MUNICIPALITY OF AMORGOS

Management for ecosystem recovery in Amorgos Island

Location: Aspro Vouno, Chora area

May 2014

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Environmental Consultant
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TABLE OF CONTENTS

MAPS

1. INTRODUCTION

Amorgos is one of the Aegean Sea islands that maintains its naturality, while having a natural and cultural environment that assign a special identity and value.

The Municipality of Amorgos decided to interfere in the field of ecosystem recovery. For this reason the Municipality elaborated management projects for ecosystem recovery in three specific locations which are its property. These projects are sequel of an initial project under the title “Management for ecosystem recovery in Amorgos Island” done in January 2014 which investigated the potential interventions within the ecosystem.

In these areas, management measures are specialized. In this way, it is attempted to manage the region of the Cycladic islands towards rehabilitation of the natural ecosystem.

This study refers to one of the three selected locations, the one in the location **Aspro Vouno** in **Chora** area of the Chora community.

The NGO "Trees for Greece gGmbl" and the organization Velanidia Foundation for Amorgos contributed to the implementation of the study.

The project as well as the initial study, is implemented by the company "YLI"-Environmental Management and Protection - Environmental Consultant", which conducts studies regarding management and protection of the natural environment.

2. PURPOSE OF THE PROJECT

This report deals with the recording and analysis of the ecosystem in this particular location on the island of Amorgos, and **suggests appropriate management actions for the recovery and improvement of ecosystem functions.**

The fundamental ecosystem elements are soil (especially the fertile one) and water in terms of soil humidity that can be conserved. The purpose of the project is to manage soil and water in such a way that the natural vegetation is rectified and the functions of soil and water conservation are improved. Amorgos, like other nearby islands, is covered primarily by shrubs and low bushes called “Phrygana”, which are degraded by the bioclimate restrictions, grazing and repeated wild fires. The vegetation consists of species that can withstand high temperatures and lack of water.

This project aspires to have a character of pioneer application and represent a good intervention example for all Cyclades and other Aegean islands that are characterized by similar conditions.

Considering the knowledge of the project area and the study of factors that affect the ecosystem, it is concluded that the key management element is the **management of the soil**. In addition, it emerges the parameter of **water management** through its storage and through the **proper selection of plant species** to be used. Management for ecosystem recovery should repair past damages due to over-logging, overgrazing, and repeated fires. Any intervention for ecosystem recovery should also regulate the relation between the natural ecosystem and agro-pastoral activities.

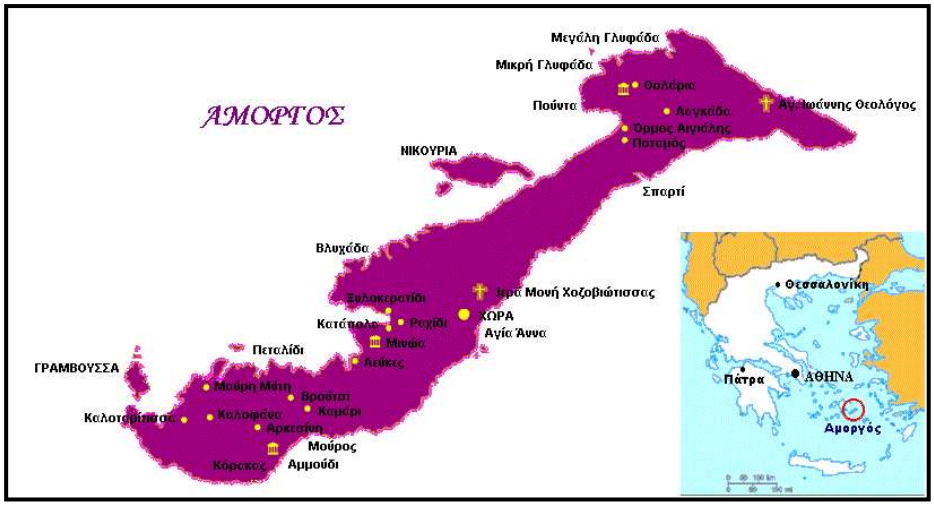
3. THE ENVIRONMENT OF AMORGOS ISLAND

3.1 Natural environment

Amorgos is the easternmost island of the Prefecture of Cyclades and has a total area of 121km^2 (the 7th largest island in the Cyclades) and 112km of coastline. The shape of the island is very elongated, with a length of about 32Km and oriented NE-SW. The shape and the geographical position of the island, is presented in the following geographic orientation map.

(Figure 1):

Figure 1: Geographical position of Amorgos



The thermo-mediterranean bioclimate of the island, as well as the long term human intervention, have created in Amorgos, restricted growth conditions of shrub vegetation. The trees are very rare due to logging, grazing, erosion and wind. Strong winds contribute to dryness of the atmosphere and thus to reduce the moisture available for the plants. The island is within high risk of desertification according to the desertification hazard map developed by the Agricultural University of Athens (AUA). In contrast with the trees and shrubs, the herbaceous flora is of great interest as many rare and steno-endemic species of flora of the Aegean region grow on the rocks.

