AQUAMONEY PROJECT

MAIN SURVEY REPORTING
LESVOS BASIN, GREECE
SEPTEMBER 2008

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A. Policy summary

The process of Common Implementation Strategy of WFD in Greece has proceeded with a slow pace. The establishment of Central Water Agency at the Ministry of Environment (YPEXODE) and the derogation of implementation responsibilities to Regional Authorities (Perifereies) represent the backbone of institutional reform. In relation to the economics of water uses and the technicalities of water demand management, Greek reporting within CIS is problematic. As it is expected, the low priority given to demand management goes hand in hand with a delay in establishing a methodological framework and the appropriate human capacity for implementing full cost pricing and cost recovery. Accordingly, the policy context of the present Aquamoney application of non-market valuation techniques in Greece is one of mistrust on the part of civil servants for any subjective, welfare-based estimation of environmental and resource cost. Though the situation is slowly changing, it will take in future a strong 'push' in terms of public awareness and information campaigns in order to consolidate in public opinion the proper meaning and uses of water benefit assessment. We hope that the results of the present pilot application will contribute to fill this gap in the public and experts opinions alike of the meaning and proper uses of environmental and resource cost within the WDF.

1. Introduction

AQUAMONEY represents a Europe-wide scientific effort to consolidate non-market benefit assessment of water services and thereby inform the practical implementation of article 9 in the context of WFD. Within this broad perspective, the specific objective of the Greek pilot case study at Lesvos Island is to value water services under water scarcity conditions. Especially the pilot study focus to assess monetary values of:

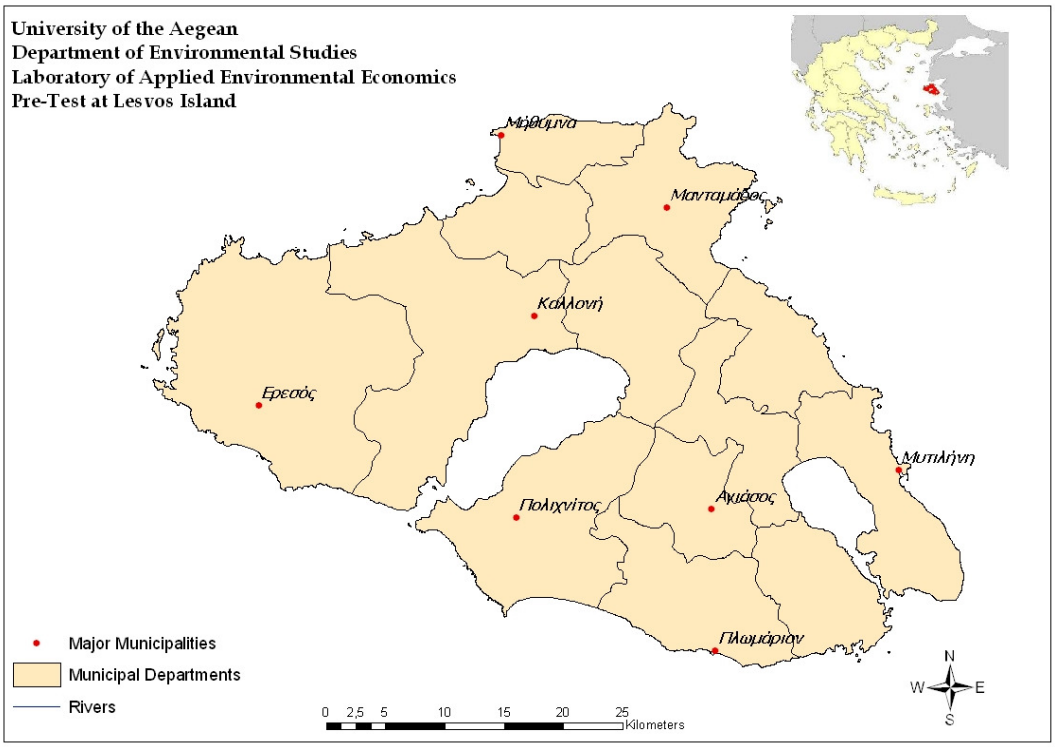
1. The environmental degradation caused to water bodies by low water flows.
2. The benefits accruing to households by alleviating insecurity of future domestic water supply.

The first monetary value - an environmental cost - is estimated under three levels of ecological status (Moderate, Good and Very Good) through the improvements in water flow levels given the main objective of the WFD. The second monetary value – a resource cost - is estimated for three levels of water availability through the reduction of the likelihood of water use restrictions. The estimation of monetary values is based on the combination of two stated preferences techniques: Choice Experiment (CE) has been applied to assess environmental and resource cost. Additionally Contingent Valuation Method (CVM) has been used to assess the resource cost.

2. Description of the case study

2.1. Location of the case study area

Lesvos is the third largest island of the Aegean Archipelago, located at the northern-eastern Aegean region. Administratively, the island of Lesvos is part of the Lesvos Prefecture, which contains also the islands of Lemnos and Agios Eustratios. The Lesvos Prefecture covers a total extent of 2,154 km^2 of which 1,636 km^2 belongs to the island of Lesvos. Map 2.1 shows Lesvos in relation to the Aegean Archipelago and its division in municipal departments. The northern-eastern Aegean region belongs to the poorest regions of the EU. Lesvos itself has experienced in the past years a long trend of depopulation through immigration. The number of inhabitants in the basin amounts today to 91,000. The main economic activities are agriculture, tourism, cattle raising, fisheries and small scale spirit distillery.



Map 2.1: Lesvos Island –Greek case study

The main characteristic of Lesvos - its insular character – provides also the specific geomorphologic and socio-economic features that impinge the physiognomy of the island in various fields, starting from the social and the economic ones, followed by the cultural and the historical sector. Referring to the "insular character", we need to emphasize the special characteristics of the island, which usually emerge as problems but sometimes also as comparative advantages. For example:

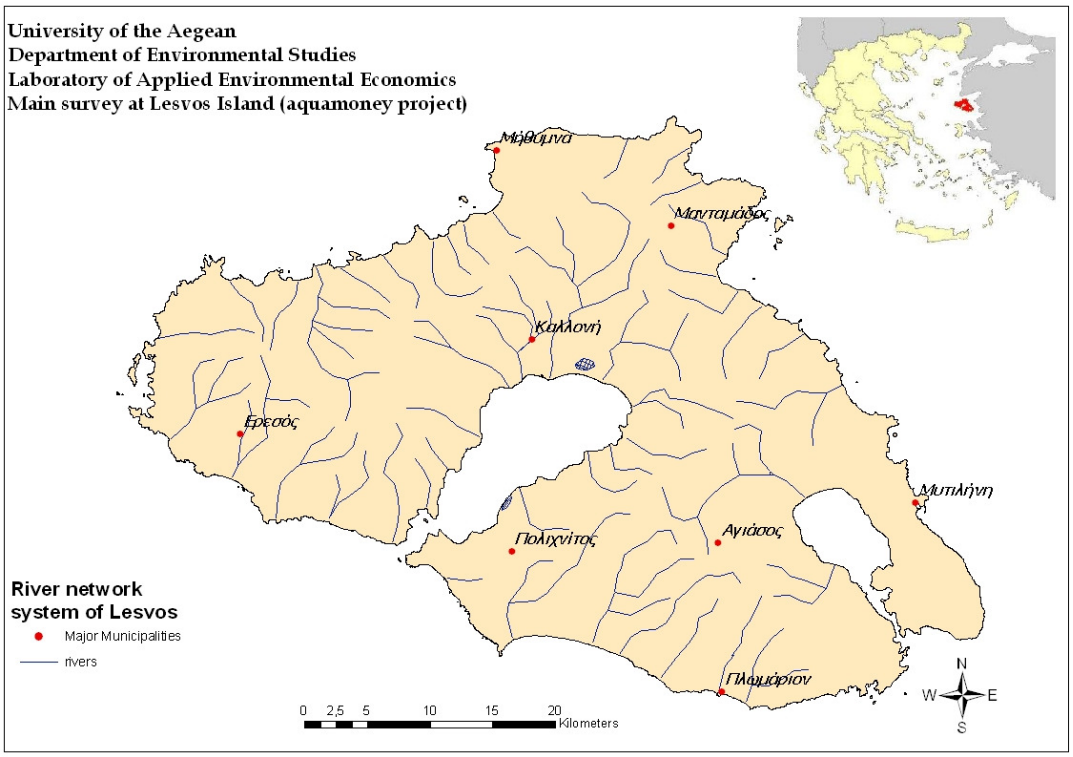
- The isolation from the mainland with all its potential consequences
- The difficulties in transports and communications
- The difficulties in energy production
- The obstacles to the development of large scale, cost-effective productive units.

