop mapping stage, particularly when a Level 2 assessment is planned next. At Level 2, a detailed assessment using standardised field survey sheets to record information will be needed. Intermediate solutions could also work well if time and resource restrictions apply; this could involve a sampling exercise using a simplified field survey sheet.
4. For detailed assessments, a field survey sheet should guide the collection of field data at each survey point. The survey sheet should be tailored to the specific study and should provide space for: a written description, a checklist of landscape elements and their significance, a checklist of aesthetic and perceptual factors, and space for observations about the sensitivity and management needs of the landscape.
5. A full and robust record of the survey should be kept and it should be as comprehensive, accessible and consistent as possible. Photographs should be an essential part of the field survey record as they are also part of the presentation of landscape types that follows next.

PART 4: CHARACTERISATION AND DESCRIPTION

4.1 FROM LDUS TO LANDSCAPE CHARACTER TYPES

The final stage of the characterisation process involves the classification into Landscape Character Types (LCTs). LCTs are generic, repeatable spatial land units with relatively homogeneous character. This means that they may occur in different areas, but wherever they occur they share broadly similar combinations of definitive attributes; i.e. they carry broadly similar patterns of landform, soils, landcover / land use and settlement / field patterns. This does not mean that every area belonging to a certain type is identical, but rather that there is a common pattern which may be discerned both on the landscape maps and in the field survey records.

LCTs are defined by the amalgamation (i.e. groupings) of LDUs based on the classification of visually significant attributes. By contrast to the mapping of LDUs, the derivation of LCTs recognises the human perception of prominent visual characteristics and/or locally distinctive features. For this reason, the classification into LCTs is possible only when field survey has been completed, allowing to include the visual dimension of the landscape into the results of the mapping process.

Experience during the MedScapes project has shown that landform and landcover have been the most significant attributes contributing to landscape character. It has thus been decided that the combination of landform and landcover would be used as the basis to inform LCT definition. Secondarily, settlement pattern has also been used to identify and describe the final landscape typology in the study areas.

There are two ways to produce the final typology; the empirical method, and the statistical method, which uses automated clustering techniques to distinguish groups of landscape units with similar attributes in the GIS. Both of them have been used by the MedScapes partners to produce the classification into LCTs in each study area. Clustering techniques have been widely used for environmental stratification purposes and may give satisfactory results, particularly when examining large datasets, such as those of the final LDU attribute tables. However, the outputs of such an analysis should not be regarded as a substitute for professional judgement. Above all, landscape is much more than an equation of figures, therefore no meaningful classification can be produced without a holistic (even though subjective) interpretation of all the information recorded during the desktop mapping and, even more significantly, the field survey stage.

The end result of the classification process will be a map of LCTs which will synthesise the detailed information recorded for each LDU into much larger landscape units. This means that, for the purposes of the classification, some of the information that has meticulously been recorded during the two previous stages of the characterisation process will be "lost" for reasons of uniformity and simplicity (for example, mixed Level 1 LDU landcover characterisations might be concealed under a more generalised LCT definition focusing on the most dominant or characteristic use only). This may sound frustrating; however you have to keep in mind that the aim of the exercise is to provide a general spatial framework that allows for a more systematic and well informed process of evaluation and decision making, where some deductions are necessary if the process were to work efficiently. In any case, the more detailed information recorded during the mapping and field surveying process may be used either as part of the LCT descriptions (i.e. as additional descriptive characteristics that contribute to landscape character at least in parts of a given LCT) or later on, as part of a finer scale of LCA for the study area.

