

Lesvos Island UNESCO  
Global Geopark, Greece -  
Systems Thinking on  
Sustainable Value

LAHTI UNIVERSITY  
OF APPLIED SCIENCES  
Faculty of Technology  
Master's Degree Programme in  
Energy and Environmental  
Technology  
Master's Thesis  
Autumn 2016  
Satish Kumar Damodar

Lahti University of Applied Sciences  
Master's Degree Programme in Energy and Environmental Technology

DAMODAR, SATISH KUMAR: Lesvos Island UNESCO Global  
Geopark, Greece- Systems Thinking  
on Sustainable Value

Master's Thesis Pages 111 Pages of appendices 14

Autumn 2016

## ABSTRACT

---

The study is an original research suggesting Lesvos Island UNESCO Global Geopark as a platform for systems thinking on sustainable value. The study provides information on Global Geoparks Network, European Geoparks Network and detailed description of Lesvos Island UNESCO Global Geopark emphasizing its distinct features. The formation of Lesvos landscape during the Miocene period due to volcanic eruptions, creation of petrified forests, geological faults and geosites coupled with natural, cultural and intangible heritage, and sustainable development resulted in the development of Lesvos island geopark system.

The research incorporates systems engineering methodology along the Vee-model of systems engineering life cycle. The geopark systems and its stakeholders have also been touched upon. The importance of requirements engineering, blending strategic management viewpoints and systems engineering viewpoints in delighting geotourists along the geopark value chain has also been highlighted. Emphasis is given on the 5Cs: credibility, communication, community, capacity building and conservation (WHC 2015) and suggests addition of 3Cs: continuity, connectivity and creativity.

The research proposes "Geopark Value Pyramid" (modified from Carroll 1991, 1999), undertakes classification and categorization of geotourists, formulates "Geotourist Engagement Model" in an effort to rationalize resources targeted at value creating geotourists, using ABC analysis. Design for Sustainability along Vee-diagram for sustainable systems engineering process, and sustainable value creation along the primary and support functions in the geopark value chain network (Porter 1985) have also been discussed.

A qualitative study was carried out in evaluating a group of ten geopark members (aspiring and UNESCO Global geoparks), and the findings are reported. An indepth study testing the new models may benefit management professionals and decision makers.

Key words: Geopark Systems, Geotourist, Petrified Forest, Requirements Engineering, Sustainable Development, Sustainable Systems Engineering

## TABLE OF CONTENTS

1	INTRODUCTION	5
1.1	UNESCO Global Geoparks	5
1.2	Importance of the Thesis	5
1.3	Aim of the Study	6
1.4	Objectives of the Study	6
2	GLOBAL GEOPARKS NETWORK	7
2.1	Purpose of Global Geoparks	7
2.2	Characteristics of Global Geoparks	8
2.3	Idea Behind Geoparks	8
2.4	Structure of Global Geoparks Network	8
2.5	Building a Successful Geopark	10
2.6	UNESCO Global Geoparks Process	10
2.7	UNESCO Global Geoparks New Application Process	12
3	EUROPEAN GEOPARKS NETWORK	13
3.1	Formation of European Geoparks Network	13
3.2	Definition of European Geoparks	13
3.3	Structure of European Geoparks Network	14
3.4	Activities of European Geoparks	16
3.5	Obtaining Membership of the EGN	17
3.6	Main Features of European Geopark	18
4	RESEARCH METHODOLOGY	19
4.1	Research Methods	19
4.2	Qualitative Research	20
4.3	Types of Qualitative Research Methods	20
4.4	Research Approach	21
4.5	Sampling Method	21
4.6	Questionnaire Design	21
4.7	Secondary Data	22
4.8	Validity and Reliability of Data Collected	22
5	LESVOS ISLAND UNESCO GLOBAL GEOPARK	24
5.1	Lesvos Island	24
5.2	Lesvos Island Geopark	25
5.3	Organization of the Lesvos Geopark	26
5.4	Petrified Forests of the Lesvos Geopark	28
5.5	Formation of Petrified Forest	29
5.6	Species of Petrified Plants	30
5.7	Plaka Petrified Forest Park	32
5.8	Sigri Petrified Forest Park	34
5.9	Nissiopi Marine Petrified Forest Park	34
5.10	Natural History Museum of Lesvos Petrified Forest	38
5.11	Activities of the Natural History Museum	38
5.12	Agrotourism Cooperative	41
5.13	Museum of Industrial Olive Production	42
5.14	Fortress Methymna (Molyvos)	46
5.15	Wetlands of Kalloni Bay	48
5.16	Ancient City of Thermi	48
5.17	Sappho	49
5.18	Mytilene Castle	50
5.19	Archaeological Museum of Mytilene	51

5.20	Lesvos Linked to Pergamon	53
5.21	Natural Heritage and Cultural Environment	54
5.22	Biodiversity and Landscape	55
5.23	Connecting Olive Oil with Tourism	56
5.24	Creating Differentiation and Value through Olive	56
5.25	Purpose of Geographic Indicators	57
5.26	Positioning of Lesvian Olive Oil	58
5.27	Signage, Publicity & Digital Promotion	58
5.28	Promotional Inputs	60
6	SYSTEMS THINKING ON GEOPARK	63
6.1	Geopark & Geopark Systems	63
6.2	Systems Engineering International Standards	63
6.3	Vee-Model of Geopark Systems Engineering	64
6.4	Geopark Systems and Stakeholders	65
6.5	Enterprise Systems Engineering	66
6.6	Requirements Process	67
6.7	Types of Geopark Requirements	68
6.8	Requirements Capturing	69
6.9	Geopark Stakeholders' Requirements	69
6.10	Scenarios	70
6.11	Geopark Value Pyramid	71
6.12	Geotourists	72
6.13	Geotourist Classification	73
6.14	Geotourist Engagement Strategies	75
7	SUSTAINABLE DEVELOPMENT IN GEOPARKS	81
7.1	Definition of Sustainable Development	81
7.2	Goals of Sustainable Development	81
7.3	Sustainable Development in Geopark	83
7.4	Sustainable Development Through Geotourism	84
7.4.1	Geotourism Charter	84
7.5	Design for Sustainability of Geoparks	85
8	ANALYSIS AND FINDINGS	88
8.1	Analysis	88
8.2	Responsibilities of Geopark Organizations	94
9	CONCLUSION	101
9.1	Result of the Study	101
9.2	Suggestions for Further Research	102
9.3	Limitations	103
	REFERENCES	104-109
	APPENDICES	110

## ABBREVIATIONS

APGN	Asia Pacific Geoparks Network
EGN	European Geoparks Network
GGN	Global Geoparks Network
IGCP	International Geoscience Programme
IGGP	International Geoscience & Geoparks Programme
IUCN	International Union for Conservation of Nature
IUGS	International Union of Geological Sciences
Q R	Quick Response
RFID	Radio Frequency Identification
SEBoK	Systems Engineering Book of Knowledge
UNESCO	United Nations Educational, Scientific & Cultural Organization
WCED	World Commission on Environment & Development
WHC	World Heritage Convention

## DEFINITIONS

Bastion	Projecting part of a fortification built at an angle to the line of a wall, so as to allow defensive fire in several directions
Biosphere	Region on the surface and atmosphere on the earth or planet occupied by living organisms
Cimmerian	Mythical people described by Homer as inhabiting a land of perpetual darkness
Crypts	An underground room used for secret meetings
Development	Efforts of the local population and stakeholders in contributing to the up-keeping and maintenance of the geological area for years to come
Geomorphology	Study of evolution & configuration of land forms
Geosite	A location that has particular geological or geomorphological significance
Governance	Processes, policies, customs, law, procedures and relationships that influence the stakeholders

Habitat	Natural home or environment of an animal or organism
Heritage	Features belonging to the culture of a particular society
Hot Spring	Thermal spring having water warmer than 98°F (37°C)
Ignimbrite	Deposit of a pyroclastic density current or flow, which is a hot suspension of particles and gases flowing rapidly from volcano
Miocene	Being the epoch of geologic time from about 23 to 5.3 million years ago, the fourth epoch of the Tertiary Period
Menander	Greek dramatist whose romantic works were influential in the development of comedy
Neogene	Period of time between about 22 to 2.5 million years ago
Paleobotany	Branch of botany dealing with fossil plants
Petrified	To convert into stone or stony substance
Prodeinotherium	Extinct representative of the family Deinotheriidae that lived in Africa, Europe and Asia in the early and middle Miocene.
Pyroclastic	Fragments of rock erupted by a volcano
Pyroclastic flow	Fast moving current of hot gases and rocks flowing out from volcanic eruption at high speed of up to 700km/h
Stratigraphy	Branch of geology dealing with the study of rock layers (strata) and layering (stratification)
Subduction	Geological process in which one edge of a crustal plate is forced sideways and downwards into the mantle below another plate
Tectonic	Processes that control the structure and properties of the earth's crust
Visibility	Developments and activities that are observable and achieved through effective communication

## 1 INTRODUCTION

### 1.1 UNESCO Global Geoparks

UNESCO Global Geoparks are defined as “single, unified geographical areas where sites and landscapes of international geographic significance are managed with a holistic concept of protection, education and sustainable development” (UNESCO 2016). The purpose of UNESCO Global Geoparks is to preserve geological heritage and link it with the cultural and natural heritage, and utilize the resources provided by earth sustainably and efficiently. Doing so helps the stakeholders, especially the local inhabitants and women entrepreneurs in creating value for their produce through branding and selling their produce in the cooperatives supported by geopark, as in the case of Lesvos Island Geopark.

Geoparks offer value which is a sense of identification, pride, employment and entertainment through creation of new and innovative enterprises that contribute to economic and social development through geotourism.

UNESCO Geoparks offers an opportunity to the stakeholders, especially the local entrepreneurs and community to align and cooperate with focus on protecting the geological heritage sites.

The five important features of UNESCO Global Geopark are specific geological value, governance, development, teamwork and visibility. Learning and collaborating with the international community, exchange of ideas, viewpoints, learning from best practices of geopark networks contribute to development. Value is generated by bundling the geological heritage with educational, cultural and service elements in an efficient method with an involvement through an effective delivery system. These activities create sustainable development in the region and bring about economic, social and spiritual prosperity (UNESCO 2016).

### 1.2 Importance of the Thesis

UNESCO Global Geoparks are established with a bottom up approach involving local, regional stakeholders and authorities in promoting long

term partnership, community engagement and preserving the geological heritage (UNESCO 2016).

This thesis explains about how geologically significant sites, archaeological artefacts and cultural heritage of Lesvos island are identified and used in sustainable development of the community through focus on geotourism. This thesis highlights the breakdown functions of Lesvos geopark and an approach to development of geopark through systems thinking.

### 1.3 Aim of the Study

To understand and identify key success factors of UNESCO Global Geoparks with reference to Lesvos Island Geopark (Greece)

### 1.4 Objectives

To understand the purpose and idea of UNESCO Global Geoparks

To study Lesvos Island UNESCO Global Geopark and understand factors that contributed to its success

To apply principles of systems engineering and develop/refine concepts that support sustainable development in geoparks

To understand the philosophy underlying other UNESCO Global Geoparks and Aspiring Geoparks.

To understand the responsibilities of geoparks with reference to economic, legal, ethical, philanthropy, principles of charity and stewardship and environmental responsibilities.

## 2 GLOBAL GEOPARKS NETWORK (GGN)

### 2.1 Purpose of Global Geoparks

“Geoparks exist to protect the geological heritage” says Dr Nickolas Zouros, President of Executive Board of Global Geoparks Network and Coordinator of European Geoparks Network. “Heritage refers to various elements that provide information on history of the planet. We have been connected to the planet since the beginning of our civilization.

Unfortunately, for most countries, the geological sites are of second value. Therefore, there is a need to connect among geological value, biological value and ecological value. The role of UNESCO is to connect the biosphere, atmosphere and geosphere” (Zouros 2016).

In the first World Heritage Convention held in 1972, it was discussed that cultural heritage, natural heritage, biotic and abiotic environment influences human society to a great extent. The first geological location (reserve) was established in France in 1982. Subsequently, in 1991, conserving Geological heritage gained importance at the UNESCO symposium. The theme of protection and sustainable development of geoheritage was ceremoniously opened at the First International Conference of Geoparks in Beijing in 2004 (European Geoparks 2016).

The first International Conference on Geoparks was held in June 2004 in Beijing with participants from 25 geoparks (8 from China and 17 from other countries) involving 1000 participants. The 2015 GGN Conference had participants from 120 geoparks (including 69 EGN, 46 APGN, 2 Latin American, 2 North American and 1 African).

According to Prof Patrick McKeever, Secretary of the IGCP, there are 1031 World Heritage Sites across 163 countries, of which 197 are natural sites. The Man and Biosphere reserves are 650 in 119 countries and 120 UNESCO Global Geoparks in 33 countries (Mc Keever 2016).

## 2.2 Characteristics of Global Geoparks

UNESCO Global Geoparks are territorial borders which are natural with well-planned route maps and holistic management of geographical territories. Tangible heritage and intangible heritage are important components of geoparks. Several geoparks are located in active tectonic areas that help people understand the dynamics of the planet through preserving the geological sites. Volcanic eruptions and earthquakes, indigenous people with landscape and culture are the treasures of geoparks. Geoparks promote local culture, geological value and educational activities.

Geoparks make geology a fun for the young children. Geoparks, with innovative field museums, connect locations and treasures and provides a link between art and geology. The UNESCO Convention for Safeguarding of the Intangible Cultural Heritage defines intangible cultural heritage as "the expressions, practices and representations that are considered part of cultural heritage" (UNESCO 2005).

## 2.3 Idea Behind Geoparks

World Heritage Sites in UNESCO Global geoparks are outstanding, unique with extraordinary universal value (Frey 2016). Geoparks relate an identity of landscape, ecosystem and human culture in a holistic way using geological heritage, cultural heritage and ecological heritage for sustainable development and geotourism. Almost 99% of geoparks are located in rural and mountainous regions. Each geopark has a distinct identity and offers opportunity to generate ideas, adopt and adapt with evolving networks, and capacity building offering benefits to the society and stakeholders.

## 2.4 Structure of Global Geoparks Network

Geoparks began as a voluntary network and became an international association in 2014. At the 38<sup>th</sup> General Conference, GGN became UNESCO Global Geoparks. The structure of GGN is given in figure 1.

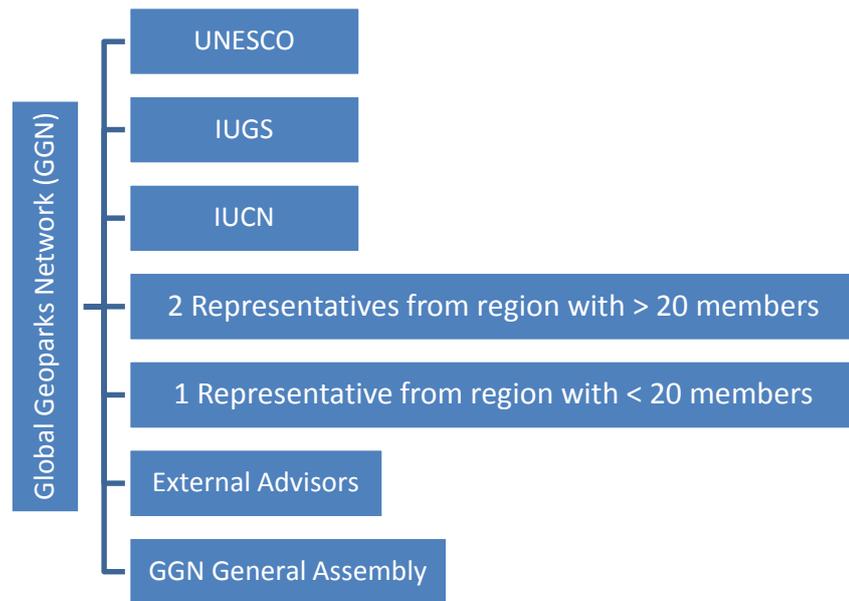


Figure 1: Structure of Global Geoparks Network (Zouros 2016)

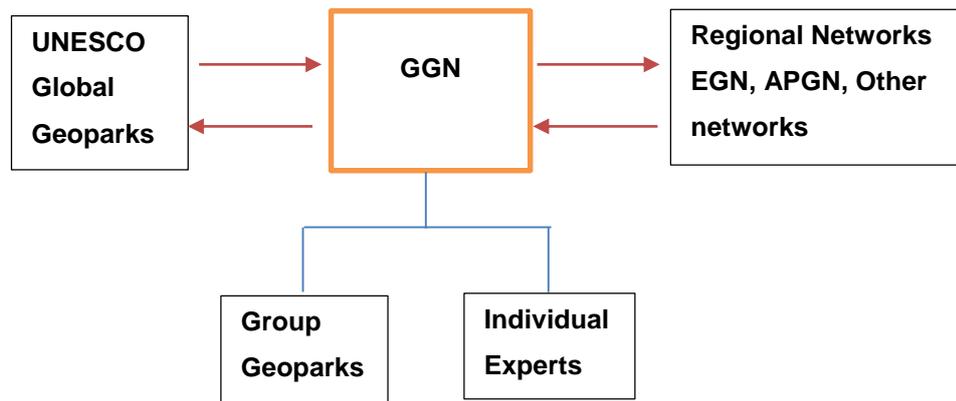


Figure 2: Global Geoparks Network (Zouros 2016)

Geoparks are evaluated by a team of international evaluators who assess and rate Geoparks based on the following: Geosites, Ecological sites and Cultural sites, Geotourism and development of local economy, Standard Operating Procedures, Quality Management Systems, Science education, Community involvement, Capacity building, Networking and Value offering.

## 2.5 Building a Successful Geopark

The essential requirements for building a successful geopark are:

- Inventories of geological heritage, natural heritage, cultural heritage and intangible heritage
- Uniqueness of the heritage sites or objects or artefacts and tradition of the village
- Developmental strategy such as economic development and geo-tourism
- Accessibility to travel by road, sea or air to the geopark sites and locations
- Heritage location and pre-existing limits
- Formal management structure
- Permanent team working for geopark
- Connections between the heritage sites, nature, history and human with story
- Integrating local society and stakeholders with the cultural sites, geological sites and historical sites
- Financial plan and forecast
- Site management
- Brand strategy and
- A Master Plan

The feature of UNESCO Geopark is “Connecting Diversity”. It is essential that a geopark is operational for at least one year before applying for UNESCO recognition.

## 2.6 UNESCO Geoparks Process

A Geopark’s calendar begins with the ‘letter of intent’ placed on the UNESCO website during the month of December. Desktop reviews are carried out during the months from November to January every year. IGCP is a government funded programme and meetings are held every year during the month of February in Paris.

Frey (2016) pointed out that it is necessary to have the 5Cs: Credibility, Conservation, Communication, Capacity building and Community for UNESCO World Heritage Sites (WHC 2015) as depicted in figure 3.

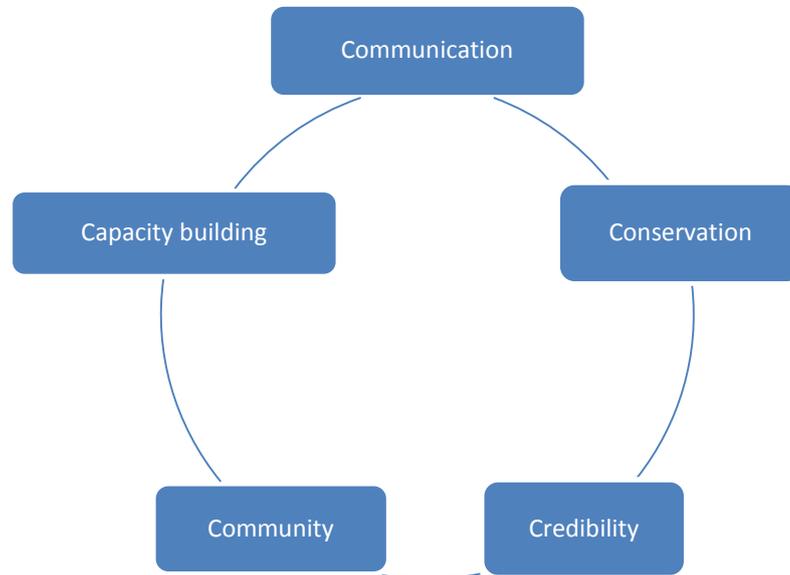


Figure 3: Strategic objectives of UNESCO Global Geoparks -5Cs (Communication, Conservation, Community, Credibility and Capacity building; WHC 2015)

An aspiring geopark must have a proven research on geological site. The heritage site is evaluated on an eight criteria; carrying one point for earth's history and seven points for nature.

According to the new guidelines created on 17<sup>th</sup> November 2015, applications for revalidation are received from 1<sup>st</sup> May to 15 August every year. The documents are to be submitted to the UNESCO National Commission which in turn submits the application to the UNESCO International. The detailed procedures are mentioned on the website.

The first time applicants must show the evidence of being active for at least one year whereas the applicant applying for revalidations must produce the evidence of continuous activity and progress. Participation in Intensive course, conferences and community engagement are given due weightage. Geoparks follow a bottom up approach in management philosophy and governance. The rules and regulations undergo change

every two years. The main activities of a geoparks are sustainable development, conservation, protection of natural resources & geological monuments, geotourism, and development of local community. The core purpose of geoparks are revolved around peace building and sustainable development.

## 2.7 UNESCO Global Geoparks New Application Process

The steps are as follows:

- a. Intergovernmental check
- b. Validation of documents with structured checklists
- c. To be approved by a body of UNESCO Geoparks council who are representatives of IUGS, IUCN, GGN from geographical areas. These include 12 members with voting rights appointed by Director General of UNESCO as deciding authority and 5 members from UNESCO Geoparks Bureau for endorsing the new application
- d. Only 2 active applications shall be considered from a Nation State in a year
- e. Payment of \$1000 as a fee to the UNESCO
- f. Expression of interest to be submitted to UNESCO National Commission between 1<sup>st</sup> October and 30<sup>th</sup> November every year
- g. Emphasis on value addition and sustainable development with geological heritage, art, culture, geoconservations, economic activity and management plan
- h. Following UNESCO procedures from the UNESCO/GGN websites
- i. Large scale maps along with one-page summary, completed self-evaluation forms are to be attached
- j. UNESCO checks the application during December and deadline for revision by 31<sup>st</sup> December
- k. UNESCO issues Green/Yellow/Red cards representing acceptance/in waiting/refusal respectively, as result of decision (UNESCO 2016).

### 3 European Geoparks Network (EGN)

#### 3.1 Formation of European Geoparks Network

European Geoparks Network (EGN) was founded through a transnational cooperation by four members, the Reserve Geologique de Haute-Provence (France), the Petrified Forest of Lesvos (Greece), Geopark Gerolstein/Vulkaneifel (Germany) and the Maestrazgo Cultural Park (Spain) in the year 2000 in Lesvos island, Greece with a purpose of promoting sustainable development, social responsibility, geo-tourism, capacity building, publication, organize regional workshops, preserving geological, ecological and cultural heritage. The aims of EGN are protecting and enhancing European Earth Heritage and promoting sustainable development through geo-tourism (Zouros et al. 2003; Zouros 2004). The EGN expanded rapidly with the assistance of EU and UNESCO, adding 32 geoparks from Austria, Croatia, Czech Republic, France, Germany, Greece, Ireland, Italy, Norway, Portugal, Romania, Spain and the UK; European Geoparks 2009). Currently there are 69 EGN members from 23 countries. EGN Charter is the basic document containing rules and regulations of EGN.

#### 3.2 Definition of European Geoparks ,

“The European Geopark is a territory that combines protection and promotion of geological heritage with sustainable local development. European Geoparks are required to possess particular geological heritage of international value with features pertaining to geological, mineralogical, geophysical, geomorphological, palaeontological and geographical appreciation. It shall include certain numbers of geological sites that possess international scientific quality, rarity, aesthetic appeal or educational value” (European Geoparks 2009). There has to be a dominance of geological sites with inclusion of other important sites of archaeological, ecological, historical or cultural value. There has to be clearly defined boundaries with emphasis on sustainable territorial development strategy (European Geoparks 2009).

According to EGN regulations, the European Geopark must have a well-defined strategy and structure and an organized management body that is capable of safeguarding the structures and implement policies fostering economic and sustainable development.

The European Geoparks are expected to evolve through a process of continuous improvement, through experimentation in the preservation of geological heritage and promote scientific research in the areas of Earth Sciences and natural environment. Special emphasis must be focused towards protecting and preserving endangered geological heritage sites for future generations and education of the community. The European Geopark must have the ability to influence the life of people living around the area (European Geoparks 2009).

### 3.3 Structure of European Geoparks Network

The European Geoparks Network is a body of representatives who are members of European Geoparks. The European Geoparks Network is managed and governed by a Coordinating Committee and an Advisory Committee. The Coordinating Committee is responsible for operations and management function whereas the Advisory Committee is responsible for strategic planning and quality systems (figure 4).

The Coordinating Committee consists of two representatives from each European Geopark, one a specialist in the area of geosciences (Geologist) and the other who is a specialist in local development. The Coordination Committee meets every six months at least, in different geoparks, to discuss on the issues and progress. The Coordinating Committee members elect a Coordinator and a Vice Coordinator, for a period of every two years, in order to sustain the growth of EGN and for representing the EGN in the international forum.