2.2 Water system characteristics

According to the official categorization of the Ministry of Urban Planning, Environment and Public Works (YPEXODE), Greece is divided in 14 Water Districts with quite similar

hydrological and hydro-geological conditions; these are today considered tantamount to watershed regions *sensu* WFD. The last of them, "Aegean Islands", with a total area of 9,103 km² and a population of 508,807 inhabitants includes also the island of Lesvos.[1]

The 'small' size of Lesvos affects the size of water basin and the number of water bodies. The basin includes a mountainous terrain with altitudes lower than 1000 m, small agricultural plains, urban areas and two gulfs (Kalloni and Gera). The larger sub-basin is located at Kalloni and covers 270 km².



Map 2.2: Lesvos Island –surface water systems

On the island there are a lot of small torrents, especially at coastal zones (map 2.2) the main of them being Tsiknias, Tsichliontas, Milopotamos, Sedoyntas and Almiropotamos. There are also small groundwater systems and same thermal springs.

[1] Ministry of Environment Physical Planning and Public Works - Central Water Agency (2006), Report on the Pressures and Qualitative Characteristics of Water Bodies in the Water Districts of Greece and a Methodological Approach for Further Analysis. Athens, June 2006

2.3. Short characterization of water use and water users

The basic water consumer in Lesvos is the agricultural sector. The latest estimations about the quantity of water demand for irrigation are based on data of 2006. According to these demands, Lesvos Prefecture consumes in average 32,700 m^3 of irrigation water annually. The animal husbandry consumes 1,320 m^3 of water annually; there is not available data for the water consumption for pisciculture activity. The estimations of water demand for domestic supply are based on data of the year 2005. Lesvos Prefecture consumes 7,770 m^3 of water for domestic supply annually, while the demand for the period from September to May is estimated to 3,290 m^3 in average. The consumption of water by the industrial sector is estimated at 480 m^3 annually.

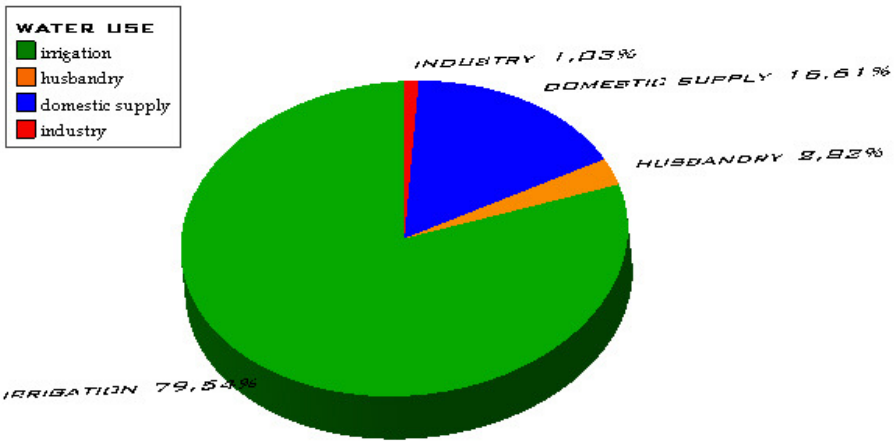


Figure 2.1: Water consumption in Lesvos

Figures 2.1 illustrate the water consumption per sector. There are also mineral springs with hot water and in some cases spa utilities but no data are available for this use.

2.4. Main water management and policy issues in the context of the WFD

The Greek water institutions are scattered in central Ministries (mainly Ministry of Agriculture, Ministry of Environment and Ministry of Development) although the new framework introduced by the WFD reallocate the water management responsibilities to the Regional Authorities (Perifereies). One basic problem is that the administrative structure of Greece (regions and prefectures) lacks in most cases the appropriate technical infrastructure and human capacity for the proper management of water resources. This has contributed to the weakness of reduction of various sizes (developmental, finances, demographic etc) in river basins. Another problem is the multiple split of competences (relative with the water resources), in a number of institutions, which are practiced at all levels of administrative divisions. The weakness of co-ordination of action of these institutions is all too oft translated to sheer competitive activities in the use of water, in national, regional, even in local level. Another weakness for policy makers in many cases is the absence of data related with water quality and water quantity, in order to plan rational water management policies.

All the above generic, management problems are equally valid in the specific case study of Lesvos. Though the Water Department of the northern Aegean Regional Authority is officially designated as responsible for the management of water resources according to the new policy framework introduced through WFD, the basic decisions are still anchored in the Municipal Enterprise for Drinking Water and Sewerage of Mytilini (DEYAM) (for drinking water and sewerage), the regional offices of the Ministry of Agriculture (for irrigation) and the Lesvos Prefecture (for drilling permits and industrial uses). The water tariffs are accordingly uncoordinated and unconnected to any notion of full cost recovery. The economic analysis of water resources uses in Greece shows that the recovery level of water services is less than 43% in for domestic supply use in Aegean Islands Water District.

Water District	Cost and Recovery	Domestic	Irrigation	Total
Aegean Islands	Financial Cost (€)	366,257,904	1,688,152	367,946,056
	Resource Cost (€)	-	26,784,000	26,784,000
	Environmental Cost (€)	-	0	0
	Agricultural Subsidies (€)	-	23,276,539	23,276,539
	Recovery (€)	157,258,153	919,609	158,177,763
	Cost Recovery Level (%)	**42.94**	**1.78**	**37.84**

Table 2.1: Cost recovery of water uses in Aegean Islands Water District

The cost recovery for irrigation is less than 2% and the total degree of cost recovery is less than 38% (table 2.1) in the Aegean Islands Water District. The environmental cost has been

set equal to zero because there is not available data about the quality of the surface and ground water systems. Almost the totality of water used is supplied through the exploitation of underground reserves, either by state drilling (for drinking water) or (mostly illegal) private drillings (for irrigation). In the absence of incentives to conserve water resources, the island of Lesvos is characterized to date by recurrent water shortages and an effort to counterbalance them through the construction of small-scale reservoirs and dams. The quantitative water problem is moreover affecting also the surface water flows and therefore causes a number of local quality problems.

