



**DESERTLINKS**

**COMBATING DESERTIFICATION IN MEDITERRANEAN EUROPE  
LINKING SCIENCE WITH STAKEHOLDERS**

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**Driving forces and pressure indicators: decision-making by local  
stakeholders**

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## **WORK PACKAGE 1.3: “DRIVING FORCES AND PRESSURE INDICATORS: DECISION-MAKING BY LOCAL STAKEHOLDERS”**

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### **Introduction**

Land use reflects both land capability which depends on climatic interactions with other physical characteristics of the environment, and land suitability complexly interrelated with various socio-economic factors including the characteristics of market supply and demands (Openshaw & Turner, 1999). Furthermore, land use change is intricately affected by an array of factors related to the physical, environmental and socio-economic characteristics. Physical factors include mainly crop management practices such as irrigation, fertilization, tillage operations, level of mechanisation, or farm conditions such as farm size, farm fragmentation and so forth. The environmental drivers provide the basic conditions for crop growth, such as air temperature, precipitation, sunshine, soil chemical and physical properties, and landscape characteristics. The socio-economic factors including among others subsidies, land tenure, product price are basic determinants in land use change.

Prediction of land use change is a complicated issue affected by various interrelated factors. Several models have been developed for predicting land use change, but they are mainly concerned with one or two socio-economic aspects of the issue, i.e., employment level shifts or population dynamics. An exception is the work undertaken by the CLUE Group (de Koning *et al.*, 1997; Veldkamp & Fresco, 1996, and 1997; Verburg *et al.*, 1997). The CLUE modelling framework (The Conversion of Land Use and its Effects) is based on a multi-scale

step-wise regression analysis predicting land use and land use change as a function of various socio-economic and biophysical factors.

Soil and water resources in the Mediterranean region are used in an unsustainable manner. The Mediterranean landscape, as a whole, is ecologically fragile and seriously endangered by the prevailing social and economic trends (Gleick, 1993). In this aspect, the future of the region may be threatened by: increasing coastal areas stress, changing land uses, expanding differentiations between tourist areas and the rural hinterlands, enhancing serious water resources interdependencies, increasing susceptibility of water pollution, and affecting sensitivity between the water and soil equilibrium. Most of the population in the Mediterranean region is concentrated in the coastal zone, and increasing tourism causes strong seasonal demands over natural resources, goods and services (Karavitis & Kerkides, 2002). In this regard sustainable development of natural resources (land and water) requires not only comprehensive policies but also valid and reliable indicators, and coherent models (Decleris, 2000) for predicting land use changes. Such an approach should take into consideration the relationship between humans, their cultures and their surrounding environments; and, the new practicing “ethos” in environmental thinking, planning and implementation (Vlachos & Braga, 2001).

The Mediterranean basin is an area that has been subjected to intensive land use for thousands of years accompanied with various land use changes. Land use changes in the Mediterranean area during recent history are due mainly to physical and technological factors as well as socio-economic reasons. Particular land uses have been related to specific population behaviors, spatial distribution changes, and pressure over natural resources. The analysis of land use evolution in Lesvos for the last 4000 years showed a dramatic increase in agricultural land by replacing forested land. Many of the areas that once supported forests were cleared in order to sustain agriculture, but since measures of soil conservation were insufficient, these areas were severely eroded and abandoned from agriculture (Fig. 1).



**Fig. 1. Examples of land abandonment from agriculture (olive groves right, and cereals left) due to land degradation in the island of Lesvos**

Predicting land use change decision-making is a complicated issue. In this context, the aim of this work package is to understand the land use changes in selected agricultural areas of European Mediterranean (Greece, Italy, Spain, Portugal) through the analysis of the impact of biophysical and human factors on farmers’ decision-making. The articulation between the human and biophysical factors, which is at the root of land use, contributes to the understanding of the complexity of the processes of change, through the comparative analysis of local case studies.

More specifically the objectives of this work package are the following:

1. To identify the environmental, physical, social, economic, institutional, and cultural factors that influence land use decision-making at the local level, by type of landowner (individual or collective) and land use (agricultural, pasture, forest).
2. To identify those factors that are, or can be, influenced by policy and those that are internal to the land use decision-making unit – i.e. to distinguish between endogenous and exogenous factors in the context of land use decision-making.
3. To identify the processes by which land use change occurs – i.e. the way that the above factors are combined to induce the landowner to change the current land use– either qualitatively or quantitatively or both.
4. To analyse which processes and factors lead to the different types of land use and land use change in the target areas, and to identify indicators related to driving forces and pressures.

The study was based on a cross-disciplinary approach to understand the change in the four areas, integrating both socio-economic and biophysical dimensions. In this work package, the societal driving forces –social, political, institutional, cultural-, the economic and environmental that influence the development of each area and modify the landscape by changing land forms, land use and land cover has been examined. The conducted research has benefited from the results of farms surveys and discussions with stakeholders organized in the target areas. Extremely usable found the outcomes of other related projects accomplished as MEDACTION and MEDALUS II-III.

## **I. Main processes and factors affecting land use, land use change, and management practices**

### **1. Methodological approach**

Two research strategies have been employed in order to analyze the factors affecting land use change-decision-making in the four target areas (Alentejo, Guadalentin, Agri, and Lesvos). The first strategy involved the use of stakeholders focus groups and the second strategy a farm survey for analysing macro-factors and micro-factors, respectively, affecting land use change. Farm survey was conducted only in the island of Lesvos.

#### Stakeholders focus group workshop

A workshop was organized in the each of the pilot areas and the various factors affecting land use change were discussed. The stakeholder workshop included land managers, policy makers, researchers, media, NGOs, local farmers, etc, drawn from the local community, giving significant contributions to the discussions. Specifically the stakeholders focus groups for the four pilot areas were drawn from the following:

#### Alentejo stakeholders focus group

- DESERTLINKS project: scientists (focus group coordinator plus one person from the module or work package most related to the workshop theme).
- Ministério da Agricultura: field officers from the local extension services Zona Agrária de Mértola, Direcção Regional de Agricultura do Alentejo, Direcção Geral das Florestas which hosts the UNCCD Portuguese Focal Point.

- Ministério do Ambiente, Instituto da Água, Parque Natural do Vale do Guadiana and from the Direcção Regional de Ambiente do Alentejo.
- Ministério do Equipamento, Planeamento e Administração do Território, Comissão de Coordenação da Região Alentejo.
- Farmers Associations.
- NGOs: Associação de Defesa do Património de Mértola.
- Câmara Municipal de Mértola
- Media: local regional and national newspapers, radio and television stations.

#### Guadalentín stakeholders focus group

- DESERTLINKS project: two scientists (the lead scientist for this work package and another who will vary for the different workshops depending on the expertise required for the specific workshop).
- Independent experts: focused on environmental and agrarian issues.
- Regional Public Administration: Department of Agriculture or Water Resources, Sub-regional Agrarian offices, Land Planning and Environment Department.
- Segura Basin Water Authority, National Administration
- Local Public Administration: municipalities will be asked for participants related to agriculture, rural communities and environment.
- NGOs: main environmental organizations in the area.
- Irrigation Communities: related to water management.
- Agrarian Organizations
- Media

#### The Agri basin stakeholders focus group

- DESERTLINKS projects: scientists (work package lead scientist plus one person from the modules or work packages most related to the workshop theme).
- The National/Regional Focal Point
- Regional Administration
- Regional Environmental Protection Agency
- River Basin Authority
- Farmers associations
- Media
- NGOs (SOS – WWF)
- National Union of Mountains Territories
- National Parks
- Research community
- SMEs (Agribusiness System)
- High school (teachers/students)
- Local residents and community representatives (free thinkers/civil society)

#### The Lesvos stakeholders focus group

- DESERTLINKS projects: scientists (work package lead scientist plus one person from the modules or work packages most related to the workshop theme).
- Independent experts: expertise on environmental and agricultural issues.
- Region of Northern Aegean: expertise preferably in agriculture or water resources, regional and rural development, environmental protection.
- Directorate of Agriculture, Prefecture of Lesvos competent in the areas of agriculture, rural development, water resources and environmental protection.

- Local communities: from areas with high land degradation .
- International Cultural Center, Eolis (working on national heritage and natural resources), located in Eresos, Lesvos.
- Farmer Organizations/Cooperatives
- Local Farmers.
- NGOs
- Media: with expertise on rural and environmental issues

The various speakers analyzed the causes and impacts of land use change on desertification using the results of research projects conducted in the area. Each presentation was followed by a discussion of 30-50 minutes. At the end, a structured questionnaire was prepared and administered to the participants (Table 1) in which participants were asked to provide their opinion and stance with respect to the principal list of questions presented in the farm survey and to identify the major forces and processes involved in land use decision-making and accounting for the observed environmental effects.

**Table 1: Summary questionnaire related to the land use change decision-making distributed to the stakeholder focus group workshops**

Factors of land use change decision-making	YES	I don't know/I don't answer
Main climatic characteristics (rainfall, air temperature, winds, etc)		
Major soil characteristics (soil depth, slope gradient, drainage, etc)		
Irrigation water (amount, quality, water rights, etc)		
Market characteristics (proximity, domestic or export, etc.)		
Labour availability (family and hired labour, seasonal needs, etc.)		
Technical skills (experience, response to innovation and change, literacy)		
Level or possibilities of mechanisation of cultivation		
Size, shape and fragmentation of farms		
Land tenure and ownership (freehold, tenancy, communal, state)		
Infrastructure (storage depots, markets, roads, schools, medical facilities, electricity, etc.)		
Produced product prices		
Tradition, attitudes and perceptions		
Food preferences		
Tourism development		
Migration		
Household size and income		
Parallel employment		
Environmental impacts (public health, wildlife conservation, flooding, water quality, etc.)		
Governmental implications, institutional support, subsidies		

Remarks: .....

The questionnaire included macro- and some micro-factors affecting land use change decision-making such as environmental, physical, management, demographic and social, economic, policy related, and attitudes (Table 2). The questionnaire was general, addressing the various factors affecting land use change decision-making since there are many

interrelations among them. For example in the environmental factors included generally climate without to define separately rainfall, aridity, winds, annual temperature, etc

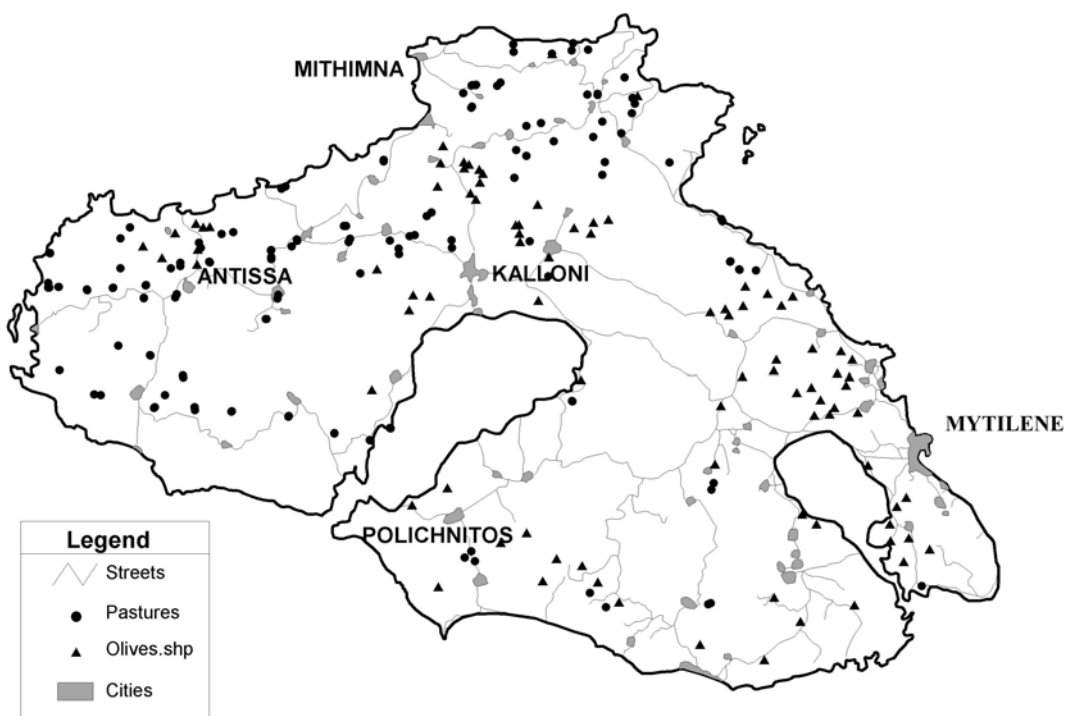
### Farm survey

The farm survey in the island of Lesvos included field measurements and informal discussions with the farmers related to: (a) the physical condition of the farm such as: parcel size, number of parcels, farm fragmentation, type of land use, period of existing type of land use, previous type of land use, (b) the physical environment such as: annual rainfall, soil depth, slope gradient, sensitivity to desertification, (c) management characteristics such as: tillage operations, application of fertilizers, animal grazing, water available for irrigation, (d) demographic and social characteristics such as: ownership, family size, farmer age, (e) policy related characteristics such as: subsidies, and policy enforcement of existing regulations for environmental protection (Table 2). The farm survey was conducted in two dominant land use types - olive groves and pastures. Forests are also important land uses in the island but these areas are strictly controlled by public agencies. The analysis of the occurred land use changes was conducted for the period 1965-2002.