According to measurements of residents of the island, in recent years, the average rainfall is in the 400-450mm, but last year was 350mm while the maximum was recorded at 600mm.

The soils of Amorgos mounted on the main geological substrates such as limestone and flysch. The limestone soils are classified in the Calcaric Leptosol and are of very low quality and very high sensitivity to desertification.

The depth of soil is directly related to the nature of the soil parent material (geology composition), the erosion, the extent of anthropogenic impact, mainly on vegetation and other factors such as inclination and orientation of slopes, the climate. The rocks which disintegrate rapidly (flysch) give, generally, deeper soils, unlike those which disintegrate with difficulty. Inclined areas where protective vegetation has been destroyed for a

considerable time have shallow soils due to intensive erosion they have suffered. Soil erosion, accelerated notably by adverse human interventions in the natural environment and extreme natural phenomena, leads to degradation of soils, reduction of their productive capacity and ultimately loss of precious, irreplaceable and non-renewable natural resource. This soil deterioration is one of the dominant factors of desertification.

The physical space of the island is used for goat and sheep grazing. In the surrounding region, there are cultivated lands and abandoned terraces, mainly on the flysch which is more fertile from the limestone and mainly retain moisture.

The NW side of Krikelos mountain (823m) was full with oaks (*Quercus ithaburensis ssp.macrolepis*), kermes oaks (*Quercus coccifera*) and Phoenician junipers (*Juniperus phoenicea*) (Miliarakis 1884). In the inaccessible location "Pappas" of Krikelos mountain even nowadays there are remnants of the former extensive forest, which was burned in the great fire of 1835 which lasted twenty days and eliminated it almost completely. Today there are only 15 individuals on the island, mainly in the northern part of the island, in the region of Lagada. Some of them have very large acorns. The Velanidia Foundation for Amorgos implements collection and planting of oak seeds in order to spread the species presence, without any evaluation of the method yet.

Other trees that were found on the island and took part in the ecosystem is the holm or holly oak (*Quercus ilex*) found in Profitis Ilias (702m), the carob tree (*Ceratonia siliqua*), few scattered individuals of which were found in Lagada and terebinth (*Pistacia terebinthus*) also with scattered individuals, mainly found in the northern part of the island. In coastal locations there are tamarisk trees (*Tamarix smyrnensis*) and in few locations with high level of aquiferous horizon, the plane tree (*Platanus orientalis*) and white poplar (*Populus alba*). Furthermore, there are recorded the almond-leaved pear (*Pyrus amygdaliformis*), the bitter almond (*Prunus webbii*) and laurel (*Laurus nobilis*).

Regarding planted tree species, they include figs (*Ficus carica*), cypress (*Cupressus sempervirens*) and the alien cypress species (*Cupressus arizonica*), the Turkish pine (*Pinus brutia*) and the Aleppo pine (*Pinus halepensis*), and few individuals of the stone pine (*Pinus pinea*).

Where the soil has been managed with stone benches and terraces, hydrological conditions are better. The terraces can be found in a great extent in the island.

The main ecosystem types of Amorgos are:

1) The evergreen kermes oak shrublands with great presence of phrygana species,

2) The shrubby areas dominated by Phoenician junipers and mastic trees and

3) The rocks which host significant flora with endemic and rare plant species.

The presence of extensive cliffs favors the development and maintenance of many chasmophytes, including several stenotopic species, Cycladic or Aegean endemic taxa. Moreover, in Amorgos exclusively exists the plant taxa *Symphytum davisii ssp. davisii*, *Campanula amorgina*, *Erysimum senoneri ssp.amorginum*. The rock flora of the island includes also the species *Helichrysum amorginum*, known only from Amorgos and Anydros islet in the SW, and *Eryngium amorginum*, which outside Amorgos inhabits Sikinos, Astypalea and Crete as well.

In the island, there have been declared protected areas of Natura 2000 network 2 areas which overlap with one another and almost entirely cover the northeastern part of the island that includes Mount Krikellos.

1. Special Protection Area for birds GR4220024 entitled " AMORGOS ISLAND (NE PART) AND ISLETS: PSALIDA, GRAMVOUSSA, NIKOURIA, MIKRO and MEGALO VIOKASTRO, KRAMVONISI, PETALIDI" area 3,038.4 ha including marine parts.
2. Site of Community Importance GR4220012 entitled "NORTH AMORGOS AND KINAROS, LEVITHA, MAVRA, GLAROS and marine zone" area of 6,062.5 hectares including marine parts.

3.2 Anthropogenic environment

Amorgos Island belongs to the Regional Section of Naxos of South Aegean Prefecture. The population of the island is 1,973 inhabitants (2011 census). The Municipality is located in Chora, Amorgos and resulted from merging of the communities Aigiali, Amorgos, Arkesini, Vroutsi, Tholaria and Katapola.