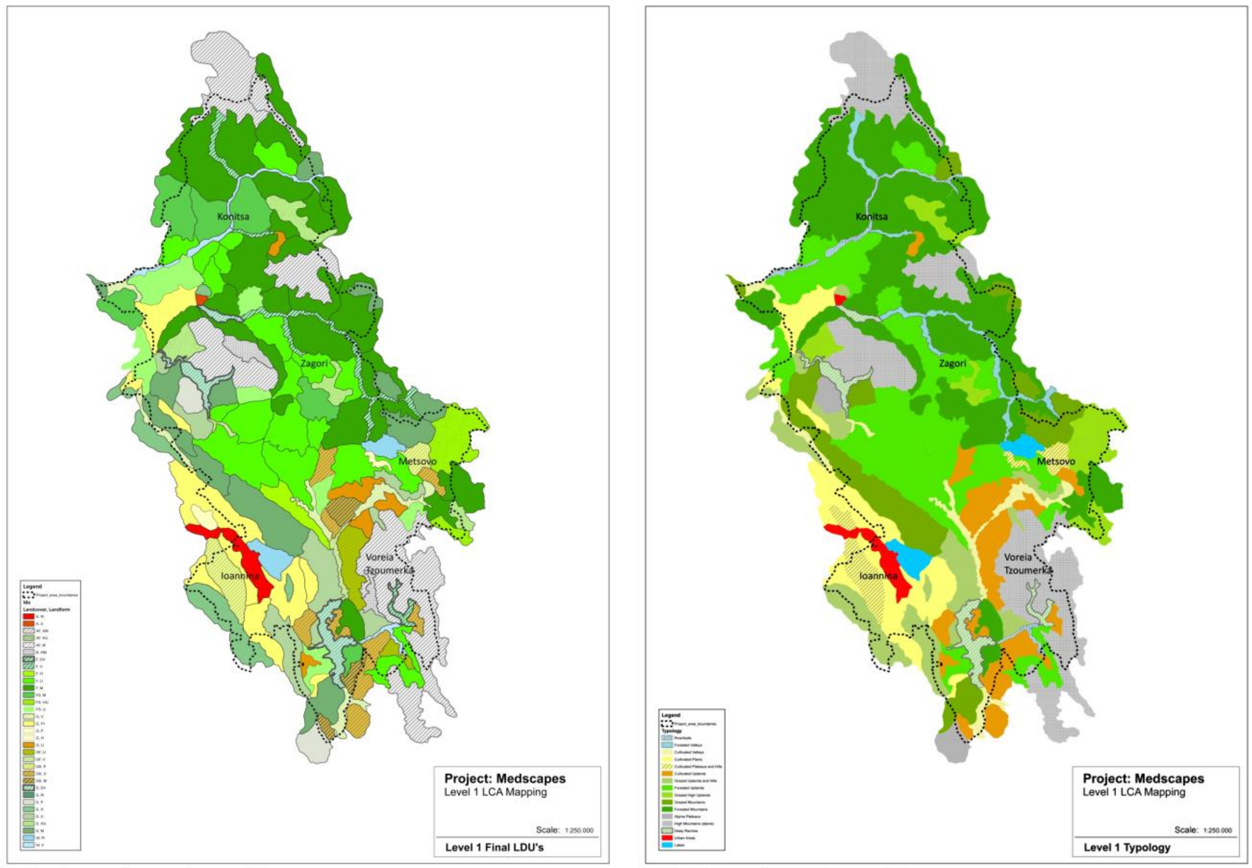


Figure 27: Moving from LDUs to Landscape Character Types

159 Land Description Units (left) amalgamated into 16 Landscape Character Types (right)

Source: MedScapes Epirus Level 1 report

4.2 Naming Landscape Character Types

LCT names are simple, two or three word, names which reflect the dominant influences on landscape character. Since LCTs are based on particular combinations of underlying natural and cultural influences on the landscape, they are given broad generic names, with a wording that relates to the main definitive attributes (geology, landform, land cover or settlement), together with more descriptive geographical terms (high, low, large, remote, etc.); for example, *Coastal Wetlands*, *Rangeland High Uplands*, *Cultivated Plateaus*, etc. Such characterisations stand as neutral statements of the current character of the landscape and may be used to raise awareness of landscape distinctiveness and to encourage appreciation of differences between individual areas. Table 13 below provides a general terminology for naming LCTs. As mentioned in the previous chapter, the landscape typology of the MedScapes project emphasised the combination of landform and landcover, using settlement as an additional descriptive attribute; naturally, this is also reflected in the names used to describe LCTs in the East Mediterranean.

Table 13: Naming Landscape Character Types

Possible generic terms that can be used in naming landscape types include:			
Geological terms	**Topographic terms**	**Landcover terms**	**Settlement terms**
e.g. Sandstone	e.g. Uplands	e.g. Forested	e.g. Settled
Limestone	Lowlands	Rangelands	Unsettled
Chalk	Hills	Cultivated	Urban
Claylands	Mountains	Meadows	Village
Alluvial	Coastal	Olige groves	Sparsely Settled
	Valley	Vineyards	Ancient
	River	Industrial	
To name **landscape types** select 2 or 3 terms which reflect the key characteristics of a particular landscape. This term should normally be in the plural, for example:			
* **Forested Mountains**	* **Rangeland High Uplands**		
* **Cultivated Lowlands**	* **Settled Cultivated Coastal Plains**		

Source: Adapted from Warnock & Griffiths, 2014

Table 14 below shows the full list of the Level 1 East Mediterranean Landscape Character Types defined by the MedScapes project. The table has the form of a matrix, to show the relation of the two dominant factors which affect landscape character for the definition of the East Mediterranean LCTs. Columns represent the main landform classes (darker colours indicate higher altitude) and rows the main landcover classes. Regular and italic fonts symbolise the other important element for LCT definition; i.e. settled or *unsettled* character. Particular landscape types of the region (i.e. the variety of coastal landscape types, wetlands and urban areas) are shown at the bottom of the matrix.

Table 14: East Mediterranean Landscape Character Types

		Landform						
	Main classes	**Mountains**	**Uplands**	**Plateaus**	**Hills**	**Valleys**	**Plains**	**Lowlands**
Landcover / Land use	**Forested**	*Unsettled forest mountains* Settled forest mountains	*Unsettled forest uplands* Settled forest uplands	*Unsettled forest plateaus* Settled forest plateaus	*Unsettled forested hills* Settled forested hills	*Unsettled forest valleys* Settled forest valleys *Unsettled deep valleys*		Forest settled lowlands
	Shrublands	*Unsettled mountain shrublands* Settled mountain shrublands	Settled shrubland uplands		*Unsettled hill shrublands* Settled hill shrublands	*Unsettled ravine shrublands*		*Unsettled lowlands shrublands*
	Rangelands	*Unsettled rangeland mountains*	*Unsettled rangeland uplands*	*Unsettled rangeland semi-arid / eroded plateaus* Settled rangeland semi-arid / eroded plateaus	*Unsettled rangeland hills* Settled rangeland hills	Settled valley rangeland	*Unsettled rangeland plains*	*Unsettled lowland rangelands*
	Cultivated	Settled cultivated mountains	Settled cultivated uplands	*Unsettled cultivated plateaus*	Settled cultivated hills Settled hills with vineyards *Unsettled cultivated hills*	Settled cultivated valleys *Unsettled cultivated valleys*	Settled cultivated plains Settled cultivated alluvial plains	Settled cultivated lowlands *Unsettled cultivated lowlands*
Alpine landscapes		*Unsettled alpine mountains*; *Unsettled alpine plateaus*						
Coastal landscapes		Settled cultivated coastal lowlands; *Unsettled cultivated coastal lowlands*; Settled coastal lowland shrublands; *Unsettled coastal lowland shrublands*; Settled cultivated coastal plains; Settled cultivated coastal alluvial plains; Settled cultivated coastal valleys; Settled cultivated coastal hills; Settled coastal hill shrublands; *Unsettled coastal hill shrublands*; *Coastal dunes*						
Wetlands		*Wetlands*; *Coastal wetlands*; *Salt flats*; *Dead Sea*						
Other		Urban; *Escarpments of the Dead Sea*						

Source: Adapted from MedScapes WP5 Final report

4.3 Describing Landscape Character Types

Once identified and mapped, Landscape Character Types need to be described in a way which captures the essence of their character. This usually takes the form of:

- a ***summary description*** and list of ***key characteristics***, supported by a ***sketch / photograph*** to convey a visual impression of the landscape;
- a **full written description** based on a compilation of information extracted from the field survey, literature review and map analysis.

Figures 28-32 below present some characteristic East Mediterranean Landscape Character Types with their descriptions, as defined from the MedScapes project.

Coastal Dunes (*Παράκτιες Θίνες*)

Low hills of unconsolidated sand, associated with a strip of bare sand/pebbles, along the coast. This is an unsettled, "wild" landscape with a covering of shrubs and other semi-natural vegetation, although patches of bare ground are a feature in places.

Figure 28: Characteristic East Mediterranean Landscape Character Types: Coastal Dunes

Source: MedScapes Cyprus WP5 Summary Report

Coastal Wetlands

Description:

Flat lowland landscapes or seascapes, characterized by coastal wetland vegetation (salt marshes) or water-body (marine water) ecosystems. Although largely unsettled, they may occasionally be sparsely settled (in certain areas, such as the Kalloni area), along the coast. This landscape type is characterized by open-field wetlands and well-developed sand dune systems, with halophilic vegetation and sandy heaths. Concerning its visual character, the scale tends to be large, while views tend be those of open landscapes defined by low hills, in the foreground.

Characteristic features:

- Flat landscapes with wide, distant views
- Unsettled landscapes with few human features
- Extensive sand dunes, interspersed with shallow waters
- Extensive salt marshes covered by halophilic vegetation
- Alluvial soils

Figure 29: Characteristic East Mediterranean Landscape Character Types: Coastal Wetlands

Source: MedScapes Lesvos Level 1 report

Forested Settled Hills

Forest, settled hills located on shallow soils over chalk and limestone; located at elevation of 300 – 600m. Settlement is usually located on hilltops, extending along vehicular roads.

