

Article

Wetlands Management in Northern Greece: An Empirical Survey

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Abstract: Water management projects have an important role in regional environmental protection and socio-economic development. Environmental policies, strategies, and special measures are designed in order to balance the use and non-use values arising for the local communities. The region of Serres in Northern Greece hosts two wetland management projects—the artificial Lake Kerkini and the re-arrangement of Strymonas River. The case study aims to investigate the residents' views and attitudes regarding these two water resources management projects, which significantly affect their socio-economic performance and produce several environmental impacts for the broader area. Simple random sampling was used and, by the application of reality and factor analyses along with the logit model support, significant insights were retrieved. The findings revealed that gender, age, education level, and marital status affect the residents' perceived values for both projects and their contribution to local growth and could be utilized in policy making for the better organization of wetland management.

Keywords: wetlands; water resources; management; public participation; decision-making; lake Kerkini; logit model

1. Introduction

Within the last decade, significant efforts have been made in terms of public policies and regime shifts in water resources management. This happened as a consequence of public concern deriving from the need to introduce sustainability in management and efficient use of water resources—along with the protection of their surrounding natural environments [1–3]. Economic and political challenges are listed as some of the major criteria for the policies adopted so far on local, regional, national, and international level. While it should be noted that fostering sustainable and efficient water resource management implicates sophisticated solutions with applicability in the future that should be designed under an integrated concept [4]. In fact, long-term benefits of a holistic approach for sustainable water resources development have become an issue of wide interest. Time and re-design of policy making will be required to implement such an approach.

At present, the best available practices and scientific knowledge are rarely incorporated adequately into decision-making. In addition, they also lack competent representation when implementing water resource policy measures or strategies. It is a fact that integrated water resources management is disregarded. Indeed, critical established elements, such as the economic environment and public participation, are not considered as important factors in decision-making processes [5]. In practice, however, effective water resources management lies beyond water-based conceptualization. In

fact, there are pressures that are significantly enhanced by human activity and end up as major environmental threats, including sedimentation, pollution, climate change, deforestation, landscape changes, and urban growth [6–9]. Changes in landscape, attributed to deforestation or land use changes and urbanization, do entail direct or indirect impacts on water resources. Moreover, one of the most serious problems for water resources is their limited contribution to water provision, a common phenomenon for certain lakes, rivers, and inland seas all around the world. In general, anthropogenic interventions have caused a notable shrinkage of wetland span, leading to new, fragile ecological balances [10]. Furthermore, humans have created and controlled an “artificial” environment through the dynamic evolution of the hydro-geomorphological processes. In the long run, this situation may activate environmental threats in a certain region [11–15].

In Greece, the drainage issue for wetlands was a common practice—to expand agricultural land or even to improve its productivity [16]. For a fixed period of 15 years between 1925 and 1940, a number of lakes—including Copais, the Lakes Yannitsa, Artzan, Amatova, and Achinos—were drained for the reasons mentioned above. In addition, the river beds of Axios, Aliakmon, and Strymon in Macedonia, as well as Louros and Arachthos in western Greece, were re-arranged [16]. In total, and based on estimates by the Ministry of Agriculture, these works had resulted in drainage of 89,900 ha of wetlands irrigation of 14,000 ha and protection from floods for 369,000 ha. The creation of these projects has led to an enormous loss of wetlands [16]. Since then, many changes in drained lakes have followed including their reconstruction, or the construction of artificial lakes such as Kerkini Lake, which is one of the most significant projects in Greece. Therefore, it is obvious for the case of Greece that the issue of water resources management is of great significance for the regional economic growth and in order to secure sustainability, whereas the achievement of these objectives should be evaluated by the residents of these wetlands or by their potential visitors.

The present study is an effort to unveil the residents’ views and attitudes regarding two water resources management projects in the region of Serres, namely the artificial Lake Kerkini. The latter is regarded as major a source of biodiversity. Meanwhile, Strymonas River beds have been rearranged, creating multiple environmental and economic impacts on the surrounding area.