The basic economic and social activities on the island, especially the last decades, are tourism and services as well. However, the primary sector (agriculture, livestock and fisheries) remains very important for the island.

The rural areas are located throughout the island, where there are gentle slopes and either being currently cultivated or have been cultured in the recent past. Generally, the rural areas of Amorgos are located in shale background. The soil in such backgrounds is better than the limestone soil, because it retains water and is deeper. These areas have an extensive network of stone benches and terraces, which are used in order to avoid soil erosion and thus many cultivations were supported or being supported such as cereals, olives, figs, pomegranates, vineyards.

The main cultivations are those of grapes, production of wine and raki and olive groves. In addition, livestock production is a very important activity for the island. The total estimated number of sheep and goats stands at 19,100 animals. Fishing activity is quite significant as well, as shown by the number of fishing vessels.

The secondary sector, in the island, is considered low, since only 40 people have been reported that are employed in small units of the island (carpenters, olive mills, construction of clay items, standardization of agricultural products).

Furthermore Amorgos is considered a popular holiday destination with a gradual increase in arrivals from Easter time onwards, with the peak of the number of visitors during the summer (especially in August) and gradual decline since September.

Regarding alternative tourism, it includes the following types:

• Trekking tourism, which is higher during the late spring - early summer and early to mid-autumn.

• Diving tourism, who emerged and developed after the movie "The Big Blue", since Amorgos gained worldwide reputation for clean and deep sea.

• Climbing tourism combined with hiking, especially in the area of Lagada where it has been created climbing center.

• Religious tourism, with reference to the Monastery of Chozoviotissa, and countless byzantine churches.

4. INTERVENTION AREA

4.1. Physiography-Terrain

The study area is located in the area of Chora, 3.4km north-northeast of the village. This distance is not in straight line, but along with the road Chora-Aigiali. It has an area of 3.2 hectares and in the west side there is an area of 0.55 hectares which is a dump, an open excavation, used for various deposits, mainly construction debris. The altitude ranges from 420m to 488m. Slopes are moderate and in most of the area are up to 35%. The orientation is NW.

4.2. Edaphic and water conditions

The bedrock is limestone throughout the area. The soil is calcareous, with a significant amount of surface rock (about 15%). The large vegetation coverage in combination with moderate slopes protects in a large extent the soil from erosion, despite intense grazing. The limestone rock is permeable to water and there is no aquifer close to the surface. The soil is clayey and poor in nutrients.

The dump has no vegetation. In the site, the erosion is avoided because it is shaped with a negative inclination on the edge of the downslope.

4.3. Specific description of vegetation and flora

The area is overgrazed with degraded bushes and phrygana. The dominating species are the kermes oak (*Quercus coccifera*) and Mediterranean buckthorn (*Rhamnus lycioides*), the individuals of which have a height of 0.40m. In addition, the following shrub species are found in the site of Aspro Vouno: the broom (*Genista acanthoclada*), the pink rock-rose (*Cistus creticus*), the Jerusalem sage (*Phlomis fruticosa*), the *Prasium majus* and the Greek horehound (*Ballota acetabulosa)*.

According to the April 2014 sampling in the study area the following herbaceous species were found:

Sarcopoterium spinosum, Urginea maritima, Gagea graeca, Asparagus acutifolius, Silene colorata, Vicia villosa, Anagallis arvensis, Leontodon tuberosus, Plantago lagopus, Asterolinon linum-stellatum, Erodium cicutarium, Cuscuta sp., Phagnalon graecum, Anthyllis vulneraria, Petrorhagia dubia, Muscari comosum , Avena sterilis, Parentucellia latifolia, Centranthus calcitrapa, Poa bulbosa, Erysimum handelii, Asphodelis ramosus, Centaurea raphanina ssp.mixta, Micromeria graeca, Rumex tuberosus, Gynandriris sisirynchium, Tordylium apulum, Trifolium campestre, Senecio vulgaris, Valantia hispida, Thapsia garganica, Mandragora officinarum, Dactylis glomerata, Euphorbia peplus.

Moreover, according to the sampling that took place in the beginning of November, they were found the following species: the cyclamen (*Cyclamen graecum*), the autumn daffodil (*Sternbergia lutea*) and a Greek endemic crocus species (*Crocus laevigatus*).

Below is the form of sampling in April 2014.