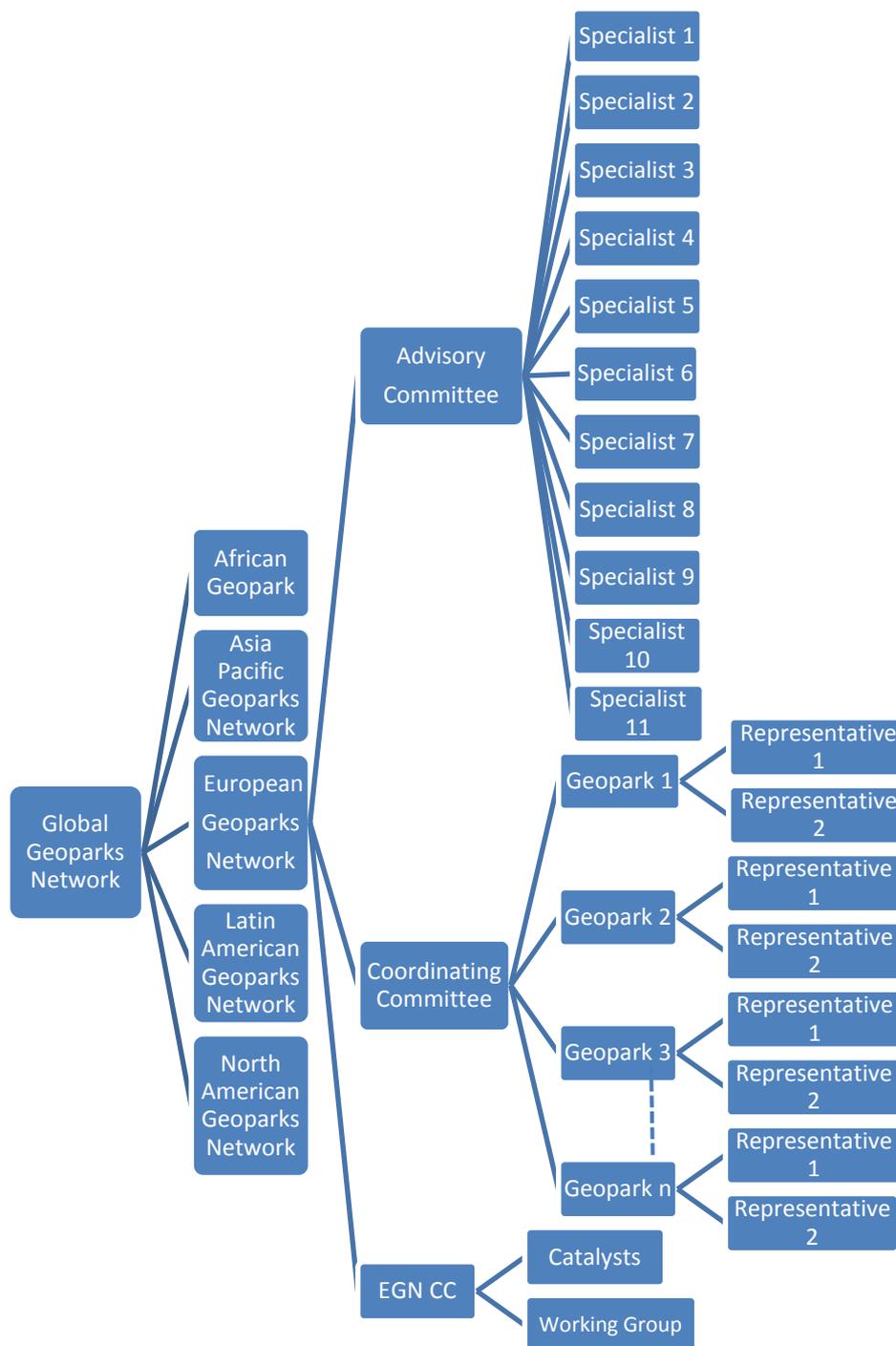


Figure 4: Structure of European Geoparks Network

The Advisory Committee consists of 11 specialists in the areas of sustainable development and geological heritage, including members from founding EGN, elected EGN CC members and international representatives in the areas of geological heritage from UNESCO, International Union of Geological Sciences (IUGS), World Conservation Union (WCU).

The EGN Coordination Cellule (EGN CC) is the office of EGN for new and aspiring members. EGN CC consists of catalysts and working groups of volunteers of 5 or 6 in each group. Catalysts are selected to advance work on a specific topic. The working groups and catalysts play an important role in strengthening the EGN. According to the “Madonie Declaration” signed in October 2004, any European region aspiring to become a member of GGN should submit a full application dossier to the EGN CC. EGN membership is mandatory to become a GGN member for countries within Europe (European Geoparks 2009).

### 3.4 Activities of European Geoparks

In order to encourage collaboration and cooperation among members, the EGN, supported by the EU Initiatives, undertake activities such as annual conferences, European Geoparks Week, exchange programmes, events, educational activities, training, common publications, common EGN website, EGN magazine and EGN Information Point.

**EGN Annual conferences:** Annual conferences of EGN members are held once a year with focus on sharing activities, experiences and common interests, strategies for geo-conservation, geo-tourism, preserving heritage and culture, and local development.

**EGN Week:** EGN Week is a festival organized during the last week of May and the first week of June with presentation on natural and cultural heritage of each geopark to the public. Other activities are exhibitions, guided tours, events and educational activities targeted at the youth and visitors with focus on preserving natural and cultural heritage.

**EGN Exchange of experience:** Workshops and seminars are organized in order to connect the biotic and abiotic factors with nature, culture and conservation. These events help benchmarking of various geoparks and understanding among various geopark members.

Exchange of events: To promote values of Earth heritage, geoparks are able to connect people with the planet, integrate cultures and bring people closer.

Education: The educational programmes offered in the geoparks are in the areas of environmental science, geology, conservation of geological fossils and natural ecosystem.

Training: European Geoparks offer employment opportunities to the youth through vocational training in their respective training centres. For example, the Vocational Training centre of the Natural History Museum of Lesvos trains the youth on a three months course in the areas of excavation, conservation and preservation of fossils in collaboration with Bergstrasse Odenwald geopark of Germany (European Geoparks 2009).

Promotional tools: The promotional tools of EGN include EGN website, EGN magazine, EGN information point (aimed at visitors to promote the activities of the EGN) and common publications of EGN members (European Geoparks 2009).

### 3.5 Obtaining Membership of the EGN

The EGN Coordination Unit is the one single contact point for an aspiring EGN member. The aspiring member submits a complete application with the following information to the EGN Coordination Cellule:

- Territorial identification
- Scientific description
- Reasons to justify joining the EGN
- Economic potential and development of the territory
- Sustainable development policy of the territory and
- Role of geo-tourism in the territory.

Official document from a responsible authority for nomination to EGN (European Geoparks 2009).

### 3.6 Main Features of European Geopark

The European Geopark must possess the following characteristics:

- i) There has to be a specific number of geological sites of aesthetic value, educational value and rarity, and must be a part of heritage – geological, archaeological, cultural, ecological & historical.
- ii) The boundaries are to be clearly defined with sufficiently large area reflecting territorial economic development.
- iii) The sites are to be networked, protected and managed. There shall be no destruction or sale of geological objects from the geopark.
- iv) In order to enforce protection of the sites, the territories of the European Geopark are to be managed through a clearly defined structure for its advancement and sustainable development.
- v) By connecting geological heritage with geotourism, the European Geoparks play an important role in economic development of the region. The European Geopark plays an active role in influencing the lives of the inhabitants, their living standards and preserving the environment. The European Geopark involves the inhabitants in assessing the values of the heritage of the region and participates in revitalizing the culture.
- vi) The European Geopark continuously develops, experiments and enhances methods of preserving the geological heritage.
- vii) The European Geopark supports environmental education, training and development, foster scientific research in various disciplines of Earth Sciences, thus helps in the enhancement of natural environment and policies for sustainable development.
- viii) The European Geopark collaborates with other members of the European Geoparks Network to create and share values. The European Geopark collaborates with local enterprise in promoting and supporting creation of new by-products linked to the geological heritage. The members of European Geoparks Network work with a team spirit of cooperation and collaboration (Natural History Museum 2008).

## 4 RESEARCH METHODOLOGY

### 4.1 Research Methods

Research is defined as “the process of gathering, analysing and interpreting data in order to understand a phenomenon” (Leedy & Ormrod 2001). Research involves “systematic method of defining the objective, managing the data, communicating the findings of research within the framework and in accordance with the given research guidelines” (Williams 2007).



Figure 5: Research questions form the basis of research process

The framework and guidelines help a researcher in investigation and answering questions 5Ws and 1H (what, why, when, where, who and how) of research (figure 5).



Figure 6: Classification of research methods (Creswell 2003)

Research methods are classified into three main types- qualitative, quantitative and mixed methods (figure 6).

## 4.2 Qualitative Research

Qualitative research methods occur in a natural setting and which helps investigators to develop a detail by involving themselves in depth in the actual experiences (Creswell 1994). According to Leedy & Ormrod (2001), qualitative research is useful in formulating and building new theories, and is therefore less structured in description. Creswell points out that qualitative research is an effective model that occurs in natural setting and that it enables researcher to develop a level of detail from being highly involved in the natural experience (Creswell 2003).

Qualitative research is an inductive research method where the researcher explains the issues through observation. The researcher is a part of the phenomena, makes observation and there exists a correlation between the observer and the data. In the qualitative research, there is no established assumption from which the researcher can begin (Leedy & Ormrod 2001). The researcher collects data through the senses in order to explain a phenomena relevant to social behaviours in new and emergent theories (Williams 2007).

## 4.3 Types of Qualitative Research Methods

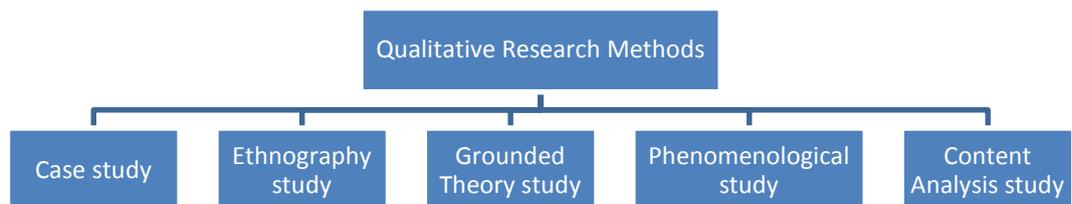


Figure 7: Types of Qualitative Research Methods (Leedy & Ormrod 2001)

There are five methods of organizing qualitative research, according to Leedy & Ormrod (2001). These are case study methods, ethnography study, grounded theory study, phenomenological study and content analysis study (figure 7). Details are given in the Appendix.

#### 4.4 Research Approach

The study adopted has both inductive (new theory generation) and deductive approach (testing an existing theory). This is because geopark is a new concept focussed towards sustainable development through capacity building, communication, community, conservation and credibility (WHC 2015). The research method adopted is qualitative data collection through participative method. The researcher identified geopark experts by gaining access to them, establishing relationships and interacting with them at the 2016 International Intensive Course held at Lesvos, Greece.

#### 4.5 Sampling Method

The researcher gathered information from both primary and secondary sources. The information is gathered through discussion with the experts and participants who are members of UNESCO global geoparks and aspiring geopark members. Each geopark member was administered one set of questionnaire. There were participants from 12 geoparks at the International Intensive Course 2016 (5 UNESCO global geoparks, 6 aspiring geoparks and 1 proposed geopark). The population of UNESCO global geoparks during the year 2016 is N=119 (UNESCO 2016).

#### 4.6 Questionnaire Design

Two questionnaires were designed, the first questionnaire contained general information about the functioning of the geoparks and the second questionnaire contained detailed questions on the responsibilities of organization, supporting the requirements of Carroll's (1991, 1999) pyramid of responsibility, Lawrence, Weber and Post's (2005) principle of charity and stewardship and environmental responsibility. The questionnaire contained both open ended and close ended question, depending on the information required for analysis. The open ended questions permit elaborate answers from the respondents in their own words and expressions and offer valuable insight into the problem under study. The open ended questions are useful in exploratory studies. The questions used in questionnaire 1 were open ended and the questionnaire

2 contained close ended questions on a 5-point Likert scale with balanced agreement in ascending order (1.Disagree- 2.Agree partially- 3.Neither agree nor disagree- 4.Agree to a great extent- 5.Agree fully). The respondents were asked to mark the most appropriate answer for each question. Close ended questions make the data collection and analysis easier than the open ended questions. According to Hair et al. (2003), a Likert scale facilitates measurement of variables and permits measurement of direction and intensity of responses based on the degree of agreement.

#### 4.7 Secondary Data

The secondary data is obtained from review of academic literatures, publications, websites, journals, lectures and educational material provided at the International Intensive Course 2016. The publications of EGN journal and Natural History Museum of the Lesvos Petrified Forests were also accessible. The information were authentic and readily available and thus saved time in searching for information.

#### 4.8 Reliability and Validity of Data Collected

Research instrument is a valuable tool in determining the purpose of data collection and measuring whether the data collected is able to provide answers to the research questions. Reliability in qualitative research refers to “trustworthiness of procedures and data generated” (Stiles 1993)

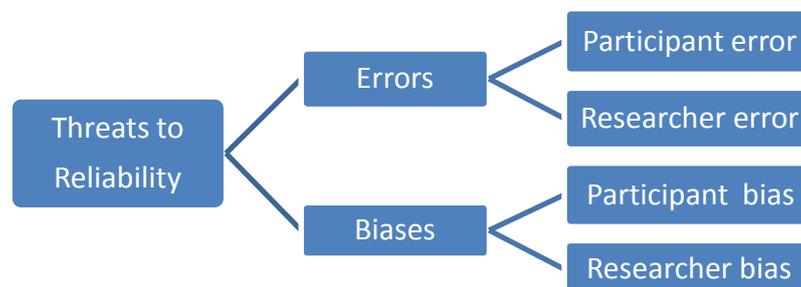


Figure 8: Threats to reliability of research

Reliability was ensured by reducing errors and biases from both researcher and participants. The participant error and bias is reduced by

identifying free time of the respondents, a time when the respondent is totally relaxed, after field hours at a time convenient to the respondent so that there is no interference from other participants, and ensuring that no one overhears the discussion.

Researcher bias is reduced by recording all the information in an objective manner and checking each question with the respondent with regard to clarity in understanding. Researcher error is reduced by fixing up interview with one respondent per day during the 11 day Geopark Intensive Course. Only one participant was not able to provide adequate information and another member did not participate due to lack of time. The researcher included only responses that were complete in all respects from the remaining 10 respondents.

Validity in qualitative research is “an assessment of how well the research tool measures the phenomena under investigation” (Punch 1998).

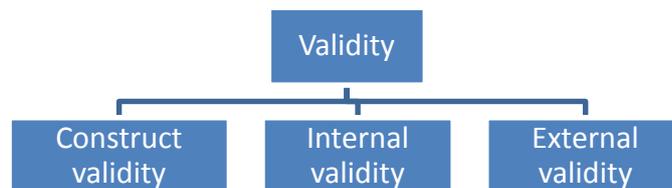


Figure 9: Types of validity in research

Construct validity ensures that the questionnaire measures what it claims to measure. Internal validity demonstrates causal relationship between two variables. External validity is valid if the study’s research findings can be generalised to other relevant settings or groups.

In order to ensure construct validity, research was undertaken using the questionnaire that has already been validated and tested using Carroll’s (1991) pyramid of CSR framework, Lawrence, Weber, Post’s (2005) principle of charity and stewardship and environmental responsibility in several organizations.

## 5 LESVOS ISLAND UNESCO GLOBAL GEOPARK

### 5.1 Lesvos Island

Lesvos, the third largest island in Greece, is located on the North Eastern Aegean region. It covers a land area of 1670 sq.km (Zouros 2016a). Before the ice age, the island was connected to the Turkey. Mytilini strait divides the island from the mainland. The North Aegean region includes islands of Lesvos, Chios, Lemnos, Psara, Samos, Oinousses, Ikaria, Fournoi Korseon and Agios Efstraitios with capital at Mytilene. According to Dr N Zouros, there are approximately 110,000 inhabitants living in the Lesvos island. The Lesvos island is a symbol of natural beauty and rich cultural heritage (Zouros 2016a).

Agriculture is the main occupation of the inhabitants of Lesvos. The eastern part of Lesvos has more than 14 million olive trees. The western part of Lesvos is mainly dry land and cattle or sheep rearing is the main occupation. There are more than 350,000 sheep in the island. Lesvos attracts tourists due to its close proximity with Turkey. Family owned tourism is one of the main activities of the inhabitants. Lesvos has geodiversity due to volcanic eruptions and creation of petrified forests. This connected to the natural history of the place and cultural heritage of the villages is an ideal location for establishing a geopark in Lesvos (Zouros 2015).

According to Global Geoparks Network, the islands of Lesvos represents a part of the Cimmerian Continent, with Metamorphic basement formed during the Miocene period. The western part of Lesvos is covered by the Petrified Forest, formed due to intense volcanic activity in the late Lower Miocene. The petrified trees are found in an area of 15,000 hectares and are preserved by The Natural History Museum of the Lesvos Petrified Forest. The other connecting links in the Lesvos islands are the fossil of mammal Prodeinotherium, thermal springs, volcanic sites and landscapes created due to volcanic eruption, waterfalls, geological faults and coastal

geosites (Zouros 2015). The Lesvos island has the archaeological remains of habitation of Thermi who lived during 3000 BC to 2000 BC. The textbooks mention that Mytilene was founded during the 11<sup>th</sup> century BC and was a prominent centre in the Mediterranean region during the 2<sup>nd</sup> Century BC.

The Lesvos island can be divided into four main physiographical provinces. The southern part is dominated by Olympus mountain, at a height of 967m. The Gulf of Kalloni is covered by Neogene and tertiary sediments. The central region begins from the west of Kalloni where chain of volcanic centres is located, extending to the north. The highest peak is Lepetymnos at 968m. In the west of Lesvos are irregular peaks at 600m and pyroclastic formation due to continuous erosion of pyroclastic rocks (Natural History Museum 2008).

## 5.2 Lesvos Island Geopark

“Petrified Forest protected area PD344/1985” was created in 1985 under the National natural monument of Greece (Zouros 2015). A project was created to safeguard and protect the Petrified Forest of Lesvos which resulted in development of lava pathways in 1998. The project focussed on connecting terrain, various sites of interest and the site of petrified trees through creation of pathways.

Although tourists visited the petrified trees in Lesvos during that period, they did not contribute to the local economy because they did not stay longer in Lesvos. The more number of days the tourists stay in a destination, the more money they spend and thus contribute to the local economy. Several activities were organized with the support of the local people in order to retain tourists in Lesvos. These activities include:

- Fencing the petrified forest area,
- Creating pathways & enabling accessibility of the site to the public,
- Developing new sites through excavation,
- Involving university to visit several archaeological sites,
- Creating observation posts,

- Placing panels at the entrance of the petrified forest,
- Creating several fossil parks in different locations (5 parks were developed). These five parks are fossil sites in Bali Alonia Petrified Forest Park, Sigri Petrified Forest Park, Plaka Petrified Forest Park, Nissiopi Islet Marine Park and Mythimna at Aghia Kyriaki.

Several petrified fossils appeared while excavating site for the construction of wind mill park in the adjacent area. Natural History Museum of Lesvos is the custodian of the petrified forest and preserves the fossil trees in its original place. The maps of Lesvos petrified forest and various sites of interest are provided in the Appendix. The structure of Lesvos Island Geopark is given in figure 11 in the next page.

### 5.3 Organization of the Lesvos Island Geopark

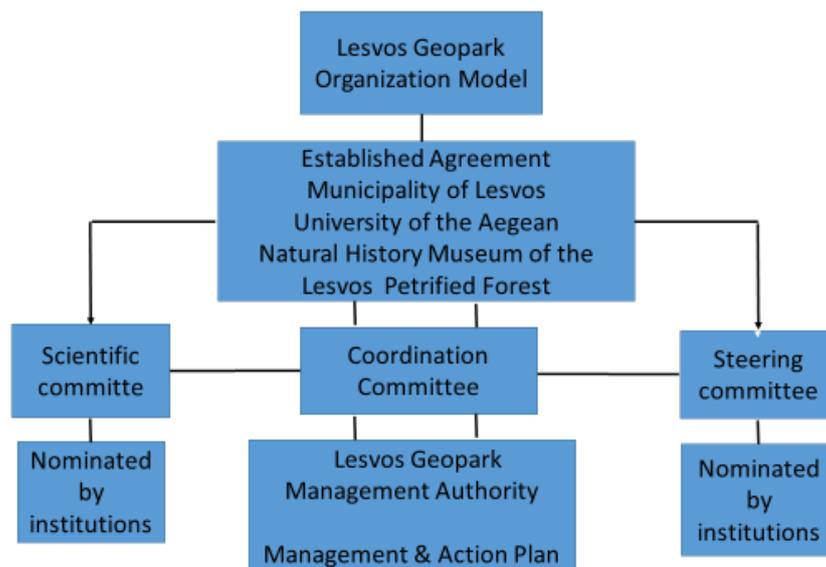


Figure 10: The Lesvos Geopark Organization (Zouros 2016a)

The Managing Authority of Lesvos Geopark consists of seven Board Members and include Ministry of Culture, Ministry of Environment, University of Athens, University of the Aegean, Municipality of Lesvos / Sigri Community, Two local society personalities with contribution to the Petrified Forest protection. The Lesvos geoparks organization is depicted in figure 10 above.

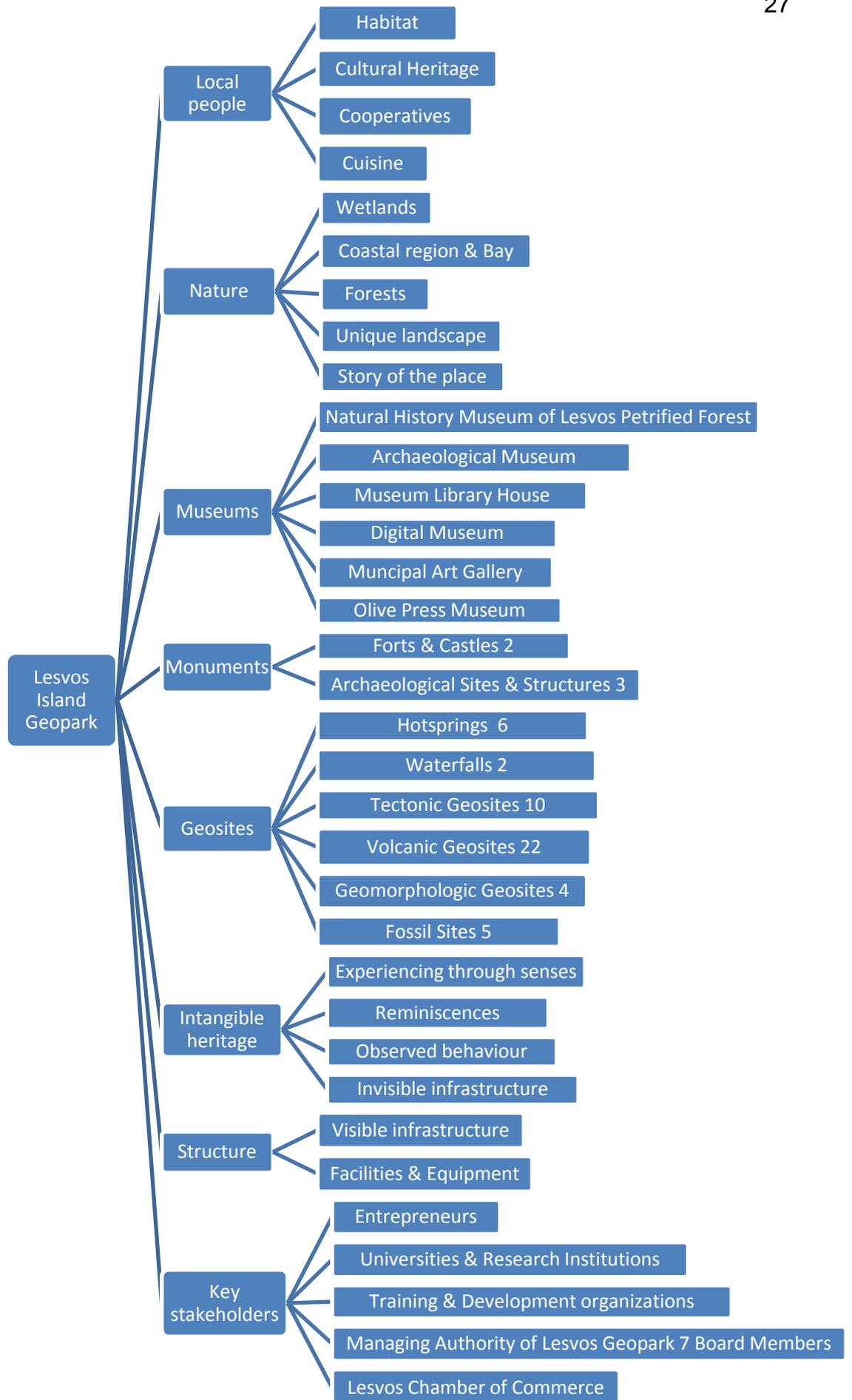


Figure 11: Structure of Lesvos Island Geopark



Figure 12: Petrified tree with root system (Tsalkitzi 2016)

#### 5.4 Petrified Forests of the Lesvos Island

Petrified Forests of the Lesvos are ecosystem of standing tree trunks petrified in its natural position due to volcanic eruption in the north eastern Aegean region during the lower miocene period, about 20 million years ago. The Petrified Forest of Lesvos occupies an area of 150,000,000 sqm. The Lesvos Petrified Forest reminds us of the geological events that had

taken place in the past. The fossilised tree trunks are preserved as it was in the original state of destruction, some of them with standing in the upright position with visible roots. The Petrified Forest of Lesvos is a 'Preserved Natural Monument' by a Presidential Decree 443/1985 (Natural History Museum 2006). The fossils and the excavation sites are protected by means of wooden fencing as well as shelters to prevent degradation.

The petrified forest was known to people during the early years. Theophrastus, the student of Aristotle and founder of Ecology, Biology and Mineralogy, had mentioned about the presence of fossils around the period 347BC. The fossil site was popular during the 18<sup>th</sup> Century. Ilias Valiakos, the Deputy Director of the Natural History Museum mentioned that the Austrian Ambassador of the Ottoman Empire visited this site in 1844 on his tour to Italy and took 45 boxes of petrified wood to Vienna. However, it was in 1994 that the Petrified Forest was awarded a legal status.