**Table 2. Factors affecting land use change decision-making at micro- meso- and macro level in each target area**

FACTORS	SUB-CATEGORIES	MICRO – SITE LEVEL	MESO- BROADER COMMUNITY (OR ISLAND)	MACRO- BROADER REGION
1. SOCIETAL				
	a. <u>Demographic trends</u>	Family size Age of farmer	Depopulation Migration	
	b. <u>Institutional</u>	Farm size Parcel size No of parcels	Land fragmentation Land tenure Common Agricultural Markets Cooperatives	
	c. <u>Policy</u>	Subsidies National policy enforcement		Governmental interventions Globalization EU enlargement
	d. <u>Technological</u>	Technical skills Level of mechanisation	Accessibility	Infrastructure
	e. <u>Culture</u>	Perceptions & attitudes	Education level	Food preferences
2. ECONOMIC		Farmers' income Land value Parallel employment	Market characteristics	Tourism development Product prices
3. ENVIRONMENTAL		Soil conditions Soil depth Slope gradient Sensitivity to desertification	Environmental problems  Water availability	Climate characteristics Rainfall Winds
		Tillage operations (times/year) Application of fertilizers Presence of terraces		

A questionnaire was prepared addressing the principal micro-factors that are relevant to the respective population. The study field sites – ranging in size from 1.5 to 4.0 hectares – were located on topographic maps (scale 1:50,000, grid 400 meters by 400 meters) following the systematic sampling procedure described by Webster (1977). Unfortunately, a small number of sites were studied following this methodology because it was rarely possible to find the farmer on his land in the specific site for collecting all the information related to land management and crop production. Therefore, the majority of the study sites were randomly distributed in the various land use types located in fields where a farmer was found (Fig. 2). In each field site the questionnaire was completed in collaboration with the land user and the measurements were conducted for describing the physical environment characteristics. Each determinant of contemporary land use change was described after defining distinct classes. For example, type of ownership was described as private, rent, state, specific regulations (Table 3). The classes were defined using existing classification systems such as the European georeferenced soil database (Finke *et al.*, 1998), or existing research data. A total of 228 field sites were studied distributed over the entire island (Fig. 2).



**Fig. 2. Distribution of the study field sites during the farm survey in the island of Lesbos**

The following parameters: land ownership, family size, farm size, number of parcels, farmer age, parallel employment (if any), tillage operations, application of fertilizers, source of the available irrigation water, number of animals grazing the land, period of existing land use type and available subsidies were defined in collaboration with the land user.

Soil depth to unconsolidated bedrock was measured in auger holes or after digging the soil. The following classes were used: very shallow (depth 0-15 cm), shallow (15-30 cm), moderately shallow (30-60 cm), moderately deep to very deep (>60 cm) (Table 3). Slope gradient was described using topographic maps of the appropriate scale. The following dominant slope classes were distinguished: <6%, 6-18%, 18-35%, and >35%.

Long-term daily weather records were supplied by the meteorological stations of Mytilene, the capital of Lesbos, representing the eastern part of the island (45 years records-

Greek National Meteorological Service), and the station of Antissa representing the western part of the island (29-years records-Agricultural Research Service, Greek Ministry of Agriculture).

Land terracing was determined by the extent to which a field site was covered by terraces and the degree in which these were protected from collapsing. The extent to which a study site was covered by terraces was defined as the ratio of the area protected to the total study area. The same kind of information was used for assessing the extent to which terraces were protected and it was expressed as a percentage.

**Table 3. Questionnaire including factors with corresponding classes used in the farm survey for analyzing land use change in the island of Lesvos**

Site number:..... Date of description: .....									
Author describing: ..... Location: ..... ESA: .....									
Elevation (m): .....latitude: .....Longitude:.....									
Type of Ownership	Private	Rent	state	Specific regulations	Other				
Family size	1	2-3	4-6	6-10	>10				
Farm size	<1 ha	1-5 ha	5-10 ha	10-30 ha	30-50 ha	50-100 ha	>100 ha		
Number of Parcels	1-3	4-6	7-9	10-12	13-15	16-19	>19		
Parcel size Measured	<1 ha	1-5 ha	5-10 ha	10-30 ha	30-50 ha	50-100 ha	>100 ha		
Age of farmer	6-15 years	15-35 years	35-65 years	>65 years	Other				
Parallel employment	NO	Industry	Tourism	State	Municipality	Other			
Subsidies	NO	sub/area	sub/animal	sub/kg	Other				
Tillage operations (times/year)	NO	Plowing	Disking	Cultivator	Other				
Application of Fertilizers	NO	<100 (kg/ha)	100-300	300-500	>500	other			
Animal grazing (animals/ ha)	NO	<1	1-3	3-6	6-10	10-15	15-20	>20	Other
Type of Land use	Agriculture	Pasture	Shrubland	Forest	mining	Recreation	other		
Period of existing Type of land use	<1 year	1-5 years	5-10 years	10-20 years	30-50 years	>50 years			
Previous type of Land use	Agriculture	Pasture	Shrubland	Forest	mining	Recreation	other		

Soil depth (cm)	<15	15-30	30-60	>60			
Slope gradient (%)	<6	6-18	18-35	>35			
Annual rainfall (mm)	<280	280-650	>650				
Water Source	No	Ground water	Collective	Dam	Small pond	Surface water	Other
Presence of terraces (terraced area/total area)	NO	<20%	20-50%	50-75%	>75%	Other	
Degree of policy Enforcement	Adequate >75% of the area	Moderate (25-75% of the area)	Low (<25% of the area)	No	other		

The effectiveness of the policies on environmental protection depends on the degree of enforcement, while they are rated based on their degree of effectiveness. Hence, the information collected on the existing policies depended and their implementation/enforcement of the policy under consideration. For example, in the case of terracing protection policy, a relevant piece of information was the ratio of protected terraces to existing terraces in the study field site.

The location of each field site was accurately defined by using a GPS (Magellan, 500 DX). All the data collected on the indicators related to land use change decision-making were further analyzed. Each indicator was described after defining distinct classes. The classes were defined using existing classification systems such as the georeferenced soil database, or existing research data. A statistical analysis was conducted by using the statistical package STATISTICA (version 5X). A principal component analysis was applied for all data collected in the farm survey. Finally, after the analysis of each target area we conclude with some general remarks regarding driving forces and land use changes.

## 2. Analysis of factors and processes affecting land use change

Planning sustainable land use types in areas sensitive to desertification is an important action for combating desertification. Such an action has been included in the NAPs is high priority. Land use change decision-making by the farmers is affected by various environmental, physical, social, economic, institutional, and cultural factors. The identification and the analysis of the factors that can be influenced by policy and those that are internal to the land use decision-making unit are very important for promoting sustainable land use types in sensitive areas to desertification. In the following discussion the various factors affecting land use change decision-making is analyzed separately for each target area.

### 2.1. Alentejo, Portugal

The Alentejo region lies to the South of Portugal, between the Tagus River to the North and the Algarve mountain ridge to the South. In east borders on the Spanish regions of Extremadura and Andalusia and in west sees the Atlantic Ocean. From a transportation perspective, the region is linked by land to the capital, the Algarve region and Spain. By sea

there is the Sines harbour on west and by air Alentejo has two airports, the Military Base in Beja and the Municipal airfield in Évora.

The Alentejo region has a Mediterranean climate with hot dry summers and cool wet winters. The rainfall is variable (400 to 600 mm/year) and soils are generally poor, derived from schist, granite and limestone or sandstone. This region is dominantly flat with some deep narrow valleys and a few low altitude hills.

Originally this area was covered with cork oak and holm oak forest, which was cleared for grazing and cereal production. Montado is the agro-silvo-pastoral system that most characterizes Alentejo agricultural management, open oak woodlands with extensive grazing and cereals. Other typical land uses include olive groves and vineyards, particularly near villages and towns. Farm units are generally between 50 to 1000 ha, reflecting the extensive type of agriculture practiced.

## A. Societal factors

### Demographic Trends

According to the 2001 General Population and Housing Census, the resident population in Alentejo totals 776.585 inhabitants (Table 4), a relatively very small group of the national population (7%) which being in a relatively extensive area (in 2003 amounted to 31.483,6 km<sup>2</sup>, corresponding to approximately 1/3 of the national territory (91.946,7 km<sup>2</sup>). Between 1991 and 2001 censuses the population decreased by 0.7%, the only negative trend in continental Portugal. The Alentejo region shows a population density of 24.4 inhab./sq. kilometres (Table 5), much lower than the national figure of 112,4 inhab./sq. kilometres, being the least populated region of the country.

**Table 4: Population data of Alentejo region**

	2001 census residents	2001/1991 census residents	2002 residents	Present population	2001/1991
Portugal	10.356.117	5.0%	10.407.465	10.148.259	2.9%
Alentejo	776.585	-0.7%	767.983	760.896	-2.2%

MAIN DEMOGRAPHIC INDICATORS				
2002				
	GROWTH RATE POPULATION (2001/2002)	CRUDE BIRTH RATE	CRUDE DEATH RATE	INFANT MORTALITY RATE
	%	‰		
<b>Portugal</b>	0.8	11.0	10.3	5.0
<b>Continente</b>	0.8	10.9	10.2	4.9
e	0.7	11.3	8.7	5.4
Centro	0.5	9.6	11.8	3.8
Lisboa e Vale do Tejo	1.0	11.5	10.2	5.0
Alentejo	0.0	8.7	14.5	4.8

Algarve	1.9	11.4	11.8	5.1
<b>Açores</b>	0.5	12.9	11.2	6.5
<b>Madeira</b>	0.4	12.9	11.1	5.8

<b>DEPENDENCY RATIOS AND AGEING INDICES</b>	
<b>2003</b>	
	<b>%</b>
<b>Elderly ratio</b> (65+years / 0-14 years)	106.8
<b>Total dependency ratio</b> (0-14 e 65+ years) / 15-64 years	48.3
<b>Youth dependency ratio</b> (0-14 / 15-64 years)	23.3
<b>Elderly dependency ratio</b> (65+ years / 15-64 years)	24.9
<b>Note: Calculated Indicators based on the Census 2001 final data</b>	

*Source: Portuguese National Statistics Institute*

According to the results of the questionnaire, only 18 (Table 6) respondents considered migration issues as a factor affecting land use change. Emigration is a strong reason for depopulation phenomena in Alentejo. Emigration on a massive scale began in the second half of the twentieth century and continued until 1980s (after the oil shock that slowed the economies of West European nations and reduced employment opportunities). The main motive for emigration was economic. Portugal was long among the poorest countries in Europe. With the countryside able to support only a portion of farmers' offspring and few opportunities in the manufacturing sector, many Alentejans had to go abroad to find work. In some periods, Portuguese emigrated to avoid military service. Thus, emigration increased during World War II and during the 1960s and early 1970s, when Portugal waged a series of wars in an attempt to retain its African colonies. Its noticeable that during the 1960's Alentejo lost almost 200.000 inhabitants which amounts for 20% of its total population.

**Table 5: Alentejo Population density**

1970	22.6 hab/Km2
1981	21.5 hab/Km2
1991	20.2 hab/Km2
1997	19,9 hab/Km2
2002	24.4 hab/Km2

*Source: Portuguese National Statistics Institute*

Additionally, Alentejo has met an outmigration over the past 15 years. Lack of investment motives in agriculture prompt the young people to move to the industrial zones of Lisbon and Setubal seeking a job, leaving behind an ageing generation. Furthermore, big cities on the coast offer a much more investment opportunities than Alentejo.

According to National Statistical Survey the occupation of the population in primary sector performs a firm descending course since 1960s (Table 7). Alentejo's services sector dwarfed agriculture and industry, both as a contributor to regional GDP and as a source of employment. In 1973 services accounted for 39 percent of GDP; by 1990, that share had risen to nearly 56 percent. In 1985 services employed slightly over 47 percent of the region's

labour force, and in 2004 that share reached more than 61 percent. The agricultural employment rate has dramatically fell off from 31.0% in 1985 to 14.4% in 2004, a fact that according to the questionnaire results constitutes the second significant driving force to land use change decisions.

**Table 6. Results of the questionnaire related to land use decision-making driving forces**

	<b>Factors of land use change decision-making</b>	<b>RELEVANT- YES (%)</b>
<b>1</b>	Water irrigation	40
<b>2</b>	Labour availability	39
<b>3</b>	Main climatic characteristics	38
<b>4</b>	Environmental impacts	38
<b>5</b>	Level of possibilities of mechanisation of cultivation	35
<b>6</b>	Governmental implications, institutional support, subsidies	34
<b>7</b>	Major soil characteristics	33
<b>8</b>	Produced product prices	30
<b>9</b>	Natural hazards	28
<b>10</b>	Tradition, attitudes and perceptions	28
<b>11</b>	Tourism development	28
<b>12</b>	Size, shape and fragmentation of farms	27
<b>13</b>	Market characteristics	26
<b>14</b>	Technical skills	26
<b>15</b>	Infrastructures	25
<b>16</b>	Food preferences	25
<b>17</b>	Land tenure	20
<b>18</b>	Parallel employment	19
<b>19</b>	Migration	18
<b>20</b>	Household size and income	17

These demographic factors are associated with land use changes such as abandonment of agricultural land, expansion of pastures, or in some cases expansion of olive groves in other agricultural land uses or forests or some farmers resort to parallel employment (part time agriculturalists, e.g. when it comes to olive groves) supplementing their income.

**Table 7. Alentejo: Structure of Active Population by Sector**

Year	Primary	Secondary	Tertiary
1985	31.0%	21.6%	47.4%
1990	23.3%	23.7%	53.0%
2004	14.4%	24.3%	61.4%

*Source: Portuguese National Statistics Institute*

#### Institutional

Land tenure and farm fragmentation compose have a relatively small influence on decision-making. The system of land tenure in Alentejo was largely collectivised until late 1980's due to the expropriations issued by the Agrarian Reform Law<sup>1</sup>. Very large collective farms were formed in Portalegre and Beja (averaging between about 3,500 and 4,200 hectares); smaller units were created in Santarém and Setúbal (averaging between about 860 and 1,180 hectares). By the 1990's the gradual decollectivisation of agriculture led to concentration of ownership in the south-central provinces of the country. Until then, the large collective farms proved incapable of modernizing and their efficiency was declining.

On the other hand, today farmer's co-operatives/associations are playing a crucial role in communication and advice and are referred to by farmers as key factors affecting their decision-making (34 responses). Local farmers associations are almost the only source of information on agricultural policy and aids. They help their members in form filling, advising, animal disease control and in running the agri-environmental measures and they also contribute with organizing training courses for advisory technicians specifically in specialized fields such as organic farming, olive production and irrigation (*Juntti & Wilson, 2003a*)

### Policy

Since Portugal's accession in EU in 1986, European policies on agriculture and rural development have played a decisive role on farmer's decision (34 respondents) (Table 8). This decisive role can be reflected in the identification in the evolution of the Alentejo farming the last twenty years.

