Analyzing land-cover change within North West rural landscapes

Chantal Cassar
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Analyzing land-cover change within North West rural landscapes

CHANTAL CASSAR

M.Sc. in Sustainable Environmental Resources Management
& Integrated Science and Technology

November 2012
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A dissertation submitted to the Graduate Faculty of

JAMES MADISON UNIVERSITY

In

Partial Fulfillment of the Requirements

for the degree of

Master of Science in Sustainable Environmental Resource Management/ Master of Science in Integrated Science & Technology

Dr L.F Cassar, Dr E. Conrad, Dr M. Papadakis

November 2012
Statement of Authenticity

I, the undersigned declare that this dissertation is the result of my own research. Any figures, conclusions and statements contained herein are mine unless otherwise stated.

__________________________________

Chantal Cassar

November 2012
Dedication Page

To my grandmother Eunice, who was my first teacher.

To my parents whom taught me how to appreciate history and the environment.
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Abstract

Landscape change is an issue of concern within the Maltese Islands; records of landscape change go back at least 450 years, and the rate of change has been particularly accelerated in recent decades. Notwithstanding the importance of this phenomenon, there have been few attempts to trace out patterns of landscape change over time. This study seeks to develop an understanding of landscape change within rural landscapes, over a period of 400 years. A qualitative analytical approach was used with a focus on five case study rural settlements in the North West of Malta. Land surveys and historic documentary sources together with cartography and GIS were utilized in order to map out landscape change. A number of semi-structured interviews with specialists having relevant expertise were also carried out. Results were inputted into Vensim and a system dynamics model was produced, showing the main elements of rural landscape change and linkages between these. The main driving forces identified in this study leading to landscape change were agricultural practices, economic factors and land fragmentation. Rural landscape change is expected to continue to occur in response to changes in the agricultural sector, including governmental initiatives and the emergence of innovative practices. Meantime, pervasive issues such as inheritance laws leading to subdivision of land parcels, remain relevant. The study proposes strategies for better understanding and managing rural landscape change.

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Keywords: AGRICULTURE, LAND-COVER CHANGE, RURAL LANDSCAPES, LAND FRAGMENTATION
Chapter 1

Introduction
1.1. Background to the topic

Adrian Phillips introduces four concepts of landscape change. Phillips states that landscapes are universal, dynamic, hierarchical and holistic. Landscapes are found in several different contexts, being remote places, countryside, villages or towns (Phillips, 2005). They can be understood as being an interaction between people and nature. This leads to landscapes being a dynamic setting where landscapes inevitable change and evolve over a period of time (Phillips, 2005). Landscapes are active systems and thus change occurs as a response to anthropogenic and natural activities. They are understood as being hierarchical. This means that a larger landscape can contain areas of smaller terrain (Phillips, 2005). Thus landscapes are a complex phenomenon which needs to be understood in an integrated, multi-disciplinary approach which incorporates social, cultural, economic and ecological criteria. Landscapes are an important constituent of any county’s heritage. Safeguarding this heritage is challenging however landscapes are inherently dynamic, changing over time (Wood & Handley, 2001). Understanding processes of change is crucial, not only in order to identify driving forces having led to that change, but also to gain insights into how landscapes are likely to evolve in future, allowing the development of proactive management strategies (Antrop, 2003). The study of landscape change is thus an interdisciplinary concern, bringing together elements of history, archaeology, geography, ecology and environmental management (Bürgi, Hersperger, Hersperger, & Schneeberger, 2004).

The Maltese Islands have been colonized by several different rulers in the 4000 years of their history, with many of these attracted to the islands largely as a consequence of its strategic geographical position in the central Mediterranean. The evolution of Maltese landscapes has thus been shaped by a range of cultural influences, and is also linked to a complexity of natural, historical and socio-political factors (Conrad and Cassar, 2010). Whilst urban areas of Malta (e.g. the Grand Harbour area) have perhaps traditionally been more extensively considered in the literature, for the reason that these areas were disproportionately important for the economic/strategic/military role of the island, rural areas have also undergone landscape change over time.

Land-use conflicts in rural areas are presently on the increase, as greater pressures are being imposed on these regions to provide a wider range of activities such as
economic and tourism investments (Williams & Shaw, 2009). Urban sprawl is also leading to pressures on both urban and rural areas. Urbanization rated in Europe has increased by 74.6% between the years 2000 and 2012 (Eurostat, 2011). Malta in particular, has one of the highest rates of urban land cover across the European Union, currently standing at some 22% of total land cover (EEA, 2010).

Nevertheless, agriculture remains Malta’s largest user 51.2% (Figure 15) (EEA, 2006). Agricultural activities are one of the main causes of landscape change in rural area; agriculture is also, however, responsible for changing the rural landscape in a number of ways (EEA, 2006). The issue of land fragmentation provides an example. Land fragmentation occurs as a result of Maltese inheritance Laws (chapter 16, article 308), where by a parcel land is split amongst offspring upon inheritance. As a consequence, the land is parcelled into even smaller factions. This effectively limits options for land cultivation, precluding the use of heavy machinery and limiting possibilities of economies of scale (Ministry for Resources and Rural Affairs, 2012).

This research seeks to better understand historical patterns and processes of landscape change in rural Malta, over a time period spanning the rule of the Knights of St John, the French, the British, and the period since Malta gained independence (1964), i.e over a total of 400 years. This analysis can also provide insights into likely future trajectories of rural landscape change.

The dissertation focuses on five case study rural settlements in the Maltese islands, situated in the vicinity of the Victoria Lines. The Victoria Lines were constructed by the British for reasons of defence. From 1800 to 1814 Malta was under the protection of Great Britain but with the Treaty of Paris 1814, the Maltese islands became the full property and sovereignty of the British Empire (Laspina, 1971). The British conducted a military survey after 1814 around the island and concluded that the area of the Great Fault would provide ideal grounds for the construction of a line of military fortification, subsequently implemented as the Victoria Lines. The area of the Victoria Lines (Great Fault) (which is protected by Heritage Malta) provided an ideal setting for case studies on rural landscape change (Blouet, 1963). Case studies have been grouped into two, depending on their geographic location, with three settlements sited north of the Great Fault, and another two settlements sited south of the Great Fault.
This defence structure thus acts as a reference point or midpoint, allowing patterns between the two groups to be noted.

The chosen locations are Tas-Santi, Nadur (Malta), Ghajn Tuffieha, Selmun, and Mta'leb. The hamlets of Selmun, Tas-Santi and Ghajn Tuffieha are found towards north of the island as can be seen in (Figure 1). The rest of the case studies are found towards west of the island. The hamlets of Selmun, Mta’leb and Ghajn Tuffieha have played an important role during the Knights of St. John as well as in the British era, as these locations contributed towards maintaining the agricultural economy on the island (Wettinger, 1981).

![Map of Malta](image)

Figure 1: Map of Malta showing the five case studies being Selmun, Ghajn Tuffieha, Tas-Santi, Nadur and Mta’leb. Source: (Google Earth).
1.2. Rationale

Understanding the origin of change and patterns of land-use change over time within theses selected sites will allow the rediscovering of historical trends of agricultural land use change and land management. The case studies are located in high landscape sensitivity zones (Figure 2), where the conservation of rural areas is considered to contribute towards safeguarding of local heritage. These case studies thus cannot be understood in isolation but must be considered within the broader context of rural land-use change.

Figure 2: Different levels of sensitivities in Malta. The north western region is considered to be a very high landscape area. Source: (MEPA, 2005).
1.3. Aim

The aim of this study is to assess the extent of rural landscape change in case study sites North West Malta over a period 400 years, and to identify the main characteristics and patterns of that change, as well as underlying driving forces of change.

1.4. Objectives

The objectives will look at various thematic components that are all interrelated to the research question.

- To reconstruct, on the basis of documentary/cartographic/toponymic and other historical sources, what the landscape within case study sites might have looked like at various points over the past 400 years;
- To map spatial patterns of landscape change within the case study areas over the same period;
- To compare landscape change in rural hamlets north and south of the Victoria Lines;
- To identify the causes of landscape change, past and present, in North West Malta;
- To investigate population trends of relevance.

1.5. Structure of thesis

The dissertation is divided into the following chapters:

Following the introductory chapter, Chapter 2 gives a broad perspective on landscape and land cover changes highlighting the different driving forces responsible for landscape change as well as discussing different methodologies used to study change.

Chapter 3 provides an insight into Malta’s physical landscape and land cover characteristics. The chapter also gives a brief historical overview of the various documentary sources used in this study. Policy obligations relating to landscape management are also discussed.
Chapter 4 explains the methodology used which followed a qualitative approach. Apart from the documentary review and mapping elements of the study semi-structured interviews with academics and experts in the field were also conducted.

Chapter 5 investigates landscape change of the five rural case study hamlets over a period of 400 years, presenting results obtained through the documentary review, land survey, cartographic survey, toponymic analysis and through the results of interviews.

Chapter 6 outlined concluding thoughts from this study and makes observation relating to the likely future landscape change. It also provides recommendations in order to establish a pattern of management control.
Chapter 2

A Rationale for Assessing Landscape Change
2.1. An Introduction to Landscapes

Landscapes are defined by the European Landscape Convention as an ‘area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors’ (Council of Europe, 2000). Landscapes are constantly changing and it is important to understand, analyze and manage these changes in order to protect them for present and future generations (Terkenli, 2010). Alexander von Humboldt defines landscape as ‘the total character of a region of the Earth’ (Antrop, 2003). Thus landscape can be understood as a space defined by spatial, natural elements and socio-economic conditions (EU, 2001). The development of landscape is influenced by different natural processes. These processes are constantly changing due to the activity of humans using the space for settlement, agriculture, industry, energy, sports and recreational areas. As a result natural landscape is being transformed into various cultural landscapes (USGS, 2012).

The term ‘land cover’ is defined by the European Convention as ‘part of the land as perceived by local people or visitors which evolves through time as a result of being acted upon by the natural forces and human beings ‘(EU, 2000). Land cover refers to the materials that are visible on site such as vegetations, rocks, sand, buildings and water (Wilson, 2002).

Studying landscape will entail looking at the landform, vegetation cover, buildings and any other elements that contribute to the formation of a landscape. These three main domains listed above are linked to history, changes in the land use, culture, wildlife and local climate (Wilson, 2002). Landscape evolves through time and is affected by several different entities. They are constantly changing due to external or internal forces. For example new policies or declining agricultural practices play an important part which can result in changes to the land cover. Thus monitoring landscape will sustain the distinctive local character which will continue to affect the way it is experienced and valued (Tapiador, 2008).

Landscape is important because it encompasses the environment (Wilson, 2002) such as habitats, soils and climate (England Natural, 2012). Further importance needs to be
given to such landscapes because they contain our natural resources, being land, vegetation, geology or even a habitat for plants and animals (Devon Council, 2012). Landscape is a product of natural and anthropogenic features which together seek to create a unique place (Phillips, 2005). Landscape cannot be appreciated solely for their natural beauty but need to be understood in their local context. Aesthetics aspire to human perception and thus play a crucial part in assessing motivations, emotions or ideas (Ulrich, 1966). They are also an ideal setting that may or may not include anthropogenic feature which in this case would aspires to sensual, cultural and spiritual aspects (Head, 2000). This underpins the idea of appreciating both natural and cultural landscapes which will be explained in the forthcoming sections. Scenery also needs to be protected for its rich archaeological and historical evidence. Landscape is also valuable for being a local recreational resource (Wilson, 2002).

Landscape has a different significance to various people being it spiritual, cultural or simply an economic gain through infrastructure. It enhances quality of life, national identity, tourism, recreational space as well as spatial planning (Antrop, 2005). Landscape is directly tied to human societies. Landscapes are seen to present a direct link with the past, present, nature, humans, tangible and intangible values (Phillips, 2005). Landscapes are understood as providing a two way relationship where anthropogenic features shape the landscape and as a result the landscape shapes our identity (Phillips, 2003). This two-way association, ‘reacts’ back by affecting society and thus this needs to be taken into consideration (Conrad, 2010). Landscapes are an active structure which reacts to a cause and effect system. This action proves that landscape is not passive, thus rendering it a subject of interest to researchers, planners and policy makers. This interest came about because any extreme change to landscape may result in an irreversible loss to heritage values or resources (Antrop, 2005).

Landscapes are perceived as in four main ways (Dissart, 2007):

1) Geological formations: land forms, flora and fauna
2) Man-made landscapes: construction
3) Different perceptions: Spiritual, cultural, historical or ecological significance
4) Time: Landscapes are continuously changing
The term ‘culture’ has been defined as anthropogenic, a function or a social process. The above are cultural values which are perceived as commons values which are aspired by a group or a community. On the other hand a value has been identified as a ‘social construction arising from the cultural context of a time and place’ (Stephenson, 2008). Value can only be understood if seen in a cultural context (Stephenson, 2008). As can be noted from (Figure 3) landscape is important not only for aesthetic beauty of its scenery, but also important for an array of different entities. Any changes to the landscape will influence its character. Policy and planning authorities have managed, planned and protected landscapes in order to allow a full range of ecosystem services (Scottish Natural Heritage, 2012).

Figure 3: Different aspects that are most commonly recognized as forming the landscape (Stephenson, 2008).

Landscapes are a dynamic active system that needs to be managed with the concept of sustainable landscapes. Management, conservation and decision planning are tools which will facilitate any change that needs to be undertaken (Antrop, 2006). Active systems will encounter change if acted upon. At local, regional or international scale, landscape is of concern. Major changes to landscape can result in positive or negative effects. (Wilson, 2002). Positive changes can be understood as being efficient mitigation programs whereas negative effects are seen as irreplaceable habitat loss. Studying landscapes and applying the appropriate management and policies will protect them for present and future generations. Protection at international level is given via the European Landscape Convention or the IUCN. The European Landscape...
Convention seeks to protect and manage European landscapes (Council of Europe, 2011). On the other hand the IUCN has a set of five categories which seeks to protect landscapes at its fullest. Category V protects landscapes and seascapes whereas category 1a and 1b deal with human intervention on landscapes. The following three categories deal in minimizing human activity in order to protect the uniqueness of the overall landscapes (IUCN, 2009).

The European Landscape Convention is a regional policy that ensures that landscape is protected through efficient and effective management, planning and protection strategies. Malta has not yet ratified the convention, even though (Council of Europe, 2012), it is a signatory but other local policies such as the Structure Plan or the Landscape Assessment Study, provide guidance on landscape and land use in Malta (MEPA, 2004). The Landscape Assessment study together with the designation of Areas of High Landscape Value through scheduling provides the ideal tools to enhance the landscape dynamics (MEPA, 2010). Together with these policies, an Environmental Impact Assessment (EIA) or a Strategic Environmental Assessment (SEA) can be conducted in order to assess the level of impact that any project may have on the environment including on landscape and the visual scene.

The protected landscape approach allows for the conservation of nature and culture and encourages people to exercise stewardship. The idea of stewardship allows for landscape to be understood as being a mosaic of different land ownership. Therefore individuals and the community are equally responsible to care for landscapes.

Landskapes are protected due to the strong interactions of people and nature over time. This idea of landscape based approach developed during an IUCN workshop. These approaches rely on a holistic and inter disciplinary approach that accounts for the participation of various stakeholders. This strategy finds its strength in applying a broad approach which seeks to cater for an array of processes and traditional systems in order to sustain the people’s relationship to the land (Brown et al., 2005).

Landscape is complex in nature and is tied to specific spatial and temporal scales. The present landscape is the result of several past processes that have been impacted upon by changing forces (Terkenli, 2010). Carl Sauer in the paper ‘The morphology of landscapes’ states that in order to characterize landscapes, aerial descriptions together with ground surveys are needed (Head, 2000). This methodology will allow researchers
to distinguish changes in the ‘geognostic’ factors, the land forms and the different morphology that constitute the landscape. (Mitchell, 2000). The Landscape Character Assessment has become another important tool for policy stakeholders as it provides a comprehensive baseline description which can then be used for management purposes. This tool is region specific and stakeholder oriented (Wascher, 2005).

2.2. Cultural and Natural Landscapes

Landscape is dynamic in nature and as a result it is important to understand certain differences between cultural and natural landscapes in order to better understand the process of change. Landscapes are stratified records of past activities which influence the present cultural history (Phillips, 2005). Cultural landscapes represent material constructions that reflect the basic organisation of society and the economy (Terkenli, 2010). Carl Sauer in the mid twentieth century coined the term ‘cultural landscapes’ (Head, 2000). Sauer accepts cultural landscapes and distinguishes natural from cultural landscapes, by stating that cultural landscapes are an ‘agency of man on earth’ (Mitchell, 2000). On the other hand, natural landscapes are described as natural environmental settings that have remained untouched by mankind (Mitchell, 2000). Unfortunately there are only a few areas that can be truly classified as natural landscapes. These have remained untouched by mankind because of the pervasiveness of human influence. Sauer applied an empirical approach to understand the role humans played in the evolution and adaptation of such landscapes. Basic methodologies such as morphological analysis and cultural history were used in order to underline the evolution of landscapes (Stephenson, 2008). Mediterranean cultural landscapes are a result of long urban traditions that have been ruled by political, cultural and social ideologies (Stephenson, 2008).

Landscape provides a clear link between the past and the present (Terkenli T. S., 2010). Landscape can be perceived as a palimpsest (Hill, 2003) containing stratified layers of human ancestry (Conrad, 2010). The idea of a palimpsest comes from the ancient Greek world where manuscripts used to be written and then rubbed off to produces a new document (Britannica, 2012). This idea is linked to landscapes because they are compared to being ancient relics that have been produced under the influence of several entities such as climate, culture or anthropogenic influences.
Landscapes have encountered several periods of geomorphic changes and each change acts upon the surface that has been previously processed. Having a historical perspective will facilitate the process of comprehending better the landscape’s history (Viles, 2011). This historical overview is critical because valuable information for managing cultural landscapes and future trajectories of change may be extracted (Bürgi et al., 2004).