### 5.5 Formation of the Petrified Forest

During the Miocene period, which is 5.3 million to 23.8 million years ago, the Aegean region was a single landmass called Aegiis. There occurred a phenomenon where the Eurasian tectonic plate in the north collided with that of the African plate in the south thus pushing the African plate below the Eurasian plate. The subducted African plate melted when it was pushed about a few hundred kilometres below the ground level. The melted liquid was ejected outwards the ground surface creating volcanic eruptions. The intense volcanic eruptions resulted in large amounts of volcanic ash and materials from the earth's inner surface thrown into the atmosphere and covered the forests. This followed by heavy rainfall resulted in the flow of pyroclastic material that flowed from east to the west. These pyroclastic material covered the dense forests of the western region. The hydrothermal fluid rich in silica covered the trees and under

optimal conditions, resulted in petrification of the trees. With the passage of time, the organic carbon compounds in the trees were replaced by the inorganic hydrothermal fluid rich in silica and was preserved in the same way as it existed 20 million years ago (Natural History Museum 2008).



Figure 13: Petrified tree trunk in lying position (Tsalkitzi 2016)

#### 5.6 Species of Petrified Plants

The fossilized trees, roots, leaves, trunk were identified to be that of the family of Protopinaceae, which is an ancestor of the current day Sequoia

tree. These trees grow to a height of more than 100 meters and are found in the west coast of United States (Natural History Museum 2008).

The central Lesvos region is currently dominated by *Pinus brutia* forests, which are descendants of *Protopinaceae*. Based on the observation of the fossils, scientists believe that Aegean region had a mixed conifer forests with broad leaves and palms at the lower regions. This leads to the conclusion that the region had a subtropical climate, which changed into a continental climate.

The Petrified Forest was initially managed by the Forest authority which is bureaucratic in structure. The forest authority found it difficult to manage the Petrified Forest as there was difficulty in hiring seasonal staff. The Petrified Forest was later handed over to the Natural History Museum of the Lesvos. In order to prevent damage to the petrified trees due to winter, these trees were protected and covered with plastic bags. The Petrified Forest attracts 75,000 visitors annually, most of the visitors are during the summer months of July and August. During the recent years, there has been report of drop in number of Greek visitors whereas the visits by foreign tourists are steady.



Figure 14: Petrified tree trunks at the site (Tsalkitzi 2016)

There are four reasons for uniqueness of the Petrified Forest

- The Petrified Forest consists of standing petrified trees with root system were discovered in the same preserved condition as 20 million years ago
- Excavators discovered more than 50 different species of petrified trees
- All parts of the trees were petrified
- Skeletal remains of the largest and oldest animal (an elephant) that lived in the region was found beneath the petrified trees

### 5.7 Plaka Petrified Forest Park

The Plaka peninsula is located 500km south of Sigri, covered by petrified forests. The Plaka park has pyroclastic rocks formed due to intense volcanic eruptions during the Miocene period. The rocks in the Plaka peninsula is divided into three horizons: The upper horizon with rounded pyroclastic sediments with coarse grains. The thickness of this horizon is in the range of 6 to 8 metres. The middle horizon includes the mud flows rich in plant fossils at a depth of 1.5 to 2 meters. The lower horizon has a fine grained pyroclastic material which were transported to the area through air. The thickness of this horizon is 60 to 80cm (Natural History Museum 2008).

#### Eroded Volcanic Rocks

Along the shorelines of the western part of Plaka Park are found eroded honey comb structures of volcanic rocks, known as 'tafoni'. These are created when the salt water of the sea coast infiltrate into the small fractures and cavities of the rocks. During the dry climatic condition, the water evaporates leaving the crystalline salt in the pores resulting in the fracture and breaking up of rocks. Thus leaving an eroded honeycomb formation on the volcanic rocks (Natural History Museum 2008).



Figure 15: Eroded volcanic rocks (Tsalkitzi 2016)

#### Fossils Forest of the Plaka Park

The researchers at Natural History Museum of the Lesvos Petrified Forest suggested that the climate prevailed in the region during that time was subtropical climate, identified and mapped the fossils in the region. It was reported that there were 20 standing trunks in the western sector and 23 standing trunks in the eastern sector (Natural History Museum 2008). The researchers at the Natural History Museum also discovered 4 downed trunks in the western sector and 3 in the eastern sector and another fossilized tree trunk in the sea. In addition, large fragments of tree trunks: 3 in the western sector and 6 in the eastern sector were discovered. Fossils of leaves, twigs and pine needles along with fossil prints were also discovered in the area (Natural History Museum 2008). The Petrified Forest provides information on life and climatic conditions in the Aegean region in the geological past (Natural History Museum 2006).

### 5.8 The Sigri Petrified Forest Park

The Sigri Petrified Forest Park is located adjacent to the Natural History Museum in Sigri. The park contains impressive collection of fossilized plants with root system preserved in a full stage of development, in their original position. These petrified trees belong to the ancestors of pine family (*Pinoxylon paradoxum* and *Pinoxylon* spp.). The excavators have identified petrified trees with branches, seeds, leaves from conifer and angiosperm trees (Natural History Museum 2008).

Based on the mineral and grain size distribution, researchers found that the upper layer consists of large epiclastic rocks with chunks of lava are located in irregular shape with fine grained main mass. The middle layer consists of pyroclastic flow made up of fine grain volcanic material and the lower layer contains epiclastic layer of large rocky chunks of lava and finally the last layer of magma (Natural History Museum 2008).

### 5.9 Nissiopi Marine Petrified Forest Park

The Nissiopi Marine Petrified Forest Park is the first marine fossil park in Greece. The Nissiopi island, located towards the west of Sigri, is the nesting area for about 5000 to 6000 sea gulls that arrive during April, nest and fly away during the end of May each year. The island has reported 62 different species of birds, 100 different species of plants, 3 species of mammals and 3 species of reptiles. The Nissiopi island has 44 fossil sites of 20-million years old petrified trees. The excavators have discovered a giant sequoia tree of length 17.20 meters in this island.

According to the Barcelona convention, the Nissiopi island is a protected area under Natura 2000 network. The visitors can tour the Nissiopi islets on a special glass bottom motor boat to observe the sea bottom along the coastline (Natural History Museum of the Lesvos Petrified Forest 2013). The coastal region and sea beds of the Nissiopi islets uncover the ancient ecosystem, the formation of landscape, the geotectonic processes that led to the formation of the present day structure. The Nissiopi park has several petrified trees with the root system fossilized in a standing as well as

downed position. The petrified tree trunks, branches and twigs along with the volcanic material are also visible at the site.

According to the Natural History Museum, the Fossil Cove is the rich fossil site in the Nissiopi Park. Fossils are embedded in volcanic ash along the cliffs of fragments of fossilized trees are seen on the coastal areas of Nissiopi Park. It is evident that repeated volcanic eruptions of high intensity covered the forests with the pyroclastic material. On the eastern part of Nissiopi, one can observe closely the standing coniferous trees with large root system under the successive horizons of the pyroclastic rock. This suggests that the sudden engulfing of the trees by volcanic eruptions leading to fossilization of the forest. Faults were created all along the coastline when Nissiopi was separated from the main island (Natural History Museum of the Lesvos Petrified Forest 2013).



Figure 16: Petrified tree trunk at Nissiopi (Tsalkitzi 2016)

During the period 2013-2015, the Natural History Museum of the Lesvos initiated excavation of dozens of petrified tree trunks and reconstructed damaged and fragmented fossils strewn all around. In order to protect the petrified tree trunks from winter, the museum authorities erected a number

of protective covers. One of the prominent fossil is a 15-meter long pine tree trunk, cut into two by the north-south fault. The small trunk of this pine tree was shifted eastwards at a lower elevation (Natural History Museum of the Lesvos Petrified Forest 2013).



Figure 17: Standing petrified tree trunk (petrifiedforest.gr 2016)



Figure 18: Standing petrified tree trunk (lesvosmuseum.gr 2016)

#### 5.10 Natural History Museum of the Lesvos Petrified Forest

Natural History Museum of the Lesvos Petrified Forest, located in Sigri in the western part of Lesvos, was established in 1994 to study, research, exhibits collection of petrified trees. The museum houses fossils excavated in Lesvos and provides information on various geological processes that resulted in the creation of the Petrified Forests. The work on Natural History Museum of Lesvos was opened in September 2001. It integrates biodiversity, cultural diversity and geological diversity.

The Natural History Museum of the Lesvos Petrified Forests supervises the excavations of fossils, transports the excavated fossils for cleaning, conservation and studying them, and works in coordination with the Lesvos Forest Department. The largest fossilized tree trunk discovered is an ancestor of Sequoia tree and measures a height of 7.02 meters and perimeter of 8.58 meters (Museum of the Lesvos Petrified Forest 2006).

#### 5.11 Activities of the Natural History Museum

**Geotourism:** Geotourism is an activity focused on geological, cultural and natural heritage of a region with emphasis on sustainable development. The areas of interest with regard to geotourism are visiting places of interest, guided tours, observing nature, education and sharing of geological features of scientific, educational and cultural value. The historical and cultural monuments of the Byzantine and Ottoman period adds value to the geotourism activities.

**Research Activities:** The Natural History Museum of the Lesvos Petrified Forest undertakes research activities such as mapping, excavations, paleobotanical research, palaeontological research, recording and evaluation of volcanic geotopes, recording the flora and fauna. The research laboratory is equipped with ultrasound bath, curing oven, conductometer, stereoscopes, precision scales, microscopes, sediment sieves and tools required for research.

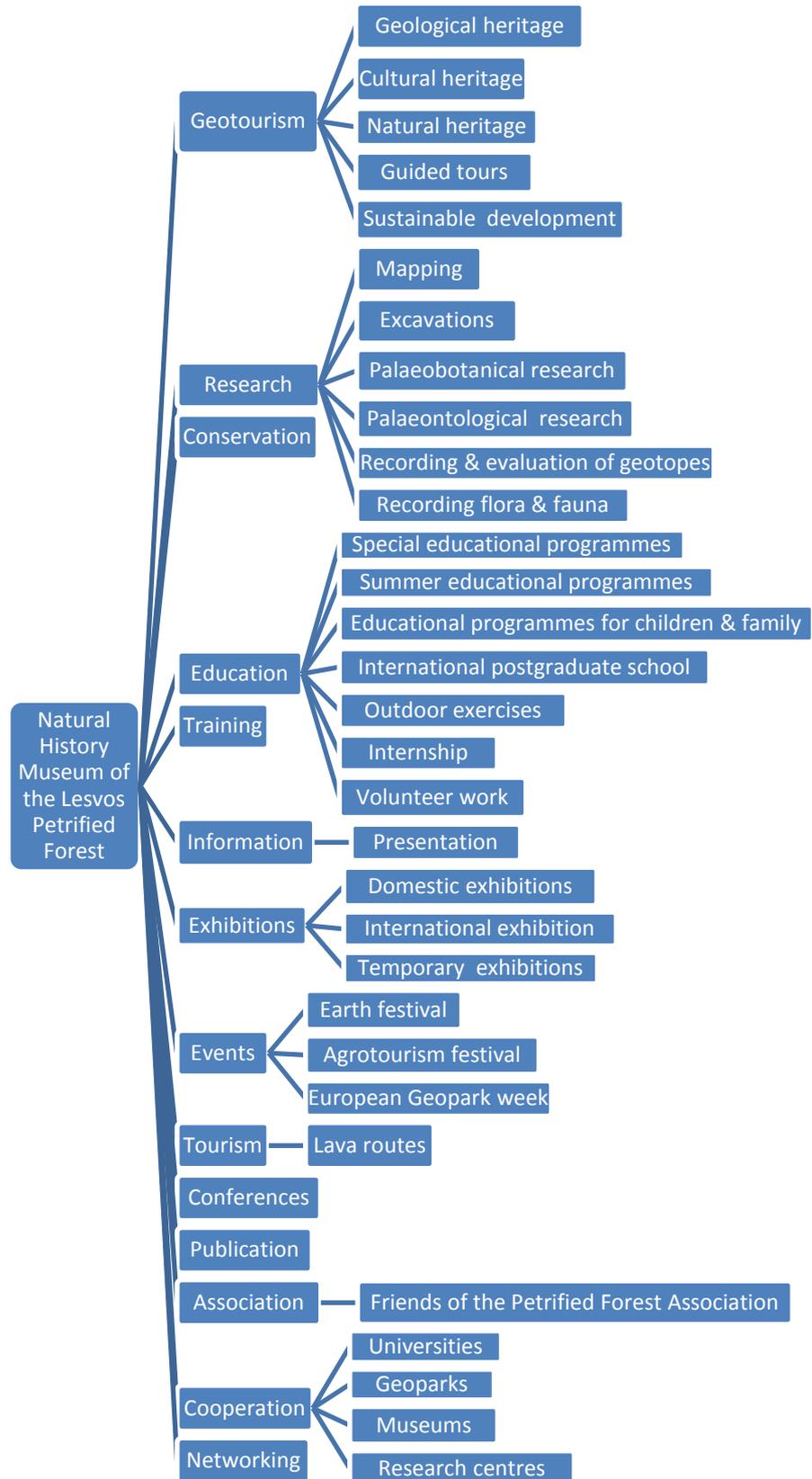


Figure 19: Structure of the Natural History Museum of the Lesvos Petrified Forest

Educational Activities: According to the UNESCO guidelines, a geopark must provide support, tools and activities to communicate geoscientific knowledge and environmental concepts to the public. A geopark permits and fosters scientific research and cooperation with universities, geoscientists and local people through museums, interpretive and educational centres, trails, guided tours, popular literature and maps using communication media. Dina Valiakos, who is in charge of the educational activity at the Natural History Museum of the Lesvos Petrified Forest said that special emphasis is targeted at children since children are future visitors to the museum since they come back on repeat visit after they are grown up.

According to Dina Valiakos, the educational programmes targeted at school children are as follows: 4 educational programmes for children aged 4 to 7 years; 8 educational programmes for children aged 8 to 12 years; and 10 educational programmes for children aged 13 to 18 years. The educational methodology is to understand concepts through tour of the Natural History Museum. Experiencing earthquake on a simulator, cleaning and conserving fossils and tour of open air petrified fossil park, etc., makes children realize the changes that had taken place on the planet helps people connect to the planet earth.

The Natural History Museum of the Lesvos undertakes educational activities for various age groups, scientific tours, training programmes, special education, summer education programmes, educational routes through the lava path, students' practicum, training of volunteers, etc. The Lesvos geopark organizes cultural activities, conveys information to visitors on Petrified Forest, volcanic activity and evolution of life.

Dina mentioned that summer education programmes of 3 to 4 days were organized by the Lesvos geopark in collaboration with schools, and include examining minerals of the sea shore using microscope. Special education programmes organized for those with issue of vision include that of examining fossils. Other programmes are "Young Palaeontologists Programme" wherein children were trained in excavation of fossils,

simulation of volcanic eruption to understand the effect of volcano and its consequences.

The “Special education programme” organized by the Lesvos geopark is “Asp Net UNESCO School”, which networks schools across countries through Asp Net. Three schools are connected to the Lesvos geopark in the network, which collaborates with universities for special education and courses. There are also seminars for teachers and unemployed people in the area of conservation management and forestry.

Other Activities: The Natural History Museum of the Lesvos Petrified Forest undertakes training of personnel in the area of protecting the monuments. It performs travelling exhibitions within Greece and in other countries exhibiting fossils of plants. The temporary exhibitions organized in Lesvos, other locations in Greece and abroad attracted more than 35,000 visitors to Lesvos geopark annually.

The events organized by the Natural History Museum of the Lesvos Petrified Forest include earth festival, agrotourism festival, European geopark week, conferences, publications, associations, cooperation with the Aegean University and the National Technical University of Athens. The Natural History Museum collaborates with the Aristotle University of Thessaloniki, the Natural History Museum of Crete, National Observatory of Athens, the Foundation of the Hellenic World and other institutions (Museum of the Lesvos Petrified Forest 2006). The seismological station located at the Natural History Museum of the Lesvos continuously monitors seismic activity in the region. The meteorological station located at the Sigri Park records meteorological data which are useful in predicting natural disaster. In order to attract and retain visitors, the Lesvos geopark innovates and creates interesting new programmes.

#### 5.12 Agrotourism Cooperative

The agrotourism cooperative was initiated in the Lesvos island in 1980 with 12 cooperatives owned by women. The agricultural society in collaboration with the Natural History Museum promotes home made

products at the museum. The women's cooperative produces catering and food specialities of the local region for events, conferences, marriages and naming ceremonies, etc. The women's cooperatives has a direct social influence resulting in women becoming producers of goods and services. Income through cooperatives helped women support their families and thus bringing equality in the rural areas. The idea of women's cooperatives were shared with the whole of Greece. Sustainable results were achieved through networking.

As stated by Dr Nickolas Zouros, there are more than 100 women's cooperatives from twelve villages of Lesvos island, some of them were successful and a few not so successful. It is important for the survival of these women's cooperatives since these cooperatives are connected to the Lesvos Island Geopark. There is a need for legal recognition of these societies. According to Ilias Valiakos, the main issue with the women's cooperatives are that these are located far apart, making travel difficult, and more so, an individual promotes one's cooperative independently. The permission is granted to promote Lesvos island as a whole geopark destination. Dr Nickolas Zouros added that the administrative unification of the Lesvos island under one municipality in 2012 strengthened the Lesvos Island Geopark.

### 5.13 Museum of Industrial Olive Production

The museum of industrial olive oil production is a community owned oil mill located in Aghia Pareskevi in Lesvos and complements the museum of olive and Greek olive oil in Sparta. The museum of industrial olive oil production is owned by the Cultural Foundation of Bank of Piraeus, and collaborates with the Natural History Museum of the Lesvos Petrified Forest. Mr. Dmitris, the staff at the museum said that the olive production begins during the month of November and ends in March/April during the winter months. It takes about 10 to 20 days to collect the olive seeds. The olive seeds are plucked every alternate year for production unless watering the olive trees on the mountains.



Figure 20: Layout of the Museum of industrial olive oil production (Piraeus Bank Cultural Foundation 2015)



Figure 21: Museum of industrial olive oil production (Piraeus Bank Cultural Foundation 2015)



Figure 22: Olive oil production process at the museum of industrial olive oil production (Piraeus Bank Cultural Foundation 2015)

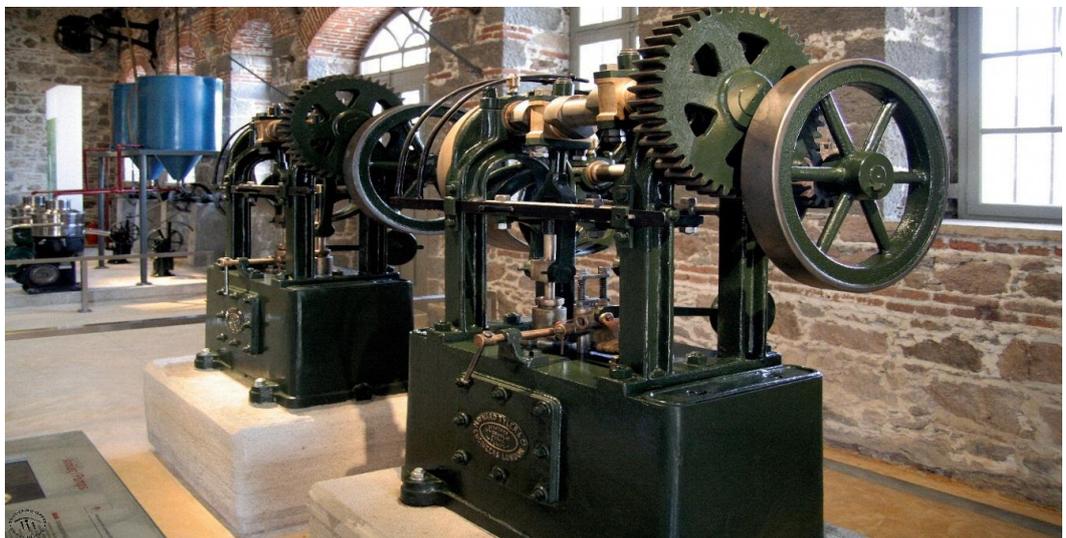


Figure 23: Flywheel used in olive oil production at the museum of industrial olive oil production (Piraeus Bank Cultural Foundation 2015)

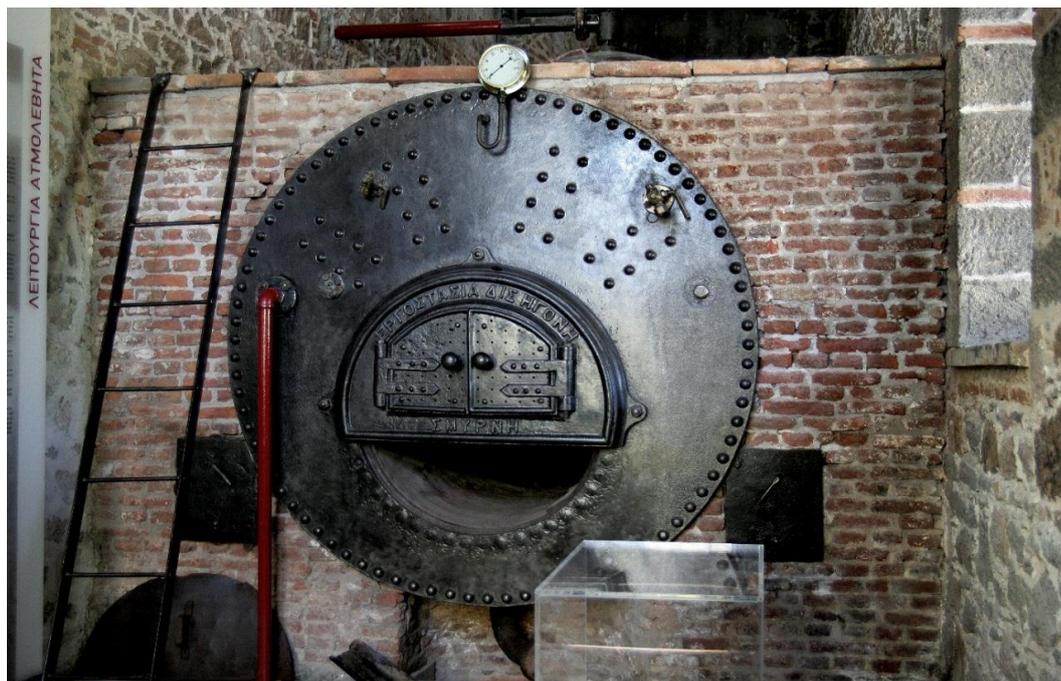


Figure 24: Olive oil production equipment at the museum of industrial olive production (Piraeus Bank Cultural Foundation 2015)



Figure 25: Packaging of olive oil displayed at the museum of industrial olive oil production (Piraeus Bank Cultural Foundation 2015)

The olive oil produced in the Lesvos island is through manual process using old methods since it was not possible to install machines on the hills. The olive trees require specific type of Mediterranean subtropical climate with mild winter and long warm dry summer. The small olive trees and branches are destroyed at -5° Celsius and freezing temperature of -10° degree Celsius destroys an olive tree.

The olive press contains machines that employ mechanical methods to extract olive oil from the olive seeds. The three basic steps in olive oil production are crushing the olives, pressing the olive pulp and separating the olive oil from water. The museum of industrial olive oil production is an industrial heritage and reflects the sociocultural heritage of the island (Piraeus Bank Group Cultural Foundation 2006).

#### 5.14 Fortress Methymna (Molyvos)

Molyvos (medieval name Methymna) was the second most important city of Lesvos since the ancient period. The castle of Molyvos was constructed at the summit of the hill during the Byzantine period. This castle overlooks the northern passage at the Adrammitynos Bay. The Methymna castle is built from the stones of an earlier castle captured by Achilles during the Trojan war, and is mentioned in the Iliad of Homer. The castle was captured by the Venetians during 1128, and later by Baldwin II of Flanders during 1202 to 1287.

The Molyvos castle went into the hands of Catalans during the late 13<sup>th</sup> century. The castle was fortified in the 15<sup>th</sup> century by the Gattelusi dynasty to protect the region from the Turkish invasion. The Ottoman empire repaired the castle during the 15<sup>th</sup> and 17<sup>th</sup> centuries and constructed new ramparts and extension of the northern and eastern side of the castle. The Molyvos castle is protected by ten towers in square and circular shape, placed on a high altitude. There are four bastions which are four-sided and three circular bastions (Monuments and Museums of Greece 2015).



Figure 26: Molyvos Castle (Lesvosgreece.gr 2016)



Figure 27: Molyvos Castle (Lesvosgreece.gr 2016)

### 5.15 Wetlands of Kalloni Bay

The wetlands of Kalloni are active industrial salt plains where migratory birds from Sahara flock and settle in the region to breed during the spring season. During the autumn season, the migratory birds from Europe flock in the region, although a fewer in number. It is interesting to observe birds from Asia and Europe in this region. Several birds such as flamingo, black wings, black stork, white stork, common turn and little turn are seen in this salt plane of Lesvos. The origin of flamingos is Turkey where they breed and across the hill. The gulls arrive here from Africa and return back after the breeding season. The bird watching guide Elena organized binoculars for birdwatching at Kalloni. It was in the Gulf of Kalloni that Aristotle spent about two years observing nature and animal behaviour and began the work of classification of living things. Theophrastus, the father of Botany was born in Eressos, in the Lesvos island.

### 5.16 Ancient City of Thermi

On the east coast of Lesvos lies the ancient city of Thermi that flourished during 3000 BC. According to historians, the city of Thermi was destroyed around the same period as Troy. The inhabitants who lived in Thermi during the early Bronze Age (2700 BC to 2500 BC) had similar cultural characteristics as the people who lived in the area during the late Bronze age (1500 BC to 1300 BC). This is evident from the tools and monuments excavated from the area. An example of intangible heritage reported from the area is that a person living in this area is able to reproduce clay pottery used in the ancient period, employing the same technique and style.