During the pre-accession period Portugal's agriculture was very backward employing a large labour force (25% of the total labour force). The system was based on intensified cereal farming due to high prices paid by the State. The farmers were clearing the montados of holm oak forest in order to enable mechanized cereal farming.

The first five years after the EU accession in 1986 and the introduction of the Common Agricultural Policy (CAP) brought EU capital aid and subsidies for farm modernization, mechanisation and intensification causing an increase in cropping areas and soil mobilization, fertilizer, herbicide and pesticides use, and a decrease in fallow pasture areas.

Following the CAP revision of 1992 the decrease of crops subsidies and the introduction of the agri-environmental measures in 1994 directed the farmers to reduction in cereals, an increase in fallow pastureland and a decrease in animal stocking rates. There was also the beginning of minimal cultivations, an increase in the area of irrigated crops, and an increase in montado area and new tree plantings<sup>2</sup>.

The most recent period 2000-02 saw the CAP Revision "Agenda 2000" and the wide scale change from soft wheat to durum wheat crops due to the higher subsidy for the latter being offered. Also there has been a further increase in irrigated areas, including new areas of olive groves and vineyards.

Cork tree plantations aside<sup>3</sup>, the Alentejo is currently going through a significant change with regard to its agricultural vocation. With intervention subsidies on cereals and livestock falling away to make way for a more market driven economy, most Alentejano landowners and farmers are seeking new ways to make their farms viable. Crops such as

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<sup>1</sup> 29 July 1975

<sup>2</sup> 2080/92 Regulation to afforest farmland

<sup>3</sup> Alentejo produces over 50% of the world cork crop

vineyards, olives, tomatoes and to a lesser extent sugar beet are currently the more popular options. With prices of the latter two “annuals” being directly controlled by the European Union, income from these crops is likely to continue falling as market forces begin to take hold.

With the popularity of Alentejano wines increasing (a clear recognition of quality), both at home and abroad, numbers of new vineyard plantations are likely to continue increasing over the next few years.

Most of the farmers now fear the consequences of EU enlargement on their agricultural products, since the value of EU subsidies in their incomes has been very significant, sometimes as high as 60% of total income.

Besides EU policies, central government has paid little attention to regional rural development. They feel isolated. Even administration extension services in the Alentejo are very limited in use due to lack of qualified staff and even more; they are being trimmed down as part of a general cut back in government administrative costs. The farmers see them as a burden of paper work that must rely on them to process subsidy forms and projects.

**Table 8. Policies influencing Alentejo farmers decision-making**

<b>EU Regulation</b>	<b>Type of aid</b>	<b>Take-up</b>	<b>% Farmers</b>
797/85	farm improvement aid	Most farms	17
2328/91	improvement aid	Most farms	17
1257/99	rural development regulation	Most farms	10
465/86	less favoured areas	Most farms	36
1094/88	set-aside	Cereal farms	20
Several	co-finance cereals	Cereal farms	17
2078/92	agri-environmental measures	Farms	42
2309/97	durum wheat quotas	Cereal farms	28
2366/98	olive oil CMO	Olive farms	21
2467/98	sheep and goat CMO	Farms	12
1254/99	cattle CMO	Farms	8
1493/99	wine CMO	Vineyards	4

Source: MEDACTION

### Technological

An important role to land use decision-making plays the level of mechanisation (35 responses). Low level of mechanisation and lack of equipment are mainly factors for land abandonment or expansion of pastoral activity. In the first half of the 1980's Portugal has the lowest mechanisation level in Europe. Even though later the number of tractors more than doubled due to EU aid, the level still remains low. Furthermore, the general education level is low and there are not many skilled workers because they have sifted to more profitable industry and services sectors.

### Cultural

Primary sectors' development of the region upon new foundations is favoured by new prevailing ideological tendencies / life style approach across Europe, biological farming products, agrotourism and health/natural nutrition. Some part of the European funds resources are allocated to such new activities, rendering obsolete the traditional farms. In recent years,

great emphasis has been placed on the production of olive oil and wine using organic cultivation methods.

On the opposite there are some cultural characteristics that according to the interviewed farmers' opinions they are a setback to agricultural development in general: Individualism, laziness, lack of organization, lack of enterprising and associative spirit.

## **B. Economic factors**

Since Portugal's entry in EU, Alentejo already being among the poorest regions in Europe couldn't easily fit into new conditions. Market deregulation and Common Agricultural Policy resulted in agricultural prize's decrease. New market characteristics such international competition, new consumer modes and technological changes were till then unfamiliar to farmers and they found difficulties in marketing farm produce. In free market conditions nowadays the farmers associations and co-operatives have become very important for marketing mainly cereals, olives and grapes, and to a lesser extent livestock.

Farmer's financial difficulties are another important factor affecting their decisions. Due to the adverse soils and climatic conditions in the Alentejo, as well as the continuing falling farm incomes, many farmers are restricted in their ability to invest in new machinery for example. Increasingly most farmers were strongly dependant on subsidies, which amounted for almost 60% of their income having also in mind that there is a continually cutting off by EU. Alentejo is among the 25 most poor regions in European Union, by GDP per capita. It passed from the third position in 1986, with a GDP per capita of 37% of EU average, to the 16<sup>th</sup> position in 1996, with GDP per capita 59,7% of EU average. Today Alentejo has the smallest GDP per capita 9.6 thousand euros in Portugal (GDP per capita 11.9 thousand euros) (Table 9).

Despite the fact that the greater part of Alentejo area is in agricultural use, the primary sectors contributes only 15.1% of regional GDP and 3.9% of national GDP. Low productivity level is steadily diminishing in all sub regions of Alentejo, following the same record by employment rate. The tertiary sector holds the entire dynamic<sup>4</sup> and absorbs the employment. A considerable part of the farmers interviewed said that they have some outside income. Rural depopulation affects labour availability especially for seasonal work such as olive picking and the grape harvest.

North Alentejo is mostly affected by strong decrease in farm labour resulting to an increase in mechanical harvesting and soil preparation. While the south Alentejo hasn't been so much affected, on the contrary, in larger farms where there has been noticed an increase in labour is usually associated with a change to more intensive crops such as new olive groves and vineyards, or other irrigated crops.

Investments around the big regional cities such as Portalegre, Evora and Beja keep their population, but not in agricultural sector, due to the uncertainty about future prices and subsidies. Nowadays, vineyards and irrigated crops (maize, tomatoes) are flourishing, keeping also a good level of seasonal employment.

### **Table 9. Regional Economic Accounts for Agriculture**

Gross value added  
at basic prices  
Current prices

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<sup>4</sup> Tourism sector is growing but not very fast. There are some dynamics yet unexploited.

(Base 1995)

	1995	1996	1997	1998	1999	Unit: 106 Euros 2000
<b>Portugal</b>	<b>2,641.24</b>	<b>2,790.74</b>	<b>2,568.07</b>	<b>2,482.17</b>	<b>2,864.79</b>	<b>2,668.54</b>
<b>Norte</b>	<b>750.31</b>	<b>787.19</b>	<b>600.75</b>	<b>622.49</b>	<b>769.30</b>	<b>703.31</b>
<b>Entre Douro e Minho</b>	<b>404.28</b>	<b>372.22</b>	<b>261.01</b>	<b>290.41</b>	<b>333.31</b>	<b>268.27</b>
Trás-os-Montes	346.03	414.97	339.74	332.08	435.99	435.04
<b>Centro</b>	<b>492.38</b>	<b>545.01</b>	<b>486.42</b>	<b>469.33</b>	<b>529.99</b>	<b>538.44</b>
Beira Litoral	336.59	359.24	318.02	311.81	335.92	326.94
Beira Interior	155.79	185.77	168.40	157.52	194.07	211.50
<b>Lisboa e Vale do Tejo</b>	<b>721.07</b>	<b>719.33</b>	<b>779.62</b>	<b>716.04</b>	<b>838.68</b>	<b>723.20</b>
<b>Alentejo</b>	<b>385.35</b>	<b>441.13</b>	<b>407.19</b>	<b>383.05</b>	<b>400.80</b>	<b>384.88</b>
<b>Algarve</b>	<b>120.56</b>	<b>117.50</b>	<b>126.98</b>	<b>124.35</b>	<b>142.85</b>	<b>116.59</b>
<b>R. A. Açores</b>	<b>126.92</b>	<b>132.18</b>	<b>121.71</b>	<b>122.62</b>	<b>137.66</b>	<b>150.22</b>
<b>R. A. Madeira</b>	<b>44.65</b>	<b>48.40</b>	<b>45.41</b>	<b>44.29</b>	<b>45.51</b>	<b>51.90</b>

Source: *Portuguese National Statistics Institute*

### C. Environmental factors

According to the results of the questionnaire, environmental concerns (water availability, climate, soil condition) are the most important factors affecting land use change in Alentejo.

The Alentejo is a raised plain and comprises of montados, open cereal fields, olive groves or steep river valleys and scrublands. Alentejo's area is around 2,700,000 ha and it is characterized mainly by vast flat to rolling topography, the peneplain, where some mountain ridges reach 600 meters: Ossa, Portel, Grândola and Monfurado. The São Mamede mountain ridge, the highest in the region with an altitude of 1000 meters, lies in the extreme North.

Approximately 61.5% of the region's land is less than 200m above sea level and low plateaus with extensive fluvial basins (Guadiana, Mira, Sado e Tejo).

The geology is dominated by Herciano mass, with two well-defined areas: the basins of the Tejo and the sado and a large extension of schist and complexos derivados.

Approximately 650.000 ha of soil, correspond to 24.1% of the Alentejo region, present great risk for erosion, thickness problems, and stone agglomerations.

The climate of the Alentejo is Mediterranean with warm dry summers with temperatures reaching 30-40°C. There are local climatic differences depending on proximity to the coast, height above sea level and exposure to Atlantic winds. The average sunlight hours are high, above 3,000 hours annually. The rainfall pattern is notoriously irregular and rain often falls in torrential showers, one of the main reasons for the high soil erosion rates that occur in the

region. The average annual rainfall is 500-600 mm, concentrated from the end of the Autumn/beginning of Winter and in the Spring (March).

The Alentejo produces about 75 percent of the country's wheat, much of the area is classified as arable land, poor soils dominate most of the area, and consequently yields of dryland crops and pasture are low by West European standards. The Alentejo is also known for its large stands of cork oak and its olive groves.

The eventual increase in the area of irrigated land in the region doesn't raise a lot of enthusiasm from farmers who have been confronted with a shortage of quotas to be able to profit from the potential increase in production. Nevertheless, water availability comes out as an important factor in land use change decision-making for the farmers (*Juntti & Wilson, 2003a*). Due to the Portuguese Water Policy, the Government promoted the increase of irrigated areas with investments such as the Alqueva dam scheme (creating the largest artificial lake in the EU) on the river Guadiana, which was completed in 2002. Once fully operating, the reserve will irrigate another 110,000 hectares of intensive crops although it is not clear whether it will be viable in a future scenario, as the availability of production quotas could be a limiting factor.

In Alentejo 89.1% (1.924.044 ha) of the total area (2.158.884 ha) is dedicated to agriculture. Alentejo's agricultural system (Table 10) is predominated by the montados, occupying an area of 1 million hectares (36 % of the area of the region). The *montado* is the agro-silvo pastoral system specific to the region, comprising an open formation of cork and holm oaks in varying densities, combined with a rotation of crops/fallow/pastures.

There are also areas of permanent pasture usually with spontaneous grassland and shrubs, which accounts for 500 thousand hectares (18 % of the total area of the region). Arable crop areas, cover an area of 18% and they are used for the production of dry land cereals; soft wheat, durum wheat and oats. Finally, in 5 % (160 hectares) of the Alentejo agricultural area there are permanent crops of olive grove and vineyard.

**Table 10. Agricultural land structure**

Agricultural Systems in Alentejo	%
Montados (pastoral and arable farming)	36%
Permanent pasture, (natural grassland and shrubs)	18%
Arable crop areas (dryland cereals of soft wheat, durum wheat and oats)	18%
Olive groves and vineyards	5%
Total area in Alentejo	2.158.884 ha

*Source: MEDACTION*

The last twenty years CAP and subsidies were the main reason for management changes on farms. On better soils there was an increase in irrigated crops such as maize, tomatoes, melons, sunflowers, olives and vines and so an increase in use of water. The same period there were changes in soil management with less use of the moldboard plough and a more common use of chisel type ploughs or heavy discs with some reduction of soil run-off.

## 2.2 Guadalentin Basin, Spain

Traditionally, the Guadalentín basin has been used for dryland agriculture, mainly cereals, tree crops and grazing (sheep and goats). Since the 1970s, there has been a strong increase in irrigated agriculture, partly driven by subsidies and increased export opportunities provided by the EU. Besides arable land, the area consists of a mix of stipa lands, forest lands (Mediterranean deciduous forests with oaks, wild pistachio, cistus, etc.), pinus halepensis planted forests, maquis and, locally, badlands. These lands are used for hunting and grazing, with minor wood production from the pine trees.

On the basis of the interviews with selected stakeholders and the farm questionnaire the following analyses which driving forces affect land use decision-making, categorized by societal, economic and environmental conditions.

## A. Societal factors

### Demographic Trends

The Guadalentín basin covers slightly over 3.000 km<sup>2</sup>, i.e. 26.5% of Murcia Region. It is populated by 182.953 inhabitants representing (Table 11) 15.4% of total Region's population. Administratively belongs to the Autonomous Region of Murcia (45 municipalities) and is comprised by two districts, Bajo Guadalentín (Aledo, Totana, Librilla, Alhama de Murcia, Mazarrón) and Alto Guadalentín (Lorca, Puerto Lumbreras, Aguilas) (*Anuario Estadístico De La Region De Murcia 2004*).