Characteristic Features:
- Open to filtered views
- Quercus and Pine vegetation

Special Features:
- Terraced agricultural cultivation

Threats:
- Urbanization
- Erosion
- Forest fires

Figure 30: Characteristic East Mediterranean Landscape Character Types: Forested Settled Hills

Source: MedScapes Lebanon Level 1 report

Semi-arid plateau rangelands

A gently undulating plateau surface with wide open views dissected by small wadis. The landscape is mostly an unsettled and rangeland area with shallow soils widely covered with small gravels. The plant cover is poor except for some annual herbaceous plant species like Anabasis (*Anabasis articulata*) increasingly appearing in wadis.

Figure 31: Characteristic East Mediterranean Landscape Character Types: Semi-arid Plateau Range-lands

Source: MedScapes Mujib Level 1 report

Grazed High Uplands (*Ορεινά Βοσκοτόπια σε Μεγάλο Υψόμετρο*)

Undulating and gently undulating landscape of high altitude (around 1,500m). This particular landscape type appears along wide mountain ridges and is characterised by significant grazing activity and low settlement density, having a sense of openness and continuity. In terms of landform, it can neither be characterised as a plateau nor as a mountain, due to its intermediate slope pattern; in terms of landcover, its shrubland character is a product of intense grazing and not of climatic conditions, as it lies below the alpine vegetation zone.

Figure 32: Characteristic East Mediterranean Landscape Character Types: Grazed High Uplands

Source: MedScapes Epirus Level 1 report

PART 5: LCA POTENTIAL APPLICATIONS - THE WAY FORWARD

5.1 USING LANDSCAPE MAPS AS TOOLS FOR DECISION-MAKING

5.1.1 SETTING THE SCENE

Many different factors contribute to change in the landscape. They are as diverse as climate change, severe weather events like floods and droughts, built development, and changing land management, among others. The balance between the different factors varies from place to place. There can be little doubt, however, that in some areas built development is one of the most significant causes of change. Most forms of built development are subject to planning controls and both planning policies and the implementation of these policies through development control can have a significant influence on the evolution of the landscape. Landscape Character Assessment can make a valuable contribution to the formulation of planning policies, to development control activities, to the allocation of land for development, and to processes such as environmental assessment (Swanwick, 2002).

However, as pointed out by studies in the UK[27], the major constraint on the use of LCA is thought to be the scale of the work and the lack of prescription, as, although the descriptions of character are thought to be particularly helpful, the accompanying management guidelines are generally considered less helpful. It has thus been recognised that there is a stage between the assessment and the development plan process in which there is a need to expand the content of LCA and address specific issues in more detail[28].

The MedScapes partners have recognised the gap between the characterisation process and the decision-making stage of LCA. To this end, a specific Work Package (WP7) has been devoted to develop a spatial Risk Assessment Model (RAM) and Decision Support System (DSS) that integrates the results of the MedScapes LCA aiming to allow for a better understanding of the implications in land use and conservation decision-making in view of the risks to cultural and natural heritage. WP7 has been led by the American University of Beirut (AUB), who developed the platform of the RAM as an online tool in the website of the East Mediterranean Landscape Observatory (EMLO), for which it is also responsible.

5.1.2 THE MEDSCAPES RISK ASSESSMENT TOOL AND DECISION SUPPORT SYSTEM[29]

Risk is the probability of an event happening in a given time span (hazard) and the magnitude of its impact when it occurs (vulnerability). The Risk Assessment Model (RAM) proposed in MedScapes is built to assess the risk of loss of landscape character in the study areas of each partner country. Its objective is to develop a methodology able to take into account the protection of landscapes of particular interest and the wise planning of all landscapes, with special emphasis on the rational use of natural resources.

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[27] See for example David Tyldesley Associates, 1999. *The Use of Landscape Character Assessments in Development Plans*. Report to Scottish Natural Heritage (cited in Swanwick, 2002).

[28] Similar questions were also raised by planning department officials in Greece during the MedScapes national stakeholders' seminar where the methodology and results of the Greek LCA case studies have been presented and discussed.

[29] This Chapter is based on MedScapes WP7 Final report (titled *LCA Results Integration and Risk Tool development*), prepared by the American University of Beirut (AUB).

The end product is a Decision Support System (DSS) designed to aid decision-making by enabling end-users to build scenarios and make future projections according to a set of risk related parameters. The specific aims of the RAM are to:

- make advancements towards assessing the risk of loss of landscape character;
- quantify the valued assets that contribute to landscape character;
- assess what hazards threaten the loss of this character;
- develop a methodology for the protection of landscapes of particular interest;
- support rational planning of all landscapes in respect to the particular characteristics of each landscape character type;
- assist in the development of management plans to protect the natural and cultural heritage of the East Mediterranean; and
- make this information readily available to stakeholders.

The methodology of the RAM is based on the assessment of ***Hazard*** and of ***Landscape Value***, using the MedScapes Level 1 LDUs from each study area as the building blocks of the risk assessment.

- ***Hazard*** is defined a potential threat that is likely to cause damage to landscape character in case it occurs; and
- ***Landscape Value*** is the value of assets in each LDU, mainly being ecological, natural, and historical/archaeological assets[30].

Risk is expressed through an equation:

Risk = **Hazard** x **Landscape Value**

Derived from the original equation

Risk = **Hazard** x **Expected losses**

where Expected losses is Vulnerability x Value

Before starting, the MedScapes partners were asked to fill out a questionnaire, ranking the severity of different potential hazards on the landscape and its character. Based on the partners' responses[31], four types of Hazards where chosen:

- Desertification;
- Erosion;
- Forest Fires; and
- Intensification of urban sprawl.

[30] Landscape value is often assessed by the concept of landscape beauty or landscape experience. For the purposes of this study, it is fundamental that the assessment takes into account parameters which are important in landscape planning. Landscape planning approaches use ecological parameters, such as: Compactness, Density, Fragmentation and Connectivity.

[31] The selection was done considering the following criteria: *Severity* in terms of the effect of the occurrence at a location (site parameter); *Applicability* across the partner countries; *Availability* of information; *Relevance* to results from the LCA process.

Similarly, the partners were asked to consider a series of parameters that reflect Landscape Value, building upon the LCA results. The selected Landscape Values are ecological and historical / cultural:

a. Ecological Values
   - Naturalness
   - Continuity
   - Dominant habitat type
b. Historical / Cultural Values

Figure 33 below shows a schematic representation of the incorporation of the selected Hazards and Landscape Values into the MedScapes RAM.