At the archaeological museum at Thermi, one could find the Lesvian type of architecture that existed during the 7<sup>th</sup> Century BC. The walls were made from ignimbrite. There are three styles of columns used in ancient Greece– Doric, Ionic and Corinthian. These are used in the architecture in ancient Greece. The fourth style of architecture found on the column of the temple in Thermi is the Aeolic style with two volutes rising from a shaft in

the opposite direction. The ancient people assembled once a year in Thermi to discuss and find solution to their issues.



Figure 28: Aeolic style of architecture (Robin 2015)

Other archaeological remains in the island of Lesbos are the remains of Roman aqueduct made from bricks and stone, and paleo-Christian churches built with ignimbrite stone. A temple constructed during the 6<sup>th</sup> century BC dedicated to Apollo Napaeos is located in Klopedi on the north west of Agia Paraskevi. The temple displays tall columnar structures depicting Aeolian capital. Other cultural monuments found in the Lesbos island are stone bridges of the Ottoman period, castles and monasteries in Kalloni.

### 5.17 Sappho

Sappho was a famous Greek lyric poet who lived around the period 630 and 612 BC in Lesbos. Lesbos was a cultural centre during the 7<sup>th</sup> Century BC. Sappho spent most of her time in Lesbos island and travelled throughout Greece. She was exiled to Sicily due to political activity in the family. It was here she was recognized by the resident of Syracuse for her work that they erected a statue of her (North 2007). Sappho was born in a wealthy family and composed lyrics in Aeolic Greek dialect. She was praised for her work by scholars and philosophers including Plato. According to the Ancient History Encyclopaedia, she invented a new style of poetry called “Sapphic Stanza” which consists of eleven beats and a concluding line of five (Mark 2014). Mytilene have also issued coins to

honour Sappho during the third century AD. Due to her personality, Sappho was able to lead a life as she pleased. The life style of Sappho reflect that women were respected in ancient Lesvos (Mark 2014).

#### 5.18 Mytilene Castle

The Mytilene castle was established in Mytilene during the reign of Justinian I in the 6<sup>th</sup> century BC. Francesco I Gattilusio rebuilt the Mytilene castle in 1373. According to Dina Valiakos, the Geologist of the Natural History Museum of Lesvos, the Mytilene castle is divided into three- the upper castle or the Acropolis, the middle castle and the lower castle. The stone used for construction of the castle is ignimbrite. Marble and lime stones were also used initially in the construction of the castle. New construction (lower castle) was undertaken during the period of Ottoman empire. The Mytilene castle has an underground shelter to protect and provide food and water to the people for three months.



Figure 29: Mytilene Castle (Tsalkitzi 2016)



Figure 30: Crypts of Mytilene Castle (Tsalkitzi 2016)

#### 5.19 Archaeological Museum of Mytilene

The new archaeological museum of Mytilene was built in 1995 exhibiting permanent artefacts of the Hellenic period 3<sup>rd</sup> Century BC and 4<sup>th</sup> Century BC. Dr Yannis Kourtzellis, the archaeologist explained the lifestyle of wealthy residents of Lesvos. Lesvos was a favourite location for the royal family. On the ground floor is the scale model of Menander house (the house where the Athenian comic writer Menander lived during the period of Alexander). In this room, one can find various abstract designs created during that period. The picture of Orpheus, the musician in Greek mythology, playing Lyon attracting animals is portrayed in the hall.

The second room is a dining room with mosaic floors with decorated walls. This probably could be the house of a wealthy citizen who lived during the period. The mosaic from Lesvos is popular in Greece. The other rooms exhibit marble sculptures of the Hellenistic and Roman period. One can also find the terracotta vessels of the first century BC with decorated pots and vessels.



Figure 31: Artefacts of ancient Lesvos (Tsalkitzi 2016)



Figure 32: Artefacts excavated at Lesvos (Tsalkitzi 2016)



Figure 33: Scale model of Menander House (Tsalkitzi 2016)

#### 5.20 Lesvos linked to Culture of Pergamon

The start of Hellenic period began after the death of Alexander in 323 BC and continued till 30 BC until the death of queen Kleopatra VII. Major changes had taken place in the early 3<sup>rd</sup> century BC. Three powerful kingdoms emerged in the Mediterranean region until the emergence of the Roman empire. These are the Ptolemies of Egypt, the Seleucids of Syria and the Antigonids of Macedonia (Sooke 2016).

Pergamon, situated in the western Turkey, was one of the important royal capitals of the Hellenic era. Pergamon is situated close to Mytilene and therefore, there is assumed to be cultural association between the cities of Mytilene and Pergamon. Archaeologist Dr Yannis mentioned that several artefacts of ancient Greek civilization were found in Pergamon such as lion made of marble, that protected the graves and cemeteries and Sphinx with the head of a woman and body of lion. Yannis also added that women

born in noble families in Lesvos were experts in riding horses, well educated, and were active members in the society (Kourtzellis 2016).

#### 5.21 Natural Heritage and Cultural Environment

Dr Yannis Kourtzellis presented an introduction to the city of Mytilene during the Hellenic and the Roman period, and provided detailed information on the mosaic floors of “House of Telephus” in Mytilene, dating to 1<sup>st</sup> and 2<sup>nd</sup> century AD. The mosaic with geometric pattern with paintings, was constructed to welcome prince Telephus, son of Herakles who arrived from Mysia, a kingdom on Asia Minor opposite Lesvos island.

Dr Yannis mentioned that there is no direct testimony of the Roman aqueducts in the ancient texts. However, the style of construction of the Roman aqueduct is that of the 1<sup>st</sup> century AD. The Roman aqueduct is made from grey limestone in monolithic columns were visible in the village of Moria. There were mention of aqueducts by Richard Pococke in 1773, Choiseul Gouffier in 1809, Wordsworth in 1853, Charles Newton in 1865 and Pouqueville in 1835. During the middle of the 19<sup>th</sup> century, natural calamities caused by earthquake has affected the structure of the aqueducts (Kourtzellis 2016).



Figure 34: Roman aqueducts of Moria in Lesvos (Lundqvist 2007)

The water bridge at rural area of Moria is the important of all Roman ducts with length 170 meters and height of more than 27 meters, made from bricks and cast stone masonry on the top. There are underground conduits that emerged at the surface of Roman marble quarry at Koutsuk Loutza or Kourzi Thermal springs. There were terminal stretches of aqueducts for collecting and distributing water. These were called Tekas. Dr Yannis added that he organized a special environment friendly route (green route) connecting the archaeological sites (Kourtzellis 2016).

## 5.22 Biodiversity and Landscape

Landscapes are a sense of sight and enriches beauty to the sceneries. Landscape include abiotic, biotic and human environment. Geoparks preserve and value landscape and biodiversity. Olive oil is the land scape of Lesvos Island Geopark. The olive supports social development in Lesvos. There are more than 9 or 10 million olive trees grown in Lesvos of which only 3.5 million trees are actively cultivated. The Lesvian soil makes the roots of the olive trees easy to penetrate. The younger generation of the inhabitants are not much interested in working in olive plantations, since hitting the olive trees to down the olive fruit takes long time and requires a hard labour.

In the current times, mechanical rotor is used to shake and fell the olive seeds. Although machines make bashing the olive trees easier, the terrain is harsh to deploy the machines. Thus the production of olive oil in Lesvos has declined by about 30% to 40%. The main reason for this decline could be due to lack of cooperation among the olive oil producing farmers, many of them disregard the cooperatives. The farmers are conservative by nature, therefore, there is a need for consistent communication and trust to motivate them. In order to create value of the olive oil produced and generate income for farmers, it is important to connect olive oil of Lesvos with tourism.

### 5.23 Connecting Olive Oil with Tourism

The tourists are the first customers and first contact point. The tourists are in happy mood and willing to spend money compared to the customers in the super markets. There is no fierce competition from other olive oil producers on targeting the tourist customers. Due to unique value proposition of the location, targeting tourist customers could create a win-win alliance between the cooperatives and the visitors. The only obstacle that comes in the way is the packing. Olive oil, in liquid state, would make it difficult for tourists to carry, thus causing transportation a bottle neck. Therefore, there is a need to work with regulators of the air transport.

### 5.24 Creating Differentiation and Value Through Olive

Olive oil produced in Lesvos can be differentiated through Geographic Indicators (GI). The Geographical Indicators are classified into Protected Designation of Origin (PDO) and Protected Geographic Indicators (PGI). There are around 1300 Geographic Indicators of which about 600 are Protected Designation of Origin and the remaining about 700 are Protected Geographic Indicators (Kizos 2016).

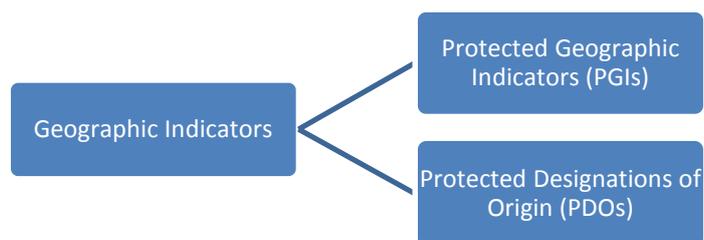


Figure 35: Classification of Geographic Indicators

In the case of Protected Designation of Origin, all the three activities of procurement, manufacturing and bottling (packaging) are done in the same location or region where as in the case of Protected Geographic Indicators, the procurement of raw materials and manufacturing process are done in the same location / region where as the packaging (bottling)

can be done in a different region. Geographic indicators are major tools for local development (Kizos 2016).

The methods of identifying the PGIs and PDOs are as follows:



Figure 36: Manufacturing Value Chain



Figure 37: Protected Geographic Indicator

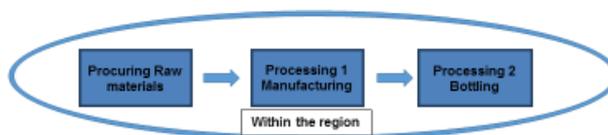


Figure 38: Protected Designation of Origin

## 5.25 Purpose of Geographic Indicators

- To protect the producers from competition
- To generate scarcity artificially through niche marketing
- Involve as many local producers as possible (the same product has to be registered by at least five different producers) in order to create a common asset of the region
- Cooperation and local value addition

There are about 100 PDOs and PGIs in Greece. Most of the products of Greece are PDOs (Kizos 2016).

The olive oil produced in Lesvos belongs to the Protected Geographic Indicators. The olive oil of Greece has one variety and is more yellowish than the olive oil found in the market. Moreover, the olive oil produced from Lesvos has a different taste compared to the olive oil found in the market. The virgin olive oil from Lesvos has an acidic pH of around 0 to 2. The extra virgin olive oil of Lesvos has a pH of 0 to 0.4 (Kizos 2016).

## 5.26 Positioning the Lesvian Olive Oil

The Lesvian olive oil may be positioned in the minds of customers, especially the geotourists, incorporating the unique features of Lesvos in the marketing plan. These are:

- Using landscape of Lesvos
- Using locality and tradition of Lesvos in producing olive oil
- Using Lesvos geopark as an environment friendly produce, and
- Connecting local people and networking

In order to position olive oil of Lesvos, it is important to consider the viewpoints of key stakeholders (local stake holders, tourists and customers) about the olive oil produced in Lesvos and the landscape of Lesvos island.

## 5.27 Signage, Publicity & Digital Promotion

Ilias Valiakos of the Natural History Museum of Lesvos provided detailed information regarding the communication media used in promoting Lesvos Island Geopark and demonstrated several sites for erecting panels, creating visible promotion of the Lesvos geopark. Ilias Valiakos emphasised that the main aim is to improve visibility and build infrastructure of the Lesvos Island UNESCO Global Geopark.

The four areas of the communication project are

- Placing the panels
- Documenting digitalization of all information with photographs
- Hoisting websites (Valiakos 2016)

Signage Panels: Valiakos (2016) informed that the project for visibility of UNESCO Global Geopark of Lesvos took 18 months to complete, beginning July 2014 and ending December 2015. Valiakos (2016) classified the signage panels into 5 types – Type A, Type B, Type C, Type D and Type E. Type D was well accepted and had good visibility from a far

distance. The organizers chose several types of panels depending on the requirements. There were 18 signage panels and 91 geosite panels developed.

The petrified forest has no vegetation; therefore, panels cannot be placed on the petrified trees. Wooden posts with serial numbering are created for each petrified tree. The geopark guide could explain to the visitors about the characteristics based on the numbering done. The Type E panel was narrow with ability to paste written material on both side of the panel, although not much visible, did not disturb the environment. Type E type was a camouflage panel with an intention to reduce visibility and align with natural landscape.

Each of these panels were inscribed with two QR codes. One QR code for Natural History Museum of Lesvos and the other QR code for the Lesvos Geopark. These QR codes were accessed through smart phones. The Lesvos geopark authorities negotiated with mobile service providers for a lower price for accessing Lesvos geopark and Lesvos museum on internet mobile service through wifi. It is expected that the mobile service will be offering free wifi network in a year or two (Valiakos 2016).

**Additional Panels:** There are specifications for placing panels at public locations, airports, town centres and roads. The roads belong to the Regional government and permission was required for this purpose. Ilias Valiakos explained that there were no hurdles in obtaining permission to erect the panels but erecting panels in the town was complicated since permission from the antiquity department was required. According to Greek legislation, in order to excavate or dig a place more than 30cm, permission from an archaeologist was required. To avoid this problem, panels were fixed to the floor by means of metal connector and screws. As a result, it was not necessity for an intervention by an archaeologist, an approval from municipality was adequate.

The panels were placed in strategic locations to enhance visibility and awareness. Precautions were also undertaken to prevent damage to the

panels by unauthorized persons. Valiakos (2016) ensured that the panels were coated with special material to prevent scratches and are tamper proof. To be specific, the panels were write-protected. This means that any writing on the panel by unauthorised persons could easily be erased.

#### 5.28 Promotional Inputs

Several marketing promotions were organized in a phased manner. Establishing credibility through visibility and communicating the value proposition of Lesvos Island UNESCO Global Geopark to the target audience, mainly the geotourists were kept in mind while designing a promotional programme. Valiakos (2016) explained that the main efforts were directed at the following activities:

**Generating Scientific Publications:** Several scientific publications were generated based on the geological history and natural history of the region. Publications on geodiversity, geological history, such as: volcanic activity about 20 million years ago leading to creation of petrified forest, ancient history of the place, nature tourism, landscape, culture were generated to form an opinion on the importance of the place.

**Location Identification & Tracking:** Geographers worked in teams for 1 year to plot the latitude and longitude of various geological sites, historical sites and locations of importance in order to accurately map the Lesvos region using Geographical Positioning System (GPS). The sites were accurately measured using highly accurate differential GPS (with accuracy of centimetres) from the Natural History Museum of Lesvos Geopark, and could be easily accessed by a person using a smartphone with installed GPS.

**Maps of Geosites:** Two sided folded maps of Lesvos geopark featuring geotouristic destinations were printed in English and Greek and presented to visitors. In all, 20,000 copies of maps were printed with picture of Lesvos map on one side and information on geosites of interest were summarised. The geosites included 5 existing fossil sites of petrified forest and new fossil sites, 23 volcanic sites, 4 geomorphological sites and 10

tectonic structures. Valiakos (2016) added that this activity took about a year to complete.

**Information Leaflets:** Information leaflets containing description of activities of Lesvos Geopark, information on habitats and cultural heritage with depiction of fossil sites, volcanic geosites, geomorphological geosites, tectonic stratigraphic geosites, waterfalls, hot springs, creation of petrified forests, history of the place, culture were published in five different languages- English, Greek, German, Turkish and Dutch and presented to visitors. Valiakos (2016) mentioned that 50,000 copies of information leaflets were printed as a part of the promotional programme.

**Field Guides:** Field guides on each and every geosite were published depicting information on the location and areas of special interest to the visitors. Field guide also contained a field map with details of latitude and longitude of the place of interest. Information on routes and connecting points linked to the area are also provided in the field guide. Information on opening and closing timing of the park and museum with tele-fax numbers, email id and websites were also provided. Valiakos (2016) informed that 8,000 copies of field guides were printed in English and Greek languages.

**Magazine on Lesvos Geopark:** A 32-page magazine on Lesvos island containing information on Lesvos island featuring Lesvos geopark has been printed in English and Greek, 5,000 copies in each language.

**Hard Cover Book on Lesvos Geopark:** Coffee table book of 180 pages with 150 photographs of Lesvos Geopark, with hard cover, were printed using a special photo paper. The photobook contained photos taken by a famous landscape photographer of Greece. 2000 copies of photobooks were printed (Valiakos 2016).

**Websites:** The three websites hoisted are:

[www.lesvosmuseum.gr](http://www.lesvosmuseum.gr), [www.petrifiedforest.gr](http://www.petrifiedforest.gr) and [www.lesvosgeopark.gr](http://www.lesvosgeopark.gr)

Four tabs were provided at the bottom of the websites, representing timeline, virtual tour, map navigation and educational support.

The photographs published in the websites were of high quality of 30 Megapixels. A visitor to the website could navigate deep inside the photos. The photographs were placed sequentially, in the same way as the real landscape so that a visitor could experience virtual reality on browsing through the photographs. All geosites were enabled with map navigation. The photographs were taken by a team of photographers using 360 photographs (photosphere). Valiakos (2016) added that “beautiful pictures create great feelings”.

A glimpse through the promotional inputs reminds us the time and efforts invested towards creating a memorable impression through photography. “One picture equals one thousand words”. Therefore, it is all the more important to depict the images in the right spirit to kindle imagination. An innovative approach undertaken by the Natural History Museum of the Lesvos Geopark is the use of drone in capturing video images of the petrified forest using high resolution camera. The video images captured by the drone provided different views of the landscape and was impressive. Valiakos (2016) mentioned that it was difficult to capture the underwater images of marine petrified forest using drone.

Valiakos (2016) highlighted that public money was involved in the project and the geopark organization invited tender from advertising agencies and interested parties through an “open call”. In the bidding process, six companies came forward and four companies (advertising agencies) met the requirements. Of the four companies, the “most appropriate” bidder (not the lowest bidder) was selected (Valiakos 2016).

## 6 SYSTEMS THINKING ON GEOPARK

### 6.1 Geopark and Geopark Systems

This chapter focuses on applying systems engineering principles to the Geopark, enabling a robust process and systems for geoparks. Systems engineering is defined as “an interdisciplinary approach to translating users’ needs into the definition of a system, its architecture and design through an iterative process that results in an effective operational system. Systems engineering covers the life cycle of a system from the concept development to final disposal” (Mitre 2014). “Systems Thinking is concerned with understanding or intervening in problem situations, based on principles and concepts of the system paradigm. Systems Thinking considers the similarities between systems from different domains in terms of a set of common systems concept” (SEBoK 2016).

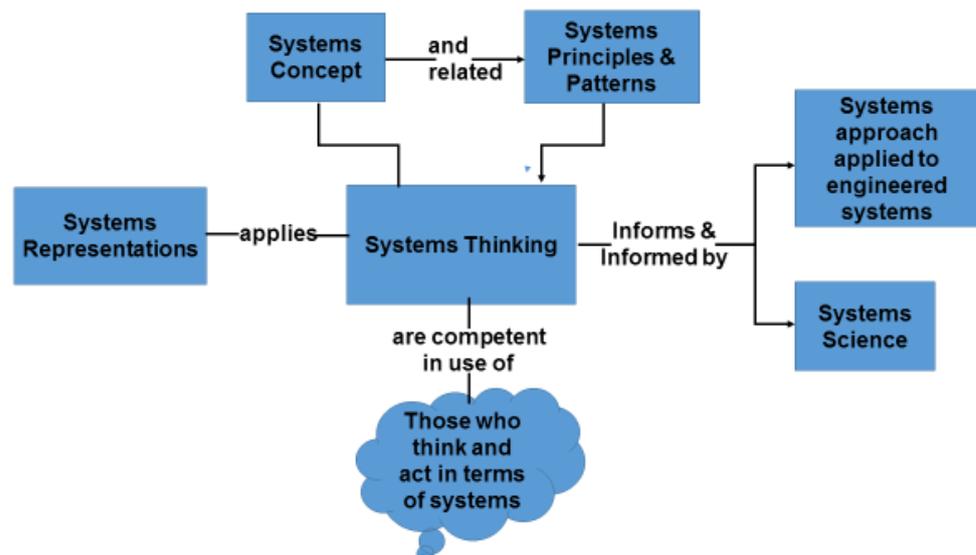


Figure 39: Systems Thinking (SEBoK 2016)

### 6.2 Systems Engineering International Standards

According to ISO/IEC15288, the system engineering standards include various life cycles and processes. The processes are “technical, project, agreement and enterprise” (ISO/IEC15288). The life cycle stages are “concept, development, production, utilization, support and retirement” (ISO/IEC15288).

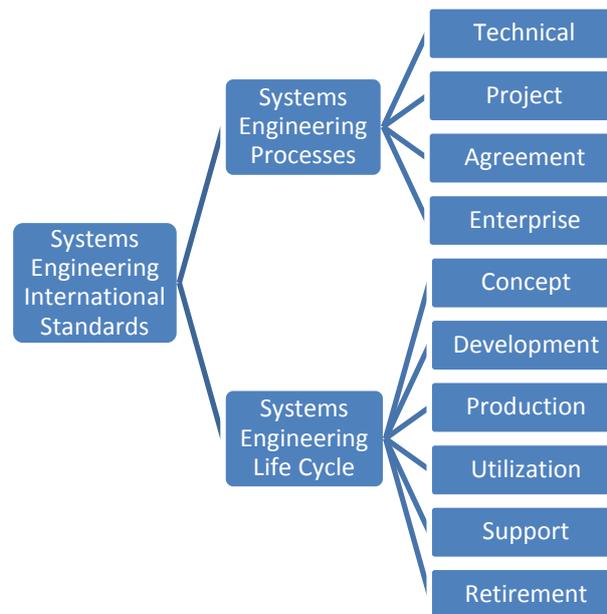


Figure 40: ISO/IEC15288 Systems Engineering Standards

In the systems engineering life cycle of Geoparks, the life cycle stages slightly vary from the ISO/IEC15288 standards. The production could be termed as excavation in the case of a geosite or archaeological site or site of geological /historical importance. Utilization refers to efficient use of resources- biotic, abiotic and people for sustainable development. Support refers to all the requirements necessary to maintain the functioning of the geopark and help its progress. Retirement refers to the end of life cycle of a geopark when the geopark reaches a declining phase in its life cycle.

### 6.3 Vee-Model of Geopark Systems Engineering

The Vee model is a graphical representation of the systems engineering life cycle. The left side of the Vee-diagram depict partitioning of the subsystems of a geopark. The concept development and requirements of geoparks are listed into physical entities and functions. The individual components of the geopark can further be architected, designed and developed to for subsystems of geopark. On the right side of the Vee-diagram, the subsystems are integrated, tested and evaluated through a process of verification and validation to operate as global geoparks.

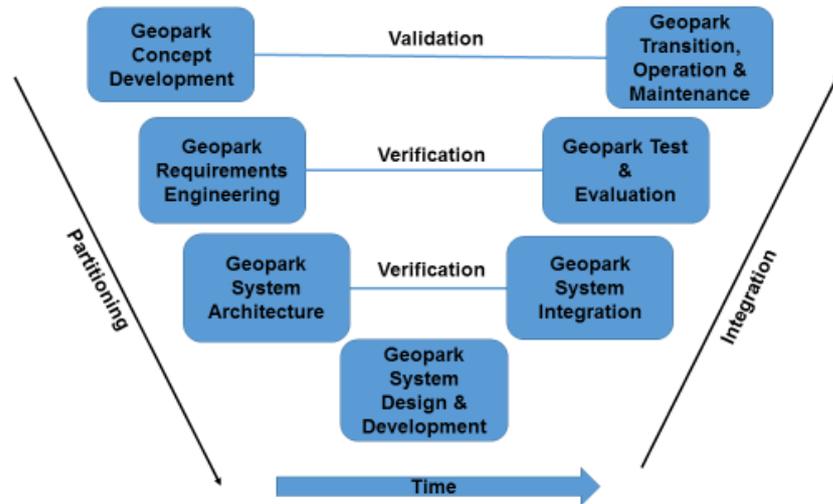


Figure 41: Vee-Model of Geopark Systems Engineering Life Cycle (Modified from Mitre Systems Engineering Guide 2014)

#### 6.4 Geopark System and Stakeholders

Applying systems engineering methodology to the geopark concept, given below is the onion diagram of geopark system. The geopark system consists of hard and soft system at the core with system operators-geoscientist and a geopark project manager.

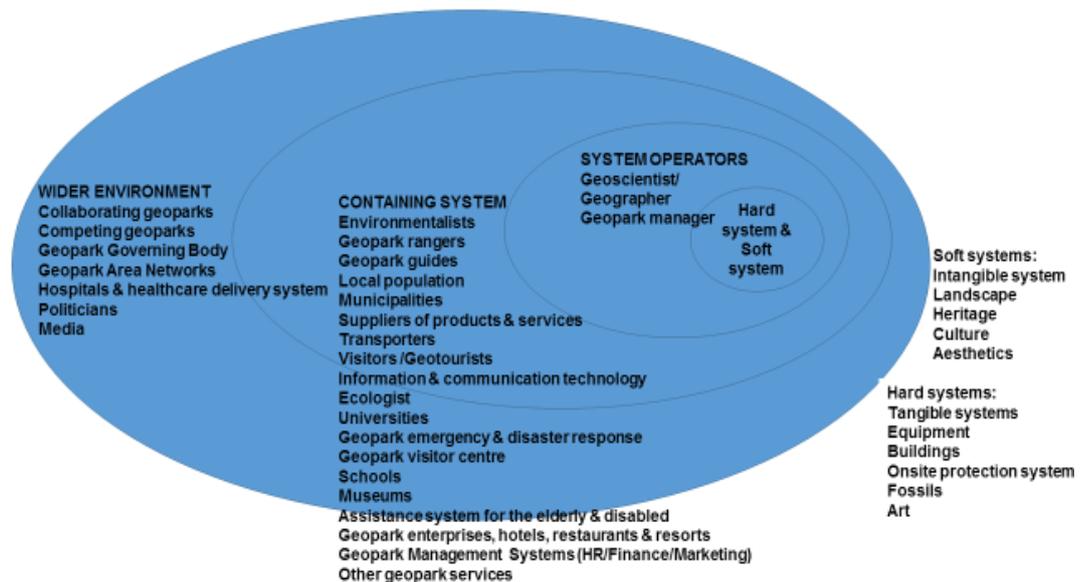


Figure 42: Onion diagram of Geopark System & Stakeholders (Modified UCL CSE 2012)

The containing system include all the subsystems and people that are involved in the operation of a geopark. The wider environment refers to all the systems and people that are not directly involved in the operation of the system but their decision may have some effect on the functioning of the system.