3. Set up of the survey

3.1. Questionnaire design (common)

The questionnaire used in the present valuation survey is the offspring of intensive discussions among the research teams of Spain, Italy and Greece on the structure of a Common Valuation Design (CVD). The CVD was considered indispensable in order to be able to compare results in all case studies. A nine-page questionnaire has been accordingly set up. In its final form, the common questionnaire contains three parts:

The first part starts with a general question about the most important problem of the respondent area, followed by questions referring to the importance of the environment and possible water uses exercised by the respondents. The first part also collects information about the experiences of respondent in relation to water restrictions.

The second part contains the Choice Experiment scenario. In introducing it, a short description of the expected situation for the drinking water availability for the next 10 years is presented. It is assumed that future climate change will affect Lesvos bringing about an increment of water scarcity due to more extreme weather conditions (droughts) and an overall decrease in expected annual rainfall. After that information is given about expected water restrictions in different water uses. The main part of choice experiment excerise contains the scenario (annex A) the attributes and the payment vehicle.

The attributes and their levels are:

1. The likelihood of household facing outdoor water use restrictions with 3 levels:
    a. 3 summers in the next 10 years
    b. 2 summers in the next 10 year

c. 1 summers in the next 10 years
d. Plus the future expected status (Described as 4 summers in the next 10 years)

2. Environmental quality with 3 levels:
   a. Moderate
   b. Good
   c. Very good
   d. Plus the future expected status (Described as poor)
3. Cost with 6 levels
   a. 20 €
   b. 40 €
   c. 60 €
   d. 80 €
   e. 100 €
   f. 120 €
   g. plus the do-nothing option which do not cost in monetary terms

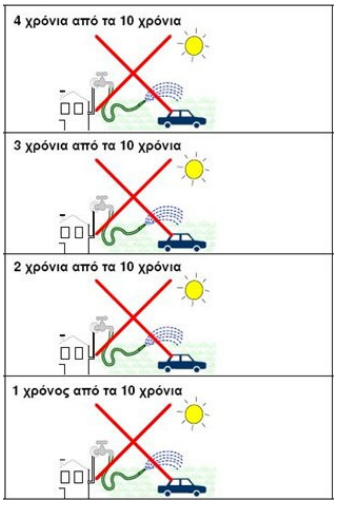


Figure 3.1: pictograms of 1st attribute

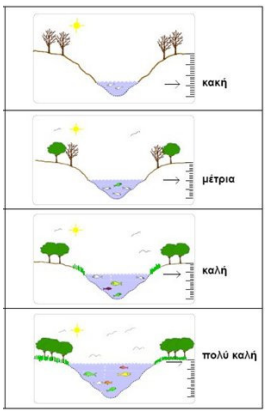


Figure 3.2: pictograms of 2nd attribute

The payment vehicle has chosen to be an increase of the current annual water bill for the coming 10 years until 2018. Each respondent faced four cards, each card presenting three

alternative situations, where in every card the 3rd alternative is the "do-nothing" option. The choice trade-offs were exemplified to the respondents (figure 4) before they were asked to choose the preferred alternative in each choice situation. This part collects also information about the reason of choice, but additionally in the Greek case study it contains also the Contingent Valuation question with same payment vehicle and mechanism (Annex A).

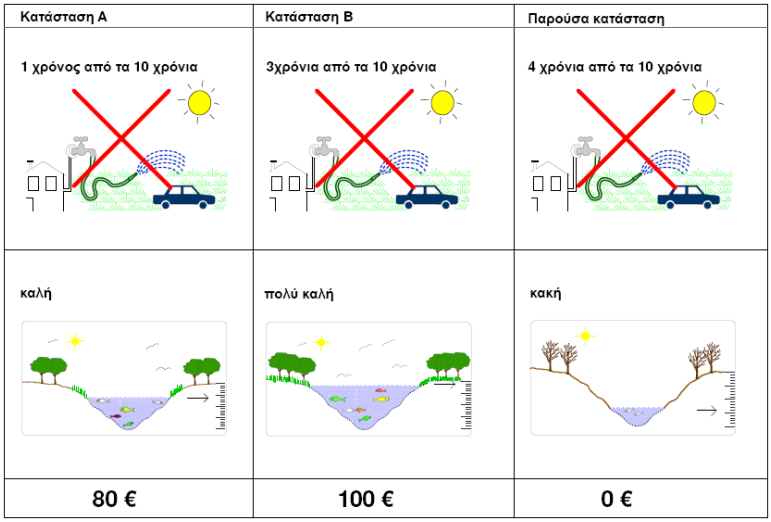


Figure 4: example card

3.2. Sampling procedure and response rate

The population of Lesvos Island according to the 2001 census is 90,643 inhabitants. The target was to complete 300 questionnaires (approximately 0.3%). In order to avoid analysis problems from possible protest bids 312 interviews have been finally implemented. The sampling area is the whole island of Lesvos and not any separate sub-basins. Three trained Ph.D students complete 312 face-to-face interviews from 01/08/2008 to 30/08/2008. Table 2 gives an overview of the distribution of the sample per municipal department.

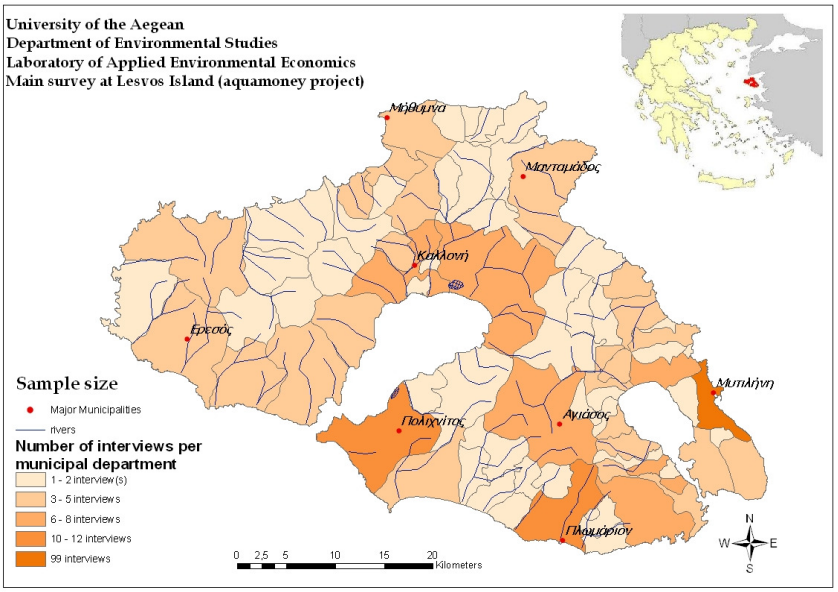
Municipality	Municipal department	Population (2001)	Sample size
Agia Paraskevi	Agia Paraskeui	2346	8
	Napi	282	1
Agiasos	Agiasos	2587	9
Gera	Papados	1640	6
	Mesagros	1048	4
	Paliokipos	1283	4
	Perama	633	2
	Plakados	343	1