It is a hard task to define urban from rural landscapes as this carries uncertainty as can be seen from Table 1. Urbanization is no longer tied to the growth of cities but it is also influenced by rural country sides. The movement of people from urban to rural setting is now also being considered to be urbanization (Tapiador, 2008).

Understanding the division of the landscape will facilitate to comprehend the several threats, weakness or opportunities that are linked to each area (Tapiador, 2008). Each rural landscape is unique. The extensive growth due to urbanization is affecting the extent of remote rural villages. As a result, landscape structures are being affected as this introduced new functionality which will conflict with the current land-use. This change resulted due to changes in the urban and rural relationship which is thus affecting the way of life. There are four domains (Table 1) which distinguish the rural from the urban landscapes. These are the urban centres, the sub urban fringes, the rural country side of the urban network and the remote rural countryside (Tapiador, 2008).

<table>
<thead>
<tr>
<th>Landscapes</th>
<th>Conflicts</th>
<th>Opportunities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban Centres</td>
<td>• Social disturbance</td>
<td>• Focus on more high quality residential environments</td>
</tr>
<tr>
<td></td>
<td>• lack of open spaces and green spaces</td>
<td></td>
</tr>
<tr>
<td>Urban Fringe</td>
<td>• Increase in traffic and social segregation</td>
<td>• Due to close link to rural setting it is possible to generate economic and ecological diversity of farming</td>
</tr>
<tr>
<td></td>
<td>• Decrease in natural environment</td>
<td></td>
</tr>
<tr>
<td>Rural</td>
<td>• Highly dependent on</td>
<td>• Links the urban to</td>
</tr>
</tbody>
</table>
urban centres and fringes, thus leading to a loss of identity.

- An increase in fragmentation

| ‘Deep’ rural | - Conflicts between new urban settlers and locals | - Vast open spaces with high natural and ecological potential. |

Table 1: Landscapes are complex and can be understood as being urban, rural setting. Landscapes cannot be studies in isolation but ideally seen in a greater context (Tapiador, 2008).

2.3. Landscape Dynamics

![Landscape Dynamics Concepts]

Figure 4: The graph shows the different landscape transformation that takes place during recovery and disturbance rates (Megarigal, 2010).

Landscape dynamics is understood as a process of physical evolution that through the natural environment and humankind have managed to shape both the past and present landscapes (University of Oxford, 2012). Landscape dynamics are affected through
disturbances rates, rates of recovery following disturbance, the size and spatial occurrences of events, as shown in Figure 4. Landscape dynamics are also affected by the drivers of change and the different management strategies implemented (Wood & Handley, 2001). Dynamics can be studied by modelling a change in a system and comparing the initial and final states (Wilson, 2002). This method can be applied to changes in rural land cover where dynamic models can be used as a base for future management of the area. The team of scientists at Earth Resources Observations and Science Centre (EROS) study landscape dynamics at both a local and regional level. Several studies have been conducted where satellite imagery, aerial photography together with maps and datasets have been used to monitor land cover change. Their main goal is to identify the rate of change of these landscapes (USGS, 2012).

2.4. Landscape Sensitivity

Landscape change will provide a ‘sensible, recognizable and persistent response’ (Usher, 2000). Defining sensitivity is not an easy task (Usher, 2000). Sensitivity is classified into two different sectors: the prosperity of change or the capacity of a system to absorb the change. Both sectors depend on the response time of the system (Brunsden & Thornes, 1979). A rapid response time results in a high sensitivity where a system will react quickly and then calm down again (Scotthis Natural Heritage, 2012). A slow response time results in a slow adapting process where systems are passive. Sensitivity depends upon the magnitude of change and the capacity of the system to absorb the change (Brunsden & Thornes, 1979). Sensitivity of the landscape depends on four different factors namely (Wilson, 2002):

1. The present land use of the landscape.
2. The different patterns and magnitude of the landscape.
3. The visibility being an open or enclosed view.
4. The landscape’s value.

Changes to these factors will affect the local character of the landscape. The sensitivity of the landscape is tied to the degree to which a landscape is able to absorb such change. Landscapes vary in the capacity to accommodate different forms of development (Wilson, 2002). As a consequence, sensitivity is thus not absolute but is
highly linked to change according to the existing landscape, the nature of development and the type of change being considered. As a result, sensitivity is considered to be an assessment of effects being imposed on the landscape rather than a landscape baseline (Wilson, 2002).

2.5. Landscape Change

Figure 5: Systems view model of landscape change (Dawson, 1983).

Landscape change (output) (Figure 5) can be understood as being the effect of a resultant force. The resultant forces in this case are the physical environment (input) and culture (input). The latter are the two main forces of change that are acting on a landscape. Cultural changes in landscape are brought about by the economy, society and are directly reflected in the character of the landscape. Changes to the physical environment can affect habitats, survival, mitigation of several different species or even changes to the composition and structure of vegetation that pertain to the landscape. This phenomenon affects the form and function of physical landscapes as well as landscape planning and management strategies (Antrop, 2004).

Antrop (2004) identifies the rate of change affecting landscape by presenting a specific set of questions. These are:

1. What is changing?
2. What is the frequency of change?
3. What is the magnitude of change?
4. What is the time span of change?

Change can be understood as inputs of energy that affect or disrupt a constant system, which in this case is the landscape (Figure 6). This effect can be compared to the Second Law of Thermodynamics where any disorder within a system is termed as ‘entropy’ (Clayton & Radcliffe, 2006). To achieve a steady state system, this depends upon continuous exchange within a system’s environment. Stress or disorder act to degrade a functioning system. This will depend on whether the system is robust enough to withstand change (Wood & Handley, 2001).

![Simplified Landscape Change model (Selman, 1992).](image)

Resilience primarily depends on the character of the soils and the landforms. The presence of clays that shrink and swell, with the constant drying and wetting, allow the soils to recover from compactions and physical degradation. Soils without this capacity are less resilient (Colquhoun et al., 2010). Resilience is also tied to age and amount of nutrients a landscape has. A younger landscape tends to return to its previous state as it has sufficient nutrients to re-establish itself. Resilience is measured by the amount of change a system can experience before it is forced to reorganize (Australian Government, 2011). This change is the landscape overload. This happens when the stress factors exceed the capacity of the receiving systems. Land reclamation is a common key source which is easily identified in several landscapes. Environmental managers need to comprehend that landscape has a specific carrying capacity. Excessive loads can result in producing excessive damage. Overloads can be
solved by increasing the environmental carrying capacity (Wood & Handley, 2001). The English Forestry Strategy states that there needs to be a greater adoption of trees and woodlands in both rural and urban areas. This is a simply way of increasing the carry capacity (Hill, 2003).

Change can be perceived as something negative or positive. Negative effects are defined by Wood and Handley as being ‘obsolescence’ and ‘dysfunction’. Obsolescence is linked to changes in land patterns that evolved due to social and economic influences (Wood & Handley, 2001). This phenomenon can be mostly identified in rural landscapes where due to intensive agricultural practise, woodlands and hedges are removed. This affects the character and structure of any landscapes. Examples of dysfunction activity can be seen in telecommunications masts, where these threaten the landscape character and alter the land cover of the area (Wood & Handley, 2001).

Landscape change can also be understood by looking at the coherence of any setting. Coherence is understood as the amount to which ‘elements of a particular landscape are consistent with each other within space and through time’ (Cakci et al., 2012). There are four different types of landscape coherence. These are listed below (Cakci et al., 2012):

1. Vertical coherence: This type of coherence refers to the link between abiotic factors, biotic factors and land use.
2. Horizontal coherence: This shows the association between visual, spatial, function and the ecological elements.
3. Seasonal coherence: This show the connection between the different seasons, colour, form and the landscape texture.
4. Historical coherence: This shows that human activities are linked with the past, present and future.

According to Professor Richard Forman, landscape change can be attributed to deforestation, suburbanization, agricultural intensification, corridor construction, desertification and reforestation (Forman, 1995). These changes need to be taken into strong consideration as they affect the significance and potential for management (Wood & Handley, 2001).
Change is occurring because landscapes are active systems where several processes occur. This phenomenon is the result of natural or anthropogenic features. The goal is to identify these causes which are altering the landscape. Applying the DPSIR framework (Figure 7) is very beneficial in order to apprehend landscape change.

Figure 7: DPSIR framework showing the various links needed to comprehend landscape change (Kristensen, 2004).

This integrated approach provided a clear picture for policy makers in order to understand the main underlying driving forces and thus apply the most efficient strategy (Kristensen, 2004). The driving forces are defined as forces which cause an observed landscape change. These can be associated to be social, economical, ecological or even positive or negative influences. Pressures can result from human and natural processes which affect the landscape as seen in (Figure 8). State is understood as the current situation of the environment under current conditions. Impacts are direct or indirect modifications to the state. Responses are the necessary efforts needed to address the changes in the ‘state’ and ‘impacts’ (Land use change, 2010).
When looking at both models (Figure 5 on pg 16 and Figure 6 on page 17), one can clearly note that landscape change is a guaranteed result. It would be beneficial to both models if landscapes would be included as a separate variable. As already discussed, landscapes may withstand change if resilience, overload and carry capacity are not exceeded. The first model is simpler defined than the second model. In the first model, culture and the physical environment are the sole two inputs. The Dawson model presents the idea of a constant loop where a cause and effect scenario can be noted. In the second model, Selman clearly distinguishes between the natural and the anthropogenic features. Selman presents a link between the past landowner’s decisions and the present management strategies which will affect the landscape in the future.

2.6. Methodology for assessing landscape change

2.6.1. Landscape and Visual Assessment

Landscape and Visual Assessment is a technique used to demonstrate the effects of change on the landscape. The main idea behind this methodology is to reduce or to prevent any change that can cause negative effects on landscape (Scotish Natural Heritage, 2012). Changes in the landscape can alter the perceived value ascribed to the
landscape. As a result a study of landscape visual effects is often requested as part of Environmental Impact Assessment (EIA) procedures (Wilson, 2002).

The Landscape and Visual Assessment has a specific methodology. The methodology can be divided into two stages: stage 1 and stage 2. Stage 1 can be seen defined here: (Figure 9)

**Stage 1**

- **Defining the scope:** The problem is clearly clarified and at this stage. The different scales, resources and the type of judgment are established. It is also suggested that a site visit is organized in order to familiarize with the location.
- **Desk Study:** Background reports, data and mapped information need to be consulted. This is done to develop a series of map overlays.
- **Field Survey:** Going on site is essential as aesthetic qualities are identified.
- **Classification and Descriptions:** This is classifying the landscape’s character.

**Stage 2**

- **Deciding the approach to judgements:** Selecting the appropriate approach is crucial in order to meet the needs of the assessment.
- **Making judgements:** The main approaches to judgements are: landscape strategies, landscape guidelines, attaching a status to the landscape and landscape capacity.
Figure 9: Flow chart of Landscape Character Assessment (Wilson, 2002).
Landscape Character Assessment (LCA) is a standard system used for identifying, describing, classifying and mapping a variety of landscapes. LCA is a set of tools used to describe the landscape character. The Landscape Character Assessment consists of studying the landscape landform, land cover and the settlements (Scottish Natural Heritage, 2012). Landscape Character Assessment uses a set of techniques and procedures used to classify, describe and understand the evolution, physical and cultural characteristics of the landscape (Wilson, 2002). An important question to consider when planning a landscape is how this is going to accommodate change. The use of geographical information systems (GIS) enables data integration and increases detail and efficiency in environmental resource inventory and analysis. This tool facilitates data collection for the LCA. Landscapes have different sensitivities and vulnerabilities which will affect the impacts of changes to historical, aesthetical and ecological characteristics of the landscape (Scottish Natural Heritage, 2012). Landscape Character Assessment is a powerful tool that provides an important strategic overview within which to develop policies for multifunctional landscape. Conflicting demands of agriculture, development, recreation and nature conservation need to be resolved. The Landscape Character Assessment can be split into three different stages which are the characterization, an evaluation of the area which emerges from the previous stage and decision making (Vogiatzakis & Griffiths, 2010). Stage 1 follows a methodology that is very similar to the Landscape and Visual Assessment. The second stage seeks to ensure that land management adhere to the aim and objectives of the European Landscape Convention. At this stage, an ecological sensitivity, cultural sensitivity and a visual sensitivity are taken into perspective. The final stage provides policy strategies which will help landscapes in forthcoming changing as well as conservation strategies (Vogiatzakis & Griffiths, 2010).

### 2.6.2. Historical Landscape Assessment

The Historic Landscape Assessment (HLA) has been developed to assess the historic ‘time depth’ of the landscape which will enable its characterization into broad HLC types (English Heritage, 2003). This is a powerful tool that allows policy makers to grasp a broad understanding of the landscape. This methodology was developed particularly in response to the LCA which increased the need for identification and
assessment of our heritage of cultural landscapes and increases the historical dimension.

Until recently, there was little attention paid to understanding the time depth of landscapes, the speed at which landscapes are changing and how and why these landscapes have changed and evolved in the past. Knowing the frequency at which landscape change is occurring will be crucial (Hampshire County Council, 2011) in making decisions about future evolutions of landscapes.

2.6.3. Historical Landscape Character

Historic Landscape Character (HLC) shows that landscapes have been in constant state of flux due to a combination of natural and anthropogenic forces that are impacting the landscape. HLC seeks to map the surviving visible historic components within our landscape which influence the process of landscape development. One can learn from past landscape changes and this can help policy makers to make an informed decision and to apply adequate management strategies in order to protect landscapes for future generations (Natural England, 2012).

The various aspects which help to determine HLC does not deal with the static survival of the countryside, but its concern is about the characteristics patterns of change and its links to the past. It also deals with patterns of physical features in the countryside. This may vary from one place to the other as patterns of change have greatly differed between various areas (English Heritage, 2003). These patterns influence short term socio-economic factors, influencing geography, history and the local tradition. Understanding how places reflect different types of trajectories of change provide a framework for judging what kinds of change in the future will be compatible with sustaining character in the long term (Natural England, 2012).

2.6.4. Historical Area Assessment

Historical Area Assessment (HAA) seeks to identify as far as possible the historic development of today’s landscape. Historical Area Assessment emphasises the past contribution of previous historic processes that constitute the landscape character. This will help to guide decisions about future change and management. It also defines
the character of a place, explaining how it has acquired its present form and evaluating its significance. This is a tool for decision making in the field of planning and conservation. It mainly focuses on the landscape local character and how it needs to be maintained in order to be preserved (Hampshire County Council, 2011).

HAA manages change in historic environments at local scale. Judgement is based upon the examination of physical fabric of a place coupled with the use of historic maps and other documentary sources. Best results for an HAA are collected from a wide range of architectural, historical, archaeological and conservation disciplines. To strengthen this technique, field surveys and investigations are carried out. Field survey is most effective when combined with the study of historic maps, documents and aerial photography (Hampshire County Council, 2011).

<table>
<thead>
<tr>
<th>Tools</th>
<th>LCA</th>
<th>HLA</th>
<th>HLC</th>
<th>HAA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Method</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mapping: digital maps or historical maps</td>
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<td></td>
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<tr>
<td>Surveys</td>
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<td></td>
<td></td>
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<tr>
<td>Landscape description</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GIS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Characterisation of historical places</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Fieldwork</td>
<td></td>
<td></td>
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<tr>
<td>Desktop Studies</td>
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<tr>
<td>Interpretation</td>
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<tr>
<td>Large scale</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Small scale</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evaluation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decision making</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Follows ELC directives</td>
<td></td>
<td></td>
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<tr>
<td><strong>Objectives</strong></td>
<td></td>
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<tr>
<td>Landforms</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Land cover</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patterns of Change</td>
<td></td>
<td></td>
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</tbody>
</table>
Table 2: Different tools which are used to assess landscape change.

<table>
<thead>
<tr>
<th>Presence of historical development e.g. built environment, settlements</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Time depth</td>
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</table>

Different tools have different strengths and weakness as seen from Table 2. The Landscape Character Assessment is seen to incorporate different entities for research purposes. On the other hand there is no one accepted methodology when applying LCA (Exmoor National Park Authority, 2007). Methodology is based on understanding the landscape quality which is determined from an assessment of strengths of character and landscape conflict (English Heritage, 2012). The Historical Landscape Assessment and the Historical Landscape Character tools have been adopted by both the Landscape Character Assessment (Scottish Natural Heritage, 2004). These tools do not seek to plot the components of the landscape but to map a generalized depiction of its overall historic landscape character. Most importantly these two tools follow a methodology adapted from the landscape assessment. The Historic Area Assessment’s weakness is that areas to be studied need to be closely examined. Very small areas can be seen to present insignificant results (Scottish Natural Heritage, 2012).

2.7. Driving forces of change

Landscapes must evolve in a way to leave a rich and diverse setting for future generations. Driving forces are defined as forces that cause observed landscape change. The European Environmental Agency (EEA, 2002) defines driving force as ‘social, demographic, economic developments in societies and the corresponding changes in life styles, overall levels of consumption and production’ (Burgi et al., 2004). Driving forces differ in origin or prolonged duration, intensity, nature and geographic extent. Each landscape is specific and will react differently when affected by the different driving forces (Klijin, 2004). Landscapes evolve through time as a result of being acted upon by natural forces or human being (Conrad, 2010). Each landscape is specific and will react differently when affected by a driving force. There
are five main driving forces which affect the landscape. These are the socio-economic, political, technological, natural and cultural processes (Bürgi et al., 2004).