Background

Water resources in Greece, including lakes and rivers, have been under huge human intervention. Present and future anthropogenic pressures imply significant degradation and serious threats for the ecosystem services. Among the multiple impacts of the changes to wetlands that occurred, the loss of biodiversity, the low quality of ecosystem services, the erosion to the associated watershed, the high irrigation costs, the limited water supply, and many others should be mentioned [17]. All these changes appear either to rivers or to the surrounding wetlands and are accompanied by severe impacts on biodiversity.

The Greek government has responded with the establishment of a notable number of new protected areas as well as by raising public awareness on conservation issues. Moreover, water resources monitoring projects received a lot of attention, and they were intensified with the implementation of the European Union (EU) Water Framework Directive (WFD). Unfortunately, bio assessment-based monitoring, long-term conservation programmes, and restoration actions in rivers have lagged behind other EU countries.

Public participation in decision-making is important for the adoption of sustainable practices addressing water management [18–20]. Decision-making and policy implementation require a number of steps, namely, defining the problem, analyzing options, making the decision, and evaluating its outcome, or in descriptive terms, they are intermediate steps of a decision-making process [18]. There are factors affecting the stakeholders’ views and attitudes in the adoption of decisions, which in turn influence the performance and efficiency of the whole procedure. The age, education, wealth, personality, access to extension, and perceptions of weather and risk are some of the aforementioned factors [21–23].

In Greece, to the best of our knowledge, the number of contingency valuation models (CVMs) studies for evaluation of artificial wetlands is very limited. Oglethorpe and Miliadou [24] used CVM to estimate the non-use attributes of Lake Kerkini. The same authors also examined the relationship between the revealed non-use values and some social characteristics and attitudes of the local community. Ragkos et al. [25], using a CVM survey, valued Zazari–Cheimaditida wetland functions in terms of the goods and services providing welfare measures that reflect the value of these functions. Birol et al. [26], using a choice experiment (CE) model, measured the changes in the ecological, social, and economic conditions of the Cheimaditida wetland. Both projects entail the involvement of the public. Therefore, their views—in terms of environmental and agroeconomic impacts—are of great significance. What is more, the public valuation of a project is based not only on direct, but also indirect values. Hence, the efficiency of implemented water management policies stands as a requirement for the protection and sustainable development of water resources. To this end, it becomes a necessity to acquire insights from the relationship involving the level of environmental concern and behaviors that are able to support sustained and generated actions, as well as to deepen the knowledge on how users of water resources assess certain environmental values [27]. Within this framework and based on the residents' characteristics and environmental values trends, it is attempted to provide insights on their attitudes towards two water projects with different characteristics, in artificial Lake Kerkini.

2. Materials and Methods

2.1. The Study Area

The study area is the Municipality of Serres in the Regional Unit of Serres, situated in the northern part of Greece. The area administratively belongs to the Region of Central Macedonia, Greece. The study involves two different wetlands, namely the River Strymonas and the man-made Lake Kerkini. Strymonas River catchment occupies a total area of 16,747 km² and is located on the Balkan Peninsula in the Municipality of Serres. It belongs in four countries, namely, Bulgaria (50.6%, 8473 km²), Greece (35.8%, 5990 km²), Republic of North Macedonia (9.8%, 1641 km²), and Serbia (3.8%, 643 km²). Strymonas River, after 25 km in Greece, flows to the north-eastern part of Lake Kerkini and continues downstream from Kerkini for 77 km. The river drains the plain of Serres and ends up to Strymonikos Gulf (Figure 1). The most significant socio-economic impact for the surrounding wetlands of Strymonas River is irrigated agriculture. According to the criteria of the European Directive 2007/60/EC, the area of Serres is considered of a high potential flood risk zone. The two water management projects have multiple benefits. The motives for its construction were area protection against floods caused by the Strymonas River. However, a few years after its construction, it began to be used as an irrigation reservoir. In addition, a unique wetland ecosystem has been developed that is protected by the Ramsar Convention and EU legislation. The lake covers an area of 73.2 km² at its highest water level, i.e., 35.8 m, and stores 345×10^6 m³ of water. Strymonas River and Lake Kerkini are the main surface water bodies in the catchment. From the 100,000 ha of arable land, 84,500 ha are irrigated and 54,500 ha (64.5% of the total irrigated area) meet their irrigation needs directly from Strymonas River and Lake Kerkini. The remaining 30,000 ha are irrigated from streams and groundwater [28].