**Table 11. Population evolution based on official census 1900-2001**

Major cities	1900	1910	1920	1930	1940	1950	1960	1970	1981	1991	2001
Águilas .....	15.753	16.037	17.315	15.903	15.466	15.427	15.535	17.187	20.809	24.894	28.226
Aledo .....	973	958	1.335	1.233	1.297	1.384	1.237	1.067	1.081	985	1.026
Alhama de Murcia .....	8.410	9.207	9.743	10.042	11.083	11.344	11.786	11.600	13.132	14.175	16.225
Librilla.....	3.076	3.498	3.184	2.981	3.049	3.032	3.079	3.194	3.516	3.764	3.945
Lorca.....	69.910	72.795	75.802	61.392	69.517	71.269	59.316	60.286	61.879	65.919	77.477
Mazarrón .....	23.362	22.878	18.206	14.120	11.928	9.501	9.998	9.191	10.270	14.591	21.229
Puerto Lumbreras (1) .....	..	..	..	..	..	..	7.205	8.046	8.560	9.961	11.069
Totana.....	13.714	14.235	14.211	13.842	15.453	14.718	14.424	16.300	18.537	20.466	23.756
TOTAL.....	135.19	8									182.953

(1) *Puerto Lumbreras belonged to Lorca.*

Source: INE. Population Census

The importance of population distribution must be considered. Four kinds of population distribution can be described in the area:

- i) The inner city, with high population density (In the Guadalentín basin the biggest part of population is situated in the major cities like Lorca).
- ii) North and south areas. A lot of settlements with little population.
- iii) The “Huerta”, continuous but disseminated settlements

iv) The north (out of the settlements) and the west, almost without population (there are 500 km<sup>2</sup> totally depopulated in the west part of the Lorca municipality).

Despite the fact that over the 20th century population in Murcia steadily arises and in particular since the 1970s, during the last years it's being noticed an outmigration towards the urban centres of the Region but mostly to major Spanish cities (Madrid, Seville, Barcelona, etc) and even though there is an immigration flow originated mainly from northern African countries (Morocco), all these prefer the big cities. Apart from this, in less than two generations farmers have returned from forced emigration to industrial centers in Barcelona and Madrid to live in the region with one of the highest growth rates of agricultural productivity in the country. This clear enhancement of people's economic standards has led to a social momentum in favour of irrigation at the expense of dryland farming.

**Table 12. Rating of factors affecting land use change decision-making in Guadalentín basin.**

<b>Factors of land use change decision-making</b>	<b>RELEVANT- YES (%)</b>
Irrigation water (amount, quality, water rights, etc)	<b>100</b>
Governmental implications, institutional support, subsidies	<b>90</b>
Produced product prices	<b>90</b>
Tourism development	<b>80</b>
Technical skills (experience, response to innovation and change, literacy)	<b>80</b>
Labour availability (family and hired labour, man-months per ha, seasonal peak periods, etc.)	<b>70</b>
Main climatic characteristics (rainfall, air temperature, solar radiation, winds, etc)	<b>70</b>
Infrastructure (storage depots, markets, roads, housing, schools, medical facilities, electricity, research, etc.)	<b>70</b>
Major soil characteristics (soil depth, slope gradient, rock fragments, drainage, texture, acidity, etc)	<b>70</b>
Level or possibilities of mechanisation of cultivation	<b>60</b>
Market characteristics (proximity, domestic or export, etc.)	<b>50</b>
Tradition, attitudes and perceptions	<b>50</b>
Household size and income (family size and age distribution, employment on and off the farm, sources of income, changes in income, total net income, etc.)	<b>50</b>
Parallel employment	<b>50</b>
Size, shape and fragmentation of farms	<b>40</b>
Environmental impacts (public health, wildlife conservation, flooding, siltation, water quality, etc.)	<b>40</b>
Migration	<b>20</b>
Land tenure (freehold, tenancy, communal ownership, state ownership)	<b>20</b>
Food preferences	<b>Not answered</b>

In Guadalentín, Ecuadorians are the largest group arriving after the collapse of their economy in the late 1990s. The majority of immigrants eventually move to the city (the "urbanistas"). There are almost 5.000 work emigrants from Ecuador and Morocco, preferring mostly the urban centres.

Also there are some European immigrants, wealthy tourists, who have chosen the Guadalentín basin for their second or even permanent residence.

Conclusively, 20% of the questionnaire respondents consider migration and it's consequences factors affecting farmers' choices (Table 12). The population increase affects the selection for some land uses (irrigation farms) in the areas where this population has some interests, changing the value that can be achieved with different land uses. On the other side, the increase of population and tourism makes necessary more infrastructures and land use changes.

### Institutional

Average age of farmers is over 35, mostly over 50 (Table 13). The next generation is unlikely to continue their parent's work because the life is tough and the work is hardly rewarding. On top of that, farmers depend on the climate and thus live in constant uncertainty, both in environmental and in economic terms. Considering the above, 50% of the respondents relate farmers family structure and age with land use choices. In most of the cases farmers abandon their lots when there are no young people to take on or keep them but as seasonal work for emotional reasons (*Censo Agrario*).

Most of the farmers are members of co-operatives and rely on them for almost all financial aspects of their farm, including the subsidies they apply for. The clear role of the co-operatives in influencing farmers' decision-making was also clear regarding the size of irrigation expansion by farmers, with members expanding to a greater extent than non-members.

Another institutional aspect pointed out by the respondents is land fragmentation (40%) and land tenure (20%). In Guadalentin 68.3% of total explorations are smaller than 5 hectares. Irrigated lands are small and there is a high percentage of rented land (Table 14). This is due to the introduction of new irrigated lands, glasshouses and residential developments and the process is increasing. While the drylands are bigger in size and mostly private.

**Table 13. Number of farmers (physical person) by age groups. 1999**

	Total	≤34 years	35-54 years	55-64 years	≥65 years
Águilas .....	676	99	372	120	85
Aledo .....	270	27	118	59	66
Alhama de Murcia .....	1.415	121	502	387	405
Librilla.....	1.210	107	453	323	327
Lorca .....	5.754	649	2.414	1.468	1.223
Mazarrón .....	785	152	358	172	103
Puerto Lumbreras .....	837	72	385	219	161
Totana.....	1.719	193	674	478	374
TOTAL.....	12.666	1420	5.273	3.226	2.744

*Source:* INE. Agricultural Census.

### Policy

Similarly to the other target areas, national and EU policies constitute the most significant factor influencing agricultural orientation in the region (90% of respondents to the questionnaire).

For Guadalentin basin, water and agricultural policies (i.e. government support for infrastructure construction and structural aid for efficiency enhancements, water concessions) promoted irrigation expansion at the expense of unattended drylands, declining since the late 1970s drought.

**Table 14. Total area and used agricultural area by municipalities and property status in 1999**

	Total Area (ha.)				
	TOTAL	PRIVATE	RENTED	FREEHOLD	OTHER STATUS
Águilas	17.567	10.631	3.730	3	3.203
Aledo	2.872	2.576	46	251	-
Alhama de Murcia	19.094	17.257	1.773	45	18
Librilla	3.414	3.381	25	1	7
Lorca	117.711	98.135	16.986	1.728	861
Mazarrón	22.167	12.679	7.201	182	2.104
Puerto Lumbreras	9.874	8.261	1.564	39	10
Totana	19.888	17.607	2.115	165	1
TOTAL	206,587	170527	33440	2414	6205

	Used Agricultural Area (ha.)				
	TOTAL	PRIVATE	RENTED	FREEHOLD	OTHER STATUS
Águilas	7.135	3.887	3.241	1	6
Aledo	1.486	1.295	45	146	-
Alhama de Murcia	11.532	9.744	1.727	45	17
Librilla	2.048	2.016	25	1	7
Lorca	66.210	52.417	12.126	1.436	231
Mazarrón	9.719	7.162	2.274	182	101
Puerto Lumbreras	6.829	5.434	1.359	28	9
Totana	8.541	6.419	1.994	128	1
TOTAL	113,500	88,374	22,791	1967	372

*Source:* INE. Agricultural Census.

CAP and subsidy policies get a very important role to many farms. Despite the enormous paperwork burden and the uncertainty about the future cutbacks, this extra little bit of financial aid stimulates farmers to cultivate certain products and provide an incentive to cultivate local products. After Spain's entry into the EU and the Single Market, subsidies for horticulture and fruits enhanced the ongoing fast expansion of irrigated lands, while subsidies for cereals, almonds and oil groves managed to support the declining dryland farms to sloped lands.

All these driving forces replace the non-existence of a land management policy by the public administration. This policy should organize the land uses in the area. The economic importance acquired by irrigation has made it unanimously supported by the entire political spectrum and both national and regional administration, and, although recognizing the negative effects of its uncontrolled increase on their respective issues of competence, both environment and physical planning departments act as subsidiary to this objective, claiming lack of effective powers to tackle the problem.

CAP contributions to farmers can be either positive or negative for erosion and desertification processes, depending on the way they are applied. The objectives are accurate but, in many cases, the bad use due to a lack of coordination and the lack of agriculture and environment objectives causes undesirable results. There is not enough coordination among the different contribution programs and a lack of preparation and sensitivity on desertification subjects by directives and managers. Subjects as erosion control, afforestation and others related to desertification are not of the politicians interest. This is because these subjects need big investments and restrictive measures, and the effects can be observed only after a long time. This is not interesting to politicians because they want results in the short term that can be turned into votes in the next elections.

### Technological

Infrastructure changes decisions in terms of increasing the possible land uses when the area is more accessible. The Autonomous Region of Murcia has developed a relatively good infrastructure, is thus less isolated and has better access to the regional and (inter)national markets.

The construction of the Tagus-Segura transfer channel built in the mid 1970s and put in operation from 1980 contributed clearly to irrigation expansion. Furthermore on its way to implementation is the new National Hydrological Plan, which foresees a huge investment in infrastructure for water transfer from the Ebro River basin (Northeast Spain) to Murcia and neighbouring regions. And the 2008 scenario National Irrigation Plan foreseeing only existing irrigation expansion enhancements (*Juntti, M., & Wilson, G., 2003b*).

Technological innovation makes feasible some land uses that weren't possible before this innovation, so this has an influence on the land use decisions (70%). This is the case of dripping irrigation technique. Flooding irrigation has been substituted in many holdings by the new management technique contributing to the reduction of certain crops such as cereals and cotton and the introduction of horticulture as well the reinforcement of vineyards.

### Cultural

Traditions, attitudes and perceptions of local people were considered to be by 50% of the questionnaire respondents as determining factor in land use.

## **B. Economic factors**

Among those selected in the workshop, farm income is one of the main driving forces for land use decisions and changes (50%). The farmer tries to optimize the benefits with the maximum net income per area.

New market opportunities for irrigation products appeared after 1970 in Spain. The preferential agreement with the EEC facilitated access to and demand from the international

market, which opened completely on Spain's EU accession in 1986 and in Single Market in 1992. Profit oriented agricultural products in combination with favourable market was the driving force (50%) for the intensification of irrigated farms and certain dryland products such as almonds and olives, supported also by EU subsidies (almond organic farming).

The low profitability of dryland farms, the difficult working conditions and the competence from the industrial farming, with more capacity for technological innovation, drive farmers today to other lucrative activities. More and more farming is a part time activity (parallel employment, 50%). The "weekend farmers" amount almost 40% of Guadalentin Basin farmers. Only 10% of them keep farming as secondary activity. (Table 15).

On the other hand, exclusive dedication to farming affects farmers who are fully dependent on subsidies.

Tourism development affects farmers choices in two ways. Increasing tourism on the one hand attracts more labour (former work in agricultural units) and on the other hand change the land value. The fear of the potential predominance of the tourism sector in the area has effect on the continuity of the farming activity. High land prices deter those farmers who usually rent areas for irrigation.

**Table 15: Number of farmers (physical person) by principal occupation. 1999**

	TOTAL	Exclusively in agriculture	Other lucrative activity		
			Total	Principal	Secondary
Águilas .....	676	460	216	187	29
Aledo .....	270	185	85	73	12
Alguazas .....	662	385	277	258	19
Alhama de Murcia .....	1.415	819	596	542	54
Librilla.....	1.210	600	610	576	34
Lorca.....	5.754	3.874	1.880	1.696	184
Mazarrón .....	785	519	266	237	29
Puerto Lumbreras.....	837	525	312	265	47
Totana.....	1.719	1.033	686	596	90
TOTAL.....	13.328	8.400	4.928	4.430	498

*Source:* INE. Agricultural Census.

### C. Environmental factors

The situation in the environmental context is characterized by surface and groundwater overexploitation, soil salinization and natural habitat destruction along with a massive increase of irrigation agriculture in the valley.

Environmental factors such as water availability, climate and soil characteristics (70%) are the first choices among questionnaire respondents regarding influence of land use change decision-making.

Climatic conditions (70%) as climatic change, high temperatures, and low rainfall rates, especially in areas with water scarcity, affect possible land uses. The area of Guadalentin has the typical Mediterranean semi-arid subtropical climate. The average annual air temperature reaches 18°C, with hot summers (registering absolute maximum temperatures of 40°C) and mild winters (an average temperature of 11°C in the winter months of December and January). Rain is scarce throughout the region (approx. 300-350 mm/year), falling mainly in

the spring (April) and autumn (October), leaving the summer an eminently dry season. Climatic conditions are also very important in land use decisions, since the frequent droughts lead to more and more marginal land uses if the access to water is not possible. Small farmers are being replaced by the big agro-business.

Access to water is the most important determinant factor (100% of the respondents) since if this access is possible, even if high investment is required and the soil conditions are not so suitable for that use, farmers will choose irrigation farming. This preference is co-determined by the big difference in the benefits obtained between irrigation and dry farming. In Guadalentín the lack of water has been a structural problem for many decades and is not just correlated with the (possible) recent acceleration of climate change. Water shortage intensifies every year in the agricultural sector with an increasing irrigated area and thus water demand. The water used for irrigation comes from two main sources: the Tajo-Segura water canal (canal transferring water from central Spain to the Segura basin and the Guadalentín, constructed in the late 1970s) and the (emergency) reservoirs. The latter is water from a low quality source because of salinisation. In progress according to the National Hydrologic Plan is the construction of a new canal to transport water from the Ebro River in the North East down to the Guadalentín. Although, there are some doubts that the extra water supply would exclusively benefit the booming tourist industry and not the farmers.