Bürgi explains that the socio-economic and the political sectors are strongly interlinked. The socio-economic demands need to be expressed in political agendas, polices and laws. On the other hand, technology changes the pristine landscape by the construction of roadways and settlements. The natural driving forces are split into two different realms. The first sector is related to site factors which include climate, topography, soil characteristics and the natural disturbance. The second section corresponds to the frequency of change. Change can occur at a slow or at a fast rate. A slow change can be identified as climatic changes whereas a fast change can be linked to hurricanes or mudslides. Culture being the final driving force leaves a deep imprint in the landscape. This driving force is linked to tradition, beliefs and governance (Bürgi et al., 2004).

2.7.1. Characteristics of driving forces

The driving forces of change are determined by spatial, temporal scales and institutional scales as can be noted from (Figure 10). The forces can be classified as permanent or temporary. A permanent force is one which needs to sustain a functioning system such as aquifers. A temporary force is one which occurs within a specific short time frame. An example of this is precipitation. It is important to state that landscape change is not necessarily the result of planned actions as this can happen due to unexpected side effects. Intentional and accidental occurrences can also result in landscape change (Bürgi et al., 2004).
2.7.2. Methodologies to study Driving forces

There is no specific method or frame work that can be implemented as driving forces problems are location oriented scenarios. Any systems approach implemented will determine the study’s boundaries and components. A plausible method would be to implement the DPSIR (Figure 8) framework or to model land use change. If the latter is used, then relationships need to be identified in order to predict future landscape change (Bürgi, et al., 2004).

Modelling land use change improves the prediction of future land use patterns. Such models can be either mathematical models such as regression model or else Markov chain model. Another way to model landscapes can be done by using system dynamics (Nijs, 2009).

Bürgi et al. (2004) proposes seven different pointers that need to be taken into consideration when coming to analyse the different driving forces. These are:

1. Compare landscapes across administrative borders: Studying neighbouring administrational units is beneficial when coming to compare regulations, subsidies and political systems.
2. Landscape change: Land management aims to reduce landscape change.
3. Driving forces: Analyse the effects as a result of landscape change.
4. Dynamic landscapes: Landscapes are inherently dynamic and can change without driving forces.

5. Rates of Change: Humans, flora and fauna need to adapt when landscapes are changing. This means that a rapid change will require a rapid adaptation whilst a slow change will require a smoother transition. It is crucial to try and identify the rate at which landscapes are changing.

6. Attractors of landscape change: Different landscapes are sensitive to various rates of change. This means that different landscapes have a different potential for change. Change refers to a specific site characteristic which is prone to attract a particular driving force that is likely to induce a new transformation.

7. Precursors of landscape change: Identifying patterns in landscape change is crucial in order to determine future development.

The main ideal behind this approach is to study the causal relationships rather than the correlations. It is ideal to have an integrated approach were both qualitative and narrative elements are utilized (Bürgi et al., 2004). In order to control change, a great diversity of sustainable landscapes and efficient sustainable management techniques are needed (Antrop, 2005).

In order to understand the extent of land-cover, satellites such as LANDSAT or SPOT are used to monitor and observe landscapes (Tapiador, 2008). The CORINE land cover 2000 is an EU initiative that provides high quality information for rural analysis. This program collects land cover information. The idea is to have a generic reference that different individuals can consult. Data has been collected since the year 2000 for all EU countries (EEA, 2009). Figure 11 below, for Malta shows the various land-cover categories for the island. From the key below (Figure 12) it can be noted that the North West landscapes of Malta are characterized by strong agricultural practices.
Figure 11: CORINE Land Cover 2000 for the island of Malta. Source: (EEA, 2009).

Figure 12: Key for CORINE Land Cover. Source: (EEA, 2009).
The VOLANTE project uses a different methodology. The project’s main aim is to understand changes in land-use by applying spatial and temporal scales from different scientific fields and modelling these changes. The team of specialists utilize three basic research questions (VOLANTE, 2010). These are as follow:

1. To investigate the socio-economic and ecological process that effect land use change?

2. To investigate how bottom-up and top-down modelling tools can be improved and used for land use change and ecosystem services?

3. To create an innovative idea that can be formulated in order to sustain future resources management and improve land use policy?

The VOLANTE project apply a specific methodology were scientific observations, management and policies are all interlinked. The methodology is divided into four specific modules. These are as follows (VOLANTE, 2010):

1. It seeks to understand the different processes to identify landscape change.

2. It attempts to refine Assessment tools in order to have more accurate results.

3. It aims to develop policy measures which are relevant to sustainable development.

4. It seeks to link both management and scientific co ordination.
Chapter 3

An overview of the landscape—an extent of Malta
3.1. Malta’s physical landscape

Landscapes are an important constituent of any country’s heritage. Maltese landscapes have been shaped by climatic changes, geomorphology and the human agency (Cassar L. F., 2010) and are linked to cultural, historical and socio-political factors that affect landscape change through time (Terkenli, 2010). The Maltese islands are situated on the Malta-Ragusa Rise (Schembri, 1993). Malta has a surface area of 316 sq km (122 sq mi) (Encyclopedia of the Nations, 2012) and a growing population which presently numbers approximately four hundred thousand inhabitants (NSO, 2010). Given the limited area and high population density, land is therefore an important and limited resource.

Geologically the island is formed from marine sedimentary rocks. The local landscape is limestone dominated with exposure of karstic, and this resource is extensively utilised for construction purposes. Globigerina Limestone is easily quarried rock whilst Blue Clay is important for fertile soil and for its impervious quality (Schembri, 1993). These types of rocks have occurred due to geological formations of sedimentary strata under the sea (Table 3). The Maltese landscape is formed from a sandwich like geological structure (Figure 13).

![Geological Map of Malta](image.jpg)

**Figure 13:** Geological map of Malta showing the four different strata that form the local geological system. Source: (Smith, Gomex-heraz, & Viles, 2010).
<table>
<thead>
<tr>
<th>Formation</th>
<th>Thickness (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper Coralline Limestone</td>
<td>150m</td>
</tr>
<tr>
<td>Greensand</td>
<td>0-13m</td>
</tr>
<tr>
<td>Blue Clay</td>
<td>0-75m</td>
</tr>
<tr>
<td>Globigerina Limestone</td>
<td>20m-&gt;100m</td>
</tr>
<tr>
<td>Lower Coralline Limestone</td>
<td>0-140m</td>
</tr>
</tbody>
</table>

Table 3: Malta geological formation (Superintendence of Cultural Heritage, 2003).

Faulting is a crack in the Earth’s surface along which movement occurs either vertically, horizontally or in both directions. North West Malta has a series of parallel faults (block faulting) which have moved rocks into a succession of ridges (horst) and depressions (grabens). The Great Fault bisects the island in perpendicular in half from Fomm ir-Rih to Madliena (Schembri, 1993). The Great Fault is an ideal example which shows a steep escarpment which in certain places exceeds over sixty meters (two hundred feet) high (Blouet, 1993).

Cliffs and valleys are an important topographic feature of ecological importance. Cliffs provide protection and shelter to several species of Maltese flora and fauna, including several endemics (Schembri, 1993). Valleys are channels formed either by stream erosion or tectonic movement or even a combination of both scenarios (Cassar, Conrad, & Schembri, 2008). Most valleys in Malta are dry valleys which are replenished during the wet months. Ecologically, the islands are characterised by a variety of Mediterranean floral assemblages.

The soils of Malta are rather young and immature since pedological processes are considered slow in calcareous soils. Soils are understood as being ‘largely artificial, being man-made or altered’ (Vella, 2001). The depth of soils depends on if soils are present on ridges, plateaux and plains. The shallowest soils range from less than 20cm to around 60cm in depth. Deep soils (measuring around 150cm in depth) are only found in isolated pocket but these are considered to be rare (Vella, 2001). The most striking feature of soils is the high content of calcium and magnesium carbonates which influences plant growth. These are three distinct soils in Malta. These are Terre Soils, Xerorendzinas Soils and Carbonate Raw Soils. The Xerorendzinas and the Carbonate Raw soils are immature soils which have high calcium carbonate content. On the other hand the Terra Soils is a matured soil which has been weathered. This
soil has low calcium carbonate content. All three soils have a low organic matter (Schembri, 1993).

During the summer months the climate is hot and dry, whilst mild and wet conditions prevail during the winter months. Malta strongly depends on rainwater percolations as this recharges the Mean Sea level Aquifer as well as the Perched Aquifers (NSO, 2006). From the graph below (Figure 14), one can note difference in rainfall during the winter and summer months.

Figure 14: Rainwater data for the years 2000-2011. The x-axis represents the different years whilst the y-axis represents the millimetres of rainfall recorded (NSO, 2012).

3.2. Land cover

Land-use conflicts in rural areas are on the increase as greater pressures are being imposed in order to provide a wider range of activities. As can be noticed, both urban sprawl and the constant changes to the landscapes are creating internal rural conflicts. Rural landscapes are being affected because infrastructure is altering the landscape (Hill, 2003).

Changes in the local rural landscape can be studied by analyzing the CORINE Land Cover (CLC) tool. This tool allows long term changes to be monitored. Short term changes require a greater accuracy and as a result are harder to monitor. Unfortunately CLC provides a coarse resolution for Malta. The CORINE classification follows a broad scale where features smaller than 100 m are not considered in the CLC inventory (European Commission, 2012). This means that ecological features such as
hedges are not recorded. From the CLC study (as can be noted from Figure 15) it resulted that agricultural practices in Malta account for 51% of the total land cover whereas urbanization accounts for 22% of the island (EEA, 2010). The CORINE Land Cover has identified that 51% of the countryside is responsible for agriculture activity (MEPA, Land, 2012).

Figure 15: Land-cover use in Malta (MEPA, 2012).

When comparing these results to the rest of Europe, similar trends can be noted. Primarily, urbanization patterns in Europe have increased to 74.6% between the periods 2000 till 2012. It is expected that till 2015, this figure will increase by 0.3% (UNEP, 2002). Agricultural practices in Europe (as seen from the Figure 16 below) have remained strong. Ireland (64.1%), United Kingdom (42.4%) and the Netherlands (37.4%) are the most European countries which are dominated with agricultural practices (Eurostat, 2012).
The term ‘agriculture’ is a complex theme that one needs to be clearly defined. The European Commission defines the term ‘agriculture’ as ‘Any area taken up by arable land, permanent grassland or permanent crops’ (European Commission, 2012) whereas the Oxford Dictionary defines it as ‘the science or practice of farming, including cultivation of the soil for the growing of crops and the rearing of animals to provide food, wool, and other products’ (Oxford University, 2012). Both definitions present a similar meaning where agriculture is seen as being a science or a practice which seeks to grow plants or crops or animal husbandry. The main aim of agriculture is to produce food and to generate economic gain.

Agricultural practices sustain the rural landscape through farming activities. It is in the interest of rural communities to protect the land. Agriculture has the potential to have a negative effect on rural environments when it becomes intensified (MEPA, 2010). This is seen through wrong practices, the use of chemicals together with construction for animal farms and greenhouses which will have a significant effect (NEPAD, 2010). As a result, environmental stewardship needs to be practiced (EPA, 2012).

Agricultural practices in Malta have changed the rural landscapes in several ways. The prime factor that can be instantly noted in rural landscapes is land fragmentation and the limited field size. The agricultural census of 2005, states that out of 11,072 hectares, 5,520 holdings had less than 0.5 hectares (NSO, 2006). With the introduction of governmental programs such as rehabilitations programs and adequate training for the farmers, a change can be noted in census of 2010. In 2010, the National Statistics
Office states that 11,452.8 hectares of the land was used for agricultural practices (NSO, 2012).

Figure 17: The pie chart shows that in Malta there are more part-time farmers than full time farmers. From the graph below, one can notice that the North Western region of the island have the greatest portion of full time farmers (NSO, 2012).

Figure 18: Ratio of Full time farmers to Part time farmers (NSO, 2012).
The number of full time farmers is on a steady decline, as the younger generation prefer to have a more comfortable job (Figure 17). This can be noted from Figure 18 above. This is leading to the loss of agricultural land. This can be seen from (Figure 19) below, where most of the fields are smaller than 0.5 hectares in size.

![Agricultural land by district and size class](image)

Figure 19: Land size distribution in the Maltese Islands (NSO, 2012).

Inheritance Law in Malta allows for inherited property to be split into smaller factions in order to accommodate the heirs. As a consequence, field size gets smaller which leads to land fragmentation. Thus a bigger strain is put on farmers to increase the demand for having a greater food production. Fields are being abandoned and this results in collapsing rubble walls and soil erosion. The rural skyline is also being affected as building structures for agricultural purposes and greenhouse development are creating a visual impact (Stephenson, 2008).

New developments in rural landscapes are tied to social and economic factors that create a new change in the landscape. These factors are tied to human preferences, values and attitudes (Hamsen & Francis, 2007). Rural areas are location specific and are immensely diverse. To sustain these locations, rural areas are more inclined towards agricultural practices, crafts and tourism. (Tapiador, 2008). This is leading to environmental costs such as externalities were loss of natural resources, wildlife and
ecosystem biodiversity are being affected. This may result in unsustainable agricultural patterns leading to a constant growth in the urban sprawl and a diffused rural development (Scholz, 1999).

3.3. Documentary Sources

The study will focus on five distinct rural settlements that are found towards the north western coast of the island. Selmun, Ghajn Tuffieha and Tas-Santi are situated towards the north part of the island. Nadur and Mtačleb are located towards the western coast of the island. Abela divides Malta into two factions: ‘Parte di Malta Inabitata’ and ‘Parte di Malta Habitata’ (Abela, 1961). The division corresponds roughly with the line of the Great Fault (Figure 21). The later construction of the Victoria Lines on the Great Fault, extended from Ras ir-Raheb to Madliena Tower (as seen from Figure 20). This seems to have been one of the causes that lead to the formation of nucleated settlements (Blouet, 1978). Historical events together with the physical background have resulted in the North West region of the island remaining less densely inhabited but is more abundant in agricultural practices (Blouet, 1963).

Figure 20: The map above shows the exact locations where the Victoria Lines are situated. Source: (Google Earth, 2012).
This unique geological formation helped in the strategic defence to protect the southern part of the island rather than the northern section (Blouet, 1993). During the early 15th century, settlements were located close to fortified cities such as Rabat. This close vicinity was ideal for peasants to seek refuge behind the fortified walls in times of trouble. This increased the vulnerability and isolation of the northern and western region in spite of fertile land situated there (Blouet, 1993). Due to frequent corsair attacks settlements in this area were abandoned. The north western region was considered to be dangerous, unsafe and lacked communication and transportation with the rest of the island (Blouet, 1993). Prior to the 14th century, Blouet states that the North western region had three major economic facets which consisted of the ‘giardini’, pasture and arable land to cultivate grain, cotton and cumin.

The North Western limestone ridges were utilized for grazing of sheep, goats and pigs (Blouet, 1963). George Percey Badger describes the agricultural terraces that prevented heavy rains from washing the soil away. These walls are formed from broken stones that probably come from quarries. These are the characteristic rubble walls that are synonymous with the local setting (Percey Badger, 1838). There is little
evidence of intensifying land use in rural Malta. The main changes occurred in the construction of walls and enclosures for animals that were built to accommodate them (Blouet, 1963).

<table>
<thead>
<tr>
<th>Period</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>5000-4000 BC</td>
<td>Neolithic</td>
</tr>
<tr>
<td>4000-2,500 BC</td>
<td>Temple Period</td>
</tr>
<tr>
<td>2,400-700 BC</td>
<td>Bronze Age</td>
</tr>
<tr>
<td>800-480 BC</td>
<td>Phoenician colonization</td>
</tr>
<tr>
<td>480-218 BC</td>
<td>Carthaginian colonization</td>
</tr>
<tr>
<td>218 BC</td>
<td>Malta formed part of the Roman Empire</td>
</tr>
<tr>
<td>AD 395-870</td>
<td>Byzantine domination</td>
</tr>
<tr>
<td>AD 870</td>
<td>Arab Occupation</td>
</tr>
<tr>
<td>AD 1091</td>
<td>Norman Occupation</td>
</tr>
<tr>
<td>AD 1194-1266</td>
<td>Swabian rule</td>
</tr>
<tr>
<td>AD1266-1283</td>
<td>Angevin rule</td>
</tr>
<tr>
<td>AD1283-1412</td>
<td>Aragonese rule</td>
</tr>
<tr>
<td>AD1412-1518</td>
<td>Castilian rule</td>
</tr>
<tr>
<td>AD 1518-1530</td>
<td>Holy Roman Empire</td>
</tr>
<tr>
<td>AD 1530-1798</td>
<td>Knights of the Order of St John</td>
</tr>
<tr>
<td>AD 1798-1800</td>
<td>French rule</td>
</tr>
<tr>
<td>AD 1800-1964</td>
<td>British rule</td>
</tr>
<tr>
<td>AD 1964</td>
<td>Independence</td>
</tr>
<tr>
<td>AD 1974</td>
<td>Malta becomes a Republic</td>
</tr>
<tr>
<td>AD 1979</td>
<td>British relinquish Malta</td>
</tr>
</tbody>
</table>

Table 4: Historical chronology of Malta

3.3.1. 14th century developments

Prior to the arrival of the Order of St John, the northwest region of the island was uncultivated apart from a few ‘giardini’ (Wettinger, 1982). Most of the areas were surrounded by a perennial springs and the area was good for pasture (Blouet, 1963). There was no proper treatment of agriculture in Malta before the arrival of the Order in 26th October 1530 (Wettinger, 1982).
3.3.2. 15th century developments

Emperor Charles V of Spain agreed to bestow the Maltese islands to the Order of St John (Fiorini, 1993). The Order was bound to donate a hawk or falcon each year at the feast of All Saints to the Emperor of Spain and to his following successions. With such an agreement, the Order was exempted from any form of obligations or military services towards the Emperor. In return full freedom was granted to rule over the Maltese islands and to continue pursuing their religious and military expeditions against the ‘infidels’ (Fiorini, 1993).