In financial terms, 36.56% of companies are active in trade, 13.50% in manufacturing, and 49.93% in services. Moreover, there is a significant dependence on the agricultural sector regarding local and regional development in the area of Serres.

The major location of the two wetlands is the Municipality of Serres characterized by the highest number of villages in Greece. It is majorly a plain area, as almost 48% of the total area is semi-mountainous. The Municipality covers 601.49 km² and it borders with the Municipality of Sintiki to the north, with the Municipality of Emmanuel Pappas to the north-east, with the Municipality of Irakleia to the north-west, and with the Municipality of Visaltia to the south.

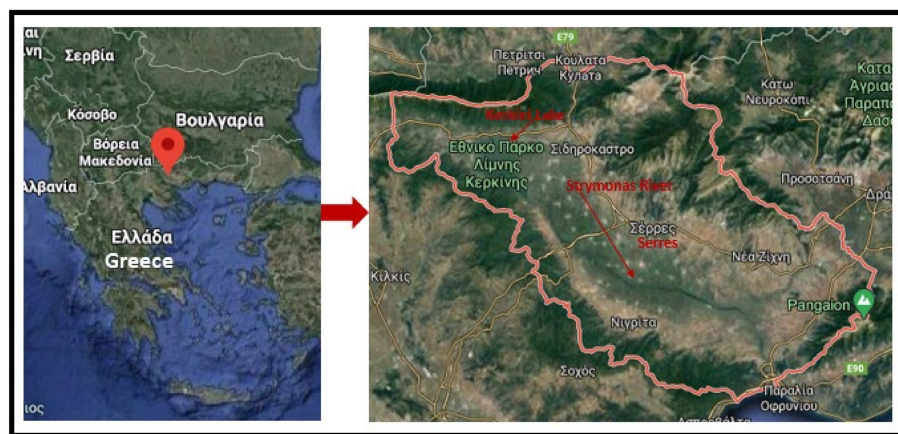


Figure 1. The map of Serres in Greece and the location of Kerkini Lake and Strymonas River (Source: Google Maps).

The Municipality has an unspoiled natural environment with rich biodiversity of rare flora, fauna, and fish fauna. Many areas of Serres are listed in the NATURA 2000 network. The protected areas by NATURA 2000 and designated as special protection areas (SPAs) are the following: Lake Kerkini; the mountain tops of Beles, Agkistro, Haropo, and Agios Ioannis; Eptamyloi; the mountain tops of Mount Orvelos; the mountain tops of Menikion, Kouskouras, Ipsoma, Vrontou, Lailias, and Epimikes; the embouchure of Strymonas River; the artificial Lake of Kerkini; Krousia mountain; and the valley of Timios Prodromos.

2.2. The Research Method

Personal interviews were used as the research tool to conduct the survey. This tool is an efficient method of collecting socioeconomic and statistical data [29]. Simple random sampling is the methodology used on account of its simplicity and less demanding nature in terms of knowledge on population characteristics [30–34]. The survey aimed to unveil the perception of local people of the water management projects impacts—not only financial, but also environmental impacts. With the assistance of preliminary sampling of 50 people and based on random sampling formulas with reposition, we have estimated the sample at 400 questionnaires [30,32,34].

The use of the questionnaire should aim at the estimation of more than one variable. On the one hand, the “fertilizers and pesticides as a major source of pollution” in Strymonas River have proven to be the most demanding variable in terms of sample size. On the other hand, the qualitative variables that required a large sample size were the following: “The satisfaction due to the river bed management and Ahinos Lake drainage”, as well as the “permanent residence” of the respondents in a distance less than 10 km and the “bad quality of underground water”. The sample size of the survey not only satisfies the most unstable variable, but also estimates with precision all the other less unstable variables [32]. The survey was conducted during 2014–2015 and, for the analyses, Statistical Package for Social Science—SPSS was used.