	Skopelos	2038	7
Eresou-Antisis	Eresos	1581	5
	Antisa	1340	4
	Vatousa	570	2
	Mesotopos	1039	4
	Pterounta	150	1
	Sigri	402	1
	Chidira	448	2
Euergetula	Sikoynta	368	1
	Asomatos	328	1
	Ipios	900	3
	Kato Tritos	767	3
	Keramion	446	2
	Lampou Mili	164	1
	Michou	363	1
Kaloni	Kaloni	2027	7
	Agra	1030	4
	Anemotia	534	2
	Arisvi	465	2
	Dafia	869	3
	Keramio	1000	3
	Parakila	926	3
	Skalochori	666	2
	Filia	677	2
Loutropoleos Thermis	Loutropoli Thermis	1113	4
	Komi	227	1
	Mistegna	905	3
	Nees Kidonies	643	2
	Pigi	502	2
	Pirgi Thermis	419	1
Mantamados	Mantamados	1452	5
	Kapi	654	2
	Klio	592	2
	Pelopi	512	2
Mithimna	Mithimna	1667	5
	Argenos	240	1
	Lepetimnos	155	1
	Sikaminia	371	1
Mytilini	Mytilini	28879	99
	Agia Marina	732	3
	Alifanta	638	2
	Afalonas	514	2
	Loutra	1414	5
	Moria	1662	6
	Pamfila	1308	5
	Panagiouda	705	2
	Taxiarxis	344	1
Petra	Petra	1305	4
	Lafionas	224	1
	Skoutaros	1100	4
	Stipsi	1024	3
	Ipsilometopo	96	1
Plomari	Plomari	3673	12
	Akrasi	445	2
	Ampeliko	230	1

	Megalochori	455	2
	Neochori	302	1
	Paleochori	530	2
	Plagia	723	2
	Trigonas	340	1
Polichnitos	Polichnitos	2975	10
	Vasilika	608	2
	Vrisa	999	3
	Lisvori	562	2
	Stauros	144	1
Total		**90643**	**312**

Table 3.1: Sampling size per municipal department

Map 3 presents the number of interviews per municipal department; a minimum of one to a maximum of ninety nine interviews have been carried out in every municipal department of Lesvos.



Map 3.1: Sampling areas and number of interviews per municipal department

4. Valuation results

4.1. Respondent characteristics and sample representativeness

All respondents are inhabitants of Lesvos Island. Interviewers took effort that every interviewee was actually living in the municipality or of the municipal department that the interview took place.

4.1.1. Public perception of water use characteristics

Only two interviewees classified water scarcity problem as the most important issue of Lesvos, although one people mention salinization, a direct result of water scarcity, as a major water problem. Eight people mention problems with water supply and one with the available quantity of water for irrigation. This in some way could be more or less connected to a perceived water scarcity problem. In general, 17% of respondents mention a water related problem as an important issue for the area.

Most important issue or problem	Frequency	Percent	Percent Valid
Unemployment	41	13,1	13,9
Bad situation of road network	24	7,7	8,1
Traffic	20	6,4	6,8
Transportation	19	6,1	6,4
Problems of tourism sector	16	5,1	5,4
Waste management	16	5,1	5,4
Total	136	43,5	46

Table 4.1: Most important issue or problem in your area

The most popular responses about the most important issue or problem are presented at table 4.1. As expected, unemployment is considered to be the most important problem. Waste management is the most important environmental issue.

	Frequency	Percent
not important at all	1	,3
not important/not unimportant	5	1,6
important	63	20,2
very important	241	77,2
don't know	2	,6
Total	312	100,0

Table 4.2: Importance of environment

Table 4.2 presents the responses about the importance of environment in general. 77.2% of respondents classifies environment as 'very important' while 20.2% classifies environment as 'important'. The majority (92.0%) of respondents do not undertake recreational activities

near open freshwater such as rivers or lakes; this is an expected result because Lesvos does not contain big rivers or lakes. The most popular responses are hunting and walking, with a percentages of almost 50% among respondents who undertake recreation activities.

	Frequency	Percent
One-two times per year	4	16,0
once every three months	2	8,0
once per month	3	12,0
once per week	7	28,0
more than once per week	6	24,0
other	3	12,0
Total	25	100,0

Table 4.3: Frequency of practice recreational activities

Table 4.3 presents the frequency of practicing recreational activities by respondents. The mean distance from the nearest open water location for water recreation is 67,48 km (Std. Dev = 192.82, maximum 1000); two out of three respondents have to travel less than 15 km and nine out of ten less than 35km.

	Frequency	Percent	Valid Percent
river	7	2,2	29,2
creek	9	2,9	37,5
lake	4	1,3	16,7
estuary	3	1,0	12,5
other	1	0,3	4,1
Total	24	7,7	100,0

Table 4.4: type of water ecosystem for recreation

Table 4.4 presents the type of water ecosystem that respondents travel to in order to practice recreational activities. The results are as expected because creeks are the majority of water bodies at Lesvos. Relatively to the perceptions about the environment and the way it is affected by water availability in Lesvos, the majority of respondents (92%) believe that environment is affected in some way. A percentage of 4.2% indicate that they are not sure or don't know; on the other hand a percentage 3of .8% state that there is not any connection.

Figure 4.1 illustrates the extent to which respondents agree with the statement '*The environment has the right to be protected irrespective of the costs*'. 51.6% of respondents agree,

while a percentage of 41.7% completely agree that the environment has the right to be protected irrespective of the costs.

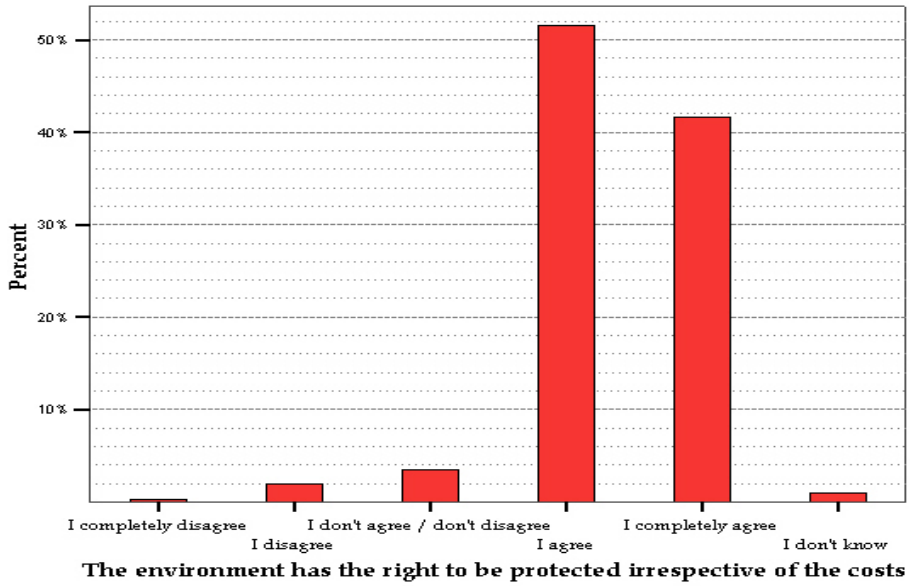


Figure 4.1: The environment has the right to be protected irrespective of the costs