Jean Quintin d’Autun comments that with the arrival of the Order in 1530, Malta had a population of 20,000 individuals. As a result rural hamlets continued to expand under the rule of the Order of the Knights of St John. Wheat documentation of 1545, states that the Maltese population consisted of approximately 30,000 individuals. One needs to take into consideration that the Order brought with them slaves, servants, as well as a few hundred families (Fiorini, 1993).

The Great Siege of 1565 led the Ottoman Empire to attack catholic Malta. If the Ottomans won the siege, this would mean that the entire Holy Roman Empire would also be under attack. As a consequence farmers were forced to abandon the fields. Livestock and crops were taken inside fortified cities in order to sustain life (Blouet, 1969). The Siege left the landscape as a shattered wreck and nearly two years after the Siege most of the island remained uncultivated and in a far worse condition than before the Order’s first arrival (Blouet, 1969). The triumph during the Siege of 1565 can be seen as ‘a milestone of major positive relevance in the demographic development and the urbanization pattern of Malta’ (Fiorini, 1993). This means that after the success of the Siege, the island benefited from new developments such as the construction of a new capital city Valletta and economic growth.

3.3.3. 16th century developments

Abela (1961), notes that the North western region of the island still remained uninhabited and food was mainly imported from Sicily were grain, cheese, butter, oil and pitch were imported. (Mallia-Milanes, 1993). Redeveloped agricultural practices are particularly evident during this century. Agricultural practices within Malta were
not adequate to sustain the population of the island. The Order made efforts to increase the local production and food demands. This was done by encouraging farmers to return back to the fields as after the Siege, extensive land abandonment was noted. Pressures on the landscape continued to grow as the population grew. Thus population growth was larger than the food demand which resulted in an unsustainable scenario.

After the construction of the new capital city of Valletta in 1566 (Attard, 2009), farmers returned to work the land and food production began to increase (Blouet, 1969). Rural populations that had been involved in the construction of the city found themselves unemployed. This resulted in a re discovery of rural activity. As a consequence, several retaining walls were constructed around farmed or arable land (Blouet, 1969). The foundations of the fields were prepared by chipping away at hard surface rock (Blouet, 1993). After this process was complete, a bed of crushed limestone was laid down. Soil was then collected from various fields (Blouet, 1963). This was then placed in the new field. This lead to the gradual formation of terraces in the hillsides and therefore more cultivated land became available on what would otherwise have been marginally productive areas (Role’, 2011).

The population continued to grow (as can be noted Table 6: Population Growth in Malta (National Archives, 1932), as did agricultural practices. Later on, a policy was established to restrict soil collection from different areas. This policy was specifically directed towards the peasantry social class that wanted to better their standard of living (Blouet, 1969). To encourage further agricultural employment, large parcels of land were given to the Universita’ of Mdina and Valletta to encourage cultivation. The Order also granted plots of land directly to peasants on condition that they would cultivate them with the best possible techniques. The 17th and 18th centuries that followed were thus instrument in encouraging agricultural cultivation (Blouet, 1969).

During the 1650 ‘spazio publico’ or open rocky grounds under the jurisdiction of the Univerista’ of Mdina and the Order were established. These were areas that were abandoned by settlements and agriculture during the Middle Ages (Blouet, 1963). The 17th century is marked by attempts to revive cultivated areas. During the 17th century, grants were granted by the Order to encourage people to work the land. Unfortunately
the same grants were revoked during the same period by Grand Master Verdala and the land became a common resource. The same policy was re introduced again and the poor and homeless families were given some tumuli or plots of land to build a house. In 1630, the same policy was revoked for the second time (Blouet, 1963).

3.3.4. 17th century developments

During the 17th century changes in land use patterns were noted due to growing economic pressures. This resulted in an increase in arable land as the local population was steadily growing (Blouet, 1963). The land was divided amongst the Order, Universita’ and the Church. As a result, the Order allocated large tracts of land to allow the agricultural economy to flourish. The Order became directly involved in agriculture and thus it became fashionable for Grand Masters to set up foundations bearing the name of the Grand Masters. These foundations consisted of fraternities and such constructions affected the land use and encouraged agriculture. To sustain such initiatives, large rural property was bought (Blouet, 1963).

The Order affected the landscape as changes were being brought about. There was a need to extend and intensify cultivated areas. This was carried out in two ways-through the reclamation of waste land and through improving existing arable land (Blouet, 1963). The land was then rented out for a number of years. The contract stated that the lessee had to improve the overall quality of the land and to cultivate the fields in accordance to the normal practices, such as crop rotation. If arrears up to two years were still unpaid, then the owner of the land had the right to confiscate the land. At the end of the termination, all improvements would return to the owner. At times stone plaque would be erected in walls to outline the stipulated contract (Blouet, 1963). These plaques still exist to the present day.

3.3.5. 19th century development

In 1801 Sir Alexander Ball became the first governor of Malta, representing the King of England. As time progressed, changes to the constitution, employment and settlement patterns were noted. Workers were encouraged to work close to major cities in order to have a greater work opportunity. As a result, people began to gradually leave the agriculture sector (Laspina, 1971).
Sir Alexander Ball comments that ‘one third of the Island is still uncultivated’ (Blouet, 1963). Towards the beginning 19th century, the British went through great efforts to cultivate the north western region of Malta. Localities such as Mellieha, Manikata and Zebbieh were established as agricultural areas (Blouet, 1993). This brought about new infrastructure such as roads (for military purposes) and the establishment of new villages towards the eastern coast (Blouet, 1963). The Victoria Lines were constructed by the British during the 19th century as a means of defence. They were intended to defend the southern part of the island which was densely populated. This defence mechanism passes close to Nadur and to Tas-Santi Valley (Solar, 1988) The Victoria Lines have a high historical value contributing to Maltese heritage (Solar, 1988).

World War I and II brought further demographic dispersion as whole families abandoned the urbanized harbour region and moved to the countryside. After the war, commercial opportunities began to grow which contributed to the shrinking countryside (Cassar, Conrad, & Schembri, 2008). Military constructions such as fort, military camps were constructed at Selmun and Ghajn Tuffieha. These military developments affected the rural areas and an increase in the human footprint was noted. The 1950s is significant for the spread of the economic footprint in rural areas. This for instance can be seen with the construction of hotels. In the consequent years (1960s) a rapid economic growth was noted which improved the standards of living but which lacked spatial planning and environmental legislation (Cassar, Conrad, & Schembri, 2008).

3.4. The significance of toponomy

Wettinger (2000) in his publication ‘Place names of the Maltese Islands’ gives a geographical description of the locations and also provides preceding names that were used during the time of the Knights. Some of the names are in Latin or Arabic which gives a better perspective of the influence at the time (Wettinger, 2000). Place names play a significant role when coming to decipher local history because they are directly linked to influences, rulers or traditions of the time (Wettinger, 2000).
• Wettinger defines the rural settlement of Ghajn Tuffieha as ‘Ayntufaha, tenimentum terrarum’. The scholar describes the area as having a horticulture setting with a fief\(^1\) in the north-west rural Malta.

• The village of Mtahleb ‘lu mutahilbu’ has also been described as having horticulture land that is situated toward Mdina heights. The ancient name hints that the land could have either belonged to Halab, who could have been the benefice or the founder of the area.

• The village of tas-Santi ‘de lu sumati’ has been defined as having a fief on the western ridge of Bingemma.

• The northern village of Selmun has been described as being situated east of Mellieha fields at Baqqari, Lombari and Hal Ghadir (Wettinger, 2000). Paul P. Borg states that the rural name of Selmun was either linked to the islands of St Paul which were previously called ‘Salamun’ or ‘Selmun’. Gian Frangisk Aberla says that the name of ‘Salamone’ is also linked to the noble deed of Captain Marco di Maria, who belonged to the Salamone family. This captain was escaping an enemy fleet but managed to manoeuvre his galleon close to the Selmun area, where the sea is much shallower (Borg, 1989).

• Nadur: Wettinger does not specifically discuss the topographic name of ‘Nadur’. The scholar mentions that in Malta there are 7 places which hold the same name.

3.5. Cultivation of crops

Quentin remarked that palm, olive and fig trees were all found on the island in 1533 (Wettinger, 1982). Documentary sources show that honey, grapes, cotton and wine was a prominent product during the time of the Knights. Fruits such as oranges and lemons were exported to France and Rome (Abela, 1961). Clover (\textit{Linnaeus hedysarum coronarium}) is a very abundant flower that is found in many fields (Abela, 1961). George Percey Badger comments that corn and cotton have been the main agricultural produce on the island. Cotton production drastically increased during the 17\(^{th}\) and 18\(^{th}\) century in rural areas (Blouet, 1963). The production of cotton ceased in the 19\(^{th}\) century and this was replaced by the cultivation of potatoes, introduced by the

\(^1\) The term ‘fief’ refers to land which is under a feudal system. Produce which used to be produced would then be partly returned to the lord as this was a feudal obligation (University of Oxford, 2006).
British (Wettinger, 1982) Wheat is sown every alternative year and harvest time begins in June (Badger, 2011). Windmills were introduced in Malta by the Order but towards the 19th century these were no longer profitable and their use started to decline (Blouet, 1969).

During the Knight’s rule different tree and plant species such as reeds (Qasab) were very common. Below Table 5 shows some of the species found in Malta:

<table>
<thead>
<tr>
<th>Trees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fig (Tin)</td>
</tr>
<tr>
<td>Citrus</td>
</tr>
<tr>
<td>Oak</td>
</tr>
<tr>
<td>Olive</td>
</tr>
<tr>
<td>Pine tree</td>
</tr>
<tr>
<td>Juniper (Gharghar)</td>
</tr>
</tbody>
</table>

Table 5: Different types of plants and trees found on the island from the time of the Knights of St John (Abela, 1961).

### 3.6. Livestock

On the hilly rocks of North West Malta, cattle, pigs, goats and sheep grazed during 1650 (Blouet, 1963). Each homestead has a cow, cattle being fattened for meat, pigs being bled and fattened, turkeys, poultry and rabbit. Goats were very important as it used to provide milk. It seems that the population preferred goat’s milk rather to cow (Dale, 1934). The Livestock policy stated that horses were to be retrained for military purposes and pigs were to be slaughtered when mature. Goats were slaughtered based on the necessity to release land for human crops (National Archives, 1932).

### 3.7. Water courses

The main water courses were found at Buskett, Mtaħleb, Fawwara, Ta’ Baldu, Wied Kannotta and Ghajn il-Kbir (Abela, 1961). Where water was in close proximity changes in the land use have been noted as this encouraged farmers to move closer to the water source. This led to the formation of ‘giardini’ or gardens as can be noted in the 16th c. Water was either pumped up from the water table or else it was collected at
the bottom of the springs. Wind pumps or even Persian wheels would have been used to collect water during 18th c (Blouet, 1969). In 1934, only 4% of the land was irrigated. This can be compared to an increase in irrigated land in 2012 with 22.2% out of the total agricultural land 28.1% (Trading Economics, 2012).

3.8. Agricultural practices

Agricultural practices from 1650 till 1750 did not involve any major agricultural intensification, apart from the ‘giardini’ (Blouet, 1993). The land use patterns were dominated by cultivation of grains and livestock (Blouet, 1993). There were constant pressures resulting from the insecurity of the North Western region. The lack of settlements in the North West meant that cultivators would have to travel long distances to till the land (Blouet, 1963). Farm size was about 3 to 4 acres in 1934. Currently most of the fields have less than 0.5 acres of land (see Figure 19). This leads to show an increase in land fragmentation. Of particular interest is that in 1934, six tractors were found on the island and these could be hired. In 2007, more than 1,000 tractors were recorded in Malta (Trading Economics, 2012).

3.9. Settlement growth

Before the arrival of the Order, a total of 17,000 people inhabited the Maltese islands. With the arrival of the Knights, the total population increased (Blouet, 1993). During the 16th century, the number of inhabitants rose to 41,084 people. It was recorded that there was a 2% annum growth in population (Blouet, 1993). This increase in population meant that there was an exponential growth in settlements.

Rural parishes were first set up in 1436 in central and southern Malta, with the only exception being Mellieha in the North of the island. Most of the population lived in villages in close proximity to fortified towns. The coast was uninhabited due to fear of piratical raids. All of the villages were centred round the parish. The parish was considered to be the hub of life. North Western Malta was inhabited by a scattered number of people that acknowledged the fertile valleys as being a good resource that could be used (Blouet, 1993). The 17th and 18th century rural areas became of great importance because the area was responsible for producing cash crops for cotton and weaving (Blouet, 1993).
The total population continued to increase but at the time of the expulsion of the French, there were less than 100,000 Maltese on the island (Table 6). This decrease in number resulted due to people trying to flee the island. With the arrival of the British there was a shift towards coastal areas, especially towards the North of the island. The British were a strong naval power and ensured protection and rehabilitation programs for the coastal areas (Blouet, 1993).

<table>
<thead>
<tr>
<th>Year</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>1500</td>
<td>17,000</td>
</tr>
<tr>
<td>1600</td>
<td>41,084</td>
</tr>
<tr>
<td>1700</td>
<td>100,000</td>
</tr>
<tr>
<td>1741</td>
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<td>1798</td>
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<td>94,000</td>
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<td>93,054</td>
</tr>
<tr>
<td>1852</td>
<td>96,403</td>
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<tr>
<td>1946*</td>
<td>285,284</td>
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<td>1947</td>
<td>294,447</td>
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<tr>
<td>1948</td>
<td>303,356</td>
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<tr>
<td>1949</td>
<td>308,929</td>
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<tr>
<td>1950</td>
<td>312,722</td>
</tr>
<tr>
<td>1951</td>
<td>312,447</td>
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<td>312,646</td>
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<td>315,952</td>
</tr>
<tr>
<td>1956</td>
<td>313,195</td>
</tr>
</tbody>
</table>

Table 6: Population Growth in Malta (National Archives, 1932).

Rapid development continued in Malta between the 1950s and 1970. It was recorded that in 1957 buildings increased from 5% to 16% in 1963. Simultaneously registered

\(^2\) Data from (Bruce, 1962)
agricultural land decreased from 56% in 1957 to 38% in 1983 (MEPA, 1990). As a consequence building development and quarrying activities increased. This meant that natural landscapes were being transformed into manmade landscapes. Road construction also increased during this period. During 1957, 893km of road were constructed whereas in 1987, 1482km of roads were constructed. This encouraged new settlement patterns in remote areas as well as new prospective for the tourism industry (MEPA 1990).

3.10. Policy and legislations

3.10.1. Landscape Conservation and planning strategies

‘The landscape is our living natural and cultural heritage, be it ordinary or outstanding, urban or rural, on land or in water’ (EU, 2000). The European Landscape Convention (also known as the Florence Convention) promotes protection, management and planning of the European landscapes. The aim of the Convention is to improve the quality of life of EU citizens and to acknowledge that landscapes form part of a common heritage. The Convention also enhances European co-operation when coming to tackle landscape issues (EU, 2000). The convention was adopted on the 20th October 2000 in Florence and was enforced 1st March 2004. The policy was beneficial for Malta as it allowed public authorities to implement the necessary landscape policy measures. Out of forty-seven member states, thirty ratified the convention. Malta signed the convention but did not ratify. Signatories to the Convention (as in the case of Malta) have the role to acknowledge landscapes in law, to implement the necessary policies, to encourage public participation and to incorporate landscapes into regional and local planning (EU, 2000). These aims are being imposed by the Maltese Government through legislation and MEPA.

The development of the EAFRD (European Agricultural Fund for Rural Development) incorporates the Common Agricultural Policy (CAP) together with financial instruments to sustain agricultural activities. This programme was established by Regulation 1290/2005. The main objective of the programme is to improve the general overall quality of the environment and to manage economic activity in rural areas. Each member needs to draw up a National Strategy Plan that covers the years 2007 till 2013. The European Union has allocated a budget of Euro
96.3 million for such programme (Europa, 2012). In Malta, the policy is being implemented by the Ministry for Resources and Rural Affairs. The policy seeks to diversify activities and to create new sources of income and employment whilst protecting the rural heritage. The Ministry has proposed four measures (Times of Malta, 2011):

1. Modernization of Agricultural Holdings
2. Information and promotion activities on food qualities schemes
3. Setting up Producer Groups

The CAP provides assistance for rural communities that depend on agriculture. Farming is the main land use that can alter the landscape and therefore it needs to be incorporated into policy. The policy seeks to assist rural farmers by offering the necessary training that will engage them into using modern farming techniques and to modernize farms with the latest technology (EU, 2012). This was evident in 2008, when a centre at Ta Qali’ was inaugurated and which provided farmers (Peregin, 2008) with the latest agricultural techniques. As agricultural practices in Malta are the main land users (51.2%) (EEA, 2006) care and modern techniques need to be implemented in order to safeguard the landscape.