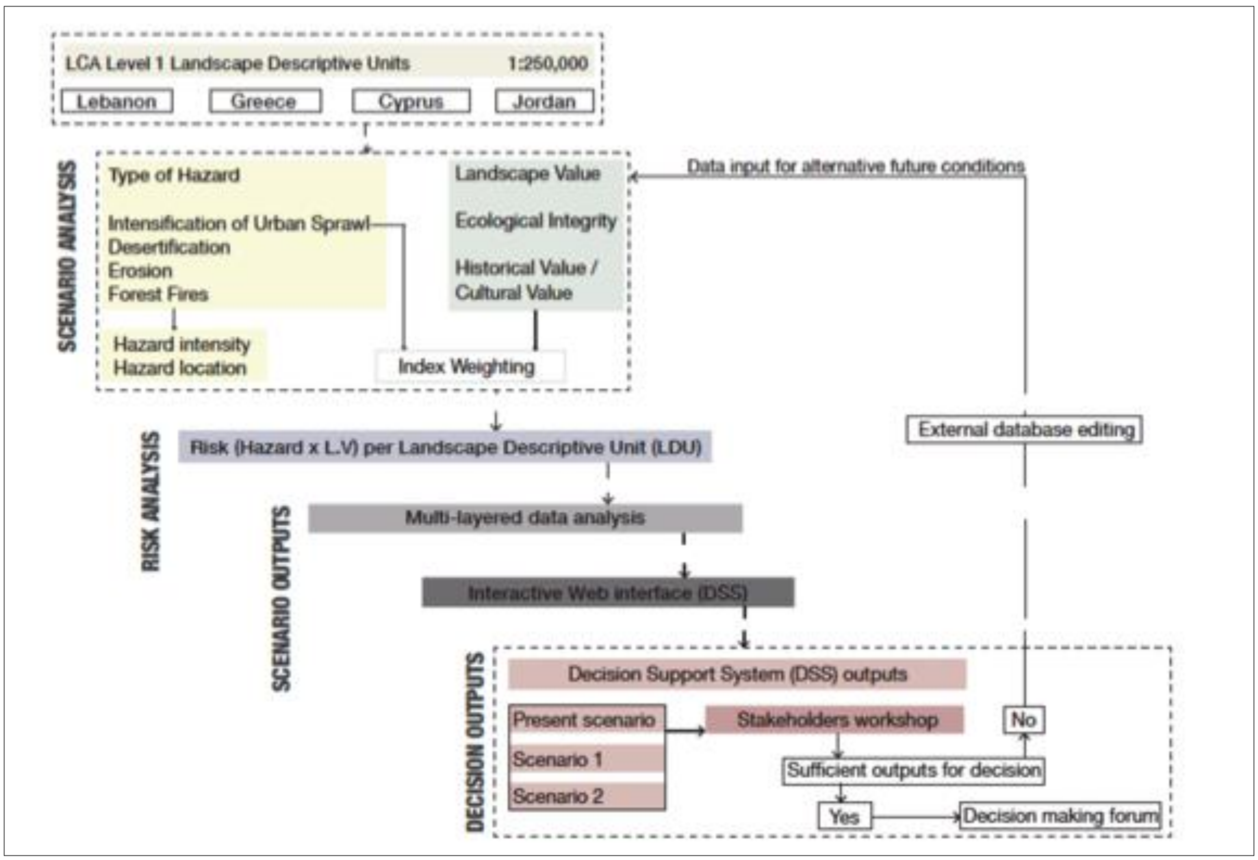

Figure 33: Diagram of the MedScapes Risk Assessment Model

Source: WP7 Final Report

Figure 34 below illustrates the methodology of the risk assessment (data processing and value ranges used as weight indicators).

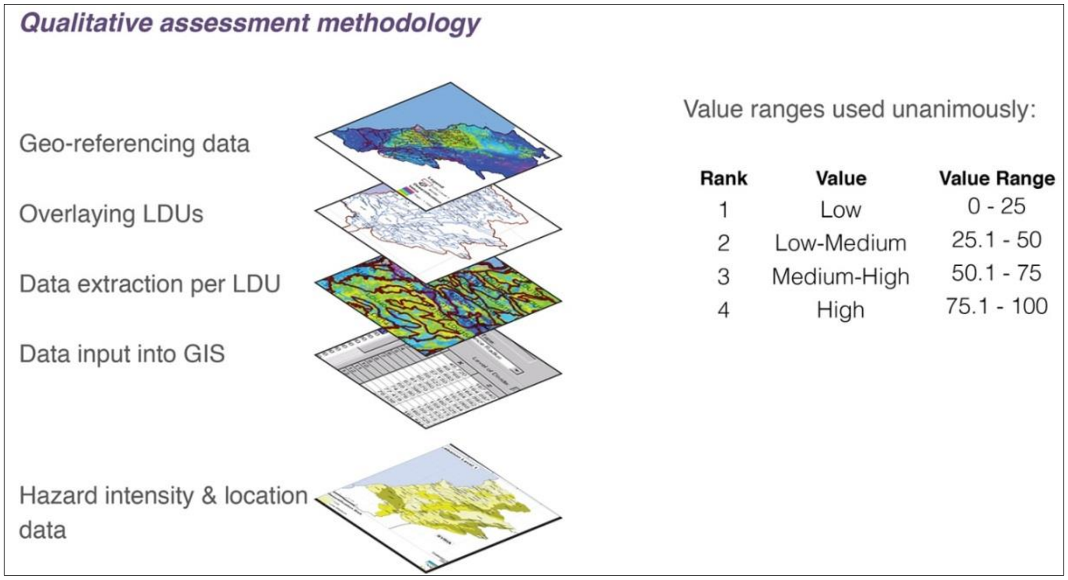

Figure 34: The methodology for risk assessment in MedScapes
Source: WP7 Final Report

The results of the risk assessment process are in the form of maps of qualitatively assessed Hazards and Landscape Value per study area. To portray the results in a form at which the viewer can automatically make relationships between the ***intensity of a hazard per LDU*** and its ***Landscape Value***, a coloured matrix was used as a legend to the corresponding map to illustrate Hazard x Landscape Value. Below is an example from Lebanon showing Erosion x Landscape Value for each LDU.