SAMPLING			
PROJECT :Management for ecosystem recovery in Amorgos Island			
TEAMWORK: YLI	GPS:		
SAMPLING DATE: 12/4/2014	SAMPLE NUMBER: 2		
PLACE: AMORGOS	SITE: Chora		
VEGETATION UNIT: Phrygana	SAMPLING AREA: Flora Transect		
PHYSIOGRAPHY:			
ELEVATION: 420-460	ASPECT: NW	SLOPE: 35%	
GEOLOGY SUBSTRATE: Limestones	STONES & GRAVEL: -		
TOTAL PLANT COVER:	LEAF LITTER:		
BARREN LAND COVER: 10-20%	SURFACE ROCK COVER: 25%		
TREE COVER: 0%	MAX. HT:	AVERAGE HT: -	
SHRUB COVER: 25%	MAX.HT: 0.40 m	AVERAGE HT: -	
PHRYGANA/HERBACEOUS COVER: 80%	MAX. HT:	AVERAGE HT: -	
ECOLOGICAL CONSERVATION STATUS - OBSERVATIONS: Heavily overgrazed area. Shrubs have been degraded and reach a height up to 0,40m. Rocky soil. At the west side of the area, alongside the road there is an open excavation which is used for masonry dumping. The road Aigiali-Chora passes through from the north side.			

OBSERVED SPECIES

	SPECIES NAME	COVER-ABUNDANCE	MAX.HEIGHT	
Tree Layer				
1				
Shrub Layer				
1	*Quercus coccifera*	**2α**	**0.4**	
2	*Rhamnus lycioides*	**2α**	**0.2**	
3	*Cistus creticus*	**+**		
4	*Phlomis fruticosa*	**+**	**0.4**	
5	*Ballota acetabulosa*	**+**		
6	*Prasium majus*	**r**		
7				
Herbaceous Layer				
1	*Sarcopoterium spinosum*	**4**		
2	*Urginea maritima*	**1**		
3	*Gagea graeca*	**1**		
4	*Asparagus acutifolius*	**+**		
5	*Anagallis arvensis*	**1**		
6	*Vicia villosa*	**+**		
7	*Silene colorata*	**1**		
8	*Leontodon tuberosus*	**+**		
9	*Plantago lagopus*	**+**		
10	*Asterolinon linum-stellatum*	**+**		
11	*Erodium cicutarium*	**+**		
12	*Cuscuta*	**+**		
13	*Phagnalon graecum*	**+**		
14	*Anthyllis vulneraria*	**+**		
15	*Petrorhagia dubia*	**r**		
16	*Muscari comosum*	**+**		
17	*Avena sterilis*	**+**		
18	*Parentucellia latifolia*	**+**		
19	*Centranthus calcitrapa*	**+**		
20	*Poa bulbosa*	**+**		
21	*Erysimum handelii*	**r**		
22	*Asphodelis ramosus*	**+**		
23	*Centaurea raphanina ssp.mixta*	**+**		
24	*Micromeria graeca*	**+**		
25	*Rumex tuberosus*	**+**		
26	*Gynandriris sisirynchium*	**+**		
27	*Tordylium apulum*	**+**		
28	*Trifolium campestre*	**+**		
29	*Senecio vulgaris*	**+**		
30	*Valantia hispida*	**+**		
31	*Thapsia garganica*	**r**		
32	*Mandragora officinarum*	**r**		
33	*Dactylis glomerata*	**+**		
34	*Euphorbia peplus*	**+**		

r: very rare, too small area	+ : very few individuals, small cover
1 : many, cover 1-5%	3 : any individuals, cover 25 - 50%
2m : too many (>100), cover < 5%	4 : any individuals, cover 50 - 75%
2a : any individuals, cover 5 - 12,5%	5 : any individuals, cover 75 - 100%
2b : any individuals, cover 12,5 - 25%	

4.4 Existing management

The site is open to the goatherd from all sides. The goats graze without the shepherds. The road Aigiali-Chora passes from the north side of the study area.

The dump has a rocky front of maximum height 6m. This area includes excavations and construction deposits as well as old household devices. There are two squares (dumps) and downslope there is an elevated crest that gives a negative inclination, which leads north to free ('bulk') slope.

4.5. Evolution and natural vegetation succession

Generally, after an intense disturbance, the ecosystem loses a significant part of the biomass and according to the ecosystem terminology, it follows regressive succession. The main aspect of the ecosystem today in Amorgos is that of a sparse and low shrub land with a strong presence of phrygana, like the one in the study area. The disturbances that bring immediate regressive succession are fire and land clearing to create arable land. By grazing on current conditions there is no regressive succession but maintaining the same degraded form. The normal undisturbed evolution is the gradual succession to a higher and denser shrub land. As plant community climax, should be considered the high kermes oak (*Quercus coccifera*) shrub land.

Therefore, if the ecosystem is left undisturbed and there be a management towards soil and water conservation, then the ecosystem could reach the form of high shrubland with *Quercus coccifera, Rhamnus alaternus, Pistacia terebinthus, Euphorbia dendroides*, and even *Ceratonia siliqua* and *Quercus ilex.*

5. MANAGEMENT INTERVENTIONS

5.1 Purpose of interventions

The **interventions for upgrading and improvement of ecosystem functions**, include projects that will help to **gradually rectify vegetation** and **improve the conservation functions of the soil and utilization of water**, in an **ecosystem which is degraded** by grazing and past fires and bound by the **limitations of the bioclimate**.