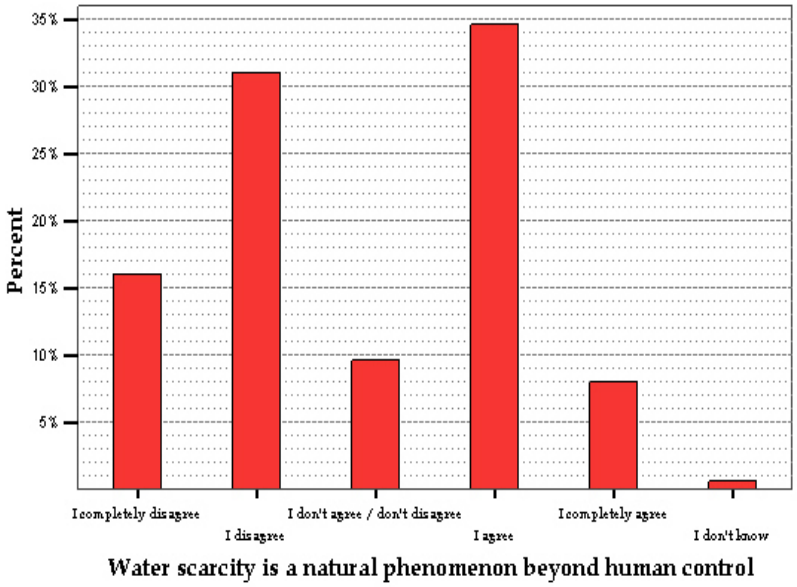


Figure 4.2: Water scarcity is a natural phenomenon beyond human control

Figure 4.2 illustrates the extent that respondents agree with the statement that *'Water scarcity is a natural phenomenon beyond human control'*. The relevant responses are in a way balanced; a percentage of 47.1% at least disagree (16% complete disagree), on the other hand a percentage of 42.6% agree (8% complete agree). A group of 9.6% or respondents could not decide where to stand on this matter.

The mean of annual water bill paid amounts to €147,98 (Std. Deviation 119,58, maximum €1200, minimum €0). When asked which were the highest water allocation priority after domestic needs were satisfied, agriculture comes first with a percentage of 53.2%, followed by environmental use which was chosen by 45.2% of respondents; industry comes third with a percentage of 0.6%.

4.1.2. Water management problems

This part contains information about the water management problems as perceived by the respondents.

	Frequency	Percent
private well ran low on water	52	16,7
households in my area were prohibited from using water for washing cars, watering gardens	34	10,9
households in my area had water pipe cuts in the past	136	43,6
households in my area were prohibited from using tap water due to water pollution	27	8,7
information campaigns were organized to voluntarily reduce water consumption	13	4,2
never experienced any water use restrictions	141	45,2

Table 4.5: water restrictions

Table 4.5 summarizes the responses about water restrictions. 45.2% of the interviewees indicated that their household never experienced any water restriction. On the other hand, the most popular answer about water restrictions is "households in my area had water pipe cuts in the past" with percentage 43.6%.

	Frequency	Percent	Valid Percent
my household does not suffer from water restrictions	11	3,5	6,7
One year	8	2,6	4,9
Two years	16	5,1	9,8
Three years	26	8,3	16,0
Four years	19	6,1	11,7
Five years	17	5,4	10,4
Six years	5	1,6	3,1
Seven years	0	0	0
Eight years	1	0,3	0,6
Nine years	1	0,3	0,6
Ten years	59	18,9	36,2
never experienced any water use restrictions	163	52,2	

Table 4.6: Frequency of household suffer from water restrictions in the last 10 years

One out of three respondents faced water restriction every year in the past ten years. Another 38.1% of respondents indicated that they have suffered water restrictions from three to five years in the last decade. Almost one out of four respondents in Lesvos was professionally affected in some way by water availability or water restrictions. More than 55% stated that water scarcity affects only irrigation, while 20% of respondents mention that water restrictions affect their job in café or restaurant.

	Frequency	Percent
no, definitely not	18	5,8
no, probably not	39	12,5
don't know/not sure	72	23,1
yes, probably	99	31,7
yes, definitely	82	26,3
Missing	2	,6
Total	312	100

Table 4.7: future water restrictions

Table 4.7 presents the responses about expectations for water restrictions in the future. Most of the respondents (58%) believe that it is probable to face water restrictions in the future. A percentage of 54.2% of respondents estimate that water restrictions will happen annually in the next decade; a percentage of 21.2% estimate that water restrictions will happen during the 5 years of the next decade.

	Frequency	Percent
not familiar at all/never heard of this before	8	2,6
not familiar	14	4,5
somewhat familiar	88	28,2
Familiar	113	36,2
very familiar	88	28,2
Total	311	100

Table 4.8: Familiarity with scenario

Table 4.8 presents the familiarity of respondents with information about the current and expected situation of water availability and environmental use of water on the island. Most interviewees (92.6%) are at least 'somewhat familiar' with a scarcity scenario and only 7.1% are not.

	Frequency	Percent
not credible at all	4	1,3
not credible	22	7,1
somewhat credible	46	14,7
credible	120	38,5
very credible	101	32,4
don't know	17	5,4
Total	310	100

Table 4.9: Increase of water scarcity

Table 4.9 presents the answers to question *'how credible is it to you that water scarcity will increase in your river basin in the next 10 years'*. A percentage of 7.1% think that this is not credible; a percentage of 1.3% think that this is not credible at all. On the other hand, 85.6% find at least credible the increase of water scarcity.

4.1.3. Demographic/Socio-economic characteristics

This part contains information about the demographics and socio-economic characteristics of the sample.

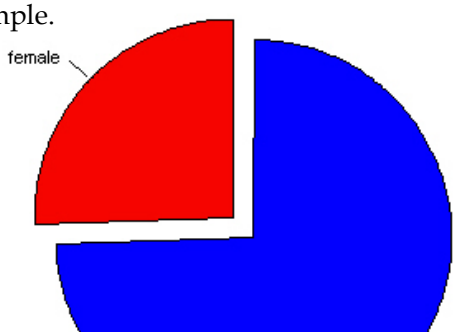


Figure 4.3: Gender of respondents

Figure 4.3 illustrates the gender of the respondents; a percentage 74.48% is male while the rest 25.3% is female.

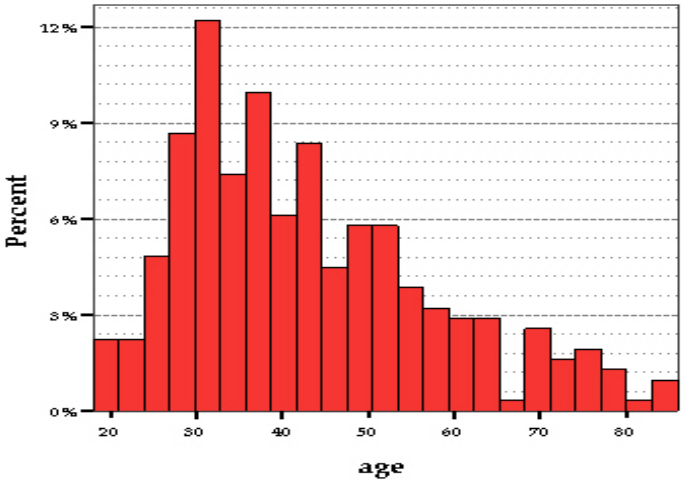


Figure 4.4: Age of respondents

Figure 4.4 illustrates the age of the respondents; the mean is 42.86 years and the median 40 years.