The questionnaire included 35 questions, some of which included more sub-questions and some of which used multi-variables. A section is devoted to the features of the cultivated area possessed by the farmers and the possibility of an erosion occurrence. Another section involves the use of fertilizers and pesticides and the potential of the farmers to adopt protection measures in their use or whether tests were conducted on the products. It follows a section about the existence of trees in the farm and their impact on the landscape, water saving, or landscape changes. Last, but not least, the questionnaire investigates the quantity and quality of water and the crops cultivated by the farmers. Moreover, their perception on genetically modified products and the prospect of adopting organic cultivations in the future was investigated. Coding the responses of the survey was followed by the

descriptive analysis of the variables employed. Meanwhile, the multi-variables were subjected to reliability analysis as well as to factor analysis. Eventually, the logit model was applied.

2.2.1. Reliability Analysis

The perception of residents on the problems related to the Strymonas River and Kerkini Lake were examined by the application of reliability analysis, as they were represented by a multi-variable. In particular, α -Cronbach reliability coefficient validates the fidelity of a questionnaire—that is, the elements aim at measuring the same thing [35]. Given that this coefficient is equal or higher than 0.70, it is accepted as satisfactory [35]. A value over 0.80 is considered more than satisfactory, while, in few cases, a value equal to 0.60 could be also acceptable [36].

2.2.2. Factor Analysis

The measurement of the public perceptions as far as their attitudes towards the impacts of the two wetland projects was based on factor analysis, and in particular on principal components analysis (PCA). The latter was also applied to provide the tool to make composite variables—denoting the environmental and economic impacts of the projects. For the river bed re-arrangement, six items concerning the impacts of this intervention were investigated. Meanwhile, the respondents answered those items based on a five-point Likert scale answer of options: positive, quite positive, neutral, quite negative, and negative. The environmental and economic goods provided by the artificial Lake Kerkini concerned eight items, and the responses were based on a five-point Likert scale answer of the following options: very significant, significant, medium significant, insignificant, and very insignificant.

The PCA has led to the extraction of two factors for each project. For the water bank re-arrangements in Strymonas River, the first factor is the impact of river man-re-arrangement and drying on the agricultural production. It includes flood protection and a reduction in the necessity of sediments' fertilization, as well as increase in farming land for cultivation, and constructs the variable. The second major factor includes climate change, impact on flora and fauna, and impact on landscape, and is denominated as the impact of river management on the natural environment.

The Keiser–Meyer–Olkin index concerning sampling adequacy was found to be equal to 0.770, which is an acceptable value based on Sharma [37]. Moreover, the Barlett's sphericity test was found to be equal to 754.305, implying that the null hypothesis cannot be accepted. This analysis was a primary step for the implementation of two logit models. These models aimed to identify and quantify the impact of demographic, environmental, and economic composite factors on the attitude of the respondents towards the level of satisfaction arising from the two projects.

As far as the artificial Lake Kerkini and its potential benefits, two similar indices were constructed; namely, the environmental index and the economic index. The environmental index included the following variables: shelter for wild animals and birds, and biological water cleaning. The economic index included the following variables: employment, recreation and ecotourism potential, fish production expansion increase in quantity of water used for irrigation purposes, and flood potential limitation.

The second index was based on a multiplication method, as factor analysis validated the existence of only one factor, and in order to be able to identify economic and environmental goods provided by an artificial wetland—Kerkini. This process was a primary step for the implementation of two logit models aiming to identify and quantify the impact of demographics and environmental and economic composite factors—the attitude of the respondents towards the level of satisfaction arising from the two projects.