The goal is that all interventions for ecosystem restoration to be implemented with respect to nature and local identity. The proposals for the various interventions reflect a conception of respect to the place so refer to projects adapted to the region, site, society, tradition (no grand interventions, no planting of alien species). These measures take into account local traditions and structures, if they do not put at risk the real goal of **ecological sustainability.**

Moreover, a second goal is the proposed projects to be implemented with the best possible use of **local resources** and the **consent and support of the local community** and the productive forces of the island (e.g. livestock farmers, farmers and other land owners). It will seek to ensure that all interventions and initiatives will be framed by the local organizations and collectives who should be involved, to some extent, in the respective planning processes.

Finally, the aim of the proposals is to build relationships and partnerships and create **synergies with other relevant local initiatives** from the cultural, economic and ecological point of view.

5.2 Capabilities and limitations

The restrictions are strong and derive from steep slopes, dry soil, xerothermic bioclimate and grazing, associated with socio-economic conditions.

The capabilities are related to both mitigate the constraints and the existence of advantages.

The advantages concern the existence of a road in one side of the site and the existence of know-how to build terraces.

5.3 Soil and water management

5.3.1 Terraces

Terraces are stone walls (masonry without mortar), that aim to prevent soil erosion and improve soil moisture, by reducing slope. They are constructed by stones without binder, as a common agricultural technique to create or expand arable land, globally applicable, in particular, widespread in the Mediterranean Basin and the Aegean islands. Stone terrace is a dominant traditional element of Greek natural environment and landscape, particularly found at the islands of the Cyclades.

In Amorgos Island they were used widely, whereas in the study location, their use is indicated for the prevention of erosion and not for creating zero gradient, which would require the transport of soil.

For this purpose, one long terrace will be built (335m), on the crest of the road slope on the north side. The terrace will have a width of 0.40m and a height of 0.60m out of which 0.15m is the foundation.

5.3.2. Terrain interventions

In the existing terrain there will be a small scale reshaping in the dump. The shaping will include leveling of deposits, removal of the household devices and scrap metal. There will be created two gentle slopes with gradient of 30% and a flat part. The display of the shaping is shown in the intervention map and in the relevant section.

There will be no change in the terrain on the remaining site.

5.3.3 Water management

The water and especially its shortage is one of the limiting factors for the improvement of the ecosystem. Any attempt for ecosystem management involves a way of collection and storage of water, which can then be used for irrigation of new plants in the first years of their lives.

However, waters supply of the countryside will be in such size range that it respects the natural landscape and environment and the sustainability of the water.

For the irrigation of the plants that will be planted, there will be used one plastic cylindrical 5m³ water tank. The placement will be done in appropriate place shown on the intervention map. The plants will be supplied with water from a suitable point on the road Aigiali-Chora, with a tanker pump, so that there is minimal difference in height between the supply point and the tank. In order the two tanks to be placed, the soil will be configured a bit and if they are visible from the street, there will be built a dry wall on the downstream side of them. The transfer to the placement position will be done manually with the use of wooden drivers with pulley. At the placement position a pulley will be mounted on a metal pole. The tank will be tied with rope while alongside a 'worker' wraps the rope so that the pulley drives the reservoir upstream. To climb the slope there will be used planks placed as guides to give track and which manually move upwards along with the movement of the tank.

5.4 Grazing management

Regarding grazing management, fencing will be practiced and it will prevent grazing animals to enter. The fence is made of a galvanized mesh, with hole 6x10cm, diameter 2.7mm and height 1.5m. For mounting there will be used galvanized poles 1.5mm Φ42 1.5m high, which will be placed every 2m.

The length of the fence will be the whole perimeter of the site (1,030m).

5.5 Installation of new plants

5.5.1. Species selection

In cases the ecosystem has suffered a significant degradation as in Amorgos, it will need some kind of plant material introduced in order to help in ecosystem recovery. Introduction can be done either by seeding or by plantings. The selection of proposed plant species should meet the following requirements:

- to be species of native flora.
- to be adapted to local bioclimatic conditions and resistant to the specific conditions of the project (drought, winds, poor soils).
- to have low requirements of water and nutrients.
- to be species present in nurseries, to be able to order it in relation to the quantities and sizes needed.
- Not to be easily affected by pests and diseases.

For the above reasons species that can be selected are:

1. the terebinth *(Pistacia terebinthus),*
2. the almond-leaved pear *(Pyrus amygdaliformis),*
3. the Holm Oak *(Quercus ilex),*
4. the fig tree *(Ficus carica),*
5. the Valonian Oak *(Quercus ithaburensis ssp.macrolepis),*
6. the Greek sage *(Salvia fruticosa)*
7. the thyme *(Coridothymus capitatus)*

The **Valonian Oak** (*Quercus ithaburensis ssp. macrolepis*) is semi-evergreen tree up to 15m. Its crown is very wide and has large cups and acorns. It is a thermophilic species, resistant to dry, calcareous soils and winds. It is a native species in the Cyclades and Amorgos.