If the problem persists some expect the emergence of conflicts over water availability and distribution between large agricultural enterprises and SMEs, as well as between the agricultural sector in general and the tourist industry. The expected outcome of these conflicts in the present situation is an abandonment of the cultivation of crops with a high water demand and eventually the end of agricultural activity in the Guadalentín.

In dryland areas, due to lack of labour and the fact of being a part time activity, farmers have abandoned soil protection techniques in cropped plots, as ploughing along contour line, terracing, gully correction etc.

In irrigated areas due to agricultural policies and subsidies in the last twenty years, farmers substituted flooding techniques with dripping technology. Technological management of water has therefore enhanced irrigation efficiency, “saved water” having been reemployed by most farmers in expanding or intensifying their irrigated area.

Moreover, some almond organic farming (agri-environmental measure) is made in the area. Commercial competitiveness and European policies ask for environmental health. There are programs to combat erosion but neither they are accurate or enough; a real determined action is not yet taken seriously.

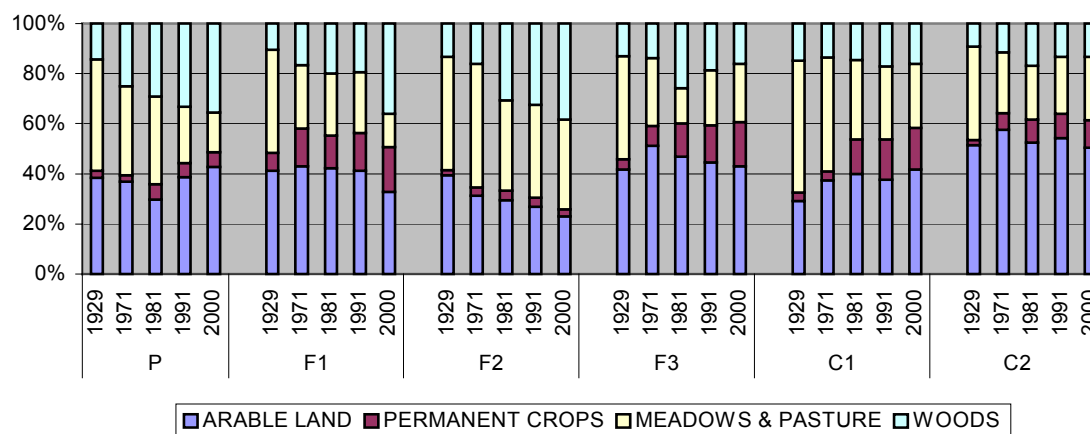
In Murcia there is nowadays a developing good practices code, mainly due to farmers obligations by CAP subsidies. What is with this title is no more than a code related to nitrates based on the Dutch model, not very suitable to climatic, edafic and topographic conditions of the area. Holland has more rainfall and the water table is superficial. In Murcia the climate is dry, the water table is very deep (400 meters, even more) accompanied with hilly landscape. So problems are different.

Guadalentín basin constitutes one of the most intensified agricultural models in Europe. Soil resource is running out in the area. The new irrigation cultures are not in the old irrigation lands but on new ones. It causes the appearance of marginal areas, those where the enlargement of the irrigation cultures hasn't reached. The high lands (north of the Guadalentín basin) has enough services for the population but not a wealthy economical activity, and it would be very difficult to introduce a sustainable activity when the economic model that the population observe is the so intensive agriculture of the nearby areas, which they try to imitate. The non-sustainable agriculture model has been a success in this area.

## 2.3 Agri basin, Italy

The Agri basin is located in the heart of Basilicata Region, southern Italy and it is considered to be economically, socially and environmentally one of the less favoured areas of Europe. In the last seventy years the land use evolution has followed a patterns mostly driven by economic conditions and market opportunities. As Fig. 4 shows a correlation between desertification and use of resources exists, with a positive trend where the type of ESA becomes more tangible (C2).

The following analysis of land use decision-making driving factors is based upon surveys and workshop organized in this region. The 3<sup>rd</sup> Focus Group for the WP 1.3 workshop was organized in Val D'Agri on 25<sup>th</sup> of July 2003. There were 26 stakeholders participating to the workshop together with the organizers. A structured questionnaire was prepared and administered to the participants. The questionnaire included macro- and some micro-factors affecting land use change decision-making.



**Fig. 4: Relation of land use change and type of environmentally sensitive areas (1929 - 2000)**

### A. Societal factors

#### Demographic Trends

The Agri basin covers an area of 1,686 km<sup>2</sup>, of which 20% are below 300m asl and the average altitude is 650m asl. Two of the most influencing demographic trends in terms of land use change are depopulation and ageing.

Agri basin lost most of its population in the 1960's when the southern Italians chose to seek better life conditions in the industrial centres of north Italy and Europe. The decrease of population continues up to day reflecting mostly the inner areas (population increase -10%), which are generally isolated. The young generation leave their birthplace finding job opportunities elsewhere. In some areas the population density reaches the lowest level 31 inh/kmq (*National Statistics Service of Italy, various data*).

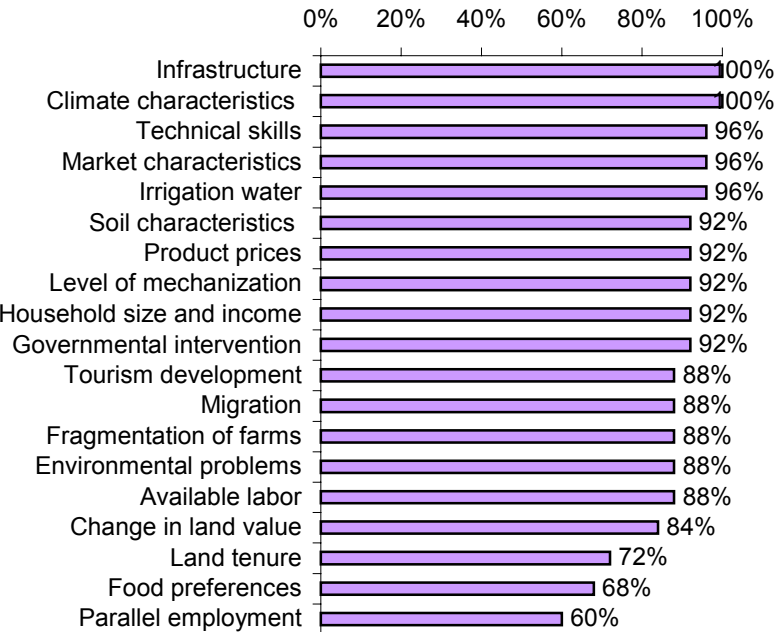
Moreover, the remaining population is ageing, and when those farmers pass their holdings to off-springs these are most likely to decline. Progressive ageing of agricultural operator influences land use change decision-making because it addresses to low intensity

forms of use. Very often lack of generation change gives less attention to maintain productive function of the same farm.

Inwards and outwards migratory dynamics, emphasized by productive activities concentration in coastal areas, above all those related to tourism sector, have deeply influenced demographic of inner rural areas. The respondents of the questionnaire believe that migration (88%, Fig. 5) is a relatively important driving force in farmers decision-making because it identifies processes directed to a progressive degradation of social texture and decrease of energies and resources in the agricultural sector and consequently to territory garrison. Land abandonment, expanded wooded area and invention of abandoned pastures by forest are the most common consequences.

Institutional

In this section we explore the way farm structural features and institutions that farmers participate, specifically Common Market Organizations (CMO), can affect land use change decision-making.



**Fig. 5: Frequency of preference by the people of Agri focus group for the various possible factors affecting land use change decision-making**

Agri basin and southern Italy in general are traditionally characterized by a high number of small and medium sized farms. Land fragmentation characteristics (size of parcels, number of farm parcels, farm size) were considered (88%) important to explain land use change as they determine the degree of mechanisation and more in general resource use intensity. Instead, less important is considered, land tenure (72%). The most common type is freehold but there are also rented areas especially by large farms with cattle breeding.

Common Market Organizations (CMOs) and public extension services act as the main information source to farmers. In particular, CMOs can affect farmers’ choices when it comes

to apply for subsidies. They orientate towards durum wheat and cattle breeding subsidies where the pay is higher than the ones for mechanisation and irrigation equipment.

### Policy

Policy effect is not unambiguous (92%). From one side, in fact, they allow farmer stay on the territory assuring a sufficient level of income (subsidies for mechanisation and irrigation equipment, financial aid regarding crop variations in Lower Agri). From the other side, they start degradation processes on the same territory. Subsidies for wheat is representative if we consider that farmers were encouraged to cultivate less suitable to cultivation, often to the detriment of scrub and forest, and with aggressive farming techniques. Also the set aside Agri-environmental measure (Regulation 2078/92) has lead to abandonment of former irrigated lands decreasing the local dynamics.

Furthermore, subsidies in dry areas where the income level is low, address productive choices thus conditioning land use. Durum wheat subsidy is key factor influencing farmers of Middle and Lower Agri basin. Decreasing durum wheat subsidies in Middle basin these last years has a consequent reduction in terms of number and surface area for the respective farms, while in Lower Agri this incline set off the expansion of horticultural production. Intensive deforestation took place on the plain and along the coast, in order to plant citrus fruit trees and other intensive crops. Consequently, there has been a booming population in this area, particularly along the sea, with the impressive growth of villages like Scanzano and Policoro. At the same time, in the hinterland, villages like Craco were emptied.

Structural subsidies are preferred by the most dynamic parts of Agri Basin i.e. Lower and Upper Agri where most of the farms have changed farming practices introducing innovations (mechanisation) and they have improved their irrigation systems.

### Technological

The questionnaire results indicated infrastructure as the most influencing factor in land use change (100%). Infrastructures in terms of transportation adequacy but also population public services, that from one side improve life quality of local communities and from the other assure market access, are considered of great importance to choose land use. If this data is read together with the weight of the factor related to market characteristics (proximity, local/external, exchange volume, etc.), it clearly appears how stakeholders consider a driving force for the territory ability to relate itself with the external and to break social and economic marginality condition that is often associated with rural areas. These factors, actually, affect not only the land use change decision-making, but also the migratory dynamics inducing these areas becoming progressively poor the social texture.

The continuing absence of land use planning by public agents and the lack of public concern for these areas are keys to marginalization of the countryside, poor infrastructure services as roads in bad condition, lack of energy of power supply or sewage system.

In terms of technological sophistication in individual level, technical farmers' skills also affect land use change (96%). New farming introduction requires the knowledge of specifically farming by farmer. This factor is explained with two elements. From one side technical assistance services sickness that can't guide farms in farming choices, and from the other social demographic and cultural characteristics of those with interests in the sector (low education levels).

Land properties are strictly related also with the level of mechanisation which is also important to define land use (92%). The texture in fact defines soil answer to use of

agricultural equipments. On the other side lack of manpower in the sector push to growing levels of mechanisation ending to boost soil setting up with use of mechanical tools.

### Cultural

New food preferences, i.e organic products, market oriented affect by 68% farmers' decision-making. National and European agricultural measures support the initiation of these activities.

### **B. Economic factors**

Crop income, in the component identified by market (product price) and in the one of European subsidies plays a substantial role to define local operators choices (92%). Market price (92%) influence decreases from irrigated farming to dry farming where are above all subsidies that define the payment for one crop or another. Strictly related to previous ones is also the factor linked to farm structural characteristics, in particular size, and economic performance. Richest farms, obviously, are those that can better invest (technology) and react to changes in competitive scenarios as well as have an easier way to enter financings.

Another less important factor is part time activity (60%). Because of the low agricultural income levels, a high percentage of farmers (almost 42% in Agri basin) keep an off farm work (primary or supplementary) such as civil servants, tourist agents, industrial workers etc (Table 16). There is a category of young farmers in Middle Agri that stay in the area for the time needed in their farms and the rest are residing in more populated coastal areas (social, economic reasons or lifestyle). (*Conferenza regionale per l'agricoltura, 1999*)

**Table 16. Number of employed by economic activity sector, % of total in Basilicata**

	1990	1994	1996	Var.96-90
Agriculture	38.000	31.000	27.000	-28,9
Industry	64.000	50.000	52.000	-18,8
Other sectors	99.000	95.000	93.000	-6,1
Total	201.000	176.000	172.000	-14,4
<b>%</b>				
Agriculture	18,9	17,6	15,7	-17,0
Industry	31,8	28,4	30,2	-5,1
Other sectors	49,3	54,0	54,1	9,8

*Source: INEA, Region of Basilicata*

Tourism development and manpower availability are factors strictly related that stakeholders set on the same level for the determination of land use change (88%). Tourist flow increase, and above all seasonal arrivals, has high impacts on the territory in terms of water consumptions increase, waste production, etc.

Agriculture has known during last years, great and constant migration phenomena, above all from young people who invested resources in other productive sectors, leading to de-activate phenomena in the farms. Depopulation of rural areas and the predominance of tertiary economic sector leave little provision of manpower in agriculture. This lack is becoming more and more a limitative factor above all for livestock sector and for orchards and horticultural crops (labour intense fruit plantations in Lower Agri). Sunken wok and extra UE manpower are adopted strategies by farms to maintain more intensive productions.

Land value is also an important (84% of respondents) factor conditioning land use change. In coastal areas the development of tourism sector has further increased the price of land generating a strong competition (usually large farms for cattle breeding tend to rent lands). In internal areas land market is quite static with sustained values, both for their characteristics of real estate of this productive factor and for the capitalization processes starting from CAP application that linked founding to land and activated transfer rights.

### **C. Environmental factors**

According to the results obtained from the distributed questionnaire to the workshop in the Agri basin, the second most significant factor affecting land use change decision-making is climate characteristics (100%).

The Agri basin presents a cool temperate Mediterranean climate, with strong differences from the coastline to the inland mountains. The inland countryside has a cooler climate and in the summertime the rainfall is above 150 mm; while on the coastline, at the same period, the rainfall is less than 100 mm. In addition to that, the summer is characterized by a strong drought and a mean monthly temperature of more than 23 °C, in the warmest months.