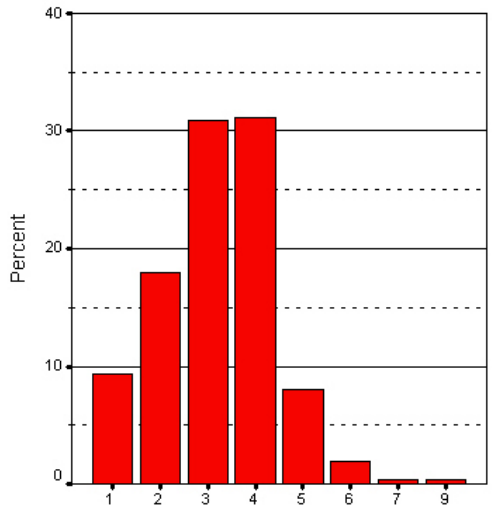


Figure 4.5: Family size of respondents

Figure 4.5 illustrates the family size of respondents; the size varies from one person to nine members, the mean is 3.2 and the median 3. For the families with members under 18 years old the mean is 0.59; almost two out of ten respondents belongs to a family with one member under 18 years old.

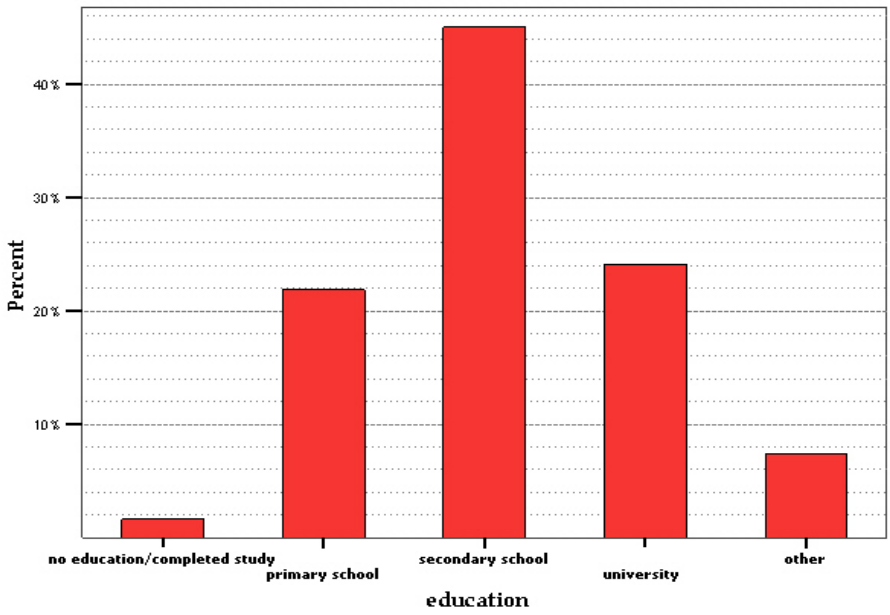


Figure 4.6: Education of respondents

Figure 4.6 illustrates the education level of respondents; the majority of respondents have complete secondary school (45%), five respondents have not finished the primary school.

	Frequency	Percent
Unemployed/looking for work	10	3,2
Farmer	43	13,8
Employed in the tourism sector	27	8,7
Fisherman	1	0,3
Employed in the service sector	35	11,2
Employed in the industry sector	2	0,6
Employed in the health care sector	5	1,6
Employed in the education sector	14	4,5
Retired	35	11,2
Student	11	3,5
Housewife/man	14	4,5
Businessman	1	0,3
Civil servant	19	6,1
Construction sector employee	2	0,6
Freelancer	69	22,1
Military	8	2,6
Policeman	1	0,3
Priest	3	1,0
Privet sector employee	10	3,2
Total	310	99.3

Table 4.10: Profession of interviewees

Table 4.10 summarize the profession of interviewees. 22.1% of respondents are self-employed. The second in size group are farmers (13.8%) .

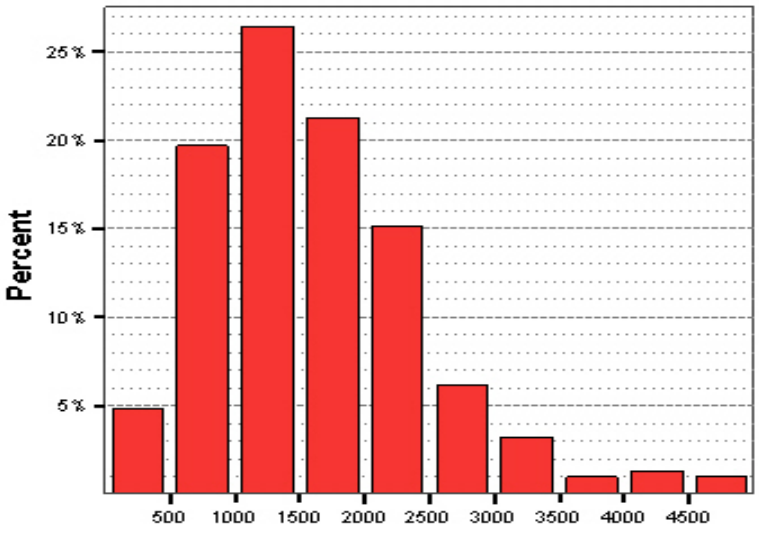


Figure 4.7: Average monthly income of respondents

Figure 4.7 illustrates the average net (after tax) monthly household annual income of respondents; the mean average annual household net (after tax) income is €19,374 (median = €15000). Note: For calculations purpose, average annual incomes < €6000 have been set equal to €3000 and average annual income > €54000 has been set equal to €57000. Only fourteen respondents are members of environmental protection organizations (percentage 4.5%). The average annual payment of water bill varies from 0 to 100 euros.

4.3. Factors explaining economic values for water resource management

Table 4.11 presents estimated effects and fit statistics for MNL and RPL choice model specifications. Models were estimated using R and S+ discrete choice libraries. The full sample of 312 CE participants was utilized. In some cases though, sample size drops to 300 due to missing values in variables of interest. In Table 4.8, MNL Model 1 uses only attributes' main effects to specify the utility function. MNL Model 2 adds interaction terms of attributes with socio-economic variables and perceptions, selected on the basis of fit to the data. RPL Model 1 uses an attribute only utility specification where the mixing distribution of the COST parameter is assumed lognormal, thus constraining its values to be negative. RPL Model 2 uses the COST/INCOME ratio (termed COSTINC) as regressor variable, again with lognormally distributed random parameter values. Testing has shown that this variable has better explanatory power than multiplicative COST:INCOME interactions.

The coefficients of attributes levels have the expected signs in all estimated models. The signs of all attributes, except of cost, are positive, as consumer preference theory predicts. These attributes are coded to show an increase in environmental quality or an increase of water availability for domestic supply under scarcity conditions which should lead to increased utility. Cost effect is negative, also in accord with standard economic theory. Environmental levels and the likelihood of household facing outdoor water use restrictions are significant determinants of utility.