The **Holm Oak** (*Quercus ilex*) is an evergreen sclerophyllous tree. The fruit is acorn. It is resistant to poor soils, drought and winds. Moreover, it is planted in cities, as an ornamental tree. Native to Amorgos.

The **fig tree** (*Ficus carica*), is a deciduous tree, up to 7m usually very spreader crown. It has large palmate leaves with milky liquid, producing a fruit, the known fig. It is a plant which is resilient in the poor soils of the deposition site.

The **almond-leaved pear** (*Pyrus amygdaliformis*), is a deciduous tree usually 4-5m high, with oblong leaves. It is also called agriapidia (wild pear tree in Greek). Its fruit are small round pears which get yellow when ripe. Native to Amorgos.

The **terebinth** (*Pistacia terebinthus*) is a deciduous shrub, used as rootstock for grafting of edible Pistachio tree. It has small red berries and ornamental foliage in autumn. Native to Amorgos.

The **Greek sage** (*Salvia fruticosa*) is a low, aromatic and pharmaceutical shrub, which is used for bee-keeping. It has glaucous fluffy leaves and pink flowers in herringbone inflorescence pattern. Native to Amorgos

The **thyme** (*Coridothymus capitatus*) is a strongly lignified, low and aromatic shrub, which is also used for bee-keeping and in cooking. Its leaves are very small, intensely fragrant, whereas its flowers are purple. Native to Amorgos.

5.5.2. Installation method

For plantings there will be used small plants in pots. The pit of the planting is small (hole) and will be made only in favorable microenvironments. The seeding has been used experimentally for the Valonian oak to Amorgos from Velanidia Foundation. For the three of these species can be used seeding: Valonian oak and Holm oak.

Planting locations

Based on the inclination map, three positions are determined approximately with slope less than the general one. The surface of each one of the three areas is approximately 280m². The rubble dump will be configured as shown in the map with the interventions.

Planting distances

The distance is not precisely defined, since the precise planting location is determined by the microenvironment. However, the distance should not be smaller nor larger than 3-4m.

For the rubble dump, the configuration will be as follows: Some species (trees and shrubs) are planted at distances of 3x3 in the squares and embankments that will occur after the final configuration. The following species Greek sage and thyme are planted in an area of 0.1 hectare to the crest of the embankment downstream of the squares on a distance 1x1m.

Seedlings' origin

Seedlings will come either from the nursery that will be established by the Municipality of Amorgos, either from the existing nursery on the island. In any other case, the seedlings should be transferred from a nursery of an adjacent island (eg Naxos). The nurseries should operate in accordance with the provisions of Law 1564/85.

5.5.3. Material and task prescription

All seedlings must be representative of the species which has been chosen and have normal branches or stems and fairly well developed, as and healthy root systems. Plants should be hardy, without phytopathological or pest abuses, unsightly knots, bark abrasions, injuries from wind and other deformities. Their appearance should be indicative of good health and vitality and to be clear that the pruning of the vertices and the cleanup of the roots has been done correctly.

If plants are grown in plastic polyethylene bags or pot, they must be fill with suitable growth subbase.

The trees should have straight trunks with proper configuration of branches, symmetrical peak and untouched central trunk. They should not have sections of the strands with diameter greater than 20mm, which have not healed completely. The height of the trees, which identify the required features, will be measured over the root node (the neck of the root). The dimensions of the overground and underground part of the plant should be in proportion. Otherwise, either roots are cut or the overground part is pruned.

Generally, the trees will be planted, will be small. The height will range from 0,20m to 1m, whereas the trunk circumference up to 8cm and the soil ball no more than 7 liters.

Planting prescription

The planting process helps the plant to adapt to the natural environment in which it will be placed. The first time after planting the plant must harden. The goal is physical and smooth integration of the new site and new conditions which are less favorable than those of the nursery. The period during which the planting should take place is either October-November or February-April. Before planting, the surface should be cleaned from aggregates and greens. It is explicitly indicated that there will not be a general leveling of soil or treatment with machinery.

The planting procedure is as follows:

Opening up of planting pit

The planting pit is opened with digging tool or machine and is usually shaped like a truncated cone. Its dimensions are proportional to the size of the plant and particularly relative to the size of the ball of soil surrounding the roots. The depth of the hole should be approximately equal to the diameter at the level of the natural ground. The minimum depth of the planting pit should be as the height of the soil ball, higher by 10 centimeters. The aim is to ensure space for the plant so it can grow. A typical planting pit of a small tree has depth of 40cm and of diameter on the surface of the natural ground 30cm.

Plant preparation

During preparation for planting the young plants which are grown in plastic bags with soil balls, the pouch that protects the soil ball is carefully remove. The pouch is cut with a

sharp knife around and then is removed the bottom. Following is a vertical cut on the side of the bag and removed without breaking the soil ball.