## 6.5 Enterprise Systems Engineering

An enterprise systems engineering refers to a network of people, process and technology that support each other to achieve a defined goal.

Geopark is an example of an enterprise system where a set of vision, mission, objectives and key result areas are achieved at various stages in the system, sub-system or geopark enterprise system. According to Mitre Systems Engineering Guide (2014), an enterprise system refers to an organization that focus on interdependence on individual systems and systems of systems, and include large network of information enabled organizations integrated together to achieve a goal.

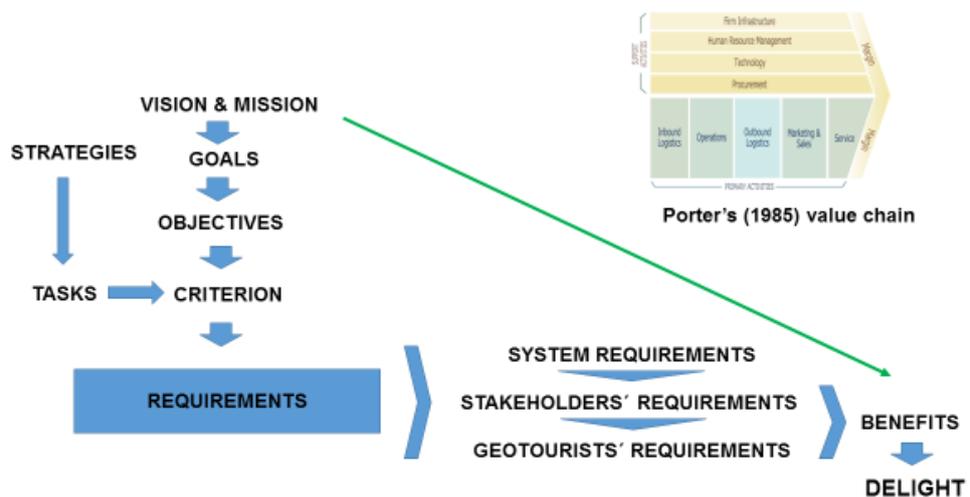


Figure 43: Integrating Management and Systems Engineering along the Porter's (1985) value chain for user (geotourist) delight

For an efficient and effective functioning of an organization, it is necessary that the vision and mission are translated into goals; which are further broken down to objectives and subdivided into criterion / criteria. The

criteria are translated to requirements, which deliver benefits and satisfaction to the customer or the end user. This activity is carried out by all members or subsystems in the organization network as depicted in the Porter's value chain. In the case of Geoparks, the Porter's (1985) value chain may be modified translating the margins into economic, environment, social, scientific, sustainable, intangible and heritage benefits. The primary and secondary activities of the Porter's (1985) value chain depict the primary and secondary activities of a geopark organization.

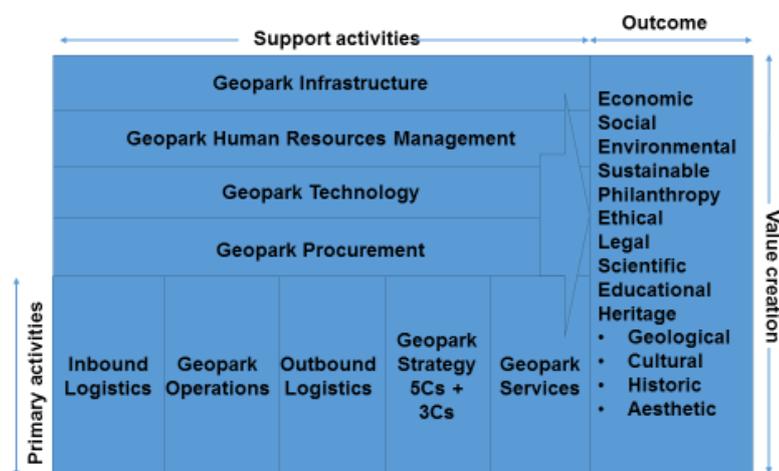


Figure 44: Geopark Value Chain Network (Modified from Porter 1985)

## 6.6 Requirements Process

“Requirements is a statement that identifies capability or function needed by a system in order to satisfy a customer need” (Sage & Rouse 2009).

“A requirement is a statement that identifies a product or processes operational, functional, or design characteristic or constraint, which is unambiguous, testable, or measurable and necessary for product or process acceptability (ISO/IEC 2007).

Requirements process requires “a consistent and iterative approach of system thinking, resolution of its consequences and conflicts, a clear definition of a system architect with well-defined system boundaries, interfaces, interactions, emergent properties and resolution of conflicts

arising through trade-offs or negotiation. Requirements use modelling and all means in order to understand stakeholders' needs and relevant technology so that a complete understanding of the system is achieved. Requirements help individual and team effort, using creativity to offer an efficient and effective solution in a complex environment" (UCL CSE 2012)

"Requirements are captured through structured interviews, questionnaires, structured meetings, scenarios (operational, maintenance and training), prototyping and modelling" (UCL CSE 2012). "A good requirement should explain what it is and not how it is. It should be unique, documented, atomic, with target identified, approved, traceable, complete, unambiguous, verifiable, with stated units, identifies application states, states assumptions. Requirement is stated as a shall, should, and will. A requirement statement avoids words: optimize, maximize, minimize, always, never, simultaneous. Requirement statements are written at an appropriate level of detail and contains the date of approval. A requirement statement is rationale, consistent, mindful of the media and allows parametrisation" (Sage & Rouse 2009).

## 6.7 Types of Geopark Requirements

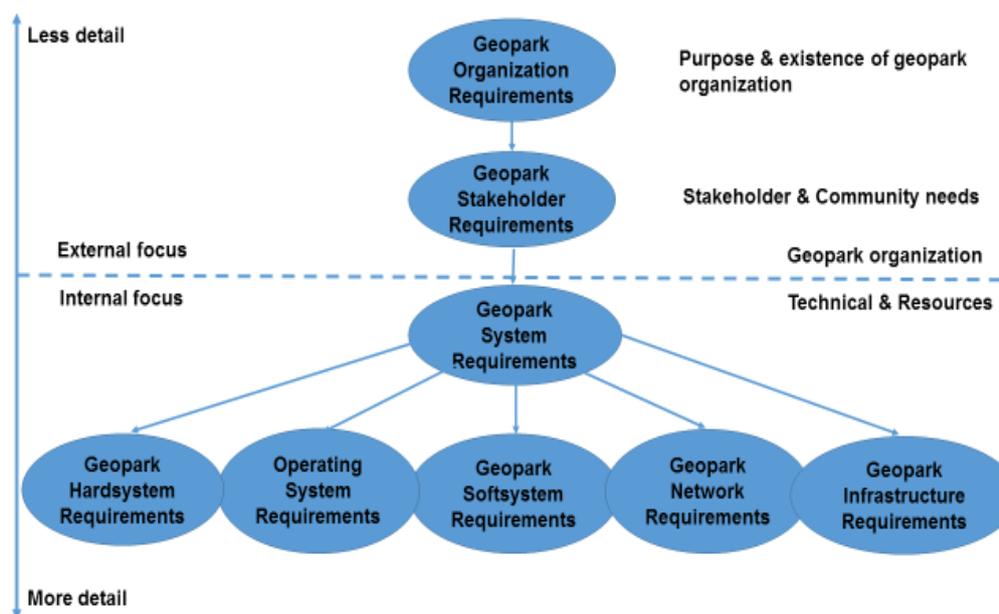


Figure 45: Requirements in a Geopark System (Modified from UCL CSE 2012)

## 6.8 Requirements Capturing

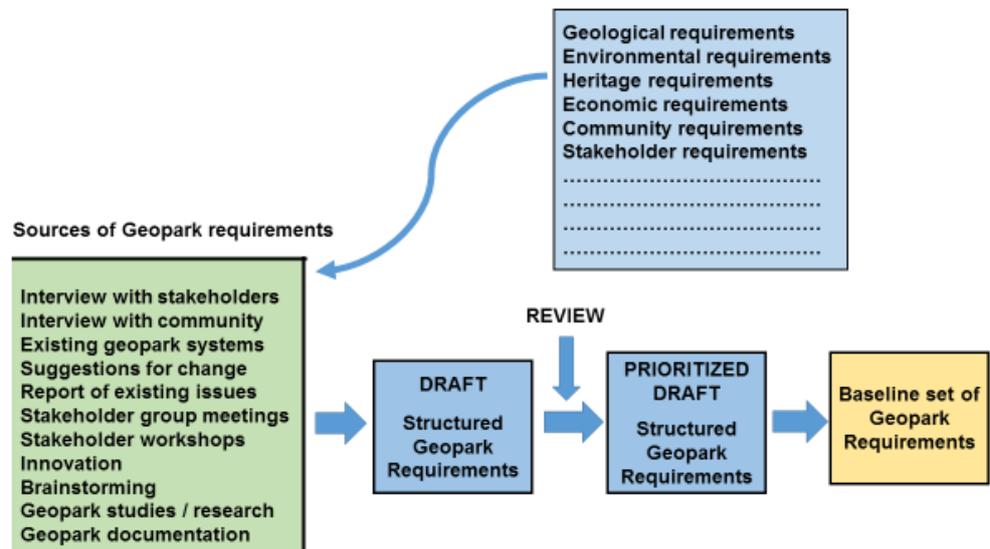


Figure 46: Capturing Geopark requirements (Stevens et al. 1998)

Requirements capturing is a process of collecting the needs of the territory/ local population / geotourists or visitors of geopark to understand and solve a given problem. However good the design may be, the foundation of any project depends on gathering the right requirements. The requirements can be captured from various sources linked to the system and system stakeholders. The main sources of geopark requirements are the stakeholders. The requirements may be captured through various methods such as: conducting interviews with geotourists or visitors, analyzing competitors' activities and evaluating performance, appraisal of the existing systems, interviewing local community, policy and procedure manuals. Policy and procedure manuals help identify the systems interaction, regulatory constraints. Observing geotourists (visitors / users of the system) and understanding how their ideas enable the system in identifying the system requirements. The sources of requirements are shown in figure 46 above.

## 6.9 Geopark Stakeholders' Requirements

Requirements engineering is one of the most important part of systems engineering dealing with identifying and eliciting the needs of the system

stakeholders or local population / heritage site / development needs and translating them to statement of geopark systems requirements.



Figure 47: Geopark Systems Requirements (Modified from UCL CSE 2012)

The statement of requirements obtained from the stakeholders or geotourists / local community is integrated with geopark development strategies. In the method of acceptance, there is a trade-off between the needs and the strategy. “The method of acceptance is carried out through a process of verification by an analysis, demonstration, inspection, test, simulation and judgement” (UCL CSE 2012).

## 6.10 Scenarios

“Scenarios are used to illustrate and understand a wide range of situations in which a system is expected to perform, to understand the anticipated use of a system, understand the intended operational environment or interfacing system, platform or products. Scenarios are used to define the concept document” (UCL CSE 2012). In the geopark systems, scenarios are important in understanding the behaviour of earth, climate changes, and hazards caused by earth such as volcanoes, earth quakes, tsunamis, flooding, draught and other natural calamities.

## 6.11 Geopark Value Pyramid

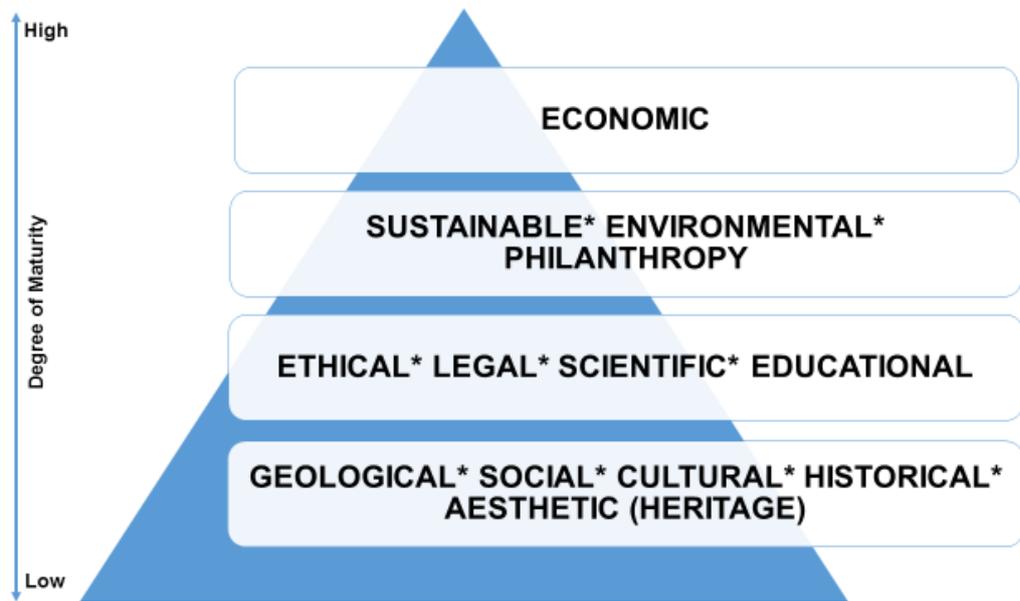


Figure 48: Geopark Value Pyramid (Modified from Carroll's (1991, 1999) Pyramid of CSR)

A geopark may be classified into several levels or hierarchies depending on the state of development. The basic values of a geopark are the heritage values which are classified as geological values, social values, cultural values, historic values and aesthetic or intangible values. This is the foundation on which a geopark exists. All aspiring geoparks must satisfy these fundamental values.

The second higher levels of values are ethical, legal, scientific and educational values aimed at contributing to the development of the society. The third level of value system is to contribute to sustainability on all the activities, inculcating environmental friendly processes in its operations such as recycling and reuse; and to contribute generously to the needy persons in the society through philanthropy. Once these aspirations are achieved, a geopark aims to generate economic prosperity by developing and deploying resources efficiently contributing to the economy of the nation.

This is similar to Carroll's (1991, 1999) pyramid of CSR where the corporations are classified based on the economic responsibility (to create

wealth or to be profitable), to abide by the law (legal responsibility), to do what is just, right and fair and do no harm (ethical responsibility) and to contribute resources to the society and enhance the quality of life of the citizens (philanthropic responsibility; Carroll 1991, 1999).



Figure 49: Pyramid of Corporate Social Responsibility (Carroll 1991, 1999)

## 6.12 Geotourists

A geopark visitor, also called a geotourist, is the next person in the geopark supply chain who uses the services of geopark for a fee, and in return gains benefit out of it or carries a lasting impression with a feeling of increased knowledge about the earth and its heritage, a sense of satisfaction or excitement. A visitor contributes to the value of geopark through payment of a service fee which is used for the development of geopark. It is, therefore, necessary to track geotourists and follow up with them in order to understand their needs and identify the purpose for using the geopark facility and services. Geotourism is defined as “a tourism that sustains and enhances the identity of a territory, taking into consideration its geology, environment, culture, aesthetics, heritage and the well-beings of its residents” (Arouca Declaration. 2011).

### 6.13 Geotourist Classification

Planning and implementing strategies to increase footfall (visits) of geotourists, maintain and repeat visits are an important area of geopark operations. The strategies create value for a geopark. Like customers for a business organization, geotourists are the pillars on which a geopark stands. The geotourists may be classified into several categories depending on the frequency of visits and duration of stay at a geopark.

There are five categories of geotourists based on frequency and regularity of visits. The first category are predominant visitors- the geotourists who visit a particular geopark on a regular basis and are brand or service loyal to a particular geopark. These visitors cherish the value offered by the geopark. The geopark management has to adopt innovative strategies to retain these predominant visitors (geotourists) so as to continue their visits on a regular basis with repeated intervals, thus help in geopark revenue generation. These visitors should be motivated, treated as special and continue with specific programmes of interest targeted at them.

The second category of geotourists are mixed visitors, those geotourists who are not particularly brand loyal to any particular geopark, but visits all geoparks equally. These geotourists are to be identified by the geopark management and special promotional campaigns that are of interest to them are to be developed in order to increase their frequency of visits.

The third category of geotourists are casual visitors, those infrequent visitors to a geopark and these visitors have no specific purpose for visiting a geopark, their visits are casual and are called casual geotourists or casual visitors.

The fourth category of geotourists are non-visitors, as the classification suggests, these visitors could be first time visitors or they have not visited a geopark because they may not be aware of its existence or services. The geopark management has to focus on creating awareness among these non-visitors so that their first visit becomes interesting and fruitful.

The geopark management is responsible for creating interest among these class of geotourists through promotional strategies.

The fifth category of geotourists are lost visitors, those who were visitors earlier but lost to another geopark or stopped visiting a particular geopark due to some reason or the other. The reason for stopping the visit could be dissatisfaction with a product or process or a service. It is the responsibility of the geopark management to identify the reasons for stopping the visit and analyze the cause of dissatisfaction among these lost visitors. The geotourist categorization is represented in figure 50 below.

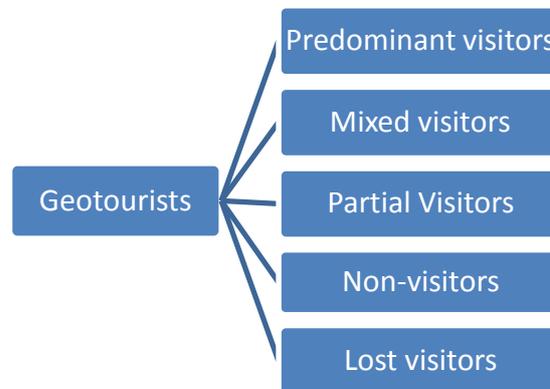


Figure 50: Categorization of geotourists based on frequency of visits

The geotourists may also be categorized according to the size or infrastructure. These could be individual geotourists, group geotourists (small and large) and institutional geotourists as shown in figure 51.

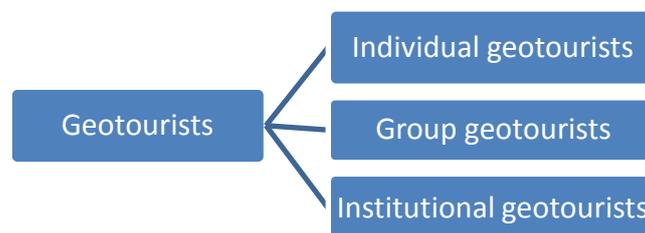


Figure 51: Categorization of geotourists based on the size

The geotourists may also be categorized based on the location of domicile or region, such as: local visitors, regional visitors, national visitors and foreign visitors, as shown in figure 52.

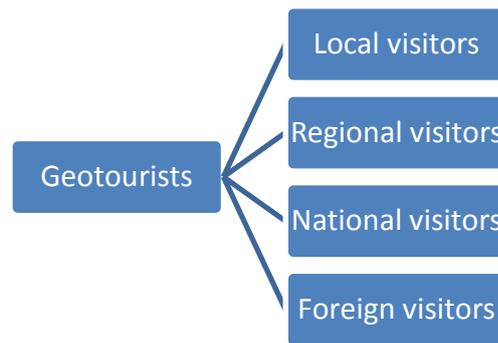


Figure 52: Categorization of geotourists based on origin

However, it is suggested that in order to develop long term relationship with the geotourists, a geopark must develop a “Geotourist Target Plan” report. This report helps understand the types of geotourists visiting the geopark.

The researcher also suggests that a geopark must initiate a separate “Target List”, also called “Geotourist Master List” aimed at various categories of geotourists- individuals and groups of geotourists, geotourist agents and institutional geotourists, for targeting. Thus three different types of “Geotourist Master Lists” may be generated with code numbers assigned to each of the geotourists and geotourist agents mentioned herein. These codes could be linked to a Customer Relationship Management software. This method could be useful and effective in planning promotional inputs and programmes for geotourists. These code numbers could further be integrated to RFID chip and connected to geotourist for efficient tracking and promotions.

#### 6.14 Geotourist Engagement Strategies

Geotourist engagement strategies are strategies developed to attract and retain geotourists/geopark visitors, and to offer them a sense of feeling, well being, belonging and value. Geopark strategy could be planned both at the strategic and operational levels. In preparing a geotourist engagement strategy, there are two key elements involved. One element is the identifying the position of a geopark, its product or service in the mind space of a geotourist; and the other element is the operational effort to transform a lost geotourist (geopark visitor) or non-visitor along the path

of casual (partial) visitor-mixed visitor to predominant visitor. The researcher terms this effort as the transformational effort.

The Geotourist Engagement Model may be explained as follows:

The researcher ranks the geopark visitors on a 5-point scale, also called “Scale of Engagement” as follows:

Predominant visitor +5, Mixed visitor +3, Casual visitor +1, Non-visitor 0 and Lost visitor -1.

The geopark organization may form two groups of task forces- strategic task force focussed largely towards the “predominant visitor” side and an operational task force focussed largely towards the “lost visitor” side on the “Scale of Engagement”. This is shown in figure 53 below.

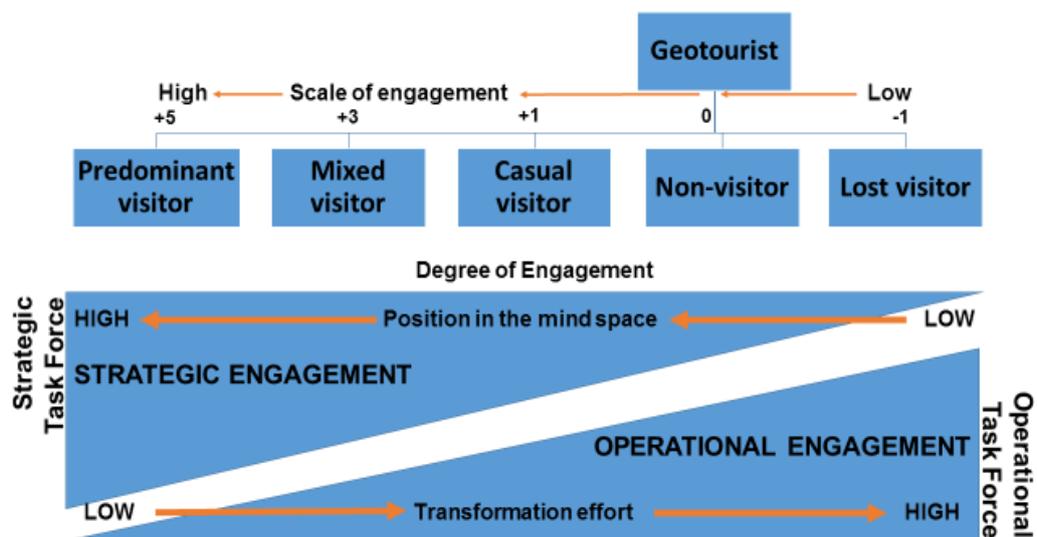


Figure 53: Geotourist Engagement Model

A “Predominant visitor” will always have a higher chance of “geopark brand recall” and a “positive feeling” compared to that of a “Lost visitor”. Therefore, the strategic task force will have a higher degree of “Strategic Engagement” towards the “Predominant visitor” side with decreasing strategic engagement towards the “Lost visitor” side of the scale. In similar way, the operational task force will have a higher degree of “Operational Engagement” towards the “Lost visitor” side of the scale. This generates a

high transformational effort at the “Lost visitor” side of the scale and decreasing operational engagement towards the “Predominant visitor” side of the scale. .

The research suggests that the above “Geotourist Engagement Model” helps a geopark manager in optimizing resources at the geotourists.

#### Geotourist Agent Strategy

A method of improving geopark visitor footfall is to collaborate with geotourist agents and tour operators in bringing geotourists to the location. A detailed strategy and a commission is to be calculated, to be paid to the geotour operators in bringing geotourists to the geopark locations. There is a need to train these agents /supply chain partners in enhancing geotourism capabilities.

#### Geotourist Management Document

Geotourist Management Document is a document that provides information about classification of geotourists, their potential and revenue generated in value. The ranking is done in descending order. ABC Analysis or Pareto’s law is based on the fact that focusing on a minority segment (a core group) contributes a significant values generaton. Identifying these minority of geotourists that contribute to the majority of geopark revenue enables a geopark to manage its resources efficiently. The details are elaborated in the tables 1 and 2 in the following page.

#### Geotourist Agent Document

Geotourist agent document provides information about classification of geotourist agents / partners of the geopark supply chain, their potential, yield (revenue generated) and ranking based on revenue contributed to geopark. This is performed using ranking method with ABC analysis (Tables 3 and 4).

In a similar method, the institutional geotourists are identified using table 5 and core institutional geotourists are selected using table 6.







## 7 SUSTAINABLE DEVELOPMENT IN GEOPARKS

### 7.1 Definition of Sustainable Development

The Brundtland report quoted in “Our Common Future”, defines Sustainable Development as “the development that meets the needs of the present without compromising the ability of the future generations to meet their own needs” (IISD 2016). “The two key components of sustainable development are the concept of need and the idea of limitations. The concept of need refers to the basic needs of the poor people to which priority should be addressed and the limitations refer to the restraints caused by technology and social organization on the environment’s ability in meeting the present and future needs” (IISD 2016).