3.10.2. Rural Land Management

The Development Planning Act 1992 was responsible for taking decisions that would affect any land use changes in Malta. The Act was enforced through a board of authorities that exercised sustainable practices on both land and sea by encouraging adequate planning strategies. The Act ensured that the overall landscape quality would be protected (MEPA, 2012). Maintaining the quality of the landscape requires a stewardship approach. One needs to remember that landscapes are universal and thus they do not belong to one single entity. A typical example can seen with the maintenance of rubble walls. Rubble walls are protected by law, and these play a crucial role in limiting movement of soil and act as a draining system. Leaving rubble walls to collapse can have a cascading effect on the landscape.
The Structure Plan is an indirect policy tool which was approved in 1990 but this was enforced under the Development Planning Act in 1992. The Structure Plan forms the basis of future land use patterns and development projects in Malta. The policy will ultimately affect the quality of life in rural, urban and coastal zones in Malta. The plan provides strategic guidance on land use in Malta. It contains more than three hundred and twenty different policies on settlements, built environments, housing and communal facilities, tourism and recreational topics amongst other additional factors (MEPA, 2012). The Structure Plan does not allow development outside the development zone and seeks to conserve the rural heritage and supports recreational activity. The Malta Environmental and Planning Authority has prepared several topic papers that would assist the Structure Plan. Of interest are the Rural Strategy Topic Paper and the Landscape Subject Plan (MEPA, 2012). The introduction of the Outside Development Zone, has been very beneficial for North West Malta which is considered to be an Area of High Landscape value. The ODZ clearly specifies urbanization boundaries and any construction/development undertaken in rural areas require close examination. This monitoring by MEPA has been beneficial as the rural characteristics have been conserved and preserved.

Following the European Landscape Convention, the Rural Development Programme (2007-2013) aims to better the quality of life and to encourage economic competitiveness in rural areas thus to sustain the rural settings. The Rural Development Programme consists of several measures that help to achieve rural development policy objectives that are set out in Council Regulation (EC) 1698/2005. The National Rural Strategy plan encourages local rural actors and stakeholders to be consulted about difficulties and priorities of the rural environment. Specific targets are then set up in order to support the Rural Development Programme (Ministry for Resources and Rural Affairs, 2012).

The Rural Development Programme is enforced by the Ministry of Resources and Rural Affairs. The programme seeks to increase and support rural economic viability through investments, to protect the local rural environment and to ensure quality of life. The policy will be enforced by strengthening the three pointers below (Ministry for Resources and Rural Affairs, 2012):
1. Enhancing economic viability through investment and modernisation
2. To preserve the rural environment and the countryside
3. It aims to support the rural economy and to improve the quality of life in rural areas.

The programme states that the major cause of land cover change occurs due to agricultural practices. Land fragmentation and land abandonment are two of the main factors that are causing the landscape to locally change. Land fragmentation is attributed to inheritance practices that have lead land tenants to split the rural land amongst offspring after their death. This is forcing fields to get smaller and smaller in size, allowing less farming activity to take place. This is also resulting in a decrease in full time farmers as revenues are low. This phenomenon has been identified in all five case studies. In some cases it has been noted that due to lack of machinery accessibility the fields are being abandoned. This is leading to a degrading soil quality and uncultivated fields (Role’, 2011). This is causing land cover change to occur in rural environments (Ministry for Resources and Rural Affairs, 2012).

The Environmental Report about land states that there needs to be an overall improvement in regards to the efficiency of land use in Malta. Initiatives by the government such as funds and incentives to farmers to work the land have resulted in a further increase in the number of farmers working the land. From 2005 till 2010 an increase to 11,452.8 hectors of the land was used for agricultural practices (NSO, 2012). The figure can be compared to 11,072 hectors of agricultural land in 2005. Rural areas are highly dominated by agricultural practices and as a result, these practice need to actively have a stewardship role in ensuring a stable countryside quality. The Maltese landscapes are facing threats such as land abandonment, loss of rubble walls, dumping, land reclamation and inappropriate rural buildings (MEPA, 2012).

Land use planning is the principal instrument were different conflicts of interests are resolved. There are several different entities and policies that effect land use changes in Malta. There is a growing pressure on the country side as this primarily occupies 70% of the land area on the island (NSO, 2012). There are several conflicting pressures that have been already discussed that require efficient management.
3.10.3. Issues faced by rural areas

The Rural Strategy Topic paper states that rural areas in Malta are dominated by agricultural practices and are characterized by scattered clusters of developments. This was noted in all five case studied. In the case studies, developments consist of dwellings, garages or huts to store tools. Several issues such as agriculture, land fragmentation, abandonment and viability are impacting the land use, quality of the landscape. The future concern will be to promote diversification and plurality of activities within a sustainable management framework (Ministry for Resources and Rural Affairs, 2012).

The study aims to influence land uses through specific area based policies taking into account the socio-economic and environmental conditions. The Rural Strategy Topic paper identifies the key issues that are occurring in rural areas and indicates the possible strategies that may address these problems. This involves the analysis of the various land uses and identification of contemporary conflicts that are present in Maltese countryside (MEPA, 2012).

The paper identifies that land use development in rural areas is on the increase but monitoring through Outside Development Zone (ODZ) clearly analyses well the effects of any developments in the countryside. It also analyses that the present land use patterns are constantly changing. Noticeable changes in agricultural practices and recreational spaces have been noted. The paper states that rural conservation is needed to protect the natural and anthropogenic heritage (MEPA, 2012).

3.10.4. Sustaining rural landscape through policy strategies

The Landscape Subject plan identifies the main landscape character of Malta. It explores any changes that have taken place over time and develops a dynamic model that will facilitate policy makers to implement measures and to sustain the rural landscape. Another tool is the Landscape Assessment Study which focuses on Areas of High Landscape value through scheduling. This will consider the main key elements that are forming the local landscape characteristics and issues that are affecting such landscapes. The purpose of this study is to outline strategic polices that will minimize human intervention on the landscape (MEPA, 2004).
Both studies focus on macro elements which form the local landscape and that develop the assessed landscape quality of an area. The studies include the anthropogenic agents which shape and alter the local landscape. Changes have been linked to natural changes that occur in the local eco-system, agriculture practice and development, settlement patterns and changes in the skyline. The latter has been quite noticeable after the end of the Second World War and with the introduction of tourism (MEPA, 2012). In all the case studies, both natural and cultural changes have occurred. As the Landscape Subject plan mentions, after the Second World War more investments were seen for instance at Ghajn Tuffieha, and later on at Selmun with the construction of hotels.

3.10.5. *Malta goes rural project-Sustaining Local tourism*

The Rural Development Plans (2007-2013) are regulated by the Ministry for Resource and Rural Affairs. Under this policy, part 313 and 323 are aimed to increase tourism in rural areas by generating a local rural economy. Part 323 is responsible for the restoration of historical buildings whilst part 313 is responsible for promoting walking trails through rural Malta. The plan is to have unaccompanied walks where information related to the specific rural village will be found on recycled wooden signs. These environmentally friendly signs will have information about the geography, geology, historical information as well as knowledge about the local economy. There is also the initiative to encourage farmers to exercise eco-tourism. Money generated from the tourism activity can be then contributed towards the maintenance of fields and to ensure that the local traditional landscape is maintained. This project will be fully implemented in 2013 where the Victoria Lines will become one of the several different locations that a tourist can visit. The Ministry is also promoting other policies such as Natura 2000 to protect to the ecosystem (MTA, 2010).
Chapter 4

Methodology
This chapter will examine the research methodology that has been employed in this study. The research question, together with the objectives established, will then be analyzed. Towards the end of the chapter, the limitations of the study will be discussed.

4.1. Data collection

Studying landscape entails adopting multi-disciplinary approach and considering disciplines such as archaeology, history and natural sciences. Data was collected from historical sources including literature and other documentary material and lithography. The subject of landscape change has been mainly studied from a historic perspective, with scholars such as Abela (1961) tracing changes in patterns. Data regarding historical development is limited and fragmented, particularly since data available is almost exclusively from records of past scholars. This raises issues with regard to the reliance and authenticity of the information, particularly since triangulation of sources is often not possible. However, this is an inherent limitation of this type of historical-based study. Before the arrival of the Order of St John, Malta can be described as lacking written records (Fiorini, 1993).

Cartography has been used to collect information regarding several case studies. Maps dating backing to the 16th century, give a clear picture of the local situation in Malta. Most of the land was uncultivated except for the fortified city of Mdina. It was with the arrival of the British, that Malta was properly surveyed. Survey maps covering the periods 1900, 1958, 1968 have been utilized in this study. Maps belonging to the Malta Environment and Planning Authority dating to 2008 have also been utilized. Maps have been digitized and inputted into Geographical Information System in order to study land cover change. Remotely sensed data (available through Google Earth) was also used in the analysis, in order to provide a bird’s eye view and to better understand the correlations between neighbouring rural landscapes. (Larsen, 2012).

Desktop studies need to be tied to field surveys in order to fully understand the landscape and for purposes of ground-truthing. Land surveys entailed visiting sites and understanding the past view of the locations which have effected the spatial distributions of the landscape. The surveys also served the purposes of cross-
referencing of data obtained from literature and maps with on-the-ground realities (Anon, 2012). Field monitoring entailed going on site in order to verify field, houses or country lanes and to record any changes. Google Earth has been used in this study to capture Malta’s terrain.

### 4.2. Site selection procedure

Five sites were chosen in North West region of the island. As a base line, the Victoria Lines separates three sites from the top north area of Malta. This scenario is ideal because it gives a better idea to check if there are similar trends or patterns that are occurring at the same time. The chosen locations are Tas-Santi, Nadur (Malta), Ghajn Tuffieha, Selmun and Mtaħleb.

![Map of Malta showing the five case studies being Selmun, Ghajn Tuffieha, Tas-Santi, Nadur and Mtaħleb. Source: (Google Earth).](image)

Figure 22: Map of Malta showing the five case studies being Selmun, Ghajn Tuffieha, Tas-Santi, Nadur and Mtaħleb. Source: (Google Earth).
Figure 23: The extent of the Victoria Lines and how this dissects Malta in half.
Source: (MEPA, 2006).

From Figure 23, one can notice that these locations were strategically chosen on either side of the Victoria Lines. Malta is divided by geological boundary or natural escarpment which bisects the main island in two, known as the Great Fault.

4.2.1. Mtaħleb

Figure 24: Aerial view of Mtaħleb. (Source: Google Earth).
Gian Frangisk Abela is known as the father of Maltese historiography (Abela, 1961). Abela mentions Mtaћleb (Figure 24) for its natural beauty and its abundant water supply (Abela, 1961). Close to the settlement, Abela identifies the area of ‘Wied il-Qasab Helu’. According to the scholar, cultivation of sugar canes occurred here (Abela, 1961). The name of the valley hints to such practices as ‘Helu’ meaning something sweet. George Percy Badger (2011) calls the village ‘EMtaћleb’. He states that the village is not situated far from the Citta’ Vecchia. Badger comments that fertile land, valleys and several water springs were found in this hamlet. The scholar also states that the village is found in close proximity to the sea. There are a few houses and several people used to live in caves. A spring used to pass through these caves (Badger, 2011). Mtaћleb’s hamlet is known for the prime location of its church (see appendix, Figure 56) that was built during 1656 which is located on the cliff faced valley. The church is dedicated to Our Lady and is constructed upon two earlier chapels that were built from the same foundations (Laspina, 1971).

4.2.2. Ghajn Tuffieha

Figure 25: Aerial view of Ghajn Tuffieha. (Source: Google Earth).

3 Citta’ Vecchia refers to Mdina. The name of the former capital city became Citta’ Vecchia after the construction of the capital city Valletta (UNESCO, 2012).
Ghajn Tuffieha consisted of arable land and a ‘giardino’ and ‘terre scapoli’ or virgin land (Figure 25). The ‘giardino’ was less accessible and concentrated upon arboriculture. It was surrounded by a high wall to protect the trees from strong winds (Blouet, 1963). There were clusters of farms that surrounded a water source. In 1652, the ‘fondazione Lascaris’ acquired the ‘Cortino di Ghajn Tuffieha’ from the Universita’ of Mdina. The purchase was used for grazing. By 1658 this was surrounded by walls and enclosures were built for animals. The majority of the land remained for grazing purposes. The Cortino of Ghajn Tuffieha was developed by the Lascaris foundation which had encouraged development in the area but this resulted to be an unprofitable investment. The rents in 1657 were 400 scudi per annum on a four year lease (Blouet, 1963). In 1769, the foundation negotiated that rents would be reduced to 160 scudi for twenty-nine years of lease (Blouet, 1963). Ghajn Tuffieha is known for its fertile land and abundant supply of fresh water. The prominent watch tower that was constructed in 1648 by Gran Master Lascaris was also utilized by the British forces during World War II. During the mid 19th century, the government sold a number of building plots which resulted in people leaving their old farmsteads in order to improve their quality of life. This led to people leaving Ghajn Tuffieha in order to settle down in Manikata (Kooperative Rurali Manikata, 2011).

4.2.3. Tas-Santi

Figure 26: Aerial view of Tas-Santi. (Source: Google Earth).
The Tas-Santi hamlet was linked to an agricultural community during the Knights period Figure 26. Several farmhouses bear the coat of arms of Grand Masters such as Wignacourt, De Vilhena and De Rohan. These farmhouses show a sign of sedentism in the area that can imply the relationship of working the land (Malta Sun Ripe, 2008). Badger mentions that the erection of new walls occurred, thus implying the raising of livestock. There is no reference to arable farming in this area (Badger, 2011).

4.2.4. Selmun

Figure 27: Aerial view of Selmun. (Source: Google Earth).
The hamlet of Selmun belonged to Caterina Vitale in 1600. According to notary records by Simeone De Lucia, Vitale bought the land from Sicilian procurator Don Geronimo Bellomi. Historical records state that Vitale paid the sum of 7300 scudi. During the 16th century Selmun was used for the ‘Monte della Redenzione degli Schiavi’ where slaves freedom was bought from the Muslims. Both Selmun and the ‘Monte della Redenzione degli Schiavi’ remained under the rule of the Order till Napoleon reached Malta in 1798 (Borg, 1989).

Selmun is synonymously linked to Selmun Castle (as can be seen Figure 27 and appendix Figure 59). The first mention of this castle can be traced to the parish records of Naxxar 1783. At the time, both the villages of Mellieha and Selmun formed part of Naxxar’s jurisdiction. The castle at Selmun acted as a summer residence for the Order. In the area of Selmun is Ghajn Hadid, a water source used to irrigate fields (Borg, 1989).

The population at Selmun in 1780 was of 22 individuals. In 1781, this increased to 23 inhabitants but in the coming years the number decreased to 17 people. During the 17th century, Selmun Castle was rented to locals and foreigners in order to generate revenue (Borg, 1989).

With the arrival of the British, Fort Campbell (see appendix Figure 53) was constructed to keep watch for the enemy. During the Second World War Fort Campbell was reinforced. This was crucial to defend St Paul’s Bay. The Royal Malta Artillery was responsible to protect the area of Selmun. During the 20th century, Selmun Palace Hotel was constructed (Borg, 1989).
4.2.5. Nadur

Figure 28: Aerial view of Nadur. (Source: Google Earth).

Nadur is located north-west of Malta at the Bingemma Gap close to the Victoria Lines. Nadur stands at a high altitude of 220 meters above sea level. The Nadur Tower which was constructed in 1637 by Grand Master Lascaris was one of the several watch out posts found around the coast of Malta (Superintendence of Cultural Heritage, 2012). The hamlet of Nadur is synonymous for a community of leprosy which no longer exists. Data was provided via word of mouth but due to data protection, this is sketchy. This could have been one of the reasons why Nadur has remained secluded.

4.3. Method of Assessment

The methodology for this study is based on a qualitative approach. The qualitative approach seeks to obtain an exploratory understanding of ways in which rural land cover and landscape characteristics have changed over time, within the Maltese Islands, based on selected case studies. Ideally a triangulation approach would have been used, with both qualitative and quantitative data sources utilised (Todd, 1979). However, adequate quantitative data was lacking, whilst the short period of time available for research was also a limiting factor.
The qualitative approach adopted follows the inductive scientific method. The inductive method requires for observations, patterns, tentative hypothesis to be formulated and ideally the creation of a new theory. Following the inductive method is ideal because the study will commence by analyzing different historical literature that discuss land cover changes (Todd, 1979). Through this general observation, one can cross reference to cartography and maps. This will lead to the identification of patterns of landscape change and trends related to that change.

Interviews with academics coming from the fields of archaeology, cultural heritage and planners with expertise in the subjected were interviewed. This was done so as to get different perspectives about the case studies. During the interview the set of questions below were asked:

1. Landscapes evolve through time and space. Do you think that landscapes in general are changing? If so in what manner?
2. Do you think the rural landscapes in Malta are changing?
3. What are the main ways in which rural landscapes have changed?
4. In your opinion, why are hamlets decreasing/ increasing in size?
5. How do agricultural practices affect landscape change?
6. The Maltese Government is currently promoting rehabilitation programs (such as providing EU funds, subsidies and adequate training for farmers). What are the possible outcomes for this decision as regards landscape change?
7. In Malta inheritance law allows for land to be split into smaller portions and divided between offspring. This differs from other EU countries such as Germany (‘Erbschei’ in Bürgerliches Gesetzbuch. Book 5) where such division of land is not allowed. Which of these systems do you agree with most?
8. North West Malta has been demarcated as being an Area of High Landscape Value. What does this imply? Should certain areas be safeguarded from human-induced impacts, in order to reduce landscape change?
9. The Ministry of Resources and Rural Affairs is promoting a new program called Maltagoes Rural. This new initiative encourages tourists to visit rural hamlets in Malta and to experience Malta from a rural perspective. How will this affect landscape change? How will rural hamlets benefit socially and culturally?
This was useful as five scholars from different fields will have different ideas and approaches with regards to the phenomenon of land use change. Each interview lasted approximately thirty to forty minutes. The questions asked were open ended to allow the necessary space for the interviewee to clearly express himself. The questions were structured in an in-depth semi-structured fashion (Boyce & Neale, 2006). In an in-depth semi-structured approach, the list of questions to be asked are not definitive although the interviewer would need to have a comprehensive knowledge of the area being explored. This informal interview is called ‘non directed’ because the interviewee would be able to freely express his opinion through casual conversation (Axinn & Pearce, 2007).