Plant placement

The placement of the plant in the pit is made with attention not to spoil the soil ball. The plant is placed in the upright position, holding it with one hand from the part between the roots and foliar (neck), and with the other hand holding the base of the soil ball. It has previously been placed at the base of the pit a layer of loose soil material (10cm). This layer helps root growth during the first stage adaptation of the plant.

Filling with soil & irrigation basin configuration

After placing the plant, the gaps are covered in the pit by soil. The added soil material must be up to 10cm below the natural ground line to form irrigation pit. The soil to be used may be the same as that which was removed during the opening of the pit after the stones have been removed. Around each plant an irrigation basin is shaped, with diameter of about 60cm for a 30cm pit. Within the irrigation basin sawdust will be added. Sawdust will retain moisture after first watering and will prevent germination of weeds around the plant.

Irrigation

After planting the first watering follows in order to eliminate the gaps and achieve the integration of the ball of soil in natural terrain. Then the pit is filled with soil if needed.

5.5.4. Irrigation and maintenance of the plantings

The seedlings are watered the dry season (June-September) for two years after planting. There will be 10 waterings in the xerothermic season. This number may change depending on the prevailing weather conditions. The water will be pumped from the tanks that have been proposed for the site of intervention. The tanks will have automatic irrigation solenoids.

A polyethylene pipe Φ40 carries water with pump to the tank. From the tank at an elevation of 485m a Φ40 pipe leads the water to the rubble dump, where two Φ32 bring water into the site. From the tank will begin three pipes Φ32 that will lead the water to the three planting positions Φ1, Φ2 and Φ3.

The tertiary irrigation network of 16 pipes receives the water from the Φ32 and distributes it to the plantings.

Digging

Digging is necessary because it improves the soil around the roots and gives better growth to the plant. It should be done in spring after the last rains (one time in total). Moreover, because of the fact that the plants will be watered during the summer period, the pits must be shaped properly.

Weeding

After planting, weeding along with digging is applied in order to create good conditions for plant growth. The task of weeding refers to the removal of weeds that grow around the plant. The weeds cut out the necessary ventilation from the plant, limit the growth space and consume soil minerals and water that are essential for the plant.

5.6. Other management interventions

There will be removing of the phryganic species *Genista acanthoclada*, *Sarcopoterium spinosum* as well as herbaceous asphodels. It is estimated that plant removing will be applied to 100 individuals of the species mentioned above. The reason is basically experimental to improve the pasture land. The unwanted plants from grazing animals will be removed in order to investigate whether other desirable plants will enter into these positions.

5.7. Task timetable

s/n	Intervention	MAY.14-SEPT.14	OCT.14-APR.15	MAY.15-SEPT.15	OCT.15-APR.16	MAY.16-SEPT.16
1	Fencing					
2	Terrace					
3	Phrygana removing					
4	Terrain configuration at the rubble dump					
5	Tanks & irrigation network establishment					
6	Planting					
7	Irrigation network function					
8	Maintenance					

The process will be monitored and the results will be evaluated. After 7 years a new study will take place, the role of which will be to identify actions that will have to be applied to fences, irrigation networks and other interventions.

6. BILL OF QUANTITIES-BUDGET

6.1. Bill of quantities of works and tasks

6.1.1. Bill of quantities table of planting sites

s/n	Site	Surface (m^2)
1	Φ1	280
2	Φ2	280
3	Φ3	280
4	Excavation of depositions	3900

6.1.2. Bill of quantities of plant species

s/n	Species	Quantity/Positions Φ1-Φ2-Φ3	Quantity/Rubble dump	Quantity
1	Holm oak	20	110	130
2	Terebinth	20	120	140
3	Valonian oak	20	50	70
4	Almond-leaved pear	0	20	20
5	Fig tree	0	30	30
6	Greek sage	0	500	500
7	Thyme	0	500	500
	Sum	60	1,330	1,390

The species 1, 3, 4 and 5 are tree species (250 in total), the species 2 is shrub, whereas the species 6 and 7 will be considered perennial species of the category Π1.

At the rubble dump the species 1, 2, 3, 4, 5 are planted in the planting distance of 3x3m in the squares and the embankments that will be created after the final configuration.

At the rubble dump the species 6 and 7 will be planted in an area of 1000m^2 towards the slope crest downslope in a planting distance of 1x1m.