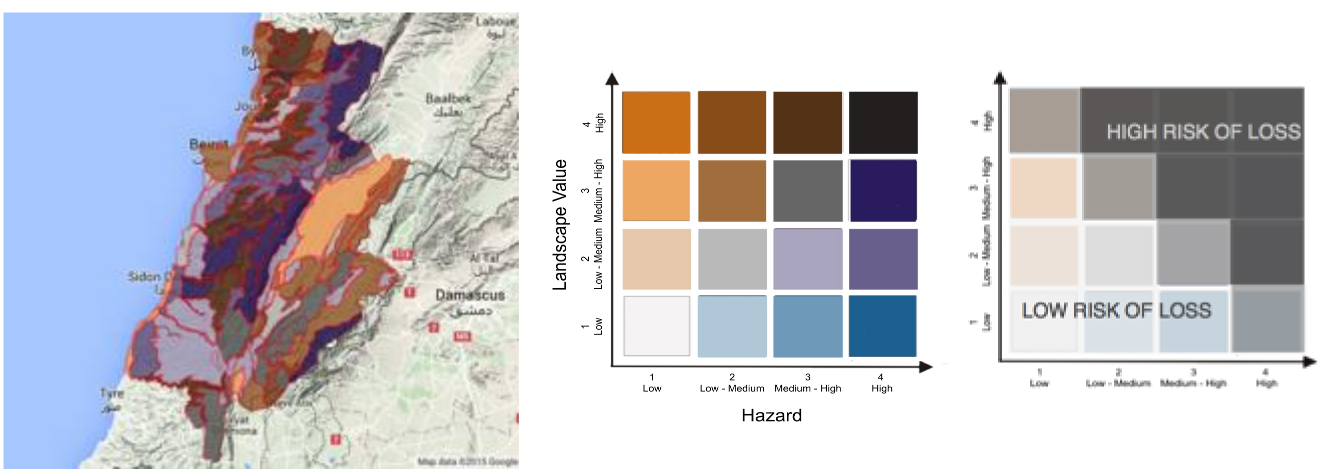

Figure 35: RAM data portrayed as a 4x4 matrix showing Landscape Value vis-à-vis Hazard risk
Source: WP7 Final Report

The DSS is defined as a computer aided system to support decision-making assisting stakeholders in comparative assessment and selection of options for change. It assists in scenario building and alteration to support future decisions. The DSS was developed as an interactive web-based interface, where the user can view the results of the LCA and RAM and develop scenarios pertaining to the intensification of urban sprawl patterns (Hazard) in relation to Landscape Value.

The DSS is designed to offer an integrative spatial framework for landscape risk assessment and scenario building to support land use planning decisions. It can help decision-makers and stakeholders to make informed judgements based on the risk affecting the land, enhancing the process of defining mitigation or prevention measures.

The architecture of the DSS has the following key features:

- It maps and visualises information on up to four (4) different Hazards and the consequent losses on Landscape Value at the scale of the Level 1 LCA.
- It enables different scenarios to be run which generate information about Hazards and Landscape Loss for all study areas, and for each LDU, so that different options for mitigating risks or land development can be compared.
- It enables scenarios to be run using different weight and rank Hazards.
- It provides a knowledge base on Hazards.

The DSS Scenario Generator has been developed with the following capabilities:

- Credible scenarios need to be scientifically translated into changes on the GIS map.
- The Scenario Generator must automatically translate the scenario into the correct model configuration.
- The Scenario Generator must either automatically provide the required model parameter information, or must query the user for the appropriate information.
- The scenario(s) may then be processed through the model(s).

The DSS of each study area in the MedScapes partner countries can be accessed at the following link:

http://www.aub.edu.lb/FAFS/LDEM/EMLO/EXTERNAL_RESOURCES/MEDSCAPES/RADSS/Pages/DSS.aspx

A User Manual is also available for download to provide assistance in the use of the DSS.

5.2 Stakeholders Engagement

5.2.1 Key Issues for Consideration

Stakeholder involvement in LCA adds value to the assessment and increases the weight given to decisions based on it (e.g. policies and guidance). Involving stakeholders in the final stages of an assessment, as well as earlier on in the process, can help to ensure that the identification, mapping and naming of landscape character types (and/or areas), as well as the description of landscape character reflect wider knowledge, experience and perceptions of the landscape. It will also ensure that outputs are fit for the audience that will eventually use the assessment (Tudor, 2014).

When considering involvement of people in the assessment process it is important to identify:

- ***who*** should be engaged (i.e. the range of stakeholders to be involved);
- ***when*** they will be involved (i.e. the stage(s) of work they will contribute to); and
- ***how*** they will be involved (remember that true stakeholder engagement involves participation, not just consultation).

The scale and purpose of the assessment will influence these important decisions for stakeholder engagement in the LCA process. Some important notes are (Tudor, 2014):

1. Where stakeholder engagement has occurred in earlier stages of the process, the same groups and individuals should be involved in the preparation of the final outputs and they should be shown how information previously submitted has been used.
2. For national / regional scale projects, suitable stakeholders to represent commissioning and partner organisations, and representatives of other bodies with an interest in landscape (i.e. communities of interest) will be relatively easy to identify. However, it may be more difficult to involve local people (i.e. communities of place) because of the focus on the larger scale landscape; in this case, limited involvement at local level may be viewed as tokenistic.
3. At the intermediate / local authority level, identifying and involving stakeholders may be more straightforward, as many organisations are used to working at this scale. These bodies with an interest in the landscape can make a valuable contribution to the classification process and their involvement can help to build understanding and ownership of the LCA process before it is finalised. Meaningful involvement of local communities at this scale can demand significant resources if not handled well (as large amounts of information can be generated, which will need to be collated, evaluated and fed into the assessment process). Sometimes an achievable approach might be to hold targeted discussions, or workshops, across a local authority area. The commissioning organisation should at least widely publicise consultation on the draft LCA.
4. At the more local scale, local people can play a very important role in the characterisation process, as they will be able to discuss their views on the draft boundaries between different types (and/or areas) and inform final boundaries, but also to provide valuable input to the final naming (i.e. using names that reflect the locality, or even the local dialect).

However, even in the UK, where LCA has been practiced for more than three decades, it is widely acknowledged that the characterisation process has "*been mainly in the professional domain, the work of specialists, and has only involved the opinions of local people to a fairly limited extent*" (Strategic Environmental Delivery Group, 2012).

The MedScapes partners have recognised the significance of stakeholder engagement in the LCA process and placed concerted efforts to overcome the inherent limitations of the project, which were posed by the large scale of the assessment (that focused in the national / regional level of 1:250,000) on the one hand, and time / resource restrictions on the other hand.

To this end, a specific Work Package has been devoted to design and implement a community-based participatory approach for LCA in the project countries. WP6 has been led by the Society for the Protection of Nature in Lebanon (SPNL), who successfully promotes the ***hima*** community-based conservation approach in Lebanon for more than ten years. For the needs of MedScapes, the *hima* participatory framework has been adapted to suit the context of the LCA process and reflect the specificities of partner countries, so as to be implemented for the conservation of distinctive landscapes in the MedScapes pilot areas in collaboration with the local communities.