This variability, obviously, is reflected on crop choices, and it is related with another factor considered of extreme importance, water (96%). Irrigated farming, of high income, are focused in lowlands while dry farming is typical of hill and piedmont areas. During last ten years many dams were built for water storage for different uses, but the considerable reduction of winter and autumn rainfall has caused a serious lack of water resource. This problem affects especially the agricultural sector, which includes up to 70% demand of the total water resource. In the whole Basilicata region it has been estimated that the lack of water for the agriculture sector is around 70 Mcm and the total irrigated area in the Agri basin is 11,220 hectares. The drought effects are strongly aggravated by an inefficient management of the water resources by policy agents that has heavily reduced its availability.

Water availability, the dynamics that addressed its consumptions and water quality (84%) are also decisive to address types of resources management more or less sustainable. The centrality of this factor derives from precariousness of storages more than from water availability. Infrastructure gaps and delays as well as competence conflict in management subject are responsible of inequitably water distribution on the territory and among productive sectors.

As regards soil situation, the area is physically subject to soil erosion and in many parts the risk of landslides and even earthquakes is quite high. In general, Agri basin is characterized by highly degraded soils. Soil characteristics (92%) are considered likewise important because, very often, their change through intensification and agricultural practices differentiate the farm productivity and income. In the coastal area progressive land salinization begins to influence the choice of what species to plant, and to determine the choice of root-plant for arboreal crops. Furthermore, higher water demand for expanding horticulture in Lower Agri results to greater pressure on the soil appearing salinization and nitrate leaching problems.

Finally, concerning agricultural practices, the most important factors that were considered as driving forces for erosive phenomena and quality of the soil are ploughing depth, fertilizers application, and the full number of farming with tractors. Ploughing direction is considered as a less important factor to explain land degradation processes.

## 2.4 Lesvos island, Greece

Lesvos belongs to the islands of the Eastern Aegean Sea and it's the third largest Greek island after Crete and Evia. It occupies an area of 1,630 square Km and its coastline stretches for about 370 km. Lesvos lies in front of the Adramytte Gulf at a distance of 5-8 miles from the Asia Minor coasts. The island of Lesvos belongs to the Prefecture of Lesvos together with the islands of Lemnos, Saint Efstratios and the islets around them to the northern. Mytilene is the capital of the island and the Prefecture of Lesvos. Also Mytilene is the administrative centre of the Ministry of Aegean, the District of the North Aegean.

### A. Societal factors

#### Demographic trends

Lesvos' population (Table 17) is about 108,000 inhabitants and it accounts 1% of Greece's total population with a strong fall off, considering it has a high rate of populations' natural decline (ascendancy of birth/1000 inhabitants: -3.2 in 2002). Between 1991 and 2001 censuses the population increased by 3,7% (Table 17).

**Table 17. Population changes in the island of Lesvos**

Municipality /Community	2001			1991			Change %		
	Men	Women	Total	Men	Women	Total	M	F	Total
<b>Greece</b>	<b>5.424.089</b>	<b>5.515.516</b>	<b>10.939.605</b>	<b>5.051.553</b>	<b>5.201.027</b>	<b>10.252.580</b>	<b>7,4</b>	<b>6,0</b>	<b>6,7</b>
<b>Lesvos Prefecture</b>	<b>55.943</b>	<b>52.351</b>	<b>108.294</b>	<b>54.090</b>	<b>50.981</b>	<b>105.071</b>	<b>3,4</b>	<b>2,7</b>	<b>3,1</b>
Mytilini	17.700	17.814	35.514	15.790	16.356	32.146	12,1	8,9	10,5
Agia Paraskevi	1.425	1.262	2.687	1.443	1.345	2.788	-1,2	-6,2	-3,6
Agiasos	1.327	1.323	2.650	1.444	1.544	2.988	-8,1	-14,3	-11,3
Atsiki	1.688	1.200	2.888	1.854	1.205	3.059	-9,0	-0,4	-5,6
Geras	3.505	3.424	6.929	3.463	3.495	6.958	1,2	-2,0	-0,4
Eressos – Antissi	2.800	2.736	5.536	2.844	2.776	5.620	-1,5	-1,4	-1,5
Evergetoula	1.795	1.537	3.332	1.669	1.639	3.308	7,5	-6,2	0,7
Kalloni	4.241	3.974	8.215	4.356	4.106	8.462	-2,6	-3,2	-2,9
Loutropoli Thermi	1.927	1.867	3.794	1.625	1.716	3.341	18,6	8,8	13,6
Mantamados	1.704	1.503	3.207	1.710	1.516	3.226	-0,4	-0,9	-0,6
Mythimna	1.227	1.169	2.396	1.199	1.160	2.359	2,3	0,8	1,6
Moudros	2.588	2.213	4.801	2.693	2.174	4.867	-3,9	1,8	-1,4
Myrina	4.007	3.440	7.447	3.844	2.974	6.818	4,2	15,7	9,2
Nea Koutali	1.735	1.134	2.869	1.867	1.034	2.901	-7,1	9,7	-1,1
Petra	1.957	1.720	3.677	1.895	1.708	3.603	3,3	0,7	2,1
Plomari	3.360	3.291	6.651	3.262	3.350	6.612	3,0	-1,8	0,6

Polixnitos	2.757	2.590	5.347	2.973	2.756	5.729	-7,3	-6,0	-6,7
Agios Efstراتيجios (community)	200	154	354	159	127	286	25,8	21,3	23,8

*Source: National Statistical Service of Greece, census 1991 & 2001*

There is a continuous decrease in population in agricultural remote areas with a parallel mass movement towards the capital city of the island or the mainland of Greece (Athens, Thessalonica, etc). According to Eurostat survey on Greek islands, the occupation of the insular population in primary sector performs a firm descending course since 1961 with only few upturns in recent years. During this period, the tertiary sector, especially tourism, surmounts the agricultural, turning the tables of the agricultural employment rate which has dramatically fell off from 40.8% in 1970 to 15.8% in 2002.

This demographic factor (52% of respondents in farm survey, (Fig. 6) is associated with land use changes such as abandonment of agricultural land, expansion of pastures, or in some cases expansion of olive groves in other agricultural land uses or forests or some farmers resort to parallel employment (part time agriculturalists, e.g. when it comes to olive groves) supplementing their income. The most frequent occurring land use change is land abandonment, as the consumption of the produced products decreased.

Examining also farmers' social status such as family size, age, traditions and perceptions, marriage restrictions, we conclude that they are as well important parameters affecting land use change. In most of the cases young people migrate to urban areas leaving behind their parents. When the farmer is getting older without any support from his family, the land is progressively abandoned or rented out to other farmers. An important factor of land use change decision-making, rising in the last decades in the island, is marriage limitations. Young girls used to migrate in urban areas, so the remaining males have low opportunities to get married. This is a severe social problem in the island especially far from the capital of Lesbos also resulting in abandonment of the land. Traditions and perceptions usually lead to a certain land use type for long periods since oftentimes people are closely connected with their parents in the way they use and manage the land.

### Institutional

Institutional parameters such land ownership and fragmentation, farm and family size have an effect on land use decision-making at the individual level. Fragmentation of farms restricts the organization of productive low cost agricultural practices. For example, in farm used as pasture with several parcels on various place, farmer has to move the animals from place to place for grazing or more labour is required to keep the animals. Also cultivation of annual crops is better organized in a continuous farm than in pieces of farm (better irrigation, ploughing, etc.).

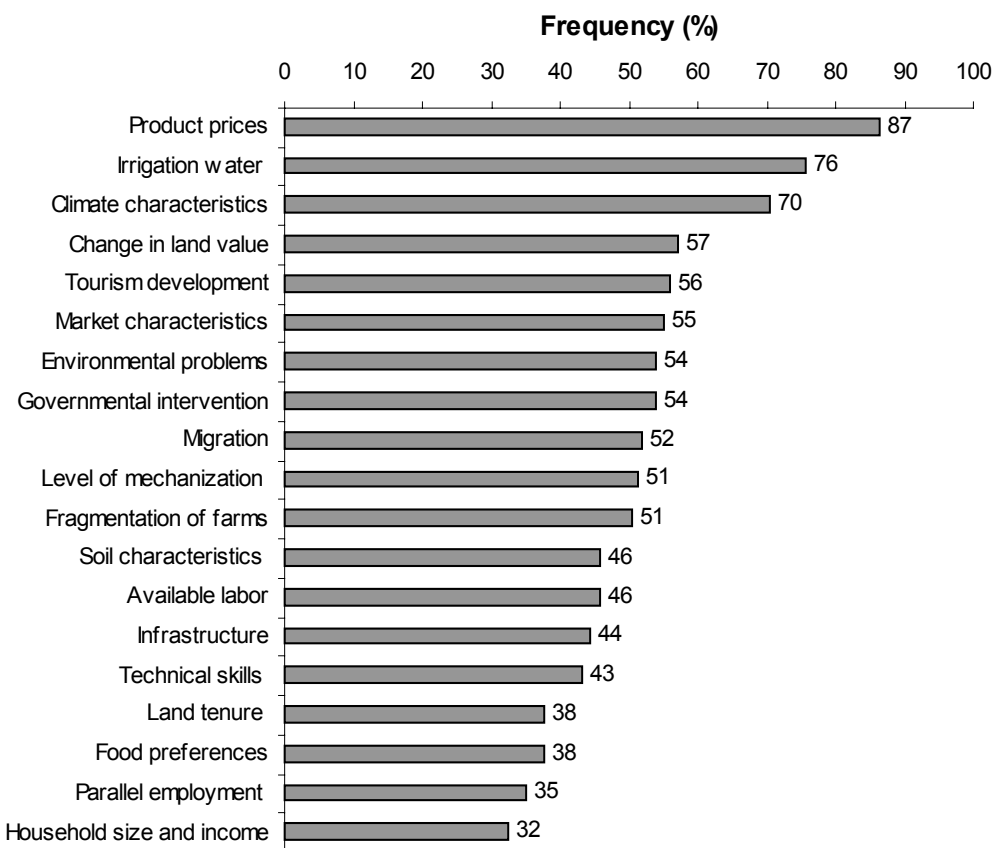
Additionally, in 93.9% of the cases in which land use change occurred farm size was greater than 10 hectares. In smaller farm sizes changes in land use were no so usual.

Family size affects positive land use change. Under adverse economic conditions with high family size, farmers try to adjust their agricultural activities, for example by changing land use, for having higher income.

### Policy

State and European Union policies on agriculture and rural development have played a decisive role on land use decision-making (54%). Since Greece's accession in EU, a significant quantity of resources have been channelled through the European Funds to Greek farmers. Such resources have been allocated through structural subsidies and the Third Community Support Framework.

Measures like early retirement of old farmers and financial support of young farmers have some influence on land use changes resulting to land abandonment or the expansion of agricultural and pasture land. Young farmers are better organized and apply new techniques for cultivating the land new crops. Governmental regulations on crop production have also affected land use changes. For example, tobacco is cultivated in areas with specific land and social characteristics in Greece. The area around Agia Paraskevi was previously cultivated with olives. When tobacco was allowed to be cultivated in the area, olives were replaced by this crop. Latter when tobacco cultivation was declined in the area due to lack of infrastructure, labour and water, land use changed to cereals or pastures.



**Fig. 6. Frequency of preference by the people of focus group in Lesvos for the various possible factors affecting land use change decision-making.**

Other policy factors having been adopted recently are the implementation of environmental regulations such as protection of oak plantations since they were declared as natural forests, expansion of national parks such as the petrified forest, and including wetlands and the surrounding areas to international treaties due to high ecological importance such as the Kaloni wetland.

Extension service provided by the Ministry of Agriculture has improved in the last decades in the island significantly, affecting land use change by introducing new crops and techniques in cultivation.

### Technological

The regional development policy has incurred great changes on the educational, public works, infrastructure, health levels. Nowadays Lesvos has a sufficient internal road network and has established frequent communication with the other islands and mainland Greece (by airplane and ferryboat), leaving behind the isolation years.

New roads, water reservoirs, medical centers, factories for secondary use of agricultural products, all have played a relatively positive role on land use decision-making (44%).

On individual level, the proximity to recreation areas and the capital of the island have affected farmers' decisions. The greater the distance of a farm from the capital or a recreation area the higher the possibility an agricultural land to be changed in pasture.

### Cultural

Primary sectors' development of the insular area upon new foundations is favoured (38% of the respondents) by new prevailing ideological tendencies / life style approach across Europe, biological farming products, agrotourism and healthy foods. Some part of the European funds resources are allocated in Lesvos to such new activities, rendering obsolete the traditional farms. In recent years, great emphasis has been placed on the production of olive oil and wine using organic cultivation methods

## **B. Economic factors**

The local economy is based on the agricultural production with emphasis on the olive oil' s production and the cattle-raising (dairy products). Also the section of distillery is developed, having as main product the worldwide famous drink of ouzo. Other products are: wheat, vegetables and fruits crops, various fishes and shellfishes. Lesvos is the 6<sup>th</sup> largest olive oil producer nationwide with 6% of total national production in 2003 and the 8<sup>th</sup> largest cheese producer with 3%.

Lesvos produces 1% of national GDP. Agriculture proportionate 15% of the island total product in 2001 from 18% in 1997 and there is produced 2,1% of total national agricultural product. During 1985-95 there has been a decline of the primary sector's percentage in Gross Regional Product by 6%.

Since 1960, an effort to break dependence on the cultivation of olive trees has started because unstable production has led to failing populations. Instead, the focus had turned to tourism and the immediate need to develop infrastructure - hotels, roads and transport set against a background of modernization, something which became more evident after Greece's accession to the EC. Today the tertiary sector is prominent while factors such small plot, restricted natural resources, ageing population and low agricultural products' competitiveness, due to high production and transportation costs, result suppressively on primary sector's growth.

Farmer's income while is declining, it is depending more and more on state subsidies and community funds, which by the revision of CAP and the enlargement will eventually cut down.