### 7.2 Goals of Sustainable Development

The 17 Sustainable Development Goals proposed by the United Nations are:

“Goal 1: End poverty and all its forms everywhere

Goal 2: End hunger, achieve food security and improve nutrition and promote sustainable agriculture

Goal 3: Ensure healthy lives and promote well-being for all at all ages

Goal 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all

Goal 5: Achieve gender equality and empower all women and girls

Goal 6: Ensure availability and sustainable management of water and sanitation for all

Goal 7: Ensure access to affordable, reliable, sustainable modern energy for all

Goal 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all

Goal 9: Build resilient infrastructure and promote inclusive and sustainable industrialization and foster innovation

Goal 10: Reduce inequality within and among countries

Goal 11: Make cities and human settlements inclusive, safe, resilient and sustainable

Goal 12: Ensure sustainable consumption and production patterns

Goal 13: Take urgent action to combat climate change and its impacts

Goal 14: Conserve and sustainably use the oceans, seas and marine resources for sustainable development

Goal 15: Protect, restore and promote sustainable use of terrestrial ecosystem. Sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss

Goal 16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels

Goal 17: Strengthen the means of implementation and revitalize global partnership for sustainable development” (UN 2016).

According to the United Nations, the 17 Sustainable Development Goals could be achieved through 5Ps – People, Planet, Prosperity, Peace and Partnership (UN 2016), as depicted in figure 54.

People- Aimed at eradicating hunger and poverty among the masses and ensure people lead a healthy life with dignity and equality

Planet- Helping the present and future generations by protecting the planet through efficient use of resources in a sustainable way so that the

resources could be protected. Activities could be carried out in order to mitigate climate change.

Prosperity- Carrying out economic, social and technological activities in harmony with nature so that all people could live in peace and harmony.

Peace- Peace and sustainable development are two sides of a coin. One cannot exist without the other. Peace is vital to sustainable development

Partnership- It is only through partnership with stakeholders across countries that the goals of sustainable development could be realized.



Figure 54: The 5P pathways towards Sustainable Development Goals (Adapted from UN 2016)

### 7.3 Sustainable Development in Geopark

“UNESCO Global Geoparks utilizes its geological heritage and linking it with the cultural and natural heritage generates awareness and influences our thinking on the issues faced by the human society. These issues are related to sustainability, climate change, reducing the impact on human being by natural calamities. The UNESCO Global Geoparks attempt to achieve sustainability by encouraging local enterprise, high quality training

and new job creation, thus generating a source of income through geotourism” (UNESCO 2016).

#### 7.4 Sustainable Development through Geotourism

Geotourism is defined as “an interdisciplinary integration of tourism industry with conservation and interpretation of abiotic environment (Sadry 2009). Geotourism is defined as “a tourism that sustains or enhances the distinctive geographical character of the place, and include the environment, heritage, culture, aesthetics and wellbeing of the residents” (National Geographic 2016). Geotourism is a product of environmental responsibility, cultural responsibility and intangible heritage. The benefits of geotourism are economic development, social development of the local population, experiencing and sharing the excitement about the heritage and culture.

##### 7.4.1 Geotourism Charter

Geotourism Charter was developed by the National Geographical Society based on 11 principles (National Geographic 2010)

- a) “Developing the place distinctive to the locale to reflect the natural and cultural heritage in order to differentiate.
- b) Adhering to the principles and code of ethics laid down by the World Tourism Organization and obeying the Principles of Cultural Tourism Charter set up by International Council for Monuments & Sites (ICOMOS).
- c) Encouraging potential tourism market segments and share information on the unique features of the local culture and heritage.
- d) Create excitement among tourists so that they carry home the memories and bring in more visitors to the region.
- e) Involve community, business and civic groups in order to create a feeling of local culture, tradition so that the visitor gains a first-hand experience of the culture, history, nature, cuisine, art and crafts of the region.

- f) Communicating destination stewardship policies to encourage economic and social benefits to the communities involved in micro, small and medium industries and tourism industries.
- g) Efforts of business to encourage natural resources and sustain natural habitat, heritage sites, local culture and aesthetic appeal. Organizing a manageable number of tourists to prevent degradation of the area. Business planning based on need and optimum use of resources.
- h) Optimum land use by anticipating requirements for development. Retaining diversity by containing sprawling of resorts and vacation homes along coastal areas and islands. Encouraging self-contained tourism attractions such as theme parks in required locations without damaging the ecology or cultural or aesthetic appeal of the territory.
- i) Recognizing and appreciating immediate economic need without compromising on the geotourism potential of the destination. Development of geotourism attracts worker immigration and this community could be used for destination enhancement. Diversify the economy and limit the influx of population to sustainable levels. Propagate practices that are compatible and create synergy to geotourism and enhance destination value.
- j) Enrich tourism through visitor – host engagement in sharing knowledge about the place. The residents must take pride in enriching the knowledge of the visitors about the natural and cultural heritage of the communities.
- k) An evaluation to be conducted by a panel of experts and feedback to be published” (Errami et al. 2015).

## 7.5 Design for Sustainability of Geoparks

Sustainable design, also called environment conscious design, is defined as “the art and science of designing objects, environment or services that are in accordance to the principles of economic, social and ecological sustainability” (McLennan 2004).

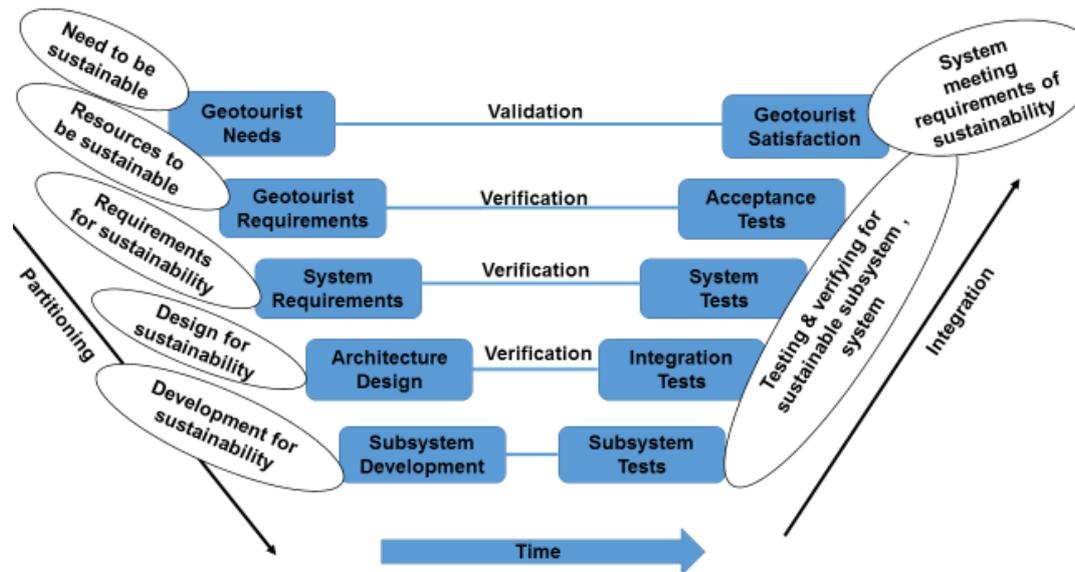


Figure 55: Vee diagram for sustainable systems engineering (Damodar 2016a; modified from UCL CSE 2012)

Sustainable design begins with identifying needs of the geotourists and evaluating the needs that are sustainable. Once the sustainable needs of the geotourists are identified, they are translated into geotourist requirements by identifying resources to meet the sustainable needs. The geotourist (visitor) requirements are then translated into sustainable system requirements. The next stage is the architecture design for sustainability. In the sustainable architecture design stage, the designer or developer used components to create a sustainable subsystems as shown in figure 55.

According to ANSI/IEEE, architecture is defined as the fundamental organization of the system, embodied in its components, their relationship to each other and the environment, and the principles governing its design and evolution (Maier et al. 2004). The sustainable subsystems are tested, verified and integrated to form a sustainable system, meeting the requirements of the geotourist (Damodar 2016a).

Incorporating sustainable design along the geopark value chain network, we may represent the Sustainable geopark network as shown in figure 56 below. In order to achieve sustainable design, efforts are to be initiated at the requirements level.

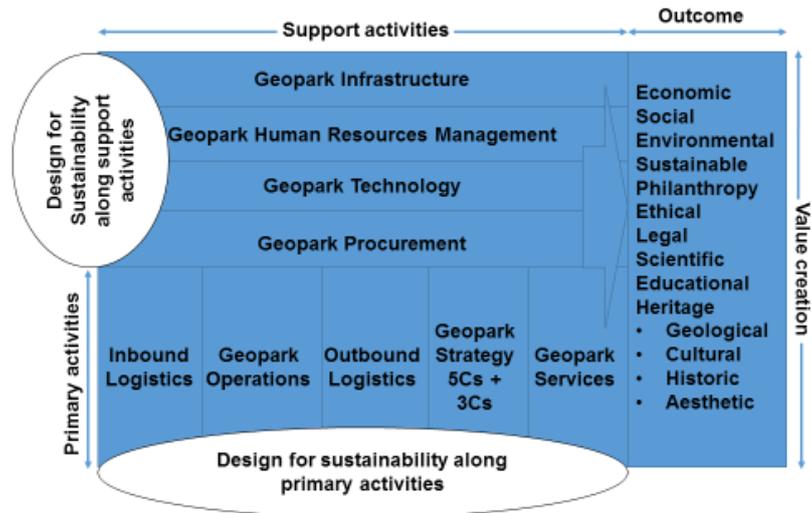


Figure 56: Design for sustainability along Geopark value chain network modified from Porter 1985 (Damodar 2016a)

## 8 ANALYSIS AND FINDINGS

### 8.1 Analysis

The researcher administered questionnaires 1 and 2 to the following ten geoparks: UNESCO Global geoparks 4, aspiring geoparks 5 and proposed geopark 1.

Questionnaire 1 was framed keeping in mind the type of geopark organization, stakeholders, focus areas, activities and operations of geopark. The questionnaire 2 is focussed on understanding and assessing the responsibilities of geoparks. For this purpose, the researcher chose the pyramid of Carroll (1991, 1999), namely, the economic responsibility, legal responsibility, ethical responsibility, philanthropy along with Lawrence, Weber & Post's (2005) principle of charity and stewardship.

According to Hart (1995) "management theory has ignored constraints imposed by the natural environment" and thereby proposed 'Resource Based View' of the firm for creating sustainable competitive advantage by linking pollution prevention, product stewardship and sustainable development. According to this theory, organizations create sustainable competitive advantage through environmental responsibility (Hart 1995).

Information on various geoparks gathered from questionnaires 1 and 2 are as follows:

#### Analysis of Questionnaire 1

##### Gunung Sewu UNESCO Global Geopark, Indonesia

Gunung Sewu UNESCO Global Geopark is a geopark managed by a society in Indonesia. According to Mr Sugeng Handoko, the manager of Gunung Sewu, the story behind Gunung Sewu is the location with beautiful landscape, ancient volcanoes and unique shore. The focus of the organization is to promote ecotourism with community development. The Gunung Sewu geopark organizes geotourism and involves the local community in carrying out plans, organizing and evaluating ecotourism.

The Gunung Sewu geopark undertakes training of the local inhabitants and marketing of their produce through organizing promotions through events, websites, social media, brochures to tourists.

#### Madonie Nature Park, Italy

Madonie UNESCO Global Geopark was established as a regional park in 1989 in the province of Palermo by the municipalities of Sicily region in Italy. It became a part of the EGN in 2001. The Madonie Nature park is unique for its distinct features. These are the rock sediments of 220 million years during the Triassic period along the marine basin of Sardinia, various species of plants, animals and wildlife, mountains, coastlines and snow troughs.

Madonie Nature park is the home of 1500 species of plants. Madonie Nature Park focuses on geotourism and has established several trails connecting various places of interest. According to Mr Francisco Greco, who represented the Madonie Nature park, it attracts about 100 visitors every day and the geopark is focused on study of rocks, soils and fossils.

#### Troodos Geopark, Cyprus

Troodos Geopark is a UNESCO Global geopark located in Cyprus. According to Dr Efthymios Tsiolakis, Geologist from Cyprus Geological Survey, the story of Troodos geopark is based on “complete and well preserved oceanic crust”. The key stakeholders are development companies and the coordinating committees include governmental departments and local non-profit organizations. Cyprus Tourism Organization and Troodos Tourism Board Organization are important partners in promoting the Troodos Geopark.

The aim of Troodos Geopark is to “make Troodos a unique global geopark” and promote geosites of Troodos and Troodos mountains to visitors. In order to maintain the geological heritage, Troodos Geopark is developing infrastructure for labelling of the area and the geosites. In order to promote sustainable development, Troodos Geopark is focused on

natural and cultural heritage of the region as well as improve traditional skills of the local population. The Troodos Geopark undertakes direct marketing of local products and handicrafts at the shop located in the visitor centre. There are approximately 950 tourists visiting the Troodos Geopark every day, mostly the local people and the foreigners.

#### Sanqingshan Geopark, China

The Sanqingshan Geopark is a UNESCO Global geopark located in Beijing, China. All Chinese geoparks are owned by the Peoples´ Republic of China. Dr Kejian Xu, geologist at China University of Geosciences, Beijing provided information about the Sanqingshan Geopark. Dr Kejian said that the stakeholders of Sanqingshan Geopark are local municipalities, product companies, hotels, restaurants and travel agents.

The story behind Sanqingshan Geopark is about “cretaceous granite located at the ancient suture zone formed by the unique columnar peaks about 1.2 million years ago”. The vision and mission of Sanqingshan Geopark is geoconservation, education and build a sustainable society. The Sanqingshan Geopark markets its services through publications, advertisements, interpretation panels at various locations, etc. The Sanqingshan Geopark employs 300 people directly and has 1200 franchises to promote its marketing efforts. The Sanqingshan Geopark attracts 1000 visitors daily and has an annual business of approximately 10 million yuan.

#### Conca de Tremp-Montsec, Lleida, Spain

Associate Professor Juan Poch Serra of Universitat Autònoma de Barcelona has been involved in the candidacy process preparation of four geoparks from Spain (Sobrarbe, Basque Coast, Central Catalonia and El Hierro). In the current geopark project “Conca de Tremp-Montsec, Juan informed that the aspiring geopark territory is owned by the association of municipalities. The theme of the geopark is “last dinosaur in Europe”. The geopark organization is focused on promoting local handicrafts, local agrofoods and cultural heritage in order to provide better life for the local

people. The Spanish geoparks outsource their training services to private companies. According to Mr Juan Poch, education, geotourism and promoting local products are the main objectives of the Spanish geopark organization. Geotourism is promoted through guided tours, interpretation panels and working groups. Most of the tourists come from different parts of Spain and France. Juan Poch mentioned that about 150 geotourists and 10 students visit the geopark on a daily basis. Private companies and private producers are important stakeholders of the Spanish geopark. The private companies offer guided tours and private producers offer local food. The geopark undertakes research in palaeontological excavation.

#### Geopark Beaujolais, France

Geopark Beaujolais is an aspiring geopark located in France. The geopark Beaujolais is owned by “Syndicat Mixte du Beaujolais” and key stakeholders include gathering of 132 municipalities, local private companies and university of Grenoble Alpes. According to Charlotte Besombes, doctoral researcher scholar of the university of Grenoble Alpes, the theme behind geopark Beaujolais is related to “human activity, geology and heritage”. The mission of the geopark Beaujolais is to develop the local region and promote economic development of the territory. The geopark Beaujolais’ effort towards sustainable development are in the areas of environmental education with the help of Ministry of Education and development of local economy through promotion of local products. The geopark also undertakes research in the area of social sciences and geography; and also organizes courses for geopark guides.

#### Geotethys, Greece

The Geotethys is an aspiring geopark located in the Grevena region, Greece. Geotethys is a public-private partnership company and the key stakeholders include the regional government, Aristotle University of Thessaloniki and local entrepreneurs. According to Dina Ghikas, the geologist at Geotethys, the story of Geotethys revolves around the Tethys ocean and the existence of Mesozoic sea. Geotethys is focused on

geoeducation, geoheritage and research. The mission of the organization is to promote the area as a tourist destination and to advance scientific knowledge.

The goals and objectives of the organization are to protect the important geosites, promote basic research and increase the number of visitors to the geopark. For this purpose, the organization undertakes documentation of threatened sites and educate the general public on their value. Dina Ghikas mentioned that in order to promote sustainability, the Geotethys undertakes reuse and repurpose of existing infrastructure, buildings and materials. In order to promote geotourism, Geotethys has developed several georoutes with signs, maps and guidebooks featuring the geosites and locations. There are plans to include studies on biodiversity, history and other subjects. The visitors to Geotethys are professionals, amateurs, families and outdoor enthusiasts.

#### Rio Coco, Nicaragua

Rio Coco is an aspiring geopark located in Nicaragua, owned by the municipalities. On interviewing Ms Monica Bueno, the manager of Rio Coco, she informed that the idea of establishing Rio Coco was put forth by a Mayor of one of the municipalities in order to bring about economic development of the territory and help people improve their quality of life. The objective of aspiring geopark Rio Coco is to protect cultural and natural heritage of the region and connect people and places together. Currently, the aspiring geopark Rio Coco is in the process of creating routes for geotrek and explaining the concept of geotourism and geopark to the schools.

#### Saimaa Geotourism Project, Finland

Saimaa is an aspiring geopark project located along the south eastern Finland. According to Minna Kahtava-Marttinen, Project Manager of the Imatra Region Development Company, the key stakeholders of Saimaa Geotourism Project are non-profit organization that include regional councils, municipalities, towns, recreation organizations, municipal

development companies and regional/municipal marketing organizations. The story of the geopark is based on “tale of the lake” which highlights formation of the lake Saimaa by glacial melting at the end of the ice age. The Saimaa lake is known for endangered species of freshwater seal that live in Saimaa. The focus is on “nature and culture tourism”.

According to Minna, the Saimaa organization is planning cooperation with the local populations and enterprises for the development of local economy and promote geotourism through marketing by regional development companies aimed at attracting visitors. The Saimaa Geotourism Project is also planning education in schools.

#### Sitia Geopark, Greece

Sitia Geopark is an aspiring geopark located in the Crete island of Greece. According to Mr Perakis Evangelos, the Geologist from Sitia geopark, the theme behind Sitia geopark is Geotourism and Local development. The geological heritage includes impressive rock forms, tectonic structures and the fossils of the area. Fossils of the Cretaceous period, 70 million years ago were found in Sitia. The skeletal remains of the Deinotherium of the Miocene period was found in Sitia. It was one of the largest animal lived in the region.

The key stakeholders of Sitia geopark are the Sitia municipality, antiquity department, forest department and university of Crete. The Sitia geopark offers guided tours, geotrails, geoeducation, and organizes events for the visitors. The goal of Sitia geopark is to increase visibility and organize programmes for the locale living in the region. The Sitia geoparks undertakes educational activities for students, teachers and the visitors.

#### Mount Popa, Myanmar

Mr Than Htun, Geologist and Secretary of the Myanmar Geosciences Society informed that they are planning to develop a Mount Popa, a dead volcano. For this purpose, Myanmar Geosciences Society is to coordinate with Myanmar Investment Commission and International Construction

Company in Singapore and Myanmar to initiate planning of the geopark. The aim of Myanmar Geosciences Society is to improve the living standard of the people and offer geoscience education.

The Myanmar Geosciences Society assists archaeological society and mining department for environmental protection in Central Myanmar. Myanmar Geosciences Society undertakes technical assistance and education in the area of earthquake and geohazards. The Myanmar Geosciences Society organizes meetings and publishing every three months in Journal of Geosciences.

## Analysis of Questionnaire 2

### 8.2 Responsibilities of Geopark organizations

#### Economic Responsibilities

1. When asked about profit maximization as the primary goal of the geopark organization, none of the geoparks fully agreed to making as much profit as possible but the idea of making profit was spread uniformly across the geoparks from disagreeing to neither agree nor disagree.
2. Regarding the question on commitment of socially responsible organizations in lowering the operational costs, majority of the respondents neither completely disagreed nor fully agreed with the statement.
3. When asked about providing highest returns to shareholders, none of the respondents agreed fully to this opinion. However, the opinion of offering maximizing returns to shareholders were uniformly spread across partially agree to fully agree to this statement.

4. When asked whether the organizations should not be distracted from their economic function by solving social problems, 40% of the respondents disagreed to this statement whereas the other respondents differed in their opinion.

#### Legal Responsibilities

5. With regard to legal responsibility, when asked about opinion on quality of organization in complying with all state laws and regulations, majority of them, 60% agreed fully to abide by the laws and regulations. It is also interesting to note that none of them disagreed, either fully or partially with this statement.
6. When asked about operating the geopark organization within the legal framework of the society, a large majority, 80% of them fully agreed with the statement and none of the respondents disagreed with the statement.
7. When asked about the violation of some laws and regulations for the interest of the organization in a particular situation, the majority of respondents, 50% of the geoparks disagreed with this statement. The remaining responses were distributed equally along the scale and is not significant. However, there is a need to further evaluate this question based on the region and culture of the people. What is true and correct in one culture need not carry the same weightage in another culture.
8. Although in the previous question, a few respondents were willing to compromise on some laws and regulations for the benefit of the organization, when it comes to adherence to all state rules and regulations although it may prove costlier for them, almost all, 80% fully agreed to the statement of adherence to the state rules and regulations and none of the respondents disagreed completely or partially with regard to this statement.

## Ethical Responsibilities

9. When it comes to the ethical responsibility of organizations, 40% of the respondents agree fully that organizations should not compromise ethical norms of the society in order to achieve organizational goals. There is a need for detailed analysis of this question because the answers are spread across in equal proportion among the remaining 60% of the respondents.
  
10. When asked about social responsibility of geopark organizations to do what is right, fair and just, 40% of the respondents agreed fully with this statement whereas 20% of respondents agreed to a great extent with this statement. Although 30% of the respondents were neutral towards this statement, none of them disagreed with the given statement.
  
11. When asked about the statement that organizations should avoid doing harm at all cost, all of the respondents agreed to the statement with 40% fully agreeing, 20% agreeing to a great extent, 10% neither agreeing nor disagreeing, and 30% partially agreeing to this statement. It is also noted that none of the respondents disagreed to this statement. There is a need to further research on the reason for partial and median agreement to this statement.
  
12. When asked about the situation in which the organizations could engage in questionable practices for economic gains, all of the respondents did not fully agree with the statement. 30% of the respondents disagreed completely with the statement whereas equal numbers (30%) agreed partially and 20% were median in terms of this agreement. There is a need to link the respondents with previous similar questions and find out if there is a pattern in response and in case there is a pattern observed, there is a need to investigate further on the cultural background. However, the researcher could get an overall impression while testing the questionnaires in a large sample size.

## Philanthropic Responsibilities

13. The compliance of respondents towards philanthropic responsibility reflected a high degree of agreement. When asked about contributing resources to the community, almost all of them, 90% of the respondents agreed fully to the statement that organizations should contribute resources to the community. Only one aspiring geopark, 10% of the respondents agreed to a great extent that the geopark organization should contribute resources to the community. This further reinstates that geopark organizations are community driven organizations.
14. When asked about socially responsible organizations striving to provide for community betterment, 80% of the respondents agreed fully that geopark organizations, being socially responsible, should provide for betterment of the community, and that the remaining 20% of the respondents agreed with this statement to a great extent.
15. It is interesting to note that in the beginning, geopark organization was created by a group of volunteers which grew organically into a professional organization supporting sustainable development and social responsibility. When asked about promoting volunteerism, the majority of geopark members, 70% agreed fully that geopark organizations should promote volunteerism. 20% of the geopark members agreed to a great extent towards actively promoting volunteerism. However, only 10% of the geopark members had this opinion at the median range, i.e., 50% of agreement. The researcher found that this particular geopark is an aspiring geopark. Therefore, a large sample size could provide more accurate information about the opinion with regard to this statement of actively promoting volunteerism.

16. When asked about committing resources to support culture and arts, 70% of the respondents agreed fully to this statement and the remaining 30% agreed to a great extent supporting this statement. This could be due to the fact that culture and heritage plays a very important role in building a geopark organization. Culture and arts are the connecting links in a geopark organization.

#### Charity Principle

17. With reference to the principle of charity, when asked about the obligation of the organization to the needy persons in the society, 40% of the respondents agreed fully to the statement and another 40% supported this statement to a great extent. Only 20% of the respondents were agreeing to this statement at the median scale. On further evaluation, it was found that these respondents were from an aspiring geopark and a proposed geopark. Therefore, the researcher suggests that a large majority of respondents support this statement.

18. When asked about providing charity to the less fortunate persons in the society, almost all the respondents, 80% agreed fully to this statement. It is also interesting to note that all the UNESCO global geoparks were fully agreeing to the statement of providing charity to the less fortunate in the society.

19. When asked about geopark organizations taking voluntary actions to promote social good, almost all of them, 90% of the respondents fully agreed to this statement. This is one of the important requirements of geoparks in the drive focused towards capacity building, credibility and community development.

20. When asked whether socially responsible organizations contribute to charitable organizations, 70% of the respondents agreed fully to this statement and these include all of the UNESCO global geopark members.

## Stewardship Principle

21. Under the category stewardship principle, the researcher asked questions on the obligation of geoparks to see that everyone in the society benefits from its actions, although none of the respondents disagreed to the statement, the response was spread across the degree of agreement. However, only 40% of the geopark members agreed to a great extent to this statement. It is also observed that the degree of agreement of all the respondents of UNESCO global geoparks are towards the positive side of the agreement scale.
22. With regard to the statement that the geopark organizations should consider the interest of all those who are affected by its decisions and actions, all of them were in the positive side of the scale with 50% of the respondents agreeing fully with the statement and the remaining 50% of the respondents agreeing to a great extent to this statement. The researcher suggests that by supporting this statement, geopark organization builds credibility among the stakeholders.
23. With reference to the statement regarding balancing the interests and needs of different groups in the society, the opinion of the respondents was tilted towards the positive side of the scale with majority of the respondents, 60% of them agreeing fully with the statement and 30% of the respondents agreeing to a great extent with the statement. However, only 10% of the respondents favoured towards the median scale and this is marginal and the response given by an aspiring geopark member.
24. When asked about the interdependence of the geopark organization and the society, majority of the respondents, 60% of them fully agreed with the statement and 10% agreed to a great extent. However, 30% of the respondents replied negatively to this statement and these were members from the aspiring geoparks. The researcher suggests that a high degree of interdependence between the geopark organization and

society are vital for achieving the strategic objectives (5Cs- Communication, Conservation, Community, Credibility and Capacity building; WHC 2015).