2.2.3. The Logit Model

The last step in the analyses involved the estimation of a logit model. This was because it is well known logit models are employed to investigate choice data [38]. The dependent variable is the satisfaction or no satisfaction generated by the two water management projects. In particular, in the

case of the present manuscript, we have grouped the responses on the Likert scale into two choices and, therefore, a reduction of a multinomial model into the standard logit model [39]. For the bed re-arrangement of Strymonas River, the dependent variable was mentioned above. The independent variables used include the demographic data, the distance from the wetland, the two factors of the impact of river man-re-arrangement and drying on the agricultural production of river management on the natural environment, as well as the surface and underground water quality of Strymonas River. The binary variable that represents either satisfaction or no satisfaction from the wetland project, along with the aforementioned independent variables, is transformed in a logistic regression formulation. The slopes of the logistic model provide the relationship of the explanatory variables to the dependent variable along with the parameters called odds ratios—the ratio of the probability that satisfaction of the program is taking place divided by the probability that it is not taking place. Therefore, in the logit form, $Pr(Y = 1)$ is transformed to the natural odds of the event $E(Y = 1)$.

The odds or the probability of satisfaction or no satisfaction generated by wetland project realization [40]. In other words, the present analysis aims to estimate the impact of exogenous variables on the binary dependent variable. The level of satisfaction was, in the case of risk, encoded with the values 1 and 0, while the general model is described by the following Equation:

$$P(Y = 1) = \frac{1}{1 + e^{-(\beta + \beta_1 X_{1i} + \dots + \beta_n X_{ni})}} \quad (1)$$

This depicts the probability of a participant responding to the first category of the dependent variable, while the exogenous variables $X_1, X_2 \dots X_n$, describe the responses of the i participant to each one of the n independent variables, which may be either quantitative or qualitative. The logistic regression model is an example of a generalized linear model. The methodology used for parameter estimation is maximum likelihood. Therefore, the estimated parameters are maximum likelihood estimates [41]. Violation of linearity hypothesis is prohibiting for the regression estimation, as given by Equation (2); therefore, from Equation (3), the logarithmic transformation of the initial equation is employed instead. In particular, the logit model is as follows:

$$\text{logit}[P(Y = 1)] = \beta_0 + \beta_1 X_{1i} + \dots + \beta_n X_{ni} \quad (2)$$

where

$$\text{logit}[P(Y = 1)] = \log \frac{P(Y = 1)}{1 - P(Y = 1)} \quad (3)$$

The term

$$\frac{P(Y = 1)}{1 - P(Y = 1)}$$

reflects the yield probability (odds) and represents the ratio of the probability of risk existence divided by the probability of no risk.

The value of the odds ratio, estimated for each independent variable, reflects the change in the odds of the dependent variable caused by a unit change in the value of the independent variable (the elasticity) [41]. As determinants, we surveyed factors affecting the respondents' perception on two different and extremely significant projects for regional economic growth. The factors studied include the demographic factors and the impacts in economic and environmental terms. Thus, two variables derived from Equation (2), based on the multi-variable question and on the concept of the sub-questions, were constructed. More specifically, the variable farming impacts involves sediment reduction and limitation in fertilization, expansion of cultivated lands, and flood protection. The second sub-variable contains environmental values including climate change, impact on flora and fauna, and impact on landscape. This variable synthesizes the environmental impact. Another explanatory variable is the distance of the nearest river side to the residence location of the respondents. We have also examined water pollution and no statistical significance was validated. Additionally, we examined the impact of

the surrounding vegetation, the significance of the vegetation regions, the establishment of a recreation park, the protection of vegetation regions, and the contribution of the environmental education on residents' activation, aiming at the protection of wetlands.

3. Results

Based on the descriptive analysis of the sample, Table 1 provides the frequencies and measures of the most important socioeconomic features of the respondents. It is apparent that 68.5% of the respondents were men, mainly farmers, not at all satisfied by their income, graduates of primary school, married, and belonged in the age group 31–40.

Table 1. Frequencies and socioeconomic features of the respondents.