4.4. Analyzing Data

One most widely used analytical packages for analyzing qualitative data is NVivo (QSR, 2012). This software package facilitates data analysis and helps users to analyze non-numerical data. This tool was used to facilitate the analysis of data obtained during interviews, through thematic coding, allowing the identification of common trends. Another tool used in this study was Quantum GIS which is an Open Source Geographic Information System. This program was established in May 2002 and seeks to provide increase access of GIS to any computer literate person who wishes to utilise the program. Quantum provides common functions and features similar to GIS (ESRI).

Vensim models were then created to assist the analysis on landscape change (Sterman, 2000). System dynamics is an interdisciplinary tool that facilitates complex problems to be understood. The system dynamic models will show the different elements that are causing change (Sterman, 2000).

4.5. Limitations of the study

One of the main limiting factors in this study was the vast amount of fragmented data. Information regarding the study areas is available but unfortunately this is scattered in several archives, governmental departments or libraries, not all of which are readily available to the public. Compiling all the necessary data was time consuming, and
effectively posed a significant limitation, as the entire study was conducted over a period of four months.

The time factor also made it impossible to include interviews with famers and/or other stakeholders with expertise relating to the case study sites. This would have provided a stronger insight into the current changes that are affecting the quality of life, economy and social wellbeing, and may be considered to further research in the area.
Chapter 5

Analysis and discussion
5.1. An overview of landscape change in Malta

Landscapes change is a natural process. Change occurs in response to new challenges that affect a landscape. Landscapes in Malta have changed due to different driving forces that have acted/are acting on the land and which will be explained in the forthcoming sections. When looking at the five case studies, one can notice that change occurred at different rates over the time-span of the study. One of the most evident changes noted over the study period of 400 years is the change from a semi-natural landscape to a more induced ‘cultural’ landscape, i.e. one more extensively shaped by human agency.

When analysing land-cover change in Malta, one can immediately note that the southern part of the island was extremely affected by population growth, urbanization and an industrial ‘boom’ over the time-frame of the study. Presently, the Northern Harbour area (Figure 29) is the most densely populated region Figure 30 (NSO, 2010) within the Maltese Islands. This can be compared to the Northern regions Table 7 of the island, which over a period of 400 years, have remained highly characterized by agricultural traditions.

Figure 29: Population growth in Malta’s districts (NSO, 2010).
Figure 30: Population count in different districts in Malta (NSO, 2010).

Table 7: The table shows the division of the different districts in Malta (NSO, 2010). The case studies are located in Rabat, Mgarr and Mellieha.
5.2. Case studies: Analysing landscape change over a period of 400 years

Field surveys and mapping exercises, together with analysis of documentary and cartographic sources, have shown that all the case study area have undergone a certain degree of change. It was also noted that in certain cases, landscape change occurred at different magnitudes. This means that change between different areas and over different time periods were noted. For instance, this was identified with settlement patterns occurring at a faster rate south of the Victoria Lines. One element that has definitely affected the landscape is the change in governance of Malta over the ages. Every successive ruler has left a particular imprint in the landscape, with many of these observable to this day. For instance, the Knights of St. John altered the skyline of the landscape in NW Malta by constructing watch towers. This is evident in three of the case studies, which are Selmun, Ghajn Tuffieha and Nadur.

5.3. Field surveys and observations

The case study areas were surveyed and land cover was mapped. Wilson (2002) states that vegetation cover, buildings together with the current landform need to be taken into consideration when considering landform. These three elements (page 9) are linked to history, culture, wild life, changes in the land use and the local climate.

5.3.1. The rural hamlet of Selmun

The topographic name of ‘Selmun’ is hard to link to any practices or landscape characteristics that occurred in the area. Wettinger (2000) comments that the rural village was situated east of Mellieha (Wettinger, 2000). In the past, the area of Selmun was previously called ‘Salamun’ (Borg, 1989) or ‘Salamone’ (Abela, 1961). Unfortunately the data above does not shed any light on local traditions or rural lifestyle.

Table 8 on the following page shows results of field observations at Selmun. Following Wilson’s (2002) guidance, the three groups of landscape elements listed above were noted and field observations were recorded.
<table>
<thead>
<tr>
<th>Selmun (rural hamlet)</th>
<th>Landscape elements</th>
<th>Field Observations</th>
</tr>
</thead>
</table>
| Vegetation cover      | • Prickly pears (*Opuntia*)  
                        | • Carob trees (*Ceratonia siliqua*)  
                        | • Capers (*Capparis spinosa*) |
| Buildings and         | • New dwellings which were constructed  
construction       | from the 1980s up to the present  
                       | • Rural farmhouses  
                        | • Hunting huts  
                        | • Selmun Palace Hotel: permits were granted  
                        | in 1976, construction began in 1979 and the  
                        | hotel opened in 1981.  
                        | • Rubble walls |
| Large-scale historical| • Selmun Castle constructed in 1783  
elements         | • Chapel dedicated to Our Lady of Ramson,  
                        | constructed in 1792  
                        | • Fort Campbell constructed in 1937 |
| Economic and Cultural | • Bird trapping  
Activities        | • Agricultural practices |

Table 8: An overview of the different landscape elements which contribute to Selmun's rural land-cover.
Figure 31: Rural farmhouses in the hamlet of Selmun. (Source: C. Cassar).

<table>
<thead>
<tr>
<th>Selmun (the region)</th>
<th>Landscape elements</th>
<th>Field Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land cover</td>
<td>Geological, Vegetation</td>
<td>Karstic landscape, predominantly made up of Upper Coralline Limestone, with fragmented Quaternary deposits. As a result of the many springs in the area, Selmun has been cultivated over the centuries. As a consequence, much terracing occurs due to the prevailing topography.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maquis ((i) archaeophytic maquis dominated by <em>Ceratonia siliqua</em> and underlying clambering species, such as <em>Asparagus aphyllus</em> and <em>Smilax aspera</em>; (ii) naturally occurring maquis dominated by a variety of shrubs including <em>Lonicera implexa</em>, <em>Rhamnus oleoides</em>, <em>Olea oleaster</em> var. <em>sylvestris</em>)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Garrigues and phyrgana include those dominated by labiate and Phagnalon garrigues, <em>Anthyllis hermanniae</em></td>
</tr>
</tbody>
</table>
phrygana, *Convulvus oleifolius* within the Maltese rdum community and Tree Spurge formations.

- Steppic communities, largely dominated by Ermes, within which *Asphodelus aestivus*, *Urginea pancreation*, *Ferula communis* and *Carlina involucrata* tend to be the main characterising species.

<table>
<thead>
<tr>
<th>Buildings and construction</th>
<th>Huts for hunting and bird trapping</th>
</tr>
</thead>
<tbody>
<tr>
<td>Historical elements</td>
<td>Watch tower constructed during the time of the Knights.</td>
</tr>
<tr>
<td>Economic and Cultural activities</td>
<td>Agricultural activity</td>
</tr>
</tbody>
</table>

Table 9: An overview of the different landscape elements which contribute to Selmun's regional land-cover.

In order to better understand change in the rural hamlet, the entire region was taken into consideration. These tables’ summarize the current land cover of Selmun. These results will be compared to information available in historical sources (dating back from 1895 up to 2008) in order to identify the gradual tradition of landscape change which has occurred over the last 113 years.

Figure 32: Rural House in Selmun Hamlet. (Source: C. Cassar).
5.3.1.1. Analysing landscape change through cartography

The oldest map of Selmun acquired for this study is a 1895 plan of the area showing the different watch towers and forts which were constructed during the period of rule of the Knights of St. John (but with little additional detail of other landscape features). This military defence mechanism has altered the skyline of the landscape in this area. Below is an image of the current Selmun Tower, leaving a negative effect on the visual landscape due to its current dilapidated state.

Figure 33: 1895 map showing the military defence structures built during the knights. (Source: Courtesy of National Library, Valletta).

Figure 33 shows a tower (demarcated by a red circle), which represents the Ghajn Hadid Watch Tower which was constructed by Grand Master de Redin. Its purpose was to act as communication link. The Red Tower or Fort St. Agatha (demarcated by a blue circle) was one of the seven towers built by Grand Master Lascaris. The Red Tower has excellent views of Mellieha Bay as it served as a crucial post to spot any
vessel approaching by sea. The tower also served as a vital communication post between Gozo/Comino and Imdina and an alarm could immediately be raised if enemy ships were sighted.

Figure 34: The present state of the Ghajn Hadid Tower (Selmun). The tower sustained severe damage during the 1856 earthquake. (Source: C. Cassar).

Change can also be noted when comparing the MEPA 2008 site plans to the 1900, 1958, 1968 site plans. When comparing the 1900 map to the 2008 map, one can notice that a significant change did occur in Selmun. In 1900, the region of Selmun is shown as an area dominated by large fields, the Selmun Castle, the Selmun Tower (Figure 34) and some rural farmhouses. In comparison by 2008, the influence of land fragmentation together with modern construction can be noted. This change is evident in comparing the 1958 maps to the 1968 maps, with additional construction readily noticeable. The map below (Figure 35) shows an overlay of the 1958 and 1968 maps. The green/yellowish marks are showing constructions present in both decades. The red demarcation is showing the presence of new developments in 1968 which was not present during 1958.
Figure 35: Selmun Castle study area (Overlay of 1958 on 1968).

Figure 35 shows Selmun Castle (constructed in 1783) and adjacent to it, is a new project comprised of pool area, tennis courts and squash courts. The chapel with scattered rural houses can be noted from Figure 35. Fort Campbell also features in the 1968 site plan and no subsequent change has occurred in this area.
Figure 36: Selmun Castle study area (Overlay of 1968 on 2008).

When comparing the 1968 map to the 2008 map, the most evident change is the construction of the Selmun Palace Hotel (date of construction 1978) and the construction of a new block of maisonettes opposite the chapel.

In summary, land cover changes in Selmun noted are below:

- The gradual growth over the years 1958, 1968 and 2008 of the neighbouring village of Mellieha into a highly urbanized village;
- Change in an increased number in the construction of sheds and rooms which are probably used to store agricultural tools;
- The construction of the Selmun Palace Hotel, which changed the character of the landscape from one that was completely rural to one with evident touristic elements;
- Land fragmentation: Fields sizes are noted to have become progressively smaller; in some instances, land division is indicated either through the construction of rubble walls or by the planting of prickly pears;

\footnote{Colours have been inverted in Quantum GIS}
• Rural hamlet of Selmun (Figure 31): Rural houses in the area have not changed from 1958 to 2008—the only change that can be noted when going on site is the abandonment and present derelict state of these rural houses.

• Growth of the road network which leads to Selmun Palace Hotel (noted in the 1968 map).

5.3.2. The rural hamlet of Ghajn Tuffieha,

The rural hamlet of Ghajn Tuffieha has been described by Wettinger (2000) that the region of Ghajn Tuffieha has a strong horticulture practice. The land survey together with cartographic analysis has confirmed that most of the area of Ghajn Tuffieha has had a strong link with agricultural practices since the time of the Knights.

<table>
<thead>
<tr>
<th>Ghajn Tuffieha, (rural hamlet)</th>
<th>Landscape elements</th>
<th>Field Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land cover</td>
<td>Geological</td>
<td>The area is cultivated and the land cover consists mostly of crops such as potatoes, tomatoes, cabbage etc.</td>
</tr>
<tr>
<td></td>
<td>Vegetation</td>
<td></td>
</tr>
<tr>
<td>Buildings and construction</td>
<td></td>
<td>Rural hamlet consists of approximately 6 to 8 farmhouses.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Water channels are dug into the rock. These channels lead directly into the freshwater spring.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rubble Walls</td>
</tr>
<tr>
<td>Historical elements</td>
<td></td>
<td>Roman Baths</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Knights emblem on 3 facades in the rural hamlet. These emblems are all facing different orientations. Two of the emblems were identified as coat of arms of Grand Master Perellos and Grand Master Wignacourt respectively. Unfortunately the last emblem</td>
</tr>
</tbody>
</table>
was partly eroded and covered by a large oak tree.

- Lower camp (presently known as Hal Ferh) was a prisoner war camp for Germany and Italian prisoners. The Upper camp was a commando training base.
- British Sick Bays

<table>
<thead>
<tr>
<th>Economic and Cultural activities</th>
<th>Agricultural activity</th>
</tr>
</thead>
</table>

Table 10: An overview of the different landscape elements which contribute to Ghajn Tuffieha rural land-cover.

Figure 37: Rural Hamlet of Ghajn Tuffieha. (Source: C. Cassar).
Figure 38: Rural Farm House of Ghajn Tuffieha. (Source: C. Cassar).

<table>
<thead>
<tr>
<th>Ghajn Tuffieha, (the region)</th>
<th>Landscape elements</th>
<th>Field Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land cover</td>
<td>Geological</td>
<td>Clay talus</td>
</tr>
<tr>
<td></td>
<td>Vegetation</td>
<td>Escarpment, with underlying scree formation (rdum)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sandy beaches, with accompanying sand dune in the case of ir-Ramla tal-Mixquqa, with sand dune species such as <em>Pancratium maritimum</em> and <em>Scolymus hispanicus</em></td>
</tr>
<tr>
<td></td>
<td>Valley</td>
<td>Valley, which in part nourishes the series of pocket beaches</td>
</tr>
<tr>
<td></td>
<td>Maltese rdum community, with <em>Darniella melitensis</em>, <em>Convolvus oleifolius</em>, <em>Crucianella rupestris</em>,</td>
<td></td>
</tr>
<tr>
<td>Various Limonium sp. (endemic)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aerohaline community, dominated by Crithmum maritimum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tree spurge formation (Euphorbia dendroides)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spiny spurge cushion garrigue (Euphorbia melitensis)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Remnants of the Nerio-tamaricetea formation, characterised by Tamarix Africana close to the strandline within the scree</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Various introduced species, notably Acacia cynophylla and Carpobrotus sp.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Buildings and construction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radisson Golden Sands Hotel (with the possibility of the Hotel Martinique to be reopened)</td>
</tr>
<tr>
<td>Scouts Camping site</td>
</tr>
<tr>
<td>Green houses</td>
</tr>
<tr>
<td>Restaurants (e.g. Apple’s Eye)</td>
</tr>
<tr>
<td>Abandoned huts</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Historical elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Watch Towers dating back to 1648</td>
</tr>
<tr>
<td>British Barracks used during World War 2</td>
</tr>
<tr>
<td>Lower camp (presently known as Hal Ferh) was a</td>
</tr>
</tbody>
</table>
prisoner war camp for Germany and Italian prisoners. The Upper camp was a commando training base.

| Economic and Cultural Activities | • Tourist resort  
|                                | • Recreational site |

Table 11: An overview of the different landscape elements which contribute to Ghajn Tuffieha’s regional land-cover.

When comparing both tables (Table 10 and Table 11) one can notice that the rural hamlet of Ghajn Tuffieha Figure 39, has generally retained its rural characteristics, whilst the wider region of Ghajn Tuffieha, has been transformed into a landscape with strong tourist-oriented elements.
Figure 39: 2008 (above) vs. 1968 (below) maps indicating the rural hamlet of Ghajn Tuffieha. (Source: National Library).

Figure 39 correspond to the 1968 and 2008 survey sheets respectively. Land fragmentation is evident in the area, with fields having been rendered progressively smaller. Fields in the area are presently cultivated and well maintained, with little evidence of abandonment. Fields are divided by rubble walls, which are likewise well maintained. The rural hamlet has not undergone significant change over the time span of the study. Whilst on survey, however, it was noted that new additions or extensions to the farmhouses were being made, possibly because of space requirements of modern-day families. These alterations to the houses imply that people still live in this
rural hamlet. Of particular interest are the three emblems indicating that the buildings were constructed during the rule of the Knights of St. John (Figure 40), specifically during the reign of Grand Master’s Wignacourt (1601-1622) and Perellos (1697-1720) (Bonello, 2008).

Figure 40: Emblems5 that are found on the facades of three farmhouses in the rural hamlet of Ghajn Tuffieha.

---

5 The coat of arms with the pears belongs to Grand Master Perellos. The second coat of arms belongs to Grand Master Wignacourt.
As can be noted from Figure 41 and Figure 42, most of the land on the plateau was at the time used for agricultural cultivation.
When comparing the area of ‘In-nah Halia’ (Figure 41 and Figure 42) (where presently the Radissons SAS hotel is found), one can note a change in the landscape over a span of 58 years (1900/1958 map). The name ‘In-nah Halia’ implies that beekeeping practices could have possibly occurred in the area. The practice of beekeeping cannot be excluded since the area has a strong horticulture practice.

In later years, the area of Ghajn Tuffieha was used by the British Military Forces. Barracks are still found in the area. Lower camp (presently known as Hal Ferh - Figure 58) was a prisoner war camp for Germany and Italian prisoners. The Upper camp was a commando training base. From the 2008 site plan, the most prominent feature noted in the landscape is the Radissons SAS hotel which dominates the landscape because of its large footprint and visually dominant scale (see appendix Figure 54).

The following points summarise the main elements of land cover change in Ghajn Tuffieha:

- The rural hamlet is still actively inhabited and has undergone a certain degree of expansion;
- Road networks have developed over the years;
- Land fragmentation has parcelled up the land into smaller portions;
The area has been used for a number of large-scale land demands, including for military barracks, for a prisoner-of-war camp, for tourist complex (Hal Ferh), and most recently, for a 5-star hotel.

New developments in the area, with a touristic focus, have emerged over the years.

Not all the maps have been overlaid on previous site maps (as in the case of Selmun and Ghajn Tuffieha). This is due to the fact that when this was done this created a visual conflict. Change in the other three case studies was harder to be identified. This was especially noted when studying field size.

5.3.3. The rural hamlet of Mtaħleb

The name ‘Mtaħleb’ has been described by Wettinger (2000) that most of the land practiced horticulture. This can be verified up to the present day, where the area of Mtaħleb has remained strongly characterized by agricultural practices.