	Model												
	MNL Model 1 [2]				MNL Model 2 [3]			RPL Model 1 [4]			RPL Model 2 [5]		
Variables	$\hat{\beta}$	$\hat{\sigma}_{\beta}$	p-val	WTP	$\hat{\beta}$	$\hat{\sigma}_{\beta}$	p-val	$\hat{\beta}$	$\hat{\sigma}_{\beta}$	p-val	$\hat{\beta}$	$\hat{\sigma}_{\beta}$	p-val
Attributes													
DOMSUP	2.357	0.485	0.000	287.1	5.323	1.268	0.000	3.090	0.559	0.000	2.369	0.514	0.000
ENV QUAL _ M	0.364	0.179	0.042	44.4	0.171	0.196	0.382	5.111	0.803	0.000	1.409	0.243	0.000
ENV QUAL _ G	1.241	0.182	0.000	151.2	0.287	0.350	0.413	6.113	0.828	0.000	2.243	0.235	0.000
ENV QUAL _ V	2.077	0.196	0.000	253.1	2.454	0.373	0.000	7.197	0.856	0.000	3.162	0.236	0.000
COST	-0.008	0.002	0.000										
COSTINC					-33.956	5.681	0.000						
Interactions													
DOMSUP:AGE					-0.082	0.028	0.003						
DOMSUP:PROAFF					2.900	0.884	0.001						
ENVQ_M:WATRESTR					0.102	0.024	0.000						
ENVQ_G:EXPREST					0.262	0.081	0.001						
ENVQ_V:EXPREST					0.237	0.081	0.004						
ENVQ_G:FAMTY					0.142	0.084	0.091						
ENVQ_V:AGE					-0.019	0.006	0.002						
COSTINC:AGE					0.188	0.067	0.005						
COSTINC:EDSC					7.321	1.600	0.000						
COSTINC:WATPRO					1.560	0.866	0.072						
Random Specification													
$\tilde{\beta}_C \sim Lognorm(\mu, \sigma)$								*C=COST*			*C=COSTINC*		
$\hat{\mu}$								-6.208	0.597	0.000	-6.827	3.534	0.053
$\hat{\sigma}$								3.213	0.524	0.000	8.179	2.537	0.001
Average CS wrt SQ	288.32					-			-			-	
Fit statistics													
Sample size				1248			1200			1200			1200
Log Likelihood				-1082.35			-935.855			-804.280			-789.912
Likelihood Ratio Index				0.211			0.290			0.413			0.424

[2] With main effects of attributes only.

[3] Main effects of attributes and interactions with individual characteristics, selected to maximize fit.

[4] Random coefficient for the COST variable.

[5] Random coefficient for the COSTINC variable.

The variables used in the models are:

DOMSUP = Domestic supply attribute, scale.

ENV QUAL = Environmental quality attribute, categorical.

_M = moderate level

_G = good level

_V = very good level

COST = Cost attribute, scale.

COSTINC = COST/INCOME ratio.

AGE = Age in years.

EDSC = Education, ordinal but assumed scale var. to reduce number of parameters. 0=none, 1= primary, 2=secondary, 3= below university level, 4=university.

EXPREST = Expectation of future water restrictions, Q14. Scale.

FAMTY = Familiarity with CE background information, Q17. Scale.

PROAFF = Professionally affected by water shortage, Q14. Binary (0=no,1=yes).

WATPRO = Perception of water availability being a problem, Q8. Scale. DK positioned in mid scale.

WATRESTR = Frequency of water supply restrictions in the last 10 years.

From our choice models estimation results it appears that:

(a) The effects of attributes and/or their interactions with individual characteristics and perceptions are plausible in all models we have estimated. This gives us confidence about the quality of the data we have collected. A summary of these effects for the larger estimated model (MNL model 2) follows.

When controlling for the effects of other variables in the model, the observed effects in utility are:

DOMSUP: The higher the supply level the more attractive the choice alternative.

ENVQUAL: The higher the environmental quality level the more attractive the choice alternative (levels M,G loose significance wrt SQ due to interactions).

COSTINC: The higher the COST wrt INCOME the less probable is a particular choice.

DOMSUP:AGE : Domestic supply is a more important utility determinant for younger respondents (possibly are more sensitive about environmental issues).

DOMSUP:PROAFF : Domestic supply is more important for professionally affected individuals.

ENVQ_M:WATRESTR : Moderate environmental quality appears more important for people that have experienced higher levels of water shortage.

ENVQ_G:EXPREST, ENVQ_V:EXPREST : High environmental quality is more important for people who expect high levels of future water shortage.

ENVQ_G:FAMTY : Familiarity with CE background information is associated with increased importance of good environmental quality.

ENVQ_V:AGE Highest environmental quality is a more important utility determinant for younger respondents (see also DOMSUP:AGE effect).

COSTINC:AGE: Older individuals have higher probability to choose an alternative with a higher COST/INCOME ratio than younger people.

COSTINC:EDSC: Persons with higher educational level tend to choose alternatives with higher COST/INCOME ratios than those with lower education level.

COSTINC:WATPRO: Individuals who perceive that water availability is a serious problem are more likely to choose alternatives with higher COST/INCOME ratios.

(b) There is a considerable amount of unobserved respondent heterogeneity in the effects of the COST and COSTINC variables in representative utilities associated with choices, as shown by a comparison of the fit statistics for the fixed (MNL) versus the random coefficient (RPL) models. We expect to achieve a better data description by a RPL model with interactions, specified through formal model selection procedures. Derivation of this model is pending.

(c) Initial estimates of the marginal WTP and average (per person and up to an additive constant) CS were derived from MNL model 1 (attributes only). WTP estimates are given in the fourth column in the corresponding partition of Table 4.11 and are discussed below. Our estimate of the average CS with respect to status quo is about €288. More accurate estimates of both WTP and CS changes under policy scenarios will be derived through simulations using more complex models with interactions, nonlinear income effects, and random parameters in representative utilities. Models incorporating such effects have not yet been fully developed, but there is strong evidence for their presence in our preliminary results. This claim is justified by the steady and statistically significant

increase in data fit (LRI and Log-likelihood measures) as we move from the MNL model 1 to RPL model 2.

4.4. Estimated economic values for water resource management

Implicit prices are interpreted as the willingness-to-pay through an increase of water bill for the next 10 years per household, annually, for a change in any of the attributes. They reveal the following:

Moderate environmental quality: Households are WTP €44.44 (€22.54 to €66.32) to avoid poor environmental quality caused by water scarcity.

Good environmental quality: Households are WTP €151.18 (€128.88 to €173.36) in order to keep environmental quality in good condition and avoid poor condition caused by water scarcity.

Very good environmental quality: Households are WTP €253.09 (€229.09 to €276.91) in order increase poor environmental quality to very good by water scarcity.

Domestic supply:
Estimation from CE: Households are WTP €287.10 (€227.93 to €346.09) every year for the next 10 years to decrease the likelihood of household facing outdoor water use restrictions.

Estimation from Contingent Valuation: Households' WTP for the reduction of the probability of water restrictions for secondary uses (while primary uses are always guaranteed) from four years to one year is €65.79 (€60.26 to €71.32).

4.5. Total Economic Value

Initial estimates of the marginal WTP and average (per person and up to an additive constant) CS were derived from MNL model 1 (attributes only). WTP estimates are given in the fourth column in the corresponding partition of Table 4.8 and are discussed below. Our

estimate of the average CS with respect to status quo is about €288. More accurate estimates of both WTP and CS changes under policy scenarios will be produced through simulations using more complex models with interactions, nonlinear income effects, and random parameters in representative utilities. Models incorporating such effects have not yet been fully developed, but there is strong evidence for their presence in our preliminary results. This claim is justified by the steady and statistically significant increase in data fit (LRI and Log-likelihood measures) as we move from the MNL model 1 to RPL model 2.

To estimate respondents overall WTP under alternative policy scenarios, it is necessary to include the results from contingent valuation method, which estimate the WTP for water availability for households. The aggregation to achieve the measure of total economic value has been based on the individual's estimations of marginal WTP and the number of households of Lesvos Island.

Two scenarios plus Status Quo scenario have been developed and presented below.