5.2.2 The MedScapes Hima Approach[32]

Hima means "protected area" in Arabic. It is a traditional approach for the conservation of natural resources that has been prevalent in the Arabian Peninsula for more than 1,500 years. The *hima* approach started with the tribal system and the need to secure their livelihood in harsh environments. Then, it evolved with the Islamic culture that added to it values such as equity, common good, equal opportunity and common decision making. One of its more important principles is that ***all individuals enjoy the rights of responsibly managing and using public natural resources***, which can be seen as a valid response to the modern "tragedy of the commons" (see Hardin, 1968) in communal lands management.

The *hima* in its concept is mainly an area that is used to promote a better livelihood for the people and protected for the benefit of all creatures of the environment. As such, it meets with the concept of landscape, as defined in the ELC (i.e. "*an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors*") in many ways:

- both concepts have the key terms "area", "people", "action and interaction" as a base for their definition;
- they both link nature to culture and people;
- they both exceed the simple notions of "land" and "view", placing emphasis on how people perceive an area, how they act towards it, and what elements in that area they find valuable because these (elements) contribute to their survival.

The importance of placing local communities in the leading role is cornerstone both to achieve effective conservation and to support transparency and democratisation in the decision-making process. After all, it is the local people who are the most knowledgeable of their land and only they can be the real stewards of their landscape and its natural resources that support their well-being. This is why conventional "top-down" conservation approaches in which local communities have no –or very

[32] This Chapter, and the Chapter which follows, are based on MedScapes WP6 Final report (titled *Hima: A Methodology for Local Involvement in Distinctive Landscape Management*), prepared by the Society for the Protection of Nature in Lebanon (SPNL).

limited– say to the matter have long shown not to be effective. People seem to have more respect for “bottom-up” approaches, such as the *hima*. Through the *hima*, there has been a shift from technical / management capacities of land planning, to a user-friendly interactive framework that spatially summarises the risks and problems and sets out the vision and goals for each landscape –***with*** the community, and ***for*** the community. Thus, the *hima* approach marks as a reliable and efficient approach that can produce significant positive results in terms of preserving natural resources, conserving ecosystems and supporting local communities.

It should be noted that time and resource restrictions did not allow for full stakehloder engagement throughout the whole project cycle, to include for example LDU and LCT boundary definitions and descriptions –as would be the “ideal” scenario for LCA implementation. The focus of the exercise has been to introduce to the local communities and stakeholders the concepts of community-based participatory management and of landscape characterisation as an overarching framework for nature and culture conservation at the local scale. The main activities carried out with the communities were problem analysis, vision formulation, scenario building and developing an action plan.

The following section presents an overview of the main lessons learned from the shared experience of *hima*-based community involvement in the LCA process in the four project countries (eight rural communities, two per country) and provides recommendations for the future. Detailed descriptions of the *hima* design and implementation process can be found in the Final Report of MedScapes WP6.

5.2.3 Lessons Learned and Recommendations

Most of the MedScapes partners had previous experience in implementing participatory approaches with the local communities. The main lessons learned from their experience in implementing the *hima* participatory framework can be summarised as follows:

- As shown both in Cyprus and Greece, the *hima* approach has certain benefits compared to the European conservation approaches. The bottom-up management approach based on general consensus of all main stakeholders for the vision and goals of the area, the participatory nature and flexibility in the implementation of the strategies developed, can help to ensure the acceptance of the local communities for the management of the area.
- Similarly, the EU Directives for protected areas, being introduced in a rather exclusionary fashion, focus mainly on the natural and ecological characteristics of the site. The *hima* approach on the other hand is more inclusive, designed to preserve and protect ecosystems for the sustainable use of their resources by the people and for the people, taking into account the social and cultural particularities of the area.
- Evidently, there is a need to follow up a “watch over” on the *hima* sites, otherwise there will be a lapse into the previous apathy; nevertheless, this experience has reinforced our conviction that NGOs are the most suitable agencies to undertake such initiatives because they are prepared to invest the time and effort required on a long-term basis.
- The presentation of the *hima* principles and methodological approach to the management of landscape resources was met, in the community of Sigri (Lesvos, Greece), with very positive and encouraging comments; both local authorities and residents found the example of *hima* very interesting and useful, especially in creating communication channels between citizens and authorities.

- Conservation initiatives should be coupled with poverty alleviation alternatives for the local community providing them with economic benefits and job opportunities.
- Community engagement is highly important but it is a long-term process that needs time and efforts to maintain; but once the community is convinced, and ownership is ensured, long-term sustainability for natural resource use will be the normal trend.

The main challenges faced by the MedScapes partners are summarised below:

- The main challenge faced when implementing the Hima approach in Cyprus was to identify appropriate sites and willing communities. As environmentally protected sites in Cyprus are already identified and backed up by "strong" Cypriot and European legislation, there is a certain fear that any agreement about land will involve limitations on its use by owners. Thus, it was a challenge to identify an area suitable for applying a participatory approach to nature conservation and sustainable use of natural resources, and to place this initiative within the framework of landscape protection.
- Property ownership was also an issue in Cyprus, as public land is usually managed centrally, while private land is managed individually, subject to restrictions by the zoning regulations of the Planning Authority (Department of Town Planning and Housing).
- Lack of awareness in the local community towards environmental issues and about the ecological value of their area is a common problem. Preparatory meetings held with the community and presentation of other successful examples helped to significantly increase awareness and gain acceptance by the communities involved.
- Local communities always fear centralized approaches due to the potential loss of their decision making power concerning their land. This fear is eliminated in the *hima* community-based approach, when the process is explained to the community and its benefits are made clear.
- However, although there has been a positive example in Lesvos (see above), it has generally been difficult to explain the *hima* concept, find a terminology in Greek and adapt it to the European reality.
- Quite importantly, the timeframe of the project has shown to be short for implementing such an ambitious initiative.
- Furthermore, limited funding, especially at the local government level, for implementing the strategy / action plan that has been developed in each case study, restricts the potential impacts of the approach. Collaborative efforts are needed to mobilise international funding for specific objectives and plans.
- An institutional challenge, for the European countries paticularly, is how to establish efficient management tools at the local level, within an otherwise centralized administrative system at the national level. An additional issue, which causes significant delays in implementation of certain actions, is the multiple authorities involved in land management and planning. Collaboration between local stakeholders is a key factor toward success for ownership of results, proper planning and implementation.