<table>
<thead>
<tr>
<th>Mtaħleb (rural hamlet)</th>
<th>Landscape elements</th>
<th>Field Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land cover</td>
<td>Geological, Vegetation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Acutely sloping terrain with exposed karst and, where cultivated, supporting steeply stepped narrow terraces</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Afforestation of <em>Pinus halepensis</em> quite extensive beneath some of the escarpments</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rupestral vegetation comprises largely of elements of the Maltese rdum community, with patchy dominance of <em>Darniella melitensis</em> and <em>Chiliadenus bocconeii</em>, two endemic species.</td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Capparis orientalis</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Triadenia scrub characterised by <em>Hypericum aegyptium</em></td>
<td></td>
</tr>
</tbody>
</table>
As in most of the embayments within this region, a freshwater spring occurs and is exploited for agricultural purposes.

- Rural houses-mostly abandoned.
- Huts and garages
- Green houses
- Juvenile detention centre: Substance Abuse Therapeutic Unit

| Buildings and construction | • Church of Nativity of Our Lady constructed in 1656 by D’amico Inguanez
|                          | • Gate with emblem dating back to Knights Period. The emblem possibly belongs to the Inguanez family. |

| Historical elements | • Church of Nativity of Our Lady constructed in 1656 by D’amico Inguanez
|                    | • Gate with emblem dating back to Knights Period. The emblem possibly belongs to the Inguanez family. |
| Cultural elements  | • Agricultural activity |

| Economic activities | • Agricultural activity |

Table 12: An overview of the different landscape elements which contribute to Mtahleb’s regional land-cover.

The rural village of Mtahleb consists of the church of Nativity of Our Lady and a group of rural houses that are found in close vicinity. The church of Nativity of Our Lady stands on the site of two earlier chapels built on the same foundations. The chapel was then enlarged to its present state and a steeple was added. The area of Mtahleb belonged to the noble Inguanez family (Figure 46).

Most of the rural houses are presently abandoned and from the 2008 map, one can note that permits for garages or sheds have been granted (Figure 43). Sheds are not being replaced by garages. Instead shed permits have been issued to allow farmers to store tools.
The region at Mtahleb (Figure 45) is highly productive in agricultural terms and this tradition of agriculture can be noted from 1895 up to the present day. The area of Mtahleb is today comprised of highly fragmented terraced fields (as seen from Figure 44, 2008/1968).

Figure 43: Site plan showing 1968 (above) and 2008 (below) Mtahleb.
Figure 44: Land-cover change at Mtaḥleb (Site plans of 1968(above) vs. 2008(below)).

Changes noted in figures above Figure 43 and Figure 44 are related to construction and development.
As a summary, landscape change in Mtaħleb has included the following characteristics:

- Strong agricultural tradition Figure 45 which can be noted from 1895 onwards;
- The landscape is highly fragmented, contributing to landscape change;
- The rural hamlet of Mtaħleb, is mostly abandoned with few inhabitants;
- New developments such as garages and sheds have been granted development permission, as per 2008 data;
- An improved road network can be seen in the 2008 survey sheet;
- British influence can be noted with the mile-stone Figure 57. This was a rock cut marker showing the distance from that spot to Valletta. These were only found in the countryside.

Figure 45: Terrance farming at Mtaħleb. Source (C. Cassar).
Figure 46: Mtaheb gate possibly showing the coat of arms of the Inguanez family. (Source: C. Cassar).

5.3.4. The rural hamlets of Nadur and Tas-Santi

The topographic names of the rural villages of Nadur and Tas-Santi do not provide much information about local tradition or landscape characteristics. Wettinger (2000) comments that the village of Tas-Santi was under feudal law and produce would then be returned to the feudal lord. This is highly plausible since Tas-Santi has highly agricultural lands. The rural village of Nadur has not been defined by Wettinger (2000).

<table>
<thead>
<tr>
<th>Nadur (rural hamlet)</th>
<th>Landscape elements</th>
<th>Field Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land cover</td>
<td>Geological</td>
<td>Upland massif (Upper Coralline Limestone) incised by embayments</td>
</tr>
<tr>
<td></td>
<td>Vegetation</td>
<td>Archaeophytic maquis, largely dominated by <em>Ceratonia siliqua</em></td>
</tr>
</tbody>
</table>
with vestigial assemblages of natural maquis
- Riparian remnants also occur on the wider banks of wider Bingemma/tas-Santi valley, with dominant thickets of *Rubus ulmifolius*
- Singles of the riparian assemblage of *Populus alba* also occur
- Mediterranean heath garrigue (*Erica multiflora*)
- Labiate garrigue elements and sparse *Anthyllis hermanniae* phrygana

<table>
<thead>
<tr>
<th>Buildings and construction</th>
<th>3 houses-possibly leper community</th>
</tr>
</thead>
<tbody>
<tr>
<td>Historical elements</td>
<td>Nadur Watch Tower constructed in 1648 by Grand Master Lascaris.</td>
</tr>
<tr>
<td>Economic and Cultural activities</td>
<td>Bird trapping</td>
</tr>
</tbody>
</table>

Table 13: An overview of the different landscape elements which contribute to Nadur land-cover.

<table>
<thead>
<tr>
<th>Tas-Santi (rural hamlet)</th>
<th>Landscape elements</th>
<th>Field Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Land cover</td>
<td>Valley</td>
</tr>
<tr>
<td></td>
<td>- Geological</td>
<td>Anthropised terraced terrain with archaeophytic elements</td>
</tr>
<tr>
<td></td>
<td>- Vegetation</td>
<td>Riparian remnants also occur on the wider banks of wider Bingemma/tas-Santi valley, with dominant thickets of <em>Rubus</em></td>
</tr>
</tbody>
</table>
Table 14: An overview of the different landscape elements which contribute to Tas-Santi’s land-cover.

These two rural hamlets are adjoining settlements which can be discussed simultaneously. Both hamlets date to the 1900s when the first houses were constructed. These two settlements are rather small in size and presently only a few of families still live in the area. When comparing 1900 to 1958 maps the only difference noted was an increase in land fragmentation.

From Figure 47 on the following page, one can note that not much change has occurred in the rural hamlet of Nadur. Figure 47 shows survey dating from 1958 and 1968 respectively. In both maps, the same buildings can be noted and thus one can conclude that over a decade no change has occurred. On the other hand, change can be noted at Tas-Santi where new buildings have been constructed and the land has become very fragmented (Figure 48). In both cases, the land is comprised of small land parcels and fields are delineated by means of rubble walls.
Figure 47: Site plans of Nadur dating to 1958 (above) and 1968 (below).
Figure 48: To the right is the site plan of 1958 Tas-Santi. The other site plan dates to 1968.

As a summary, landscape change in Nadur and Tas-Santi includes the following elements:

- Land fragmentation is affecting both Nadur and Tas-Santi;
- Nadur’s hamlet has not changed over the years whilst in Tas-Santi hamlet, new agricultural buildings have been constructed;
- Agricultural practices are very relevant to both areas.
5.4. Results from the interviews

Interviewees with different academics specializing in archaeology and environment planning and protection were interviewed. A set of nine questions were asked to each interviewer. The questions asked ranged from identifying drivers of landscape change, to discuss the implications of the inheritance law and to propose suitable measures to protect the landscape of North West Malta. The answers from the interviewees varied but generally most of the responses proposed similar ideas. When asked in what ways rural landscapes in Malta have changed, the answers varied from agricultural practices, growth in urbanization and land abandonment. Various answers were given when asked what would be the possible outcomes for rehabilitation programs being organized by the Maltese Government. The interviewees proposed that with aid from the government, this would lead to less land abandonment, more greenhouse construction and maintenance of rubble walls. A general agreement was seen when proposed if the inheritance law needs to be adjusted in order to reduce land fragmentation. As regards whether North West Malta should be safeguarded from human induced impacts, the general agreement was that the anthropogenic footprint cannot simply be erased from the landscape. All the interviewees strongly expressed the point above. When discussing the new initiative being promoted by the Ministry of Tourism most of the responses resulted in negative comments. The general concern was the conflict between tourist and the farmers, littering and a change of attitude on behalf of the farmers. Only one interviewee agreed that the initiative would be beneficial, as Malta would be promoted as a rural destination.

5.5. Why have landscapes in NW Malta changed?

Natural processes and cultural processes are the two main causes of landscape change. Natural processes are understood as being external forces which act on a landscape, and which are not directly human-induced. A typical example of such a process would be changes in weather and/or climate or wind action. Cultural processes are linked to historical, social or economic factors which have contributed to landscape change.

When analysing land cover change, one needs to account for factors which cannot be immediately identified during field surveys or whilst analysing maps. These underlying factors can be understood as being, for example, environmental policies,
agricultural incentives/disincentives, economic drivers, as well as political forces. When analysing landscape change, one thus needs to also consider the historic dimension of different driving forces of change that have acted on the landscape.

Some changes in the landscape can be noted by analysing natural process. This entails looking at climatic changes and erosion data. The average mean temperature has increased by 1.1 degrees Celsius (Times of Malta, 2011) and this has had repercussions for the land. Precipitation is very important for the island as this recharges the mean sea level aquifer, the main source of groundwater in Malta. The European Environmental Agency comment that by 2050 rainfall in the Mediterranean could decrease by 15% (EEA, 2010). In Malta, 22.2% of agricultural land is irrigated according to the World Bank Report (Trading Economics, 2012). The extent to which landscapes change in response to fluctuations in natural dynamics depends on how robust they are. This in turn depends on the sensitivity of the landscape and on the gradient of change that a system can absorb (Antrop, 2003).

Landscapes in North Western Malta have also been affected through cultural processes such as historical events. These forces of change can be understood as being changes in governance, policies and legislation or even military actions. Over a period of 400 years, Malta has had four different governing bodies, namely the Order of St John, the French, the British and an independent Malta government (with various changes in the ruling political party since independence in 1964). Each governing authority had left its effect on the current landscape. These effects will be discussed below.

5.6. Historical events: driving force for landscape change

- Prior to the arrival of the Order of St John in 15th century, the North West region of Malta was abandoned. People lived close to Citta’ Vecchia (Rabat) in order to seek protection. It was only after the siege of 1565, through policy incentives (land grants), that people were encouraged to move to the North Western part of the island. This can be considered to be the first driver of change, leading to the infiltration of people into rural areas.
- Other elements of landscape change can also be noted during the 15th c. The Great Siege had affected the country, with one historian recording sources
noting that the landscape was a wreck (Blouet, 1969). Agricultural fields were abandoned probably due to piracy attacks and thus this was lead to another change. Cultivated land was left to be transformed into a wild environment.

- Agricultural practices were needed to produce food and to sustain the quality of life of inhabitants of the country. During the governance of the Knights, agriculture was highly encouraged; thus, there was a change from predominantly land-cover to a more semi-natural cover.

- The construction of dwellings in the north-west can be noted during the time of the Knights. Such dwellings consisted of farmhouses or singular cell rooms. Hamlets such as the one at Ghajn Tuffieha have not changed much during the past century even though some of the farmhouses have been modernized. Hamlets of Selmun, Ghajn Tuffieha, Mtahleb and Tas-Santi date back to the time of the Knights.

- After the construction of the new capital city of Valletta in 1566, a shift back to the rural areas was noted. New settlements were established and this facilitated agricultural work, with farmers now able to live close to their fields. This shift resulted in new constructions such as dwellings, which altered the skyline of these landscapes. One needs to remember that roads were few and far between, and one would have had to travel from the villages back to the fields. This shift back to the countryside can also be noted during the time of the French, when the locals lived in the countryside whilst the French were blockaded in Valletta.

- The British were a military power and thus the landscape became substantially militarized. The construction of the Victoria Lines on the Great Fault is a case in point, with substantial influence on the visual landscape. When seen from a distance, one can notice a long stretch of defensive wall that contrasts with the natural/semi-natural setting.

5.7. Economy: driving force for landscape change

The economy is another driving force that has altered the local landscape. Agricultural practices together with tourism and quarrying have all contributed to a change in the landscape. Agricultural practices in Malta have increased from the year 2005 till 2010 and records from the National Statistics Office (2010) state that 11,452.8 hectares of
the land are being utilized for agricultural practices and 5,520 holdings have less than 0.5 hectares. There has been an increase in agricultural land that has been cultivated over the last five years. An archaeologist with a specific interest in landscape archaeology states that ‘rural landscapes have changed mostly through the adoption of modern agricultural practices such as green houses and machinery.’

Tourist developments in Malta can be identified after the mid 1950s, when a new economic market was created. After the Second World War, elements of local infrastructure were rebuilt and this meant that the road network was improved. New developments such as hotels started to be constructed in close vicinity to rural hamlets (such as in the case of Ghajn Tuffieha, where the Riviera Martinique hotel was constructed, subsequently closing down in the 1970s). These developments not only had an impact on the landscape but also affected the local environment.

Tourism plays a major role in generating economic growth. However, prior to 1990, tourist developments were often placed in sensitive natural environmental areas. With the introduction of the Structure Plan in 1992, more sensitive planning can be noted over the past two decades. The establishment of the Planning Services Division in 1900, (now the Malta Environment and Planning Authority) allowed the monitoring of land use patterns and the control of development project in Malta. Of most relevance to this study are the establishment of Outside Development Zone (ODZ) areas, to prevent the spread of urban settlements into the countryside. An interviewee from MEPA noted that ‘Landscape is protected through rural conservation areas, ODZ and the landscape visual area assessment. If certain sites are of ecological, historical importance etc, then these need to be protected.’

5.8. Agricultural practices: driving force of change

Agricultural practices have evolved over time as machinery has been introduced. An archaeologist interviewed noted that ‘tractors instead of ‘mohrit’ and rubble walls make working the land impossible. Terraced fields are another matter that needs to be dealt with differently.’ Rubble walls have become synonymous with the local landscape and thus these are protected by law (Chapter 16, Article 308). The building of rubble walls is a local tradition that was passed on from father to son. One needs to acknowledge that even though rubble walls form part of the local landscape character,
they still contribute to landscape change, both through their construction as well as in some instances when these are not maintained, leading to accelerated soil erosion. More fundamentally, perhaps terracing in Malta has also altered the landscape.

5.9. Land fragmentation: driving force of change

Land fragmentation is one of the major causes leading to landscape change (as can be noted in Figure 19). When analysing field size in Malta, one can notice that the majority of the fields are less than half a hectare in size (Figure 19). Fields have gotten smaller in size and over time, as a result of subdivision of larger land parcels, and this phenomenon can be noted in all the case studies. This fragments the landscape with consequent effects on the natural environment as well as on the semi-natural agro-ecosystems. Impacts on land fragmentation include the following:

- An increase in demand for road access to various land parcels;
- Agricultural techniques which can be used (including machinery) are limited;
- Due to a small field size, profitable economic returns are harder to achieve;
- As a consequence of the above, field abandonment may result:
  - When land is abandoned, soil erosion may be accelerated.
  - As a secondary consequence, land abandonment also affects terraced fields as a lack of care can lead to a loss of soil profile and a collapse in rubble walls.
  - Abandoned fields may be colonized through a process of secondary succession.

When asked if the inheritance law needs to be revised, responses from interviewees varied. The majority of the responses agreed that the trend of land fragmentation can be slowed if the inheritance law is revised.
5.10. Victoria lines: Base line study

<table>
<thead>
<tr>
<th>Hamlets:</th>
<th>Selmun</th>
<th>Ghajn Tuffieha, Tas-Santi</th>
<th>Mtahleb</th>
<th>Nadur</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural activity</td>
<td>Rubble Walls</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
</tr>
<tr>
<td></td>
<td>Terrance fields</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
</tr>
<tr>
<td></td>
<td>Green houses</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
</tr>
<tr>
<td></td>
<td>Reservoirs</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
</tr>
<tr>
<td></td>
<td>Water irrigation</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
</tr>
<tr>
<td>Hamlet</td>
<td>Houses</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
</tr>
<tr>
<td></td>
<td>Vehicle would facilitate access to the hamlet</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
</tr>
<tr>
<td></td>
<td>Shops</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
</tr>
<tr>
<td></td>
<td>Public transport (to hamlet)</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
</tr>
<tr>
<td>Historical elements</td>
<td>Watch towers</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
</tr>
<tr>
<td></td>
<td>Forts</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
</tr>
<tr>
<td></td>
<td>Knights emblems</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
</tr>
<tr>
<td></td>
<td>Churches/chapels</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
</tr>
<tr>
<td>Leisure activities</td>
<td>Hotels or accommodation in vicinity</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
</tr>
<tr>
<td>Land fragmentation</td>
<td>/</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
</tr>
</tbody>
</table>

Table 15: Overview of case studies.

The analyses above (Table 15) show the results of landscape change. As one can note, similar trends can be identified when studying hamlets in a local context. When analysing rural hamlets, different patterns have been identified. The most common trend in all five sites is land fragmentation. This seems to have become more marked over time.

All the rural hamlets have had a different fate. Some of these hamlets have remained active, with people still living there to the present day, as in the case of Nadur and
Ghajn Tuffieha. Other hamlets largely have been abandoned. What can be noted is that all hamlets studied have declined in population. This does not imply that all rural hamlets in Malta have declined in population. One can look at neighbouring hamlets such as the village of Bahrija or Mgarr (Figure 49) which have grown into substantial-sized villages. One of the interviewees linked population growth/decline to place attachment: ‘another classic case is Bahrija where the village and the local church have expanded since the 1800. There seems to be an attachment to place’. At the moment the village of Bahrija has approximately 3,000 inhabitants (Tourist Office, 2012). The figure is much higher than the corresponding population of the rural hamlets studied.