Status Quo: Business as Usual scenario
Bad status of environmental quality due to water flow level; restrictions in domestic supply for 4 years in the next 10 years

Scenario A: Guaranty domestic supply
Moderate status of environmental quality due to water flow level; restrictions in domestic supply reduced form 4 years to 1 year in the next 10 years

Scenario B: Environmental friendly scenario
Good status of environmental quality due to water flow level; restrictions in domestic supply reduced form 4 years to 1 year in the next 10 years

The steps in order to secure that the aggregation procedure is valid we have managed to:

1. Set the population of interest all households of Lesvos Island.
2. A random sample that cover island per municipality department has been chosen.
3. Mean WTP has been chosen to estimate TEV.

Additionally high response rate and complete answers to valuation question has been succeeding.

The estimations of WTP and TEV for the scenarios are presented in Table 4.12.

Scenario	Estimations of WTP per year	Total economic value (Discount rate 2.5%)	Total economic value (Discount rate 5.0%)
Status Quo	0	0	0
Scenario A	110.23€	32.153.321,03€	28.841.414,00€
Scenario B	216.89€	63.265.297,99€	56.748.746,10€

Table 4.12: Estimations of WTP and total economic value

The total economic value for scenario A is €3,593,828.69 per year for the next 10 years respectively, while the total economic value of scenario B which provides better environmental quality is almost doubled and estimated at €7,071,264.67 per year. In terms of net present value scenario A valued at €32,153,321.03 (discount rate 2.5%) and at €28,841,414.00 (discount rate 5%) while scenario B valued at €63,265,297.99 (discount rate 2.5%) and at €56,748,746.10 (discount rate 5%).

5. Best practice recommendations

Proper design and a successful valuation scenario presuppose extensive pre-testing and the use of focus groups. Useful information about the scope and frame of the problem at hand, the possible attributes and lay people perceptions can be collected through pre-testing. The identification of the legal framework and the property rights should be taken into account. Pre-testing is the most important step in order to confirm or to reject the basic ideas of questionnaire form and content. Another issue is the selection of the target population, which depends inter alia on the valuation good (or service). Generally speaking, a serious problem encountered while setting up scenarios and defining the status quo is the lack of documentation referring to benchmark water status. This can easily drive the research to the wrong direction. Many water related problems (water scarcity, water quality, water supply, waste water management) occurs locally, all over the river basin. A detailed review on such information is important.

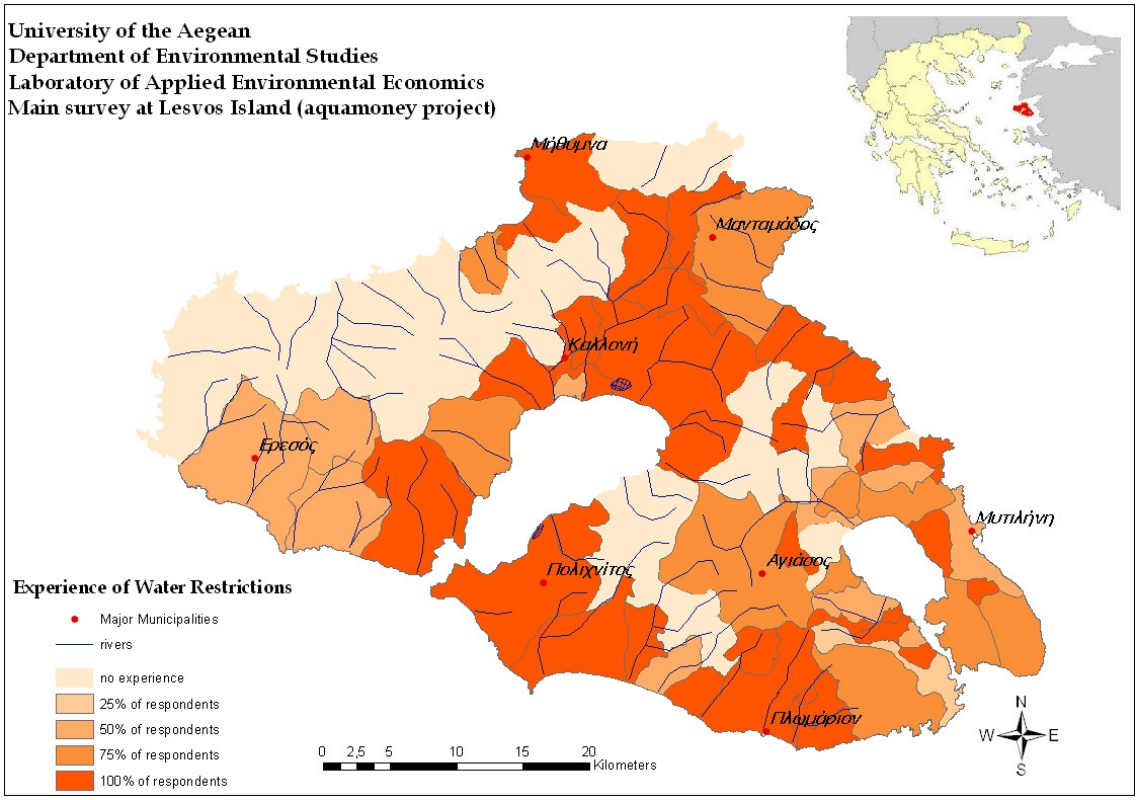
In relation to the choice experiment design we suggest the avoidance of restrictions to the attributes number or to the attributes levels. Special care should be taken when entering water allocation among different users in the design because the possible options for attribute selection could be correlated. The design should be developed by experts. A number of pre-tests should be conducted in order to check the illustrations of water scarcity attributes. Images like pictures, photos or pictograms should be tested carefully (especially with older respondents).

Face to face interviews (intercept survey) has been chosen in order to take advantages of the highly flexibility; the ability to presents complex questions to respondents; the proper form and length of questionnaire; to achieve high response rates, and of course in order to control the sampling procedure. On the other hand, special care should be taken on interviewers training in order to avoid bias.

Another interesting issue is the selection of time of implementing the survey. We have notice highest response rate on summer than winter on scarcity themes. Another interesting issue is the reporting of the results. Usually numbers should be reported along with qualitative information; Maps and well-tested graphics are very important for policy makers. Meetings with local authorities and local media are a good way to publish results at the sample area. Presentations of results to responsible civil servants and copies of executive summary will help water authorities.

6.Conclusions

Water restrictions are observed in all major municipalities. Only the north-north west part of Lesvos is does not face water restrictions (map 4). In the north part exception are Mithimna and Petra which are municipalities with high development of touristic sector, a small dam operate in the area, but the problem at Petra remains. In the west part except from Eresos water restriction happened at summers, Eresos is also a municipality with high development of touristic sector, a dam has also operated last years and the problem seems to be solved. The central part of the island (Kalloni) seems to face the most complex problem of water restrictions. The springs and drills that have been supplied municipalities with freshwater which contains high quantities of Arsenic (As). Although due to the European legislation many off them have been stop supplying freshwater to the municipalities; municipalities like Agia Paraskeui and Mantamados trying to solve the problem of domestic supply with new drillings.



Map 4: Experience of water restrictions

On the other hand at Kalloni plains the consumption of water for irrigation purpose has create small scale salinization phenomena according to respondents. The south part of the island has supply problems especially at municipality of Plomari, there are plans for the construction of a dam that hopefully will solve the water supply problems.