Product price has been considered as the most important factor affecting land use change decision-making (87%). The prices of the main products olive oil, meat, and milk do

not follow the general trends of the market, thus reducing the farmer's income. In many cases, product prices, such as olive oil, decreased while the cost of life increased. Labour cost, fertilizers, pesticides and gas cost have increased significantly without any parallel trends of the prices of the produced products. Since farm size is small, farmers use to rent abandoned land aggravating once more their income. Under such conditions olive groves have been abandoned and converted to natural areas. In addition, agricultural land used mainly for annual crops has been converted into pastures.

Increase of tourists arriving in the island in the last decades have greatly affected land use changes especially in the low land such as Kalloni plain, Eresos plain, Mythimna plain Vatera or other areas in proximity to national parks or important recreation areas such as Sigri, Plomari. Furthermore tourism development has also largely influenced land value in some parts of the island. The main land use changes that occurred due to these processes were expansion of annual agricultural crops (vegetables) and extension of urban areas into agricultural or natural areas.

### **C. Environmental factors**

The island of Lesvos covers an area of 163.429 hectares. It is characterized by a variety of landscapes, lithological units and climatic conditions. The western Lesvos in comparison with the rest, is barren with the exception of small green patches, but the eastern and central part of the island is full of olive groves (11 millions of olive trees), forests of pine-, chestnut-, oak-, breech- and plane- trees. Also the island's countryside is covered with an endless variety of herbs and aromatic plants

The climate of the area is characterized by strong seasonal and spatial variations of rainfall and high oscillations between minimum and maximum daily temperatures, typical of the Mediterranean climatic conditions. A gradient in rainfall occurs across the island with the average annual rainfall ranging from 677 mm (east part) to 415 mm (west part). Thus the western part of the island, where rainfall decreases to about 45% as compared to eastern part, is more prone to land abandonment since under significant water shortage, cultivation of rain fed crops or growth of the natural vegetation palatable for the animals is not allowed.

The average air temperature is 17.7 °C without any significant gradient across the island. The strong winds blowing throughout the year have also drastically affected land use.

Soil characteristics such as soil depth and slope gradient can be considered as important factors affecting indirectly land use decision-making (46%). The majority of the study area is characterized as hilly with relatively shallow soils. Hilly soils have progressively degraded due to soil erosion and soil depth has significantly decreased, reducing soil water storage capacity and therefore plant growth. Previously cultivated land with cereals has been abandoned and then was used as pasture due to low land productivity. In many cases where land use change has occurred, soil depth was less than 30 cm.

Land management characteristics such as water availability, mechanisation, technical skills of farmers and land fragmentation can be considered as affecting land use change decision-making.

A technological aspect in combination with the geomorphologic character of the island, the level of mechanisation, is considered important (51%) especially in the olive plantations. Even though the farmers' technical equipment is improved the traffic ability of this land is very low due to steep slopes and the presence of terraces. A tractor can't cultivate the majority of this land. In some cases, animals used for cultivation. In the majority of the cases, mechanisation of cultivation becomes possible only if terraces are removed. Such action creates severe problems of erosion with immediately loss of soil on hilly areas. This

mechanical inability in hilly terraced land resulted in many cases in the abandonment of the land due to the high cost for collecting olives. On the contrary, mechanisation of milk collection from animals resulted in expansion or retaining pastures.

Application of fertilizers is highly limited in all cases surveyed due to high cost and environmental regulation reasons. Fertilizers are rarely applied in pastures. Also several of the olive groves have been characterized as biological in which chemical fertilizers are restricted. Therefore, fertilizers application can not be considered as a factor for land use change decision-making.

The construction of a new water reservoir and irrigation networks in Eresos is expected to affect land uses in the lowland such as extension of urban area, expansion of cultivated vegetables, and expansion of cultivated plants used for animal feed (alfa alfa, legumes, etc.).

Technical skills of farmers may impose restrictions in land use change. For example, farmers keeping animals cannot easily change to other agricultural activities such as growing vegetables in greenhouses.

## **2.5 Farm survey in the island of Lesbos**

The analysis of the obtained data from the farm survey showed that the main type of land use change occurred in the island during the period 1965-2002 was from agriculture to pasture. In the majority of the field sites studied (79.6%) no land use change occurred in the 37 years period, while change from agriculture (cereals, olives, vines) to pasture was found in 19.4% of the cases. Change from pasture to agriculture was almost rare since soils on pasture land are shallow, severely degraded and in combination with the steep slopes and lack of water cannot be used for cultivation. Other land use change in the island is from one agricultural crop to the other especially in the alluvial plains. However, such areas are limited in extent and they were not analyzed here.

In the field sites studied, the majority of the land (more than 72% of the cases) was rented due to massive migration of people to urban areas and abandonment of the land. The abandoned land has been rented to other farmers remaining in the area. Dominant farm size in pastures was greater than 50 ha (frequency 52%) while in olive groves the dominant farm size was less than <10 ha (frequency 71%). Land fragmentation was greater in olive groves with dominant class 1-4 parcels. The larger parcels of land with the lower fragmentation were found in areas used as pasture. The range of age 35-65 was recorded in 62% in the study field sites. The frequency of appears of young farmers in the age lower than 35 years was relatively low, usually lower than 21% but higher than the frequency of appears of very old ages (higher than 65 years). The dominant class of family size was 4-6 persons in pastures (frequency 52%), while the family size decreased to 2-3 persons in areas where olive groves was the main land use type (frequency 63%). Subsidies were allocated in all studied land use types (olives, pastures), greatly affecting land use intensity. Water available for irrigation was rare, while fertilizers were applied only in olive groves. Pastures are never cultivated, while cultivation in olive groves is limited due to steep slopes, and presence of terraces restricting traffic-ability.

Table 18 shows the probabilities of the classes of the various factors analyzed in the farm survey for the land use change decision-making. Two cases have been analyzed, the change from agriculture to pasture and no change in land use for the 37 years period (1965-2002). Type of ownership has affected land use change decision-making. In the majority of the study field sites (67.7%) where no land use change occurred, the land was under private ownership. In the opposite, land use change has occurred more frequently when land was rented (51.9%) (Table 18).

Family size affected positively land use change. In 55.6% of the cases where land use change occurred, families had more than four members. Under adverse economic conditions, farmers with large families try to adjust their agricultural activities, for example by changing land use, to increase their income.

Farm size was an important factor affecting land use change. In 93.9% of the cases in which land use change occurred, farm size was greater than 10 hectares. In smaller farm sizes changes in land use were not so often.

Generally, land fragmentation was high in both cases of land uses (Table 18). The frequency of appearance of four or higher parcels of land was higher in the case of land use change. Fragmentation of farms restricts the introduction of productive low cost agricultural practices. For example, in farms used as pastures, with several parcels in various places, farmers have to move the animals from place to place for grazing and more labour time is required to keep the animals. Also cultivation of annual crops is better organized in a continuous farm than in many small farms (better irrigation, ploughing, etc.).

Farmer age was not an important factor. The same distribution of farmer's age was found in both cases in no land use change or change from agriculture to pasture. Most common farmer age was between 35-65 years old in the study field sites.

The obtained data showed that farmers are almost exclusively working on their farms. Parallel employment in other activities such as tourism, municipalities was limited. A slight higher frequency (25%) of parallel employment was found in the case that land use change has occurred compared to the field sites without land use change (20%).

The level of mechanisation was considered important especially in olive groves. The traffic-ability of this land is very low due to: (a) steep slopes and (b) presence of terraces. Tractors cannot be used in the majority of these lands. In some cases, animals were used for cultivation. In the majority of the cases, mechanisation of cultivation becomes possible only if terraces are removed. Such actions create, however, severe problems of erosion with immediately loss of soil on hilly areas. Therefore, mechanisation of cultivation was limited in both agricultural and pasture land with a frequency less than 21.9%.

**Table 18. Parameters affecting land use change in Lesvos identified in a farm survey (numbers in parenthesis corresponds to frequency)**

Parameter	No land use change		From agriculture to pasture	
	Private (67.7)	Rent (32.3)	private (48.1)	rent (51.9)
Family size	3 or less (53.5)	4 or more (46.5)	3 or less (44.4)	4 or more (55.6)
Farm size (ha)	>10 (56.4)	<10 (43.6)	>10 (93.9)	<10 (6.1)
Land fragmentation	>4 (67.2)	<4 (32.8)	>4 (78.6)	<4 (21.4)
Farmer age	>35 (85.1)	<35 (14.9)	>35 (88.2)	<35 (11.8)
Mechanisation	No (78.1)	Yes (21.9)	No (88.9)	Yes (11.1)
Application of fertilizers	No (78.2)	Yes (21.8)	No (87.5)	Yes (12.5)
Animals grazing	Yes (78.6)	No (21.4)	Yes (100)	No (0)
Period of land use (years)	>50 (95.7)	30-50 (4.3)	30-50 (94.2)	5-10 (5.8)
Soil depth (cm)	>30 (68.9)	<30 (31.1)	>30 (16.7)	<30 (83.3)
Slope (%)	>18 (57.3)	<18 (42.7)	<18 (61.1)	>18 (38.9)
Rainfall (mm)	>650 (72.0)	280-650 (28.0)	>650 (17.6)	280-650 (82.4)
Winds	Strong (69.5)	Moderate (30.5)	Strong (65.1)	Moderate (34.9)
Water available	No (86.0)	Yes (14.0)	No (76.5)	Yes (23.5)

Policy enforcement	Adeq-mod (68.7)	Low-no (31.3)	Adeq-mod (84.7)	Low-no (15.3)
Population density (p/ha)	0.28 (51.5)	0.68 (48.4)	0.28 (70.6)	0.68 (29.4)
Proximity to seashore	>1 km (78.8)	<1 km (21.1)	>1 km (76.4)	<1 km (23.5)
Proximity to recreation areas	Near (16.3)	Far (83.7)	Near (17.6)	Far (82.3)
Proximity to capital	>50 km (69.2)	<50 km (30.8)	>50 km (75.1)	<50 km (24.9)

Application of fertilizers was highly limited in all study field sites. Fertilizers are rarely applied in pastures. Also several of the olive groves have been characterized as biological in which chemical fertilizers were restricted. Therefore, fertilizers application can not be considered as a factor affecting land use change decision-making.

Soil characteristics such as soil depth and slope gradient can be considered as important factors. The majority of the study area is characterized as hilly with relatively shallow soils. Land previously cultivated with cereals has been abandoned, and afterwards, it was used as pasture due to its low productivity. In many cases (83.3%), where land use change occurred, soil depth was less than 30 cm.

Annual rainfall is an important factor affecting crop production since available irrigation water is limited in the area. The majority of cases where land use occurred were found in the western part of the island where the annual rainfall is reduced to about 45% as compared to the eastern part. Although the average wind speed is about twice in the western part as compared to the eastern part of the island, the obtained data showed that there was no any relation with land use change decision-making.

Water available for irrigation was rare in the majority the study field sites. The probability for a land use change to occur was higher in the case that water was available for irrigation. As Table 18 shows, water was available for irrigation in 23% of the study field sites in which land use change has occurred. In the opposite, only 14% of the study field sites without any land use change in the 37 years period had water available for irrigation.

Land use change decision-making was related to the presence of terraces. As Table 18 shows, 62.5% of the study sites in which land use change has occurred, land was no terraced. Terracing of the land under the existing soil (shallow depth) and topographic (steep slopes) characteristics of the island of Lesbos using stones is an expensive construction with high labour requirements. If a land use change occurs in a terraced land then terraces will collapsed with adverse consequences on soil conservation.

Policy enforcement on environmental protection from soil erosion was related to the land use change decision-making. When land use change has occurred, moderate to none measures for soil erosion protection was applied. As Table 18 shows, 62.7% of the study field sites were inadequate protected from erosion. In the opposite, sites in which no land use has occurred in the last decades were better protected from erosion. A 68.7% of the study field sites were adequate protected from soil erosion.

Population density was related to the land use change especially in the cases where no land use change has occurred. As Table 18 shows, 68.7% of the study field sites with no land use change were located in areas with population density less than 0.28 people per hectare. Field sites with land use change were distributed throughout the island independently of population density.

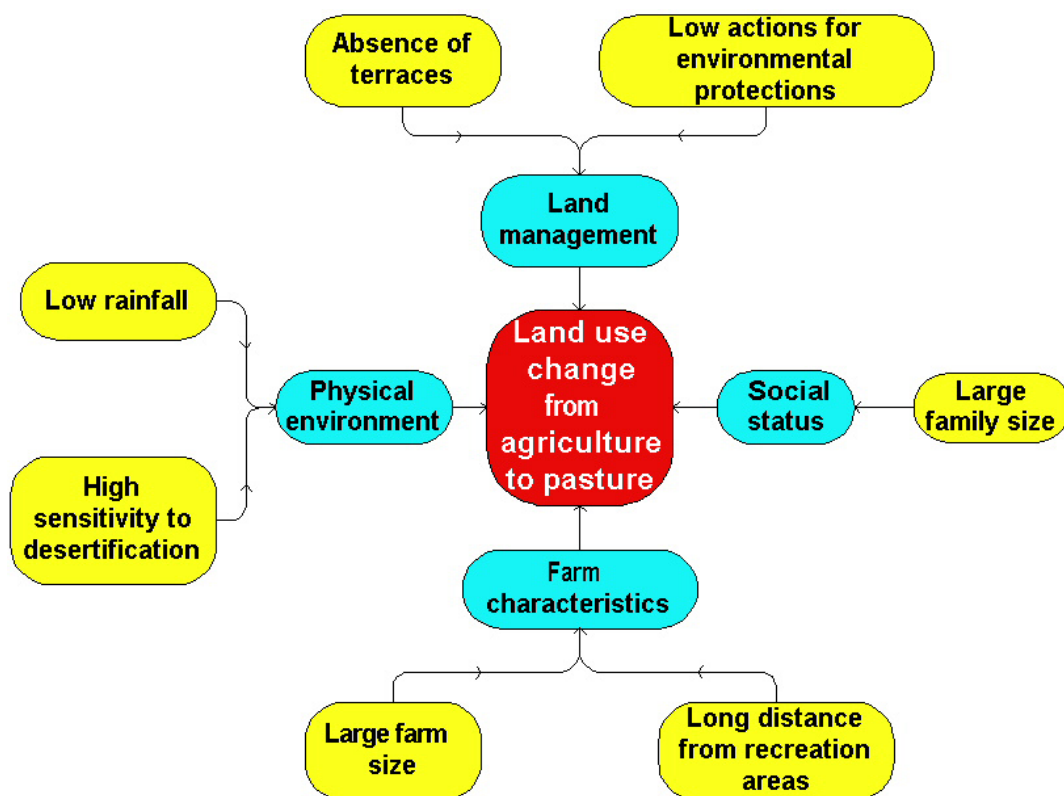
Proximity to recreation areas (tourist resorts mostly), seashores and capital of the island had no specific effect on land use change. The frequencies of appearance for both cases for no or change of land use had almost the same distribution.