Gender	
Male	65.8%
Female	34.2%
Profession	
Pensioner	6.8%
Housewife	6.8%
Farmer	17.0%
Breeder	8.5%
Fisherman	5.5%
Private employee	8.8%
Public servant	6.5%
Student	9.0%
Freelancer	12.5%
Worker	6.3%
Unemployed	12.5%
Age	
18–30	22.3%
31–40	29.8%
41–50	27.3%
>50	20.8%
Marital status	
Single	35.0%
Married	52.5%
Divorced/Widow	12.5%
Education	
Primary school	22.0%
Secondary school	15.5%
High school	21.5%
Technical school	13.5%
Technological educational institute	12.0%
Bachelor	15.5%
Income Satisfaction Level	
Absolutely satisfied	0.5%
Very satisfied	1.0%
Satisfied	8.3%
Less satisfied	23.0%
Not at all satisfied	67.3%

According to the demographics of the sample, the respondents' perceptions were examined regarding the impacts of the two projects, namely Strymonas River and the artificial Lake of Kerkini. Furthermore, an effort was made to interpret the respondents' attitudes towards the projects. Most of

the respondents are satisfied from the creation of the artificial Lake of Kerkini, while they perceive as significant the contribution of the lake to fish production (89.8%), recreation and ecotourism services (91.8%), irrigation water provision of deposits (91.2%), flood protection (83.2%), employment opportunities (82%), wild fauna shelter services (82.6%), and water purification (80%).

The logit model estimation results for the two water resources projects are provided in Table 2. The findings of the first model, namely the respondents' positive or negative attitude towards Strymonas River project, validate the statistically significant impact of the following factors. First of all, the prospect of the establishment of a recreation park seems to be statistically significant. Furthermore, environmental education as well as their perception on the significance of Strymonas delta do not seem to play a statistically significant role on the respondents' satisfaction with the Strymonas project. As far as demographic factors, education and income satisfaction seem to have a statistically significant impact on the respondents' attitudes towards the aforementioned water resources management projects.

Based on the findings of the estimated model, all the demographic features are found as statistically significant for a 5% level of significance. In addition, given that the reference category has a positive impact on either environmental or agricultural production, the less positive the perception they have about the agricultural impact of the river beds re-arrangement, the less satisfied they are with the project implementation. In the same ground, there is a common validation for the case of the environmental impacts of the project. In contrast, marital status is found as statistically insignificant. Moreover, there is a non-significant impact of the respondents' residence and distance of river banks.

Table 2. Logit model estimation results.

Dependent Variable: Satisfaction towards Wetland Strymonas Project			Dependent Variable: Satisfaction towards the Establishment of the Artificial Lake of Kerkini		
Variable	Coefficient	Odds Ratios	Variable	Coefficient	Odds Ratios
Impact on agriculture	−9.267 *** (0.000)	9.44751×10^{-5}	Fish production	−1.1 (0.00)	0.33
Environmental impact	−3.46 *** (0.0013)	0.031	Ecotourism—Recreation Potentials	0.0037 (0.324)	1.00
Recreation park establishment	2.2432 *** (0.0011)	9.423	Expansion of irrigation water availability	−0.9 (0.068)	0.41
Evaluation of vegetation	−1.13 ** (0.0207)	0.371	Flood Protection	−1.52 *** (0.00)	0.22
Protection of vegetation	−1.413 ** (0.017)	0.523	Employment opportunities	−1.06 *** (0.00)	0.35
Distance from the wetland	−0.759 (0.20)	0.4017	Wild Fauna Shelter	1.58 *** (0.001)	4.85
Significance of Strymonas Delta	−0.991 ** (0.0269)	2.9168	Organic Water Purification	0.55 (0.28)	1.73
Environmental education	−0.912 ** (0.0103)	37.2052	Environmental Education	−1.77 *** (0.00)	0.17
Gender	−5.545 ** (0.00)	0.4682	Gender	−0.961 ** (0.03)	0.38
Age	1.088 (0.1055)	0.3228	Age	0.337 (0.11)	1.40
Education	3.616 *** (0.0000)	0.243	Education	0.378752 *** (0.008)	1.46
Marital status	1.326 (0.215)	0.003905	Marital Status	−1.683 *** (0.003)	0.19
Profession	1.071 *** (0.0015)	2.945	Profession	0.073 ** (0.03)	1.08
Environmental pollution from industrial wastes (in Greece)	−1.46 *** (0.003)	3.7695	Satisfaction with income	0.85 *** (0.00)	2.35
Environmental pollution from pesticides and fertilizers (in Greece)	1.141 ** (0.0108)	1.7463			
Satisfaction with income	3.616 *** (0.0000)	0.829			
McFadden R-squared	0.751		McFadden R-squared	0.68	
LR statistic	114.9 *** (0.000)		LR statistic	70.19 *** (0.000)	
H-L statistic	1.019 (0.99)		H-L statistic	0.844 (0.999)	