Taking into account all the above points, below are some important recommendations for improving the process in the future:

- People are more ready to accept conservation initiatives when these emanate from their own heritage and language; it is therefore useful to tie them into existing practices.
- There is a need to learn more about the traditional conservation approaches, as has been already identified by the Barcelona Declaration on Land Stewardship (2014); it would be useful if links were created between *hima* and the Stewardship Movement.
- There is a need to demonstrate that protected areas are designated to serve the public good and to ensure that their benefits remain valid for the people.
- Since bottom-up approaches need much more time than top-down directives, and given that NGOs are prepared to work outside office hours and to come back again and again until consensus has been obtained, NGOs should be encouraged to become involved and formal authorities should recognize this contribution and support it.
- External facilitators, such as NGOs involved at the local level, should definitely seek to carry out necessary follow-up actions and continuously cooperate with the local stakeholders, providing technical advice and expertise for new funding mechanisms and implementation tools.
- Successful examples of community-based resource management based on the *hima* approach could be useful to raise awareness in small rural communities of Greece and Cyprus, as the areas where *hima* has been applied bear more similarities to rural Greece and Cyprus in comparison to areas of Northern Europe.
- Transparency in the relations with the local communities is highly important, both to overcome concerns and fears from top-down approaches, and to avoid overexpectations from the communities.

5.3 Conclusions and Recommendations

The end of the MedScapes project leaves us with an important knowlegde base about the character and condition of our landscapes in the East Mediterranean. This knwoledge base is not restricted to the "technical" aspects of landscape mapping, characterisation and risk assessment –which include the LCA databases, maps and reports for the study areas of the project, the summary reports and technical manuals for LCA implementation, the online web-based risk assessment tool and many more. It equally refers to the experience gained in terms of methodology development and science advancement in the field of landscape characterisation –an experience shared not only among the eight project partners, but transferred to a range of stakeholders in all of the four countries of the MedScapes project. The first East Mediterranean landscape typology and the establishment of the East Mediterranean Landscape Observatory are the main products of this joint effort, and it is hoped that they will set the foundations for further work and applied research in landscape conservation and management in the wider area.

Now that the project is to be concluded, the question that inevitably arises is how initiatives and work like the one conducted by MedScapes can improve policy and decision-making in this part of the world that currently faces a series of environmental and socio-economic challenges? In other words, is the MedScapes landscape typology and classification a tool that could provide us with a base for appropriate management and planning of our space and its resources?

The answer largely lies within the very concept of classification. “Classification is, perhaps, the basic procedure by which we impose some sort of order and coherence upon the vast inflow of information from the real world” (Harvey, 1969, p. 326). It appears that classification has become so integrated into our thinking that people do not realise that they are doing it and need to be reminded of this fundamental aspect of human cognition (Langridge, 1992). After all, “we all classify objects, be they people, places, events or any other of a host of phenomena that enter our consciousness” (Shaw and Wheeler, 1985, p. 255).

Classification is important to scientific knowledge because it provides a frame of reference that enables different researchers to communicate their results effectively. It also helps order and structure what is known (Haines-Young and Petch, 1986). The importance of classification for landscape research is no exception (Countryside Commission for Scotland, 1970). Without a landscape classification, landscape researchers are unable to effectively communicate their discoveries, and as a result a body of theoretical knowledge will be slow to develop.

The MedScapes classification or landscape character typology serves exactly this scope; to provide a common framework, and a common language indeed, to researchers and practitioners in the East Mediterranean. The end result has been a series of maps of a variety of case studies showing the boundaries between one distinctive area of landscape and another, and a clear explanation of what lies within each separate area.

The process involved the analysis and synthesis of a wide range of quantitative and qualitative methods. Statistical and clustering techniques were used to identify important characteristics (variables) and classification rules. Most importantly though, at the same time subjective albeit logical decisions were made to determine what would finally be the most useful and regionally appropriate classes. Fruitful discussions and exchange of ideas between the partners, all of them bringing in their own experiences and expertise, were cornerstone to the final landscape typology –but also to the intermediate steps of LCA implementation. We know that landscapes are based on people’s perception; it can thus be argued that the final outputs of the project encapsulate the perceptions of the partners, culminating into a methodologically solid, yet flexible and adaptable, framework for landscape assessment.

The issue of objectivity is long debated in the field of landscape characterisation practice. Objectivity in every LCA is reduced many times by not so adequate descriptions of procedures for delineating and classifying units. Sometimes identifying areas is based not only on biophysical factors, but also various memories, expectations and stereotypes about the landscape; while, the quality of classifications is rarely evaluated (Luc et al., 2015). But is this the point? Is the degree of objectivity key for our understanding of the landscape?

The answer is no… and it should never be. Because even if we come across the most objective approach, we know for a fact that it will be already obsolete as soon as its application in a given place is completed. And this is due to the continuous process of change that characterises every landscape; every landscape is both a tangible and intangible object, both permanent and ephemeral that seizes to exist simultaneously in our realities and aspirations.

What is therefore more important, is to have a structured approach to map, describe and assess the character and condition of the landscape, taking into account the needs and specificities of a given area. And this has been one of the greatest benefits of working in a cross-border cooperation programme; the opportunity to build on existing approaches and to tailor fit them to the context of the East Mediterranean, developing tools and methods with the minimum possible –and in the same time highly diversified– datasets, while speaking different languages and bringing in different understandings of our geographical and cultural realities –even the term “landscape” has been a challenge for everybody from the very beginning.

The end product, as most LCAs, was driven by a need for practical solutions for managing landscape change. Its most important contributions can be argued to be:

1. Understanding the structure and dynamics of the landscape by mapping and describing of what is locally distinctive, thus forming a base for landscape protection, management and planning in line with the requirements of the ELC;
2. Improvising to overcome dataset limitations, thus providing low-cost and efficient alternatives to landscape practitioners and end-users of the method;
3. Using the LCA results for the development of a risk assessment tool, which is designed to link the LCA framework to planning and development related issues;
4. Involving the competent authorities (i.e. Planning Departments) in all project countries to ensure continuation of efforts and increased awareness of the all-encompassing character of landscape approaches as appropriate frameworks for improving the quality of life of people in the Eastern Mediterranean.

However, this was only a first step. The most important challenges are still there:

- ➔ To improve the method and tools so as to better respond to current socio-cultural issues;
- ➔ To introduce landscape characterisation and classification processes in mainstream policies and development strategies in the East Mediterranean;
- ➔ To support other similar activities and projects in the region;
- ➔ To encourage the promulgation of legislation establishing all functions of the landscape in the fields of environmental protection and management, cultural heritage conservation and enhancement, land use planning, development control, etc.;
- ➔ To support the competent national authorities on the development of integrated and multi-level national landscape strategies, which would specify objectives and activities in the medium- and long-term and would constitute a list of evidence-based good landscape management practices, such as the one produced by the MedScapes project;
- ➔ And many more…