Factors affecting land use change from agriculture to pasture

A principal components analysis of 22 factors showed that the following eight factors can be considered as the most important affecting land use change from agriculture to pasture: family size, farm size, annual rainfall, policy enforcement, proximity to recreation areas, sensitivity to desertification, and presence of terraces, (Fig. 7). Land use change may occur in areas experiencing adverse environmental conditions. Areas with lower annual rainfall (western part) and high sensitivity to desertification are more vulnerable to land use change from agriculture to pasture.

Land use change is more probable to occur in farms with size greater to 10 hectares located in areas relatively far (distance greater than 5 km) from recreation areas such as the petrified forest at Sigri or the wetland of Kalloni. The obtained data of the farm survey showed that farmers in degraded areas, as the west part of the island, used to have larger farms than in the eastern part. Under adverse climatic conditions the most profitable agricultural activity is husbandry.

Keeping animals requires high labour during the whole year. Therefore, land use change from agriculture to pasture with large number of animals requires large families for supporting such actions. As Fig. 7 shows, land use change is more possible to occur when a family has 4 or more members.



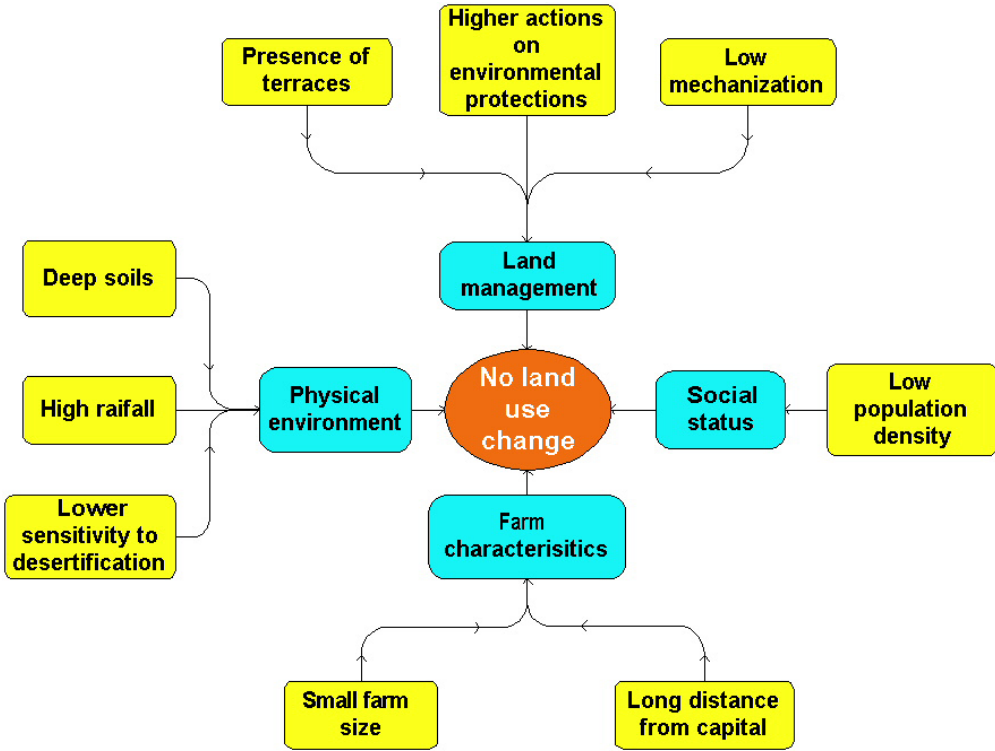
**Fig. 7. Important factors affecting land use change from agriculture to pasture**

Land management characteristics important in land use change are the presence or not of terraces and the actions undertaken for environmental protection from soil erosion. Land

use change has been found mainly in non-terraced land with low policy enforcement on environmental protection. Except individual crescentic terraces, some broad terraces have been constructed in the island in the past for cultivation of annual crops. In such case, land use change is possible to occur.

Factors affecting no change in land use

No land use change decision-making has been affected by various factors related to the physical environment, farm characteristics, social status, and land management (Fig. 8). Important factors related to the physical environment were: soil depth, annual rainfall and sensitivity to desertification. Conditions mostly favouring no land use change were deep soils, dry sub-humid climatic conditions (high annual rainfall), and lower land sensitivity to desertification. All these factors affect land productivity. One of the most profitable agricultural crops in the island for centuries was olives requiring high initial capital investment (construction of terraces) and low labour for maintenance of the crop (cultivation and harvesting). Therefore, farmers prefer to keep olive groves and land use change can occur only when soils have been severely degraded unable to economically support the crop. In such case, olive trees were removed and land use changed to pasture.



**Fig. 8. Important factors affecting no land use change**

Small farm size and long distance from the capital is a combination of factors affecting no land use change. Small sized farms were mainly found in cases of olive groves. Farmers used to keep olive groves for various reasons such as higher income, low labour requirements, traditions, parallel employment, etc. Therefore, a farmer can live at long distances from the farm, employed or having another agricultural activity and travel for certain days for applying fertilizers and harvesting.

Concerning factors associated with social characteristics, population density was found as the most important. The island of Lesbos is administratively divided in three regions, Mythimna, Mytilene and Plomari. The population density of the region of Mythimna has changed from 0.52 in 1940 to 0.28 (people/ha) in 2001, while in the regions of Plomari and Mytilene the population density changed from 1.07 to 0.87 (people/ha) and from 1.26 to 0.50 (people/ha), respectively, for the same period (Greek National Statistical Service). The analysis of data showed that no land use change was more probable in areas of low population density as in the western part of the island.

Important land management practices favouring no land use change were: presence of terraces, low mechanisation level, and adequate measures for soil erosion protection. About 22% of the island has been terraced in the past. In terracing land, change in land use can not be easily achieved since terraces will collapse creating severe problems of removal of soils due to gravity or washing by surface water runoff. Low mechanisation was partially associated with both presence of terraces and decline of olive oil price in the last two decades. Under such conditions farmers can not easily change land use waiting for better economical conditions. Soil erosion measures were associated mainly with the presence of terraces mainly adequately protecting the soil for long periods. Surface water runoff is limited or in many cases water runoff generating in the inter-space among terraces was diverted into the terraces for reduction of soil erosion and conservation of water.

## **II. Appropriate strategies for making effective policy decisions for sustainable land management**

Land use change is an undeniable and significant global, regional and local ecological trend related increasingly with desertification phenomena such as loss of biodiversity and disruption of hydrologic regimes, soil erosion, decreases in soil fertility, loss of extractive reserves and disruption of indigenous people.

In the last four decades, favourable soil and climatic conditions and the availability of ground or surface water has resulted in intensive farming of the lowlands of Mediterranean. The development of high input agriculture in the plains provided much higher net outputs than those obtained from hilly areas or terracing agriculture. Furthermore, the development of fast transportation means and the availability of cheap holiday-offers have encouraged the expansion of domestic and international mass tourism over the last 30 years. The rapid expansion of tourism in the Mediterranean Europe along the coastline resulted in the last decades in intensification of agriculture on the low lands, abandonment of agricultural terraced land on the slopes, and increase in the number and frequency of fires. The high demands for water consumption or other economic activities have increased the price of water and forcing the cost of agricultural production, while in many cases, water of low quality is used for irrigation (high electrical conductivity). Irrigation using water with high salt concentrations increased the salinity of the soil, rendering an unproductive abandoned and desertified land especially plain areas located along the coast.

The analysis of the various factors affecting land use change decision-making in the studied areas showed that there are some differences but with several similarities (Table 19). Irrigation water, climate characteristics, product price and infrastructure were considered as the first important factors for all areas.

The analyzed factors affecting contemporary land use change decision-making in the four studied areas can be distinguished as exogenous and endogenous. By identifying the most common factors placed in the first ten priority positions in Table 19, it results that there are at least five exogenous factors that can be influenced by human actions (on individual and policy level). These are governmental interventions (institutional support, subsidies), product

price, mechanisation level, tourism development and up to a certain point irrigation water (from an infrastructure public projects point of view). On the other hand the identified endogenous factors which are internal on land use change decision-making were climate (rainfall and thus water availability) and soil characteristics (soil depth, slope gradient, drainage, landslides, erosion, etc).

In general, all areas are rural, relatively isolated and predominantly agricultural in a semi-arid climate. Additionally all areas are severely affected by outmigration, especially the hilly areas, leaving behind and ageing population. Low land productivity combined with small farm size resulted in massive migration flows. The land was abandoned from agriculture was used by the remaining farmers mainly as pastures. These rural places are nowadays marginalized. The other demographic driving force is urbanization and/or littoralisation. People leaving from their homelands in search for a better life prefer urban centres or big cities along coasts where there are opportunities due to tourism growth. This concentration exercise pressure on natural resources such land by overexploitation in order to meet the consumer needs (i.e expansion of irrigated farms) and water, already limited in most of the areas studied.

**Table 19. Comparison of factors affecting land use change decision-making in the target areas (factors are listed in order of importance for each area)**

A/A	Lesvos island	Agri valley	Guadalentín basin	Alentejo region
1	Product price	Infrastructure	Irrigation water	Irrigation water
2	Irrigation water	Climate characteristics	Product price	Available labour
3	Climate characteristics	Technical skills	Governmental interventions	Climate characteristics
4	Change in land value	Market characteristics	Tourism development	Environmental impacts
5	Tourism development	Irrigation water	Technical skills	Level of mechanisation
6	Market characteristics	Soil characteristics	Main climatic characteristics	Governmental interventions
7	Environmental impacts	Product price	Soil characteristics	Soil characteristics
8	Governmental intervention	Level of mechanisation	Available labour	Product prices
9	Migration	Household size and income	Infrastructure	Tradition, attitudes, perceptions
10	Level of mechanisation	Governmental intervention	Level of mechanisation	Tourism development
11	Farm fragmentation	Tourism development	Market characteristics	Size, shape, farm fragmentation
12	Soil characteristics	Migration	Tradition, attitudes, perceptions	Market characteristics
13	Available labour	Farm fragmentation	Household size and income	Technical skills
14	Infrastructure	Environmental impacts	Parallel employment	Infrastructures
15	Technical skills	Available labour	Environmental impacts	Food preferences
16	Land tenure	Change in land value	Size, shape and farm fragmentation	Land tenure
17	Food preference	Land tenure	Land tenure	Parallel employment
18	Parallel employment	Food preference	Migration	Migration

19	Household size and income	Parallel employment	Food preferences	Household size and income
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CAP and subsidies allocated today in specific types of crops or land uses such as olives, cereals, pastures, etc., in conjunction with the market prices greatly affect in all study areas the intensity of the land use, control farmers choices and land use patterns. For example in some cases the productivity of hilly areas with shallow soils and semiarid climatic conditions cultivated with cereals is very low, not economical feasible without any support. In several cases such land must be abandoned or used as pasture if subsidies allocated per hectare withdraw. In pastures the number of animals has increased significantly in the last decades due to allocation of subsidies per animal. Subsidies in several cases have adversely affected land degradation and desertification of abandoned land.

Furthermore, it's common feature that the expansion of irrigated areas, olive groves and vineyards appeared in the context of CAP, after its revision in 1992. In Alentejo region where subsidies amount for 60% of farmers income, pasture lands decreased and durum wheat replaced soft wheat produce. In Guadalentin also, subsidies have helped the preservation of declining dryland farms (cereals, almonds, olive groves) in areas affected by rural exodus.

From the economic point of view market prices and characteristics have a significant effect in all areas. The second half of 20<sup>th</sup> century had been noticed a boom of services economy. The agricultural sector started declining so did the remaining farmers incomes. All four countries after their accession in EU found a way of keeping some farmers still "alive", but this is rather an artificial respiration tool because it doesn't finance the improvement of farming management practices or the level of technical skills or the potentials but supplements the declining farmers income. Some structural measures have been taken relatively recently and the outcomes aren't yet fully observable. To this result the way of the implementation by the governments have helped. In all target areas farmers are complaining about government disinterest or inability of coordination between competent authorities in regional and national level. Another common economic feature is parallel employment. In all areas have witnessed the so-called weekend farmers.

Geophysical parameters and climate condition have also had an impact on land use decision-making. Water and climatic changes are the most frequent answer in questionnaires. With the exception of Agri basin, in all other target areas agricultural land use is conditioning by water availability. Increasing water demand by expanded irrigation farms and tourism development has developed fears about the future. Wherever the government has tried to provide the necessary infrastructure (artificial lake in Alentejo, water transfer channels in Guadalentin) this automatically lead to intensification of the irrigated areas and heavy implications on soil conditions.

Mediterranean land degradation is often linked to poor agricultural management such as over-tilling, irrational irrigation, overgrazing in combination with droughts, steep slopes, floods, forest fires, etc.

The existing overall conditions in natural resources management requires that rather urgent and holistic decisions must be taken for combating land degradation and desertification. Development policies especially applicatory to less favoured areas, could - based on the principle of balanced development and sustainability- give all the incentives for farming modernization through training (develop technical skills), the adoption of new environment friendly methods and devices (mechanisation level) and improve the infrastructure and communications network. Furthermore, environmental policy could focus on better enforcement of adopted protection measures. Finally, Agricultural policy should be

more oriented towards supporting competitive products having in mind the latest food and cultural trends (biological products) instead of subsidizing monocultures.

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