***, **, statistical significance for 1, 5 and 10% respectively. LR, Likelihood Ratio statistics; H-L, Hosmer and Lemeshow statistic.

According to the findings of the logit model estimation, the following became apparent:

- The most significant result in the present analysis reveals that industrial wastes seem to have a negative and statistically significant impact on the residents' satisfaction with the re-arrangement of water banks. Meanwhile, a positive impact is validated for the pollution, generated by either fertilizers or pesticides. The overall significance of the model is provided by $X^2 = 84.78$ with a significance level of $p = 0.001$. Based on this value, we can reject H_0 and conclude that at least one of the coefficients is different from zero (20.05, 4 = 9.488). The Hosmer and Lemeshow value equals 0.9425 (with significance equal to 0.9788). The non-significant value provides an indication for a strong model fit in the correspondence of the actual and predicted values of the dependent variable [28].
- Concerning the odds ratios, the increase in environmental education expands 37.52 times the probability to be satisfied from the project realization. Additionally, respondents that are satisfied by the impact on agriculture or the environment seem to affect in some way the respondents' positive perception for Strymonas bed re-arrangement. Finally, the more satisfied the respondents are, the higher the odds (89%) are for them to be satisfied by the Strymonas project.
- The second model involves the results on satisfaction or non-satisfaction with the artificial Lake Kerkini, as a function of both environmental and economic values affiliated with wetland services and the respondents' demographic characteristics. It is apparent that older people seem to be more satisfied than younger ones. This could be explained by different priorities set by younger people. Moreover, greater satisfaction is generated by respondents with higher education levels. Regarding the impact of income satisfaction, it is inferred that, the less satisfied they were from their income, the more satisfied they were with the project implementation. This variable was found to be statistically significant for a 10% level of significance. Meanwhile, gender was found to have a statistically insignificant impact on the respondents' attitudes towards the establishment of Kerkini Lake. Finally, regarding the responders' marital status for the Kerkini Lake project, a statistically significant result was found.
- As far as the odds are concerned, one level of education increases significantly the positive perception concerning the establishment of Kerkini Lake. It should be underlined that, in our case, the service of the wild fauna shelter increases almost five times the probability for the responders to be more satisfied with Kerkini Lake. Finally, it seems that respondents that were more satisfied with their income increase the probability to be more satisfied with Kerkini services by twofold.
- For the second model, the overall significance of the model is validated, as the null hypothesis implicates that all the coefficients are equal to zero and it is rejected. In particular, the LR statistic is equal to 70.19 (0.000) for the artificial Lake of Kerkini. Last, but not least, the non-significance of Hosmer and Lemeshow values indicates a satisfactory model fit correspondence of the actual and predicted value of the dependent variable.

4. Discussion

It is a fact that important shifts in water resources management are required in order to meet the global standards and safeguard sustainability. The United Nations 2030 Agenda is set in way that integrated management of water resources is something indisputable. This means that a more functional model should be designed striving for the transition from a water centric goal to a multi-dimensional one. This new model is believed to fulfil both environmental and socioeconomic goals including ecosystems protection, mitigation of climate change impacts, reduction of poverty, and enhancement of energy efficiency [5].

In the case study, according to the residents' of Serres views, it is evident that there is a consensus on the benefits arising by the creation of the artificial Lake Kerkini. These benefits are perceived to appear on both direct and indirect costs. They are also believed to positively affect local growth as well the social and ecological environment of the broader area. More specifically, the project of

Kerkini is believed to be closely affiliated with the enhancement of primary production such as fish production and crops, recreation and tourism