### Environmental Responsibilities

25. Environmental responsibility has been given much importance by all the geopark organizations. When asked about the organization taking care of its natural environment, almost all, 80% of the geopark organizations agreed fully with the statement and the remaining 20% agree to a great extent to this statement. This has a direct influence on the conservation “C” of the strategic objectives of the Global geoparks.
26. When asked about the acceptance of statement that the organizations should avoid damage to the natural environment, almost all the respondents, 90% fully agreed with this statement and the remaining 10% agreed to a great extent supporting the statement. This reconfirms the above statement of conservation effort of geoparks in preserving environment.
27. When asked about the effort of geopark organizations in contributing to the upkeep of the natural environment, 70% of the respondents fully agreed with this statement and the remaining 30% of them agreed to a great extent with the statement.
28. When asked about the efforts of geoparks in minimizing waste and recycling, a vast majority of the respondents, 80% of the respondents fully agreed with the statement and the remaining 20% of the respondents agreed to a great extent to the statement. Therefore, we understand that environmental responsibility is an important part of a geopark value system.

## 9 CONCLUSION

### 9.1 Result of the Study

The research identifies strategic objectives of UNESCO Global Geoparks with regard to 5Cs- Community development, Communication, Credibility, Capacity building and Conservation (WHC 2015), and further suggests addition of 3Cs- Continuity, Connectivity and Creativity as depicted in figure 57. The role of Global Geoparks Network and European Geoparks Networks have also been dealt in the study. A detailed study on Lesvos Geopark has been undertaken in this research. The research reveals the events that led to the formation of Petrified Forest of Lesvos due to intense volcanic eruptions in the late Miocene period.

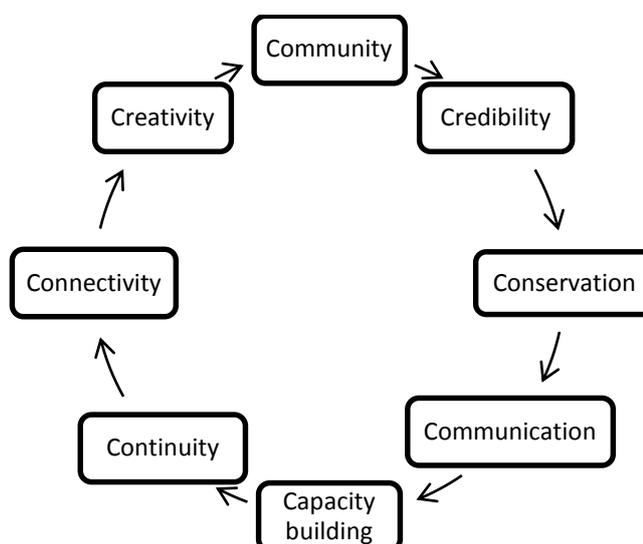


Figure 57: 8Cs of Geopark Strategy (Modified from WHC 2015)

The research applies principles of systems thinking in the geopark and develops a concept along the Geopark Value Chain Network. Geotourists are an important source of revenue generation in a geopark. In this research, the researcher develops concept to categorize geotourists and strategies to attract and retain them in order to generate revenue for sustainable growth and value generation.

## 9.2 Suggestions for Further Research

The research suggests that the Carroll's (1991, 1999) pyramid of CSR could be further modified to identify the Geopark Value Pyramid with various stages of responsibilities / values as mentioned in the study using multi-stakeholder and multi-criterion method employing pairwise comparison of Analytical Hierarchy Process (Saaty 2008). In a similar way, the research suggests development of pyramids of different value types for each industry / organization.

The current research evaluates responsibilities of a small sample of geoparks based on Carroll's (1991, 1999) pyramid, Lawrence, Weber and Post's (2005) principle of Charity and Stewardship, and environmental responsibilities. Although the study involved was qualitative in nature with a small sample size 10, the research suggests a mixed method study based on Geopark Value Pyramid using a large sample size.

The research also suggests that in order to understand the key stakeholders of geoparks, a detailed study based on Power-Influence matrix of stakeholders of geoparks could be undertaken (figure 58).

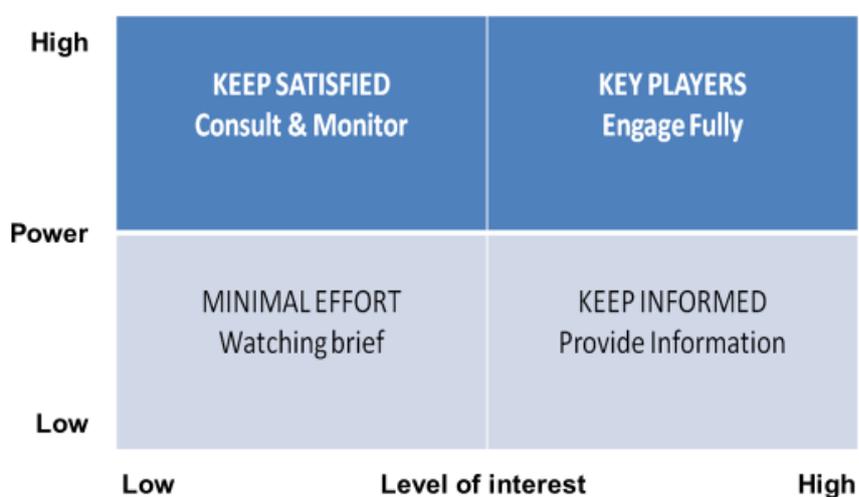


Figure 58: Power-Interest Matrix (Johnson & Scholes 1999)

The stakeholders could then be classified based on the Power-Interest matrix (Johnson & Scholes 1999) and communication strategies may be developed for effective function of the geoparks.

### 9.3 Limitations

The study was undertaken during a period of eleven days at the Intensive Course of International Geoparks. The sample used were the participants of the course and thus the sample size is 10. The Chi Square test could not be undertaken since Expected frequency is less than 5. However, the qualitative information recorded were accurate. Understanding the depth of the information, the questionnaire 2 was a quantitative scale used to measure quality of perception. The analysis done was based on qualitative method. While administering the questionnaires, there were instances that a few respondents found difficulty in answering the questionnaire 2. This could be due to the reason that the members selected were geologists who were technical professionals rather than management professionals. In such cases, the researcher clarified the doubts with the respondent discussing one to one basis.

## REFERENCES

## Printed Sources

Arouca Declaration 2011. Geotourism in Action. International Congress 09-13 November, presentation from Introduction to the Intensive Course on Geoparks 2016 held at Lesvos from July 20 to 30

Carroll, A.B. 1999. Corporate Social Responsibility: Evolution of a Definitional Construct. *Business & Society*, Vol. 38, No. 3, 268-295

Carroll, A.B. 1991. The Pyramid of Corporate Social Responsibility: Toward the Moral Management of Organizational Stakeholders'. *Business Horizons*, Vol. 34, 39–48

Creswell, J.W. 2003. *Research Design: Qualitative, Quantitative and Mixed Method Approaches 2<sup>nd</sup> Edition*. Thousand Oaks, CA: Sage Publications

Creswell, J.W. 1998. *Qualitative inquiry and Research design: Choosing among five traditions*. Thousand Oaks, CA: Sage Publications

Creswell, J.W. 1994. *Research Design: Qualitative and Quantitative Approaches*. Thousand oaks. CA: Sage Publications

Damodar, S.K. 2016a. *Sustainable Design Now and the Future*. Lahti University of Applied Sciences, Finland

Damodar, S.K. 2016. *Visitor Management Plan*. International Intensive Course on Geoparks June 20-30, Mytilene, Greece

Errami, E. et al. 2015. *From Geoheritage to Geoparks. Case studies from Africa and Beyond*. Springer International Publishing, Switzerland

European Geoparks 2009. *European Geoparks*. Published by The Natural History Museum of the Lesvos Petrified Forest, Sigri Lesvos, Greece

Frey, M.L. 2016. *UNESCO Designations Collaborations - World Heritage Site in a UNESCO Global Geopark Messel Pit & Bergstrasse Odenwald*,

Germany. International Intensive Course on Geoparks, Global Geoparks Network Document, June

Hair, J.F. et al. 2003. Essentials of Business Research Methods. John Wiley & Sons, NY

Hart, S.L. 1995. A Natural Resource Based View of the Firm. Published in the Academy of Management Review, Vol. 20, No. 4, 986-1014

Johnson & Scholes 1999. Exploring Corporate Strategy. Hemel Hempstead. Prentice Hall, Europe

Kizos, Thanasis 2016. Earth Heritage, Agricultural Landscape and Tourism in Geopark. International Intensive Course on Geoparks June 20-30, Mytilene, Greece

Kourtzelis, Giannis 2016. The Natural Environment and Cultural Heritage: The Roman Aqueduct of Lesvos. International Intensive Course on Geoparks June 20-30, Mytilene, Greece

Leedy, P. & Ormrod, J. 2001. Practical Research: Planning & Design 7<sup>th</sup> Edition. Upper Saddle River, NJ: Merrill Prentice Hall. Thousand Oaks, Sage Publications

McLennan, J.F. 2004. The Philosophy of Sustainable Design.

Mitre 2014. The Evolution of Systems Engineering. Published by The Mitre Corporation, USA

Mark, J.J. 2014. Sappho of Lesbos. Published in the Ancient History Encyclopedia

Mc Keever, P. 2016. UNESCO Global Geoparks (UGG). International Intensive Course on Geoparks June 20-30

Monuments and Museums of Greece 2015. The Castle of Methymna. Published by Hellenic Republic Ministry of Culture, Education and Religious Affairs

Museum of the Lesvos Petrified Forest 2006. The Lesvos Petrified Forest Geopark. Published by The Museum of the Lesvos Petrified Forests, Mytilene, Greece

Natural History Museum 2008. Guide to the Palka and Sigri Petrified Forest Parks. Published by the Ministry of Culture and Natural History Museum of the Lesvos Petrified Forest, Lesvos, Greece

Natural History Museum 2006. The Lesvos Petrified Forest Geopark. Published by the Ministry of Culture and Natural History Museum of the Lesvos Petrified Forest, Lesvos, Greece

Natural History Museum of the Lesvos Petrified Forest 2013. Nissiopi Marine Petrified Forest Park. Published by the Natural History Museum of the Lesvos Petrified Forest

Piraeus Bank Group Cultural Foundation 2006. Museum of industrial olive oil production in Lesvos. Published by The Piraeus Bank Group Cultural Foundation

Porter, M.E. & Kramer, M.R. 2006. The link between competitive advantage and corporate social responsibility. *Harvard Business Review*

Porter, M. E. 1985. *Competitive Advantage: Creating and Sustaining Superior Performance*. Free Press, NY

Post, J.E. et al. 2002. Managing the Extended Enterprise: The New Stakeholder View. *California Management Review*, Vol. 45, No.1, 6-28

Punch, K.F. 1998. *Introduction to Social Research*. Sage, London

Saaty, T.L. 2008. Decision Making with Analytical Hierarchy Process. *International Journal Services Sciences*, Vol.1, No. 1

Sadry, B.N. 2009. *Fundamentals of Geotourism with special emphasis on Iran*. Samt Organization Publishing, Tehran: Iran

Sage, A. & Rouse, W. 2009. *Handbook of Systems Engineering Management 2nd Edition*. Published by Wiley

SEBoK 2016. Guide to Systems Engineering Book of Knowledge.  
BKCASE March 25

Stevens et al. 1998. Systems Engineering, coping with Complexity.  
Published by Prentice Hall Europe

Stiles, W.B. 1993. Quality Control in Qualitative Research. Published in  
Clinical Psychology Review, 13, 6, 593-618

UCL CSE 2012. Systems Requirements Engineering Module MECHGS09.  
University College London Centre for Systems Engineering, June

UNESCO 2016. Celebrating Earth Heritage Sustaining Local  
Communities. UNESCO Global Geoparks. Published by the United  
Nations Educational Scientific and Cultural Organization, Paris, France

Valiakos, I. 2016. Lesvos Island UNESCO Global Geopark Signage,  
Publicity and Digital Promotion. International Intensive Course on  
Geoparks June 20-30, Mytilene, Greece

Williams, C. 2007. Research Methods. Journal of Business & Economic  
Research, March, Vol. 5, No. 3, 65-72

Zouros, N. 2016a. Lesvos island UNESCO Global Geopark. International  
Intensive Course on Geoparks, June 20-30, Mytilene, Greece

Zouros, N. 2016. UNESCO Global Geoparks and Global Geoparks  
Network. International Intensive Course on Geoparks, June 20-30,  
Mytilene, Greece

Zouros, N. 2004. Geological heritage protection and local development.  
The European Geoparks Network. Episodes 27/3, 165-171

Zouros, N. et al. 2003. Proceedings of the 2<sup>nd</sup> European Geoparks  
Network Meeting, Lesvos 3-7 October 2001, 184

## Digital Sources

Sooke, A. 2016. The most dazzling city of the ancient world / Culture [Retrieved 1.11.2016]. Available at: [www.bbc.com/culture/story/20160609-the-most-dazzling-city-of-the-ancient-world](http://www.bbc.com/culture/story/20160609-the-most-dazzling-city-of-the-ancient-world)

North, A. 2007. Isle of Lesbos [Retrieved 1.11.2016]. Available at: [www.sappho.com/poetry/sappho.html](http://www.sappho.com/poetry/sappho.html)

European Geoparks 2016. International Conference on Geoparks [Retrieved 1.11.2016]. Available at: [http://www.europeangeoparks.org/?page\\_id=633](http://www.europeangeoparks.org/?page_id=633)

IISD 2016. Sustainable Development [Retrieved 1.11.2016]. Available at: <http://www.iisd.org/topic/sustainable-development>

ISO/IEC 2007. Systems and Software Engineering- Recommended Practice for Architectural Description of Software-Intensive Systems. Geneva, Switzerland: International Organization for Standards (ISO)/International Electrotechnical Commission (IEC), ISO/IEC 42010 [Retrieved 1.11.2016]. Available at: [http://www.iso.org/iso/catalogue\\_detail.htm?csnumber=45991](http://www.iso.org/iso/catalogue_detail.htm?csnumber=45991)

Maier, M.W., Emery, D. & Hillard, R. 2004. ANSI/IEEE Standard 1471-2000. Systems Engineering [Retrieved 1.11.2016]. Available at: <http://onlinelibrary.wiley.com/doi/10.1002/sys.20008/full>

National Geographic 2016. About Geotourism [Retrieved 2.12.2016]. Available at: <http://travel.nationalgeographic.com/travel/geotourism/about/>

Zouros, N. 2015. Lesbos Global Geopark, Greece [Retrieved 12.10.2016]. Available at: <http://www.petrifiedforest.gr/?lang=en>

UN 2016. Transforming our world: The 2030 Agenda for Sustainable Development [Retrieved 15.11.2016]. Available at: <https://sustainabledevelopment.un.org/content/documents/21252030%20Agenda%20for%20Sustainable%20Development%20web.pdf>

UNESCO 2016. Earth Science for Society. Environment [Retrieved 18.06.2016]. Available at: <http://www.unesco.org/new/en/natural-sciences/environment/earth-sciences/unesco-global-geoparks/frequently-asked-questions/what-is-a-unesco-global-geopark/>

UNESCO 2005. Definition of Intangible heritage [Retrieved 15.08.2016]. Available at: [http://www.unesco.org/services/documentation/archives/multimedia/?id\\_page=13](http://www.unesco.org/services/documentation/archives/multimedia/?id_page=13)

WCED 1987. Our common future. Oxford: World Commission on Environment and Development. Oxford University Press, p.43. [Retrieved 24.11.2016]. Available at: <http://www.iisd.org/sd/>

WHC 2015. Operational Guidelines for the Implementation of the World Heritage Convention. UNESCO Intergovernmental Committee for the protection of the World Cultural and Natural Heritage [Retrieved 15.10.2016]. Available at: <http://www.unesco.at/kultur/basisdokumente/OpGuidelines.pdf>

## APPENDICES

APPENDIX 1	Maps of Lesvos island UNESCO Global Geopark
APPENDIX 2	Types of Qualitative Research Methods
APPENDIX 3	Questionnaires 1 & 2
APPENDIX 4	Information gathered from respondents





# P E T R I F I E D F O R E S T P A R K M A P

## LEGEND

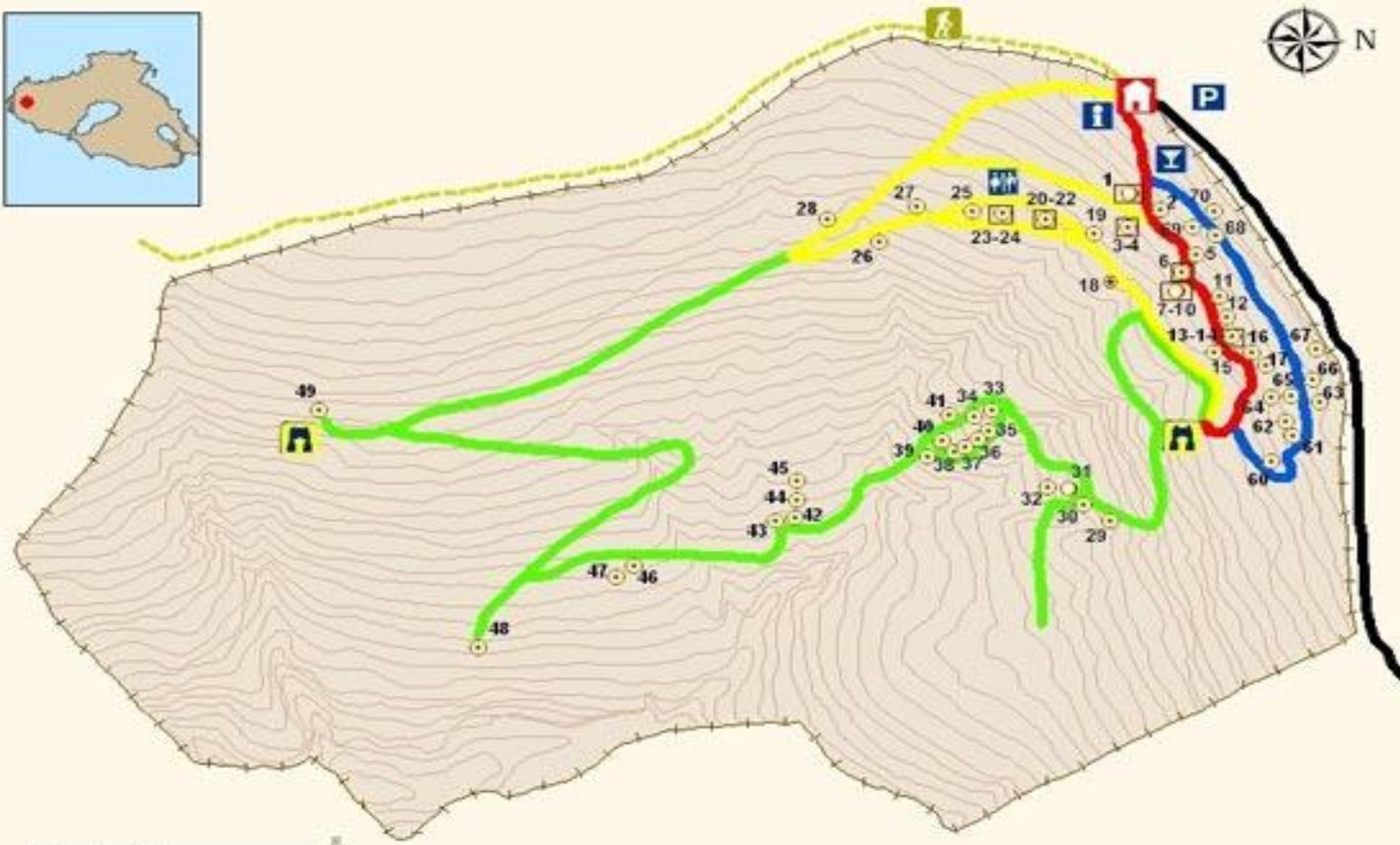
### PETRIFIED TRUNKS

- ⊙ STANDING
- ↘ LYING
- ⊙ ROOT SYSTEM

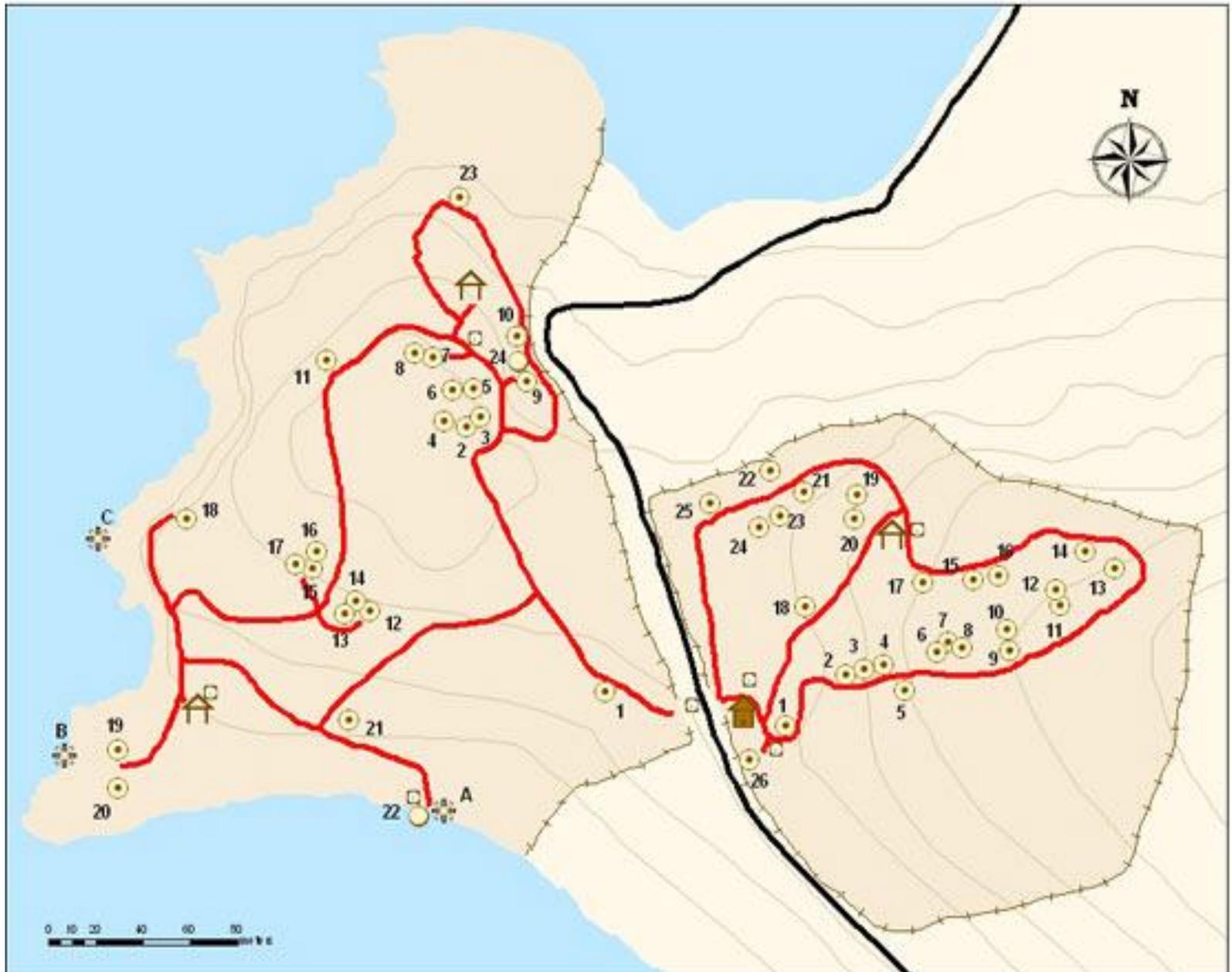
### TRAILS

- NO.1 (300M)
- NO.2 (1.121M)
- NO.3 (2.100M)
- NO.4 (556M)
- TRECKING TRAIL
- PARK BORDER
- MAIN ROAD

- 🏠 ENTRANCE
- 🏠 VIEW STAND
- 🚻 WC
- 🅑🅓 PARKING
- 📄 INFORMATION
- 🍽️ CAFETERIA



# PLAKA PARK MAP



### LEGEND

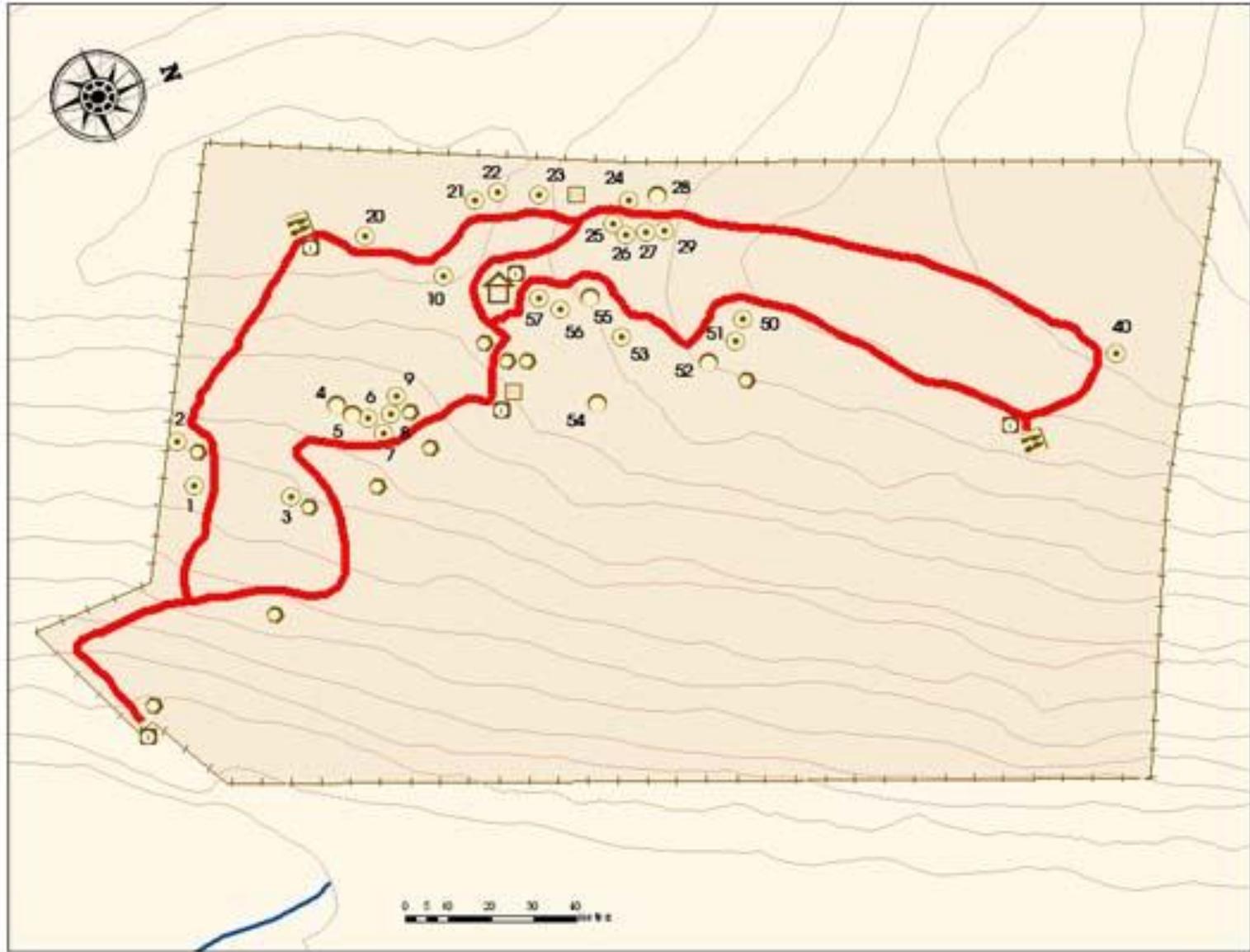
**PETRIFIED TRUNKS**

- STANDING (Yellow circle with a dot)
- LYING (Yellow circle with a horizontal line)