![Map of Bahrija and Mgarr villages](image)

Figure 49: Bahrija and Mgarr villages. Source: (Google Earth).
5.11. Characteristics of life in rural hamlets

In the past, rural hamlets were a singular community. Rural areas lack commodities such as groceries, schools or hospitals. This means that people would have to travel to the next large neighbouring village for basic services. As these rural villages are found in remote locations, transportation is crucial. The local bus system does not go to the village of Nadur, Tas-Santi, or Ghajn Tuffieha. Instead anyone wanting to go to these rural hamlets, and not in possession of a private vehicle, would have to walk a distance from the bus stop until the final destination is reached.

The few people that are still living in these hamlets enjoy good air quality, open spaces and a calmer life than in urbanized villages. People that reside in these areas either have a tie with the landscape or else they prefer to live close to agricultural fields. However, the general decline in the population of farming also reflects the fact that working the land is a tough lifestyle and people nowadays often prefer to find jobs which are more comfortable.

Below is a simplified system dynamics (Figure 50 and Table 16) model showing the main drivers of landscape change in Malta:
Figure 50: Vensim model showing landscape change in rural landscapes.
<table>
<thead>
<tr>
<th>Variables Names</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural Infrastructure</td>
<td>This refers to construction of greenhouses, sheds or garages to store machinery and irrigation facilities.</td>
</tr>
<tr>
<td>Agricultural Practices</td>
<td>Cultivation of crops</td>
</tr>
<tr>
<td>Commodities</td>
<td>This refers to basic services, including public transport and local shops such as groceries or pharmacies.</td>
</tr>
<tr>
<td>Conservation of Heritage</td>
<td>Local heritage and characteristics are protected and conserved to be enjoyed by locals and tourists.</td>
</tr>
<tr>
<td>Construction</td>
<td>Building construction for various purposes, ranging from residential dwellings to tourist hotels.</td>
</tr>
<tr>
<td>Costs</td>
<td>This entails expenses to maintain the field in good conditions which allows farmers to work the land.</td>
</tr>
<tr>
<td>Deterioration</td>
<td>Diminishing field qualities such as a lack of soil organic matter</td>
</tr>
<tr>
<td>Economy</td>
<td>The current economic growth or decline of any country in any particular time.</td>
</tr>
<tr>
<td>Employment</td>
<td>Work generated through economic growth.</td>
</tr>
<tr>
<td>Farmer’s Interest</td>
<td>Farmer’s concern and attention to the field.</td>
</tr>
<tr>
<td>Farmer’s training</td>
<td>Training which is provided to farmers in order to improve agricultural practices.</td>
</tr>
<tr>
<td>Fertile Fields</td>
<td>Productive fields having the correct soil properties and structure.</td>
</tr>
<tr>
<td>Field Size</td>
<td>Field dimensions.</td>
</tr>
<tr>
<td>Funds</td>
<td>Local or EU funds which aid farmers with training programs, purchase seeds, machinery.</td>
</tr>
<tr>
<td>Government</td>
<td>The Maltese Government</td>
</tr>
<tr>
<td>Hamlet size</td>
<td>The size of the rural hamlet which increases or decreases over time.</td>
</tr>
<tr>
<td>Infrastructure</td>
<td>Technical structures such as road, water sewers etc.</td>
</tr>
<tr>
<td>Inheritance Law</td>
<td>The system of inheritance used in Malta, based on subdivision of a parcel of land amongst the children of the heir, in cases where he/she has more than one child.</td>
</tr>
<tr>
<td>Land abandonment</td>
<td>Land which is left uncultivated.</td>
</tr>
<tr>
<td>Land Fragmentation</td>
<td>Fragmentation of fields into smaller parcels of land.</td>
</tr>
<tr>
<td>-------------------</td>
<td>-----------------------------------------------------</td>
</tr>
<tr>
<td>Land-cover change</td>
<td>Changes to the physical and biological cover over the surface of land.</td>
</tr>
<tr>
<td>Landscape Change</td>
<td>Changes which have been brought about by changing agricultural practices and housing development.</td>
</tr>
<tr>
<td>Machinery Use</td>
<td>The application of machinery for agricultural practices.</td>
</tr>
<tr>
<td>Malta goes rural Project</td>
<td>A new project which is supported by MTA in order to attract tourists to visit rural Malta.</td>
</tr>
<tr>
<td>MEPA</td>
<td>Malta Environmental and Planning Authority</td>
</tr>
<tr>
<td>MRRA</td>
<td>Ministry for Resources and Rural Affairs</td>
</tr>
<tr>
<td>MTA</td>
<td>Malta Tourism Authority</td>
</tr>
<tr>
<td>ODZ</td>
<td>Outside Development Zone</td>
</tr>
<tr>
<td>Population</td>
<td>Population growth or decrease of any country or region.</td>
</tr>
<tr>
<td>Profit</td>
<td>Financial benefits received from an investment where all charges have been paid.</td>
</tr>
<tr>
<td>Rubble Walls</td>
<td>The construction of dry walls which are used within agricultural land for delineating land parcels and in order to prevent erosion, particularly on terraced land.</td>
</tr>
<tr>
<td>Soil profile</td>
<td>This refers to the different layers of soil.</td>
</tr>
<tr>
<td>Tourism</td>
<td>This is travel for recreational, leisure or business purposes.</td>
</tr>
</tbody>
</table>

Table 16: Variable Names used in system dynamic's model.

5.12. System dynamics model showing land-cover change in Malta

Reinforcing loops:

R1: Population growth is determined by the size of the hamlet. Presently more space is needed in order to live comfortably than in the past. Additionally, the greater the population, the greater the need for commodities. If such commodities are not available, then this can lead a decrease in population with out-migration to other parts of the country. All three factors may have an impact on the landscape.

R2: With an increase in land abandonment, this will lead to a loss in the soil profile and to the collapsing of traditional rubble walls. As a consequence, this leads to
landscape change. If fields remain neglected, the farmer would have to invest money to re-establish the field. Costs will escalate and this may lead to farmers deciding to leave the fields abandoned.

R3: A growth in the local economy will lead to more expenditure on local infrastructure. When the infrastructure is established this will lead to authorities investing in the conservation of cultural heritage. Furthermore, tourism is one of the pillars which sustain the local economy. The more tourists visit the island, the greater the employment opportunities in this sector are.

R4: A growth in infrastructure expenditure will result in greater construction and urban land-cover. This will have a negative effect on agricultural/natural land-cover. Such urban growth can become self-reinforcing, with increasing demands for further construction.

R5: An increase in land abandonment will deteriorate the structure and quality of fertile fields. When the field starts to deteriorate this will decrease annual profits for the farmers. A decline in the quality of fields and profits can lead to a decrease in the farmer’s interest. The farmer may re-think it twice before continuing to work the land and this can lead to land abandonment. Land abandonment will have severe effects on the field as loss of soil profile and collapsing rubble walls will lead to a change in the landscape. In order to prevent more landscape change occurring, this entails costs (e.g. maintenance of rubble walls). The severity of the damage to the landscape can lead to high maintenance costs which will in turn lead to land abandonment.

5.13. Local initiatives to revive rural Malta

Change can be perceived as regress or as progress. Policy makers need to plan and cater for any change that might occur within a landscape. Policies and the implementation of strategies that seek to stop change are seen as a recipe for failure, given that landscapes are inherently dynamic (Antrop, 2005). On the contrary, policies need to anticipate change in order to be prepared for future scenarios. Environmental managers are required to understand the various processes that occur in a landscape. In this manner, sustainable management practices can be implemented. A sustainable landscape means that the landscape’s dynamic character is understood and acknowledged.
Currently in order to increase awareness about rural Malta, the Malta Tourism Authority is re-launching for the second time the Malta Goes Rural project. Amongst the project’s objectives is the upgrading of country walks (MTA, 2012) by restoring rural characteristics back into the landscape. Various interviewees were sceptical about this goal. A MEPA representative argues that the ‘best management is to leave things alone and to see what the needs of the area are and at what scale’. Another concern noted was the internal conflict between tourists wanting to explore rural areas and farmers trying to halt such interaction. An archaeologist interviewed remarked that ‘you can never bring farmers to the tourists if the tourists are not wanted. This is a recipe for disaster!’ It was noted that the audience being targeted was not the local but foreign. It would have been beneficial if the local population was also targeted, particularly since the project calls for stakeholder participation.

A common view emerging from interviews was that it would be beneficial for agro-tourism to be introduced in Malta. In this manner, tourists would be able to live in rural hamlets and the money generated from the agro-tourism would be directed back into the rural hamlet, effectively providing an alternative and/or complement to land cultivation. The initiative could have been implemented under the Rural Development Programme which seeks to improve the overall quality of life and to encourage competitiveness in rural areas. Most of the interviews agreed that with the initiative.
Chapter 6

Conclusions and Recommendations
6.1. Summary of study and results achieved

The target of this study was to access the extent of change in rural landscapes in North West Malta and to identify the main elements and driving forces of this change over a period of 400 years. After having analyzed landscape change within the five selected case study sites over the past 400 years, it is evident that varying degrees of change have occurred. Change to the landscape was brought about primarily by construction activities, agricultural practices and land fragmentation. These influences have remained relevant up to the present day and are likely to continue to shape the character of rural landscapes. Historical-political changes have also shaped the evolution of rural landscape studied over the long term.

From the five case studies, it would appear that landscape change has occurred at a generally slow rate inside the rural hamlet than in the region. It would also seem that population has declined in all five hamlets. Some of the hamlets are now abandoned whereas other hamlets accommodate a small number of inhabitants.

The interviewees all agreed that landscape in Malta is changing due to external driving forces. When asked how best to protect landscape in North West Malta, the general consensus was that this would be best achieved through education, a change in attitude and continuous protection through the designation of rural conservation areas, Outside Development Zones and other relevant initiatives. Government is trying to encourage tourists to visit rural Malta but it was agreed that a coordinated plan for agro-tourism needs to be developed, in participatory manner.

6.2. Future scenarios for NW rural Malta

North West rural Malta will remain highly characterized by agricultural practices if restrictions on development imposed by MEPA continue to hold, and as long as there is continued sustenance of the agricultural sector. Settlements such as Bahrija and Mgarr (Malta) have continued to expand probably due to an increase in services which may have encouraged people to settle in rural hamlets as happened; the introduction of decentralized services may thus help revitalize rural communities. Rural hamlets could potentially be economically sustained if agro-tourism is introduced into these areas, to complement agricultural cultivation, but at the moment, policy makers appear not to be keen to introduce such a strategy. Currently policy makers are more
interested in sustaining agricultural activities on the island. The Rural Development plan attempts at restructuring the agricultural sector and together with EU funds farmers have been able to restore collapse rubble walls which enhance the landscape. These initiatives have aided farmers to improve agricultural practices and to conserve the landscape. On the other hand if agro tourism had to be introduced then this could possibly compete with the main farm operations for time and labour. A successful project requires tedious planning to secure a secure long term project.

Thus more recreational pressures are altering the landscape. A typical example would be the Hal Ferh complex at Ghajn Tuffieha where a new touristic development is currently being undertaken (Figure 58).

Notwithstanding the strongly agricultural character of the hamlets surveys, however, the prospect of change resulting from urbanization may not be too distant. One strand of this is related to tourism and recreation, with Malta heavily dependent on the tourism industry (24.3% contribution of tourism to local GDP) (Ministry for Resources and Rural Affairs, 2012) and with the influence of tourism developments already evident in this study. The spread of residential buildings is also a factor of some concern; although the designation of Outside Development Zone areas have gone a long way towards safeguarding remaining tracts of countryside, there have nevertheless been several instances when developments have been approached even with Outside Development Zone areas, as well as initiatives to re-designate areas that has previously formed part of the Outside Development Zone scheme, including them in development zone areas. The rationalization exercise which commenced in 2006 is an example of this.

Trends in the agricultural sector are likely to have an influence on the future evolution of rural landscapes in Malta. Whilst there are some encouraging trends, with greater numbers of farmers working the land (Figure 18), the popularity of farming generally continues to decline, with more part-time farmers than full-time farmers, and with a generally ageing farming population (Role’, 2011). An unfavourable land tenure system may further aggravate these trends, which are also evident elsewhere in Europe (United Nations, 2006). One also needs to remember that due to lack of land in Malta, land prices are high, accompanied by economic and political pressures (Role’, 2011).
Other future drivers of change may include natural ‘stressors’ relating to climate change and water availability. As mentioned on page 36, temperatures have increased by 1.1% and European Environmental Agency comment that by 2050, the climate will get hotter and precipitation will decrease. This will lead to a gradual depletion in ground water quantity and quality. In Malta, ground water is used for drinking water and agriculture irrigation. Ground water is being depleted at a faster rate than the natural recharge rate. As a consequence the island’s aquifer is being replaced by an increase in salinity. An increase in salinity will affect the agricultural sector which will in turn affect the landscape.

6.3. Recommendations

6.3.1. The study

1. A pilot study needs to be conducted through the MRRA and MTA which provides the necessary details for a possible amalgamation of the ‘Malta Goes Rural’ project together with a study of the feasibility of agro tourism. At the same time, farmers together with local NGOs need to be made aware of new initiatives allowing a wider perspective to be taken into consideration.
2. In relation to the above, efforts need to be made to ensure that agro tourism initiatives do not lead to urbanization of the countryside, directly or indirectly.
3. It would be beneficial if abandoned houses within rural hamlets can be rehabilitated in order to accommodate new residential or other uses.
4. Communication needs to be enhanced between stakeholders. A possible way of achieving this is to use a bottom up approach were people at different levels are involved in discussion.
5. It would be beneficial to create awareness through education. People need to be informed about the implications of landscape change. Landscape does not belong to a single entity but it belongs to an entire nation. At the same time, there is a need to foster greater appreciation of the ‘landscape heritage’, given that this has been largely overlooked as a concern in its own right.
6. Schemes need to be set up were famers are encouraged to reduce land fragmentation. **It may be necessary for inheritance law to be revised.**
The following points outline constraints in analysing historical maps using GIS.

1. Each geo referenced raster can be vectorized by following the contour lines of the map/raster. This is done by creating a line shapefile for each raster. This will result in different shapefile layers producing different data. An example of this can be seen in topology, rural areas, roads/paths or water streams and even the coastline. When undertaking this step, one can easily switch on or off the shapefile layers. This results in a better visualization of change. By doing such steps, the percentage of error is reduced. As a result one shapefile has the possibility to map its line co-ordinates onto another shapefile. As a result change in landscape can be easily distinguished. This change can be shown by using the inbuilt tool called ‘buffer’. This helps the user to manually indicate change and the percentage of change is determined by the diameter of the buffer. After this process is complicated, certain buffers can intersects each other showing that a greater percentage of change occurred.

2. The maps used for this study are in raster form. Hence the only method to input maps in GIS was by geo referencing. This creates a problem, since only a certain amount of geo referenced points can be taken. The more points used for geo referencing (3 point rule) (University of Indiana, 2012) then the greater the offset is from the appropriate position. Three points were thus selected. The closer the points of geo-referencing are, the less accuracy is achieved. In some cases this could not have been avoided since the section of the map that was being worked on had either a limited overlap or lacked land marks or at times even both (an example is when the shore line is not present).

3. The raster images were initially in (.jpeg) format. Since the source of the maps could not be provided, a soft copy then a hard copy had to be worked with. This introduces another error in accuracy due to a scaling issue with the printer’s setting (fit to page setting). This changes the original scale of the map. Even if this error was avoided due to the fact that a soft copy was still needed, another error was introduced by some wrapping effecting caused by scanning the maps themselves.

4. In the early 1900s technology was still scarce thus maps in those days were drawn by hand. This introduces human error. This error affects the geo referencing part of this thesis, since both landmarks and the coastline might
contain human error. Even if geo referencing had to be done completely correctly, an offset in certain parts of the map would still be noted. This is due to the scaling ratio error that the surveyors drew the map with (minor calculation error done whilst triangulation).

5. Most of the case studies involved the shoreline. As discussed in (chapter 4, section 4.1, page 55) two different shapefiles were used for the shoreline. The MEPA 2008 coast line shapefile seems to be at an average distance of the coastline itself (fallen boulders on the peripheral of the North and West coast of Malta are calculated on the average distance they occupy). The other shapefile mentioned (Google Earth Polygon) was created by using the polygon tool within Google Earth itself. Here the boulders were considered as land (the new average is of 100%). This created an offset error between the two shapefiles.

6. Since two coastline shapefiles were used for this study, it was noted that both shapefile have a margin of error. Maps were geo referenced to the most adequate shapefiles. This resulted in certain maps being geo references to one shapefile whilst others were geo referenced to another shapefile. This may create a minor distortion in overlapping.

7. If geo referencing is slightly offset by a very small distance, then this error is magnified throughout the length of the whole map. This can be understood as being a butterfly effect. This is especially seen when only a very small overlap is available for geo referencing.

8. Since multiple combinations of the above mentioned errors are possible, the final percentage of error can be increased drastically.
Appendix 1
Figure 51: Selmun Castle. (Source: C. Cassar).

Figure 52: Terraced landscape at Selmun. (Source: C. Cassar).
Figure 53: Fort Campbell- a section is shown. This photo above is showing the fire station that was present on site. (Source: C. Cassar),

Figure 54: View from Ghajn Tuffieha rural hamlet. (Source: C. Cassar).
Figure 55: Ghajn Tuffieha Watch Tower. (Source: C. Cassar).

Figure 56: Church of the Nativity, Meterminate. (Source: C. Cassar).
Figure 57: Mile-stone, Mtahleb. This used to represent the distance in kilometres from Valletta. (Source: C. Cassar).
Figure 58: Hal Ferh Complex at Ghajn Tuffieha. (Source: Courtesy of Air Malta).

Figure 59: Selmun Castle and Selmun Hotel. (Source: Courtesy of Air Malta).
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