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APPENDICES

1. DETAILED SOIL TYPE CLASSIFICATION

Class	Code	Notes	WRB	USDA
Impoverished soils	**D**	Impoverished sandy and coarse loamy soils Podzolic soils Brown podzols	**Regosols**	
Shallow soils over chalk & limestone	**R**	Lithomorphic soils -shallow soils formed directly over rock, or soft unconsolidated sediments Rankers (humic and mineral) Rendzinas Sand rendzinas Alluvial rendzinas	**Leptosols**: This widespread *shallow* soil of undulating lands and steep slopes located mainly on the northern Mediterranean region occurs predominantly as *Calcaric, Mollic, Rendzic, Eutric* or *Haplic*. The *Calcaric* Leptosols occupy large areas of the Greek islands and much of the nearby coastal zone. Extensive areas of Leptosols occur on the highlands of Cyprus and large areas of Lebanon. Leptosol is the shallow soil of the karstic landscape, highly susceptible to erosion due to the conversion of forests to Mediterranean shrublands and degraded maquies. These process, initiated thousands of years ago, is still continuing.	
Deep Brown soils	**B**	Brown soils -free draining, brownish or reddish, loamy soils Brown earths (calcareous and non-calcareous) Brown sands (calcareous and non-calcareous) Brown alluvial soils (calcareous and non-calcareous) Argillic brown earths (calcareous and non-calcareous) Paleo-argillic brown earths (calcareous and non-calcareous)	**Andosols** *Kastanozems* and *Phaeozems*	**Spodosols**
Mixed soils	**M**		- **Gypsisols, Durisols and Calcisols** - **Cambisol**: Represents a young soil in a continuous process of pedological maturation, as revealed by the presence of the *Cambic* horizon. Cambisols stand between Fluvisols and Luvisols. Cambisols are the most widely distributed soil of the Mediterranean delimiting the semi-arid climatic regions of the area.	**Aridisols** Are primarily soils of arid areas. They are in areas that preclude much entry of water into the soils at present, either under extremely scanty rainfall or under slight rainfall that for one reason or another does not enter the soils. The vegetation in many areas consists of scattered ephemeral grasses and forbs, cacti, and xerophytic shrubs.

Class	Code	Notes	WRB	USDA
Heavy clay soils	**G**	Free draining, brownish or reddish, loamy soils * Pelosols: - Typical pelosols - Argillic pelosols	**Vertisols**: Heavy clayey of backswamps, river basins, lake bottoms, and areas with high content of expanding. Although not widely distributed in southern Europe, Vertisols cover large parts of the deltas of the Mediterranean as dominant or associated soil types with Fluvisols, Cambisols, Calcisols, Luvisols and occasionally Leptosols. Their swelling and shrinking properties lead to the development of an undulated surface micro topography. Luvisols: A Luvisol is a well-developed soil whose main pedological characteristic is the formation of the *argic* sub surface horizon through the destruction and movement (eluviation and translocation) of silicate clay from the surface topsoil layer. The Luvisols of the Mediterranean region are widely distributed throughout Portugal, Spain, Italy, Greece, Albania, Croatia, Turkey and Cyprus and are often associated with Cambisols, Leptosols and upland Regosols under forest cover. *Chromic* and *Rhodic* units (*terra rossa soil*) are widespread in Greece, the southern part of Portugal, central Spain, western and southern Turkey and northern Italy. Luvisols are observed to associate with Alisols and Acrisols in the humid parts of the Mediterranean requiring further research to understand the relations between the soil typologies and the fluctuating past and present climates of the Mediterranean. Luvisols are also present in Morocco, Algeria, and the Middle East (Jordan, Syria, Israel, Lebanon).	**Vertisols** **Ultisols**
Alluvial (wetland) soils	**W**		**Fluvisols**: Are frequently located along past or present rivers, as in the alluvial basins of Greece, Middle East and Egypt. Occasionally, they are present in the deltas of coalescing alluvial fans that extend from mountains towards the Mediterranean Sea. Are highly productive soil types.	
Terrestrial raw soils	**T**	Un-vegetated coastal sand dunes	**Arenosols**: Arenosol is a sandy soil having sand or another coarse texture in the upper 50 cm soil layer.	
Raw gley soils	**Rg**	Mud flats or salt marsh	**Gleysols- Solonchaks and Solonetz** *Gleysols* are non-stratified, in waterlogged areas that do not receive regular additions of sediments. Their typical characteristic is the presence of gleyic properties within the upper 50 cm topsoil layer of the soil profile. *Solonchak* soil occurs in the semi-arid parts of southern Europe. As salinity builds up, the rising water table follows deep seepage from lower elevations as well as spring waters reaching the alluvial surfaces, and is ultimately enhanced by high evaporation of the semi-arid environment. *Gleyic Solonchaks* are widespread within the context of waterlogged areas as back swamps. Saline Vertisols occur very occasionally in the semi-arid parts of southern Europe. Solonetz are confined to flat lands and are found with Gleysols and Solonchaks. In coastal areas, they can be associated with Fluvisols. Extensive areas of saline soil occur throughout the Middle East.	

Class	Code	Notes	WRB	USDA
Volcanic soils	**V**		**Andosols**	**Andisols**
Organic soils	**O**		**Histosols** Are peats and act as carbon pools. They cover relatively small areas throughout the region.	**Histosols** (are peats and act as carbon pools)
Arid, semi-arid soils	**S**		**Cambisols** **Gypsisols, Durisols and Calcisols**	**Aridosols**

Source: MedScapes LCA Level 1 protocol (adapted from FAO-UNESCO, 1990)

2. Detailed Corine Landcover Classes and colour codes

Source: http://www.eea.europa.eu/

3. Suggested Landcover Classes for Level 1 Mapping in Lebanon and Jordan

	Lebanon	
	National Class	**LCA Common Class**
1.	Marsh (Marais)	Wetlands
2.	Woodland (Surface boisée)	Forests
3.	Surface water bodies (Surface en eau)	Water bodies
4.	Agricultural land (Territoire agricole)	Agricultural areas
5.	Surface of herbaceous vegetation (Surface de végétation herbacée)	Shrublands
6.	Natural land without or with little vegetation (Terrain naturel sans ou avec peu de végétation)	Semi-natural areas
7.	Artificial land (Territoire artificialise)	Artificial surfaces
	Jordan	
	National Class	**LCA Common Class**
1.	Dead Sea & water	Waterbodies
2.	Pastures (Rangelands)	Semi-natural areas
3.	Vegetables	Agricultural areas
4.	Sands	Semi-natural areas
5.	Tree Crops	Agricultural areas
6.	Basaltic Rocks	Semi-natural areas
7.	Bare Rocks	Semi-natural areas
8.	Chert Plains	Semi-natural areas
9.	Dry Mudflat	Wetlands
10.	Wet Mudflat	Wetlands
11.	Dams	Waterbodies
12.	Urban Fabric	Artificial surfaces
13.	Open Forest	Forests
14.	Wadi Deposits	Waterbodies
15.	Bare Soil	Semi-natural areas
16.	Field Crops	Agricultural areas
17.	Waste Water Plants	Artificial surfaces
18.	Quarries	Artificial surfaces

Source: MedScapes LCA Level 1 protocol