**GEOTOPES**

- TAFFON (Cross symbol)
- INFORMATION PANEL (Square with a dot)
- ENTRANCE (Brown house icon)
- KIOSK (White house icon)
- PARK BORDER (Dashed line)
- TRAIL (Red line)
- SEGRI-ERESSOS ROAD (Thick black line)

# CHAMANDROULA PARK MAP



### LEGEND

DETRIFIED TRUNKS

- STANDING
- LYING
- ◐ TRUNK PARTS
- ◻ DRYSTONE CONSTRUCTION
- ◻ INFORMATION PANEL
- 🏠 GUARD HOUSE
- 🏞️ VIEW STAND

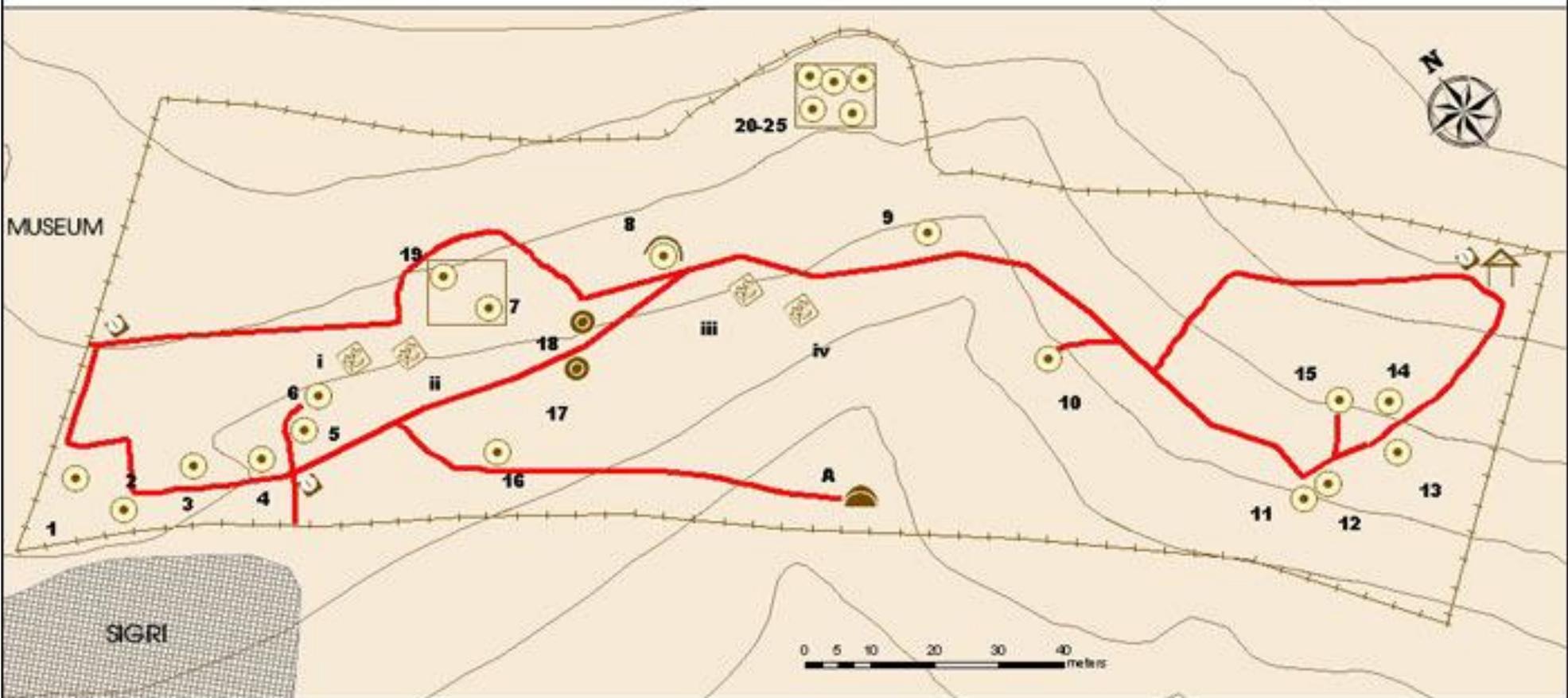
⚡ PARK BORDER

👉 TRAIL

— TSGIKIONTAS RIVER



# SIGRI PARK MAP



## LEGEND

### PETRIFIED TRUNKS

- STANDING
- ROOF SYSTEM

- PETRIFIED LEAVES
- GEOTOPE

### FACILITIES

- INFORMATION PANEL
- ROOK

- PARK BORDER
- TRAIL



## APPENDIX 2

### Types of Qualitative Research Methods

**Case study:** Case study is defined as “exploring in depth a programme, a process, an activity, an event or one or more individuals” (Creswell 2003). According to Creswell (1998), the structure of a case study method should be the problem, the context the issues and the lessons learnt. Case study methods can be a single case or case bounded by time and place (Creswell 1998). A case study attempts to “learn more about a little known or poorly understood situation” (Leedy & Ormrod 2001). In a case study, the researcher spends onsite studying in depth about the situation, activities and people; and collects data through observation, interviews, documents, archival records, audio visual materials and physical artefacts.

**Ethnography study:** Ethnography study refers to studying an entire group that shares a common culture (Leedy & Ormrod 2001). The researcher studies an intact cultural group in a natural setting over a prolonged period of time by collecting primarily observational data (Creswell 2003). Ethnography studies are undertaken in order to understand change in behaviour or culture over a period of time. The three steps in ethnography process are to gain access to the site, building trust through establishing relationships, and interacting with all members of the group to understand and gather the detailed information (Leedy & Ormrod 2001). The information gathered is documented and recorded to support the claim made by the researcher.

**Grounded theory study:** Grounded theory is the study where the theory emerges from the data collected in the field rather than from the research literature (Leedy & Ormrod 2001). The grounded theory is based on observing the actions and interactions among the society members, as a result, this theory is widely used in social research. The ingredients of grounded theory : describing the research problem, literature review, describing the methodology, data analysis explaining the theory and discussing implications (Leedy & Ormrod 2001).

**Phenomenological study:** The phenomenological study enables the researcher to understand and experience the viewpoints of the participants (Leedy & Ormrod 2001). Image, feelings, perceptions, memories generate an inner conscience and an outward expression. The phenomenological study helps in identifying the central meaning of the experience (Creswell 1998). In order to understand, uncover and interpret perceptions of individuals, the researcher employs lengthy interviewing techniques. The procedure used in phenomenological study is as follows: writing the research question to explore the meaning of the experience, organizing interviews with the participants, data analysis to discover the clusters of meanings and report writing wherein the reader is able to enhance the understanding of the essential structure of the experience (Creswell 1998).

**Content analysis study:** Content analysis is “a detailed and systematic examination of the contents of a particular body of material in order to identify pattern, themes or biases (Leedy & Ormrod 2001). Content analysis could be used in all types of communication and include verbal and non-verbal such as behaviours, visuals, observations, etc. The steps in content analysis are as follows: analysis of the material and organizing the frequencies of individual characteristics. Performing a statistical analysis to obtain a quantitative report. The report should contain description of the material studied, quality and nature of the material, methodology used, statistical analysis and conclusion (Williams 2007).

## APPENDIX 3

### QUESTIONNAIRE FOR GEOPARKS 1: General Information

Please provide relevant information on the following. This information is meant for research purpose only and shall be treated in strict confidence.

Type of organization:	Government	Public company	Private company	Trust	Any other
Size of organization:	Enterprise	Large	Medium	Small & Micro	

Annual business (Sales revenue): ..... per annum

Who are the owners of your Geopark:.....

Number of employees: ..... Location (Country) : .....

1. Every Geopark has a story behind it. Please state the story (theme) of your Geopark?

.....  
 .....

2. Please provide information on unique features of your Geopark organization?  
 How is it different from other similar organizations?

.....  
 .....

3. How is Marketing & Sales Department organized in your Geopark?

Direct marketing ..... Franchised ..... Both .....

No. of marketing and sales personnel: Direct employees ..... Franchisees.....

Methods of sales promotion.....

4. What services do you outsource?

.....  
 .....

5. Please state the vision of your organization

.....

6. Please state the mission of your organization

.....

7. Please state the goals and/or objectives of your organization

.....

8. Please state the activities undertaken by your organization in order to maintain geological heritage?

.....  
 .....

9. Please provide information on the activities undertaken by your organization in order to promote sustainable development

.....  
 .....

10. Please state the activities undertaken by your organization for developing the economy of the local population and the region

.....  
 .....

11. Please provide information on the method of promoting tourism

.....  
 .....

12. Please provide information on the method of promoting education and skill training

.....  
 .....

13. Please state if your organization undertake research?

Yes

No

If yes, please elaborate on the research undertaken

.....

14. Please state who your customers are?

.....

15. How many customers visit your Geopark every day. Please provide an approximate value

Institutions: ..... Tourists: ..... Others: .....

16. Please provide information on key stakeholders of your organization and their role

Key stakeholders

Roles of key stakeholders (please mention points)

## QUESTIONNAIRE FOR GEOPARKS-2 (5 point agreement scale) – Please highlight the right choice

### Economic Responsibility

1. The primary goal of an organization is to make as much profit as possible

Disagree completely	Agree (25%) partially	Neither agree (50%) Nor disagree	Agree to (75%) a great extend	Agree (100%) fully
---------------------	-----------------------	----------------------------------	-------------------------------	--------------------

2. Socially responsible organizations strive to lower their operational costs

Disagree completely	Agree (25%) partially	Neither agree (50%) Nor disagree	Agree to (75%) a great extend	Agree (100%) fully
---------------------	-----------------------	----------------------------------	-------------------------------	--------------------

3. Geopark organizations should strive for the highest returns to their shareholders

Disagree completely	Agree (25%) partially	Neither agree (50%) Nor disagree	Agree to (75%) a great extend	Agree (100%) fully
---------------------	-----------------------	----------------------------------	-------------------------------	--------------------

4. Geopark organizations should not be distracted from their economic functions by solving social problems

Disagree completely	Agree (25%) partially	Neither agree (50%) Nor disagree	Agree to (75%) a great extend	Agree (100%) fully
---------------------	-----------------------	----------------------------------	-------------------------------	--------------------

### Legal Responsibility

5. Well run organizations strive to comply with all the state laws and regulations

Disagree completely	Agree (25%) partially	Neither agree (50%) Nor disagree	Agree to (75%) a great extend	Agree (100%) fully
---------------------	-----------------------	----------------------------------	-------------------------------	--------------------

6. Organizations must operate strictly within the legal framework of the society

Disagree completely	Agree (25%) partially	Neither agree (50%) Nor disagree	Agree to (75%) a great extend	Agree (100%) Fully
---------------------	-----------------------	----------------------------------	-------------------------------	--------------------

7. It is sometime expedient for organizations to violate some laws and regulations

Disagree completely	Agree (25%) partially	Neither agree (50%) Nor disagree	Agree to (75%) a great extend	Agree (100%) Fully
---------------------	-----------------------	----------------------------------	-------------------------------	--------------------

8. Organizations have to adhere to all state rules and regulations even though it may be costly for them

Disagree completely	Agree (25%) partially	Neither agree (50%) Nor disagree	Agree to (75%) a great extend	Agree (100%) fully
---------------------	-----------------------	----------------------------------	-------------------------------	--------------------

### Ethical Responsibility

9. Geopark organizations should not compromise ethical norms of the society in order to achieve organizational goals

Disagree completely	Agree (25%) partially	Neither agree (50%) Nor disagree	Agree to (75%) a great extend	Agree (100%) Fully
---------------------	-----------------------	----------------------------------	-------------------------------	--------------------

10. Socially responsible organizations always do what is right, fair and just.

Disagree completely	Agree (25%) partially	Neither agree (50%) Nor disagree	Agree to (75%) a great extend	Agree (100%) Fully
---------------------	-----------------------	----------------------------------	-------------------------------	--------------------

11. Geopark organizations should avoid doing harm at all cost

Disagree completely	Agree (25%) partially	Neither agree (50%) Nor disagree	Agree to (75%) a great extend	Agree (100%) Fully
---------------------	-----------------------	----------------------------------	-------------------------------	--------------------

12. It is sometime expedient for organizations to engage in questionable practices for economic gains

Disagree completely	Agree (25%) partially	Neither agree (50%) Nor disagree	Agree to (75%) a great extend	Agree (100%) Fully
---------------------	-----------------------	----------------------------------	-------------------------------	--------------------

### Philanthropic Responsibility

13. Geopark organizations should contribute resources to the community

Disagree completely	Agree (25%) partially	Neither agree (50%) Nor disagree	Agree to (75%) a great extend	Agree (100%) Fully
---------------------	-----------------------	----------------------------------	-------------------------------	--------------------

14. Socially responsible organizations strive to provide for community betterment

Disagree completely	Agree (25%) partially	Neither agree (50%) Nor disagree	Agree to (75%) a great extend	Agree (100%) Fully
---------------------	-----------------------	----------------------------------	-------------------------------	--------------------

15. Geopark organizations should actively promote volunteerism

Disagree completely	Agree (25%) partially	Neither agree (50%) Nor disagree	Agree to (75%) a great extend	Agree (100%) fully
---------------------	-----------------------	----------------------------------	-------------------------------	--------------------

16. Geopark organizations have to commit resources to support culture and arts

Disagree completely	Agree (25%) partially	Neither agree (50%) Nor disagree	Agree to (75%) a great extend	Agree (100%) fully
---------------------	-----------------------	----------------------------------	-------------------------------	--------------------

#### Charity Principle

17. Geopark organization has an obligation to needy persons in the society

Disagree completely	Agree (25%) partially	Neither agree (50%) Nor disagree	Agree to (75%) a great extend	Agree (100%) Fully
---------------------	-----------------------	----------------------------------	-------------------------------	--------------------

18. Geopark organization should be charitable toward the less fortunate in the society

Disagree completely	Agree (25%) partially	Neither agree (50%) Nor disagree	Agree to (75%) a great extend	Agree (100%) fully
---------------------	-----------------------	----------------------------------	-------------------------------	--------------------

19. Geopark organization should take voluntary actions to promote social good.

Disagree completely	Agree (25%) partially	Neither agree (50%) Nor disagree	Agree to (75%) a great extend	Agree (100%) fully
---------------------	-----------------------	----------------------------------	-------------------------------	--------------------

20. Socially responsible organizations contribute to charitable organizations.

Disagree completely	Agree (25%) partially	Neither agree (50%) Nor disagree	Agree to (75%) a great extend	Agree (100%) fully
---------------------	-----------------------	----------------------------------	-------------------------------	--------------------

#### Stewardship Principle

21. Geopark has an obligation to see that everyone in the society benefits from its actions.

Disagree completely	Agree (25%) partially	Neither agree (50%) Nor disagree	Agree to (75%) a great extend	Agree (100%) fully
---------------------	-----------------------	----------------------------------	-------------------------------	--------------------

22. Geoparks should consider the interests of all who are affected by its decisions and actions.

Disagree completely	Agree (25%) partially	Neither agree (50%) Nor disagree	Agree to (75%) a great extend	Agree (100%) fully
---------------------	-----------------------	----------------------------------	-------------------------------	--------------------

23. Geoparks should balance the interests and needs of different groups in the society.

Disagree completely	Agree (25%) partially	Neither agree (50%) Nor disagree	Agree to (75%) a great extend	Agree (100%) fully
---------------------	-----------------------	----------------------------------	-------------------------------	--------------------

24. Geoparks and society are interdependent.

Disagree completely	Agree (25%) partially	Neither agree (50%) Nor disagree	Agree to (75%) a great extend	Agree (100%) fully
---------------------	-----------------------	----------------------------------	-------------------------------	--------------------

#### Environmental Friendliness

25. Geoparks should take care of the natural environment.

Disagree completely	Agree (25%) partially	Neither agree (50%) Nor disagree	Agree to (75%) a great extend	Agree (100%) fully
---------------------	-----------------------	----------------------------------	-------------------------------	--------------------

26. Geoparks should avoid damaging the natural environment.

Disagree completely	Agree (25%) partially	Neither agree (50%) Nor disagree	Agree to (75%) a great extend	Agree (100%) fully
---------------------	-----------------------	----------------------------------	-------------------------------	--------------------

27. Geoparks should contribute to the upkeep of the natural environment.

Disagree completely	Agree (25%) partially	Neither agree (50%) Nor disagree	Agree to (75%) a great extend	Agree (100%) fully
---------------------	-----------------------	----------------------------------	-------------------------------	--------------------

28. Geoparks should have waste minimization and recycling programs.

Disagree completely	Agree (25%) partially	Neither agree (50%) Nor disagree	Agree to (75%) a great extend	Agree (100%) fully
---------------------	-----------------------	----------------------------------	-------------------------------	--------------------

## APPENDIX 4

### Information on geoparks who completed questionnaire 1

S.No	Name of geopark	Location / Territory	Type of geopark	Organization	Size	No. of direct employees
1	Conca de Tremp Montsec	Spain	Aspiring	Public company	Small & micro	7
2	Geotethys	Greece	Aspiring	Private company	Small & micro	3
3	Troodos geopark	Cyprus	UNESCO Geopark	Government	Small & micro	4
4	Madonie's Geopark	Sicily, Italy	UNESCO Geopark	Government	Medium size	10
5	Saimaa Geopark	Finland	Aspiring	Municipalities	Small & micro	3
6	Beaujolais	France	Aspiring	Government	Small & micro	8
7	Sitia Geopark	Sitia, Crete	Aspiring	Public company	Small & micro	9
8	Gunung Sewu	Indonesia	UNESCO Geopark	Trust	Medium size	62+
9	Rio Coco	Nicaragua	Aspiring	Government	Small & micro	2
10	Sanqingshan	Beijing, China	UNESCO Geopark	Government	Large	300
11	Mt Popa (anticipated)	Myanmar	Proposed	Government	Small & micro	Not started

Information gathered from questionnaire 2 based on responsibilities of geoparks are as follows:

**Economic responsibilities of geopark organizations**

S No	Particulars of economic responsibilities	Disagree	Agree partially 25%	Neither agree nor disagree 50%	Agree to a great extend 75%	Agree fully 100%
1	The primary goal of an organization is to make as much profit as possible					
	No. of geoparks	3	3	2	2	0
	Percentage	30%	30%	20%	20%	0%
2	Socially responsible organizations strive to lower their operational costs					
	No. of geoparks	1	3	3	2	1
	Percentage	10%	30%	30%	20%	10%
3	Geopark organizations should strive for the highest returns to shareholders					
	No. of geoparks	0	4	1	3	2
	Percentage	0%	40%	10%	30%	20%
4	Organizations should not be distracted from their economic functions by solving social problems					
	No. of geoparks	4	0	2	1	2
	Percentage	40%	0%	20%	10%	20%

**Legal responsibilities of geopark organizations**

	Particulars of legal responsibilities	Disagree	Agree partially 25%	Neither agree nor disagree (50%)	Agree to a great extend (75%)	Agree fully(100%)
5	Well run organizations strive to comply with all the state laws and regulations					
	No. of geoparks	0	0	3	1	6
	Percentage	0%	0%	30%	10%	60%
6	Organizations must operate strictly within the legal framework of the society					
	No. of geoparks	0	1	1	0	8
	Percentage	0%	0%	10%	0%	80%
7	It is sometime expedient (helpful in a particular situation) for organizations to violate some laws and regulations					
	No. of geoparks	5	1	1	1	2
	Percentage	50%	10%	10%	10%	20%
8	Organizations have to adhere to all state rules and regulations even though it may be costly for them					
	No. of geoparks	0	0	1	1	8
	Percentage	0%	0%	10%	10%	80%

**Ethical responsibilities of geopark organizations**

	Particulars of ethical responsibilities	Disagree	Agree partially 25%	Neither agree nor disagree 50%	Agree to a great extend 75%	Agree Fully 100%
9	Geoparks should not compromise ethical norms of the society in order to achieve organizational goals					
	No. of geoparks	2	2	0	2	4
	Percentage	20%	20%	0%	20%	40%
10	Socially responsible organizations always do what is right, fair and just					
	No. of geoparks	0	1	3	2	4
	Percentage	0%	10%	30%	20%	40%
11	Geopark organizations should avoid doing harm at all cost					
	No. of geoparks	0	3	1	2	4
	Percentage	0%	30%	10%	20%	40%
12	It is sometime expedient (helpful in a particular situation) for organizations to engage in questionable practices for economic gains					
	No. of geoparks	3	3	2	2	0
	Percentage	30%	30%	20%	20%	0%

**Philanthropic responsibilities of geopark organizations**

S No	Particulars (philanthropic responsibilities)	Disagree	Agree partially 25%	Neither agree nor disagree 50%	Agree to a great extend 75%	Agree Fully 100%
13	Geopark organizations should contribute resources to the community					
	No. of geoparks	0	0	0	1	9
	Percentage	0%	0%	0%	10%	90%
14	Socially responsible organizations strive to provide for community betterment					
	No. of geoparks	0	0	0	2	8

	Percentage	0%	0%	0%	20%	80%
15	Geopark organizations should actively promote volunteerism					
	No. of geoparks	0	0	1	2	7
	Percentage	0%	0%	10%	20%	70%
16	Geopark organizations have to commit resources to support culture and arts					
	No. of geoparks	0	0	0	3	7
	Percentage	0%	0%	0%	30%	70%

#### Charity principles of geopark organizations

S No	Particulars of principles of charity	Disagree	Agree Partially 25%	Neither agree nor disagree 50%	Agree to a great extend 75%	Agree Fully 100%
17	Geopark organization has an obligation to needy persons in the society					
	No. of geoparks	0	0	2	4	4
	Percentage	0%	0%	20%	40%	40%
18	Geopark organization should be charitable toward the less fortunate in the society					
	No. of geoparks	0	0	1	3	6
	Percentage	0%	0%	10%	30%	60%
19	Geopark organization should take voluntary actions to promote social good					
	No. of geoparks	0	0	1	0	9
	Percentage	0%	0%	10%	0%	90%
20	Socially responsible organizations contribute to charitable organizations					
	No. of geoparks	0	0	1	2	7
	Percentage	0%	0%	10%	20%	70%

#### Stewardship principles of geopark organizations

S No	Particulars of principles of stewardship	Disagree	Agree Partially 25%	Neither agree nor disagree 50%	Agree to a great extend 75%	Agree Fully 100%
21	Geopark has an obligation to see that everyone in the society benefits from its actions					
	No. of geoparks	0	1	2	4	3
	Percentage	0%	10%	20%	40%	30%
22	Geoparks should consider the interests of all who are affected by its decisions and actions					
	No. of geoparks	0	0	0	5	5
	Percentage	0%	0%	0%	50%	50%
23	Geoparks should balance the interests and needs of different groups in the society					
	No. of geoparks	0	0	1	3	6
	Percentage	0%	0%	10%	30%	60%
24	Geoparks and society are interdependent					
	No. of geoparks	3	0	0	1	6
	Percentage	30%	0%	0%	10%	60%

#### Environmental responsibilities of geopark organizations

S No	Environmental responsibilities	Disagree	Agree Partially 25%	Neither agree nor disagree 50%	Agree to a great extend 75%	Agree Fully 100%
25	Geoparks should take care of the natural environment					
	No. of geoparks	0	0	0	2	8
	Percentage	0%	0%	0%	20%	80%
26	Geoparks should avoid damaging the natural environment					
	No. of geoparks	0	0	0	1	9
	Percentage	0%	0%	0%	10%	90%
27	Geoparks should contribute to the upkeep of the natural environment					
	No. of geoparks	0	0	0	3	7
	Percentage	0%	0%	0%	30%	70%
28	Geoparks should have waste minimization and recycling programs					
	No. of geoparks	0	0	0	2	8
	Percentage	0%	0%	0%	20%	80%