6.1.3. Summary table of bill of quantities of works and tasks

No	Tasks	Unit	Article	Quantity
1	Stone terracing with elaborate surface	m^3	B.9-ΟΔΟ	80.40
2	Tree supply	item	Δ1.1.	250.00
3	Shrub supply	item	Δ2.1.	140.00
4	Perennial supply	item	Δ6.1	1,000.00
5	Pits open with hand tools of dimensions 0.3x0.3x0.3m	item	E2.1.	1,390.00
6	Planting with soil ball 0.4-1.5lt	item	E9.3	1.390,00
7	Formation of basins with diameter up to 0.60m	item	ΣΤ1.1.	1,390.00
8	Shrub clearing	item	Z1.2	100.00
9	Surface elaboration	ha	Γ1	4.00
10	Tank $5m^3$ made of polyethylene	item	NEO	1.00
11	Polyethylene tube Φ16/6Atm	m	H1.1.1	1,100.00
12	Polyethylene tube Φ40/6Atm	m	H1.1.5	355.00
13	Polyethylene tube Φ32/6Atm	m	H1.1.4	345.00
14	Self-regulating dripper, visitable	item	H8.1.1	1,390.00
15	Simple type irrrigation battery programmer	item	H9.2.2.1.	1.00
16	Fencing mesh	m	E5-ΟΔΟ	1,030.00

The terraces are applied in a total length of 335m with a width of 0.40m and a height of 0.60m.

The cutting and uprooting of shrubs refers to 100 individuals of *Sarcopoterium spinosum* and broom (*Genista acanthoclada*).

The general area reshaping is applied in 0.4 hectares of the rubble dump.

The bill of quantities of the irrigation pipes and the paths were based on the map of interventions.

6.2. Unit prices

No	Tasks	Unit	Article	Cost (€)
1	Stone terracing with elaborate surface	m^3	B.9-ΟΔΟ	43.80
2	Tree supply	item	Δ1.1.	3.50
3	Shrub supply	item	Δ2.1.	2.10
4	Perennial supply	item	Δ6.1	0.85
5	Pits open with hand tools of dimensions 0.3x0.3x0.3m	item	E2.1.	0.80
6	Planting with soil ball 0.4-1.5lt	item	E9.3	0.80
7	Formation of basins with diameter up to 0.60m	item	ΣΤ1.1.	0.40
8	Shrub clearing	item	Ζ1.2	2.00
9	Surface elaboration	ha	Γ1	105.00
10	Tank $5m^3$ made of polyethylene	item	NEO	1,000.00
11	Polyethylene tube Φ16/6Atm	m	Η1.1.1	0.30
12	Polyethylene tube Φ40/6Atm	m	Η1.1.5	0.85
13	Polyethylene tube Φ32/6Atm	m	Η1.1.4	0.65
14	Self-regulating dripper, visitable	item	Η8.1.1	0.22
15	Simple type irrrigation battery programmer	item	Η9.2.2.1.	100.00
16	Fencing mesh	m	Ε5-ΟΔΟ	4.00

6.3. Budget

Project budget (Prices of Single Tariffs Government Gazette B363/19-2-2013)						
No	**Tasks**	**Unit**	**Article**	**Price/unit (€)**	**Quantity**	**Cost (€)**
1	Stone terracing with elaborate surface	m^3	B.9-ΟΔΟ	43.80	80.40	3,521.52
2	Tree supply	item	Δ1.1.	3.50	250.00	875.00
3	Shrub supply	item	Δ2.1.	2.10	140.00	294.00
4	Perennial supply	item	Δ6.1	0.85	1,000.00	850.00
5	Pits open with hand tools of dimensions 0.3x0.3x0.3m	item	E2.1.	0.80	1,390.00	1,112.00
6	Planting with soil ball 0.4-1.5lt	item	E9.3	0.80	1.390,00	1,112.00
7	Formation of basins with diameter up to 0.60m	item	ΣΤ1.1.	0.40	1,390.00	556.00
8	Shrub clearing	item	Ζ1.2	2.00	100.00	200.00
9	Surface elaboration	ha	Γ1	105.00	4.00	420.00
10	Tank $5m^3$ made of polyethylene	item	NEO	1,000.00	1.00	1,000.00
11	Polyethylene tube Φ16/6Atm	m	Η1.1.1	0.30	1,100.00	330.00
12	Polyethylene tube Φ40/6Atm	m	Η1.1.5	0.85	355.00	301.75
13	Polyethylene tube Φ32/6Atm	m	Η1.1.4	0.65	345.00	224.25
14	Self-regulating dripper, visitable	item	Η8.1.1	0.22	1,390.00	305.80
15	Simple type irrrigation battery programmer	item	Η9.2.2.1.	100.00	1.00	100.00
16	Fencing mesh	m	Ε5-ΟΔΟ	4.00	1,030.00	4,120.00
Total tasks cost						**15,322.32**
Contingencies 15%						2,298.35
Final Project value						**17,620.67**

7. PHOTOS

Photo1. The vegetation and soil conditions of the area of Aspro Vouno.

Photo2. The area from above to the east.

Photo3. The excavation of rubble deposition.from the west to the east.

Photo4.The excavation of rubble deposition from the center to the west.

Photo5.The site is located downstream from the rocky ground of the picture. In the backgaround view of the Nikouria area.

Photo6.The *Rhamnus lycioides ssp.oleoides* as results by the effect of overgrazing. The height does not exceed 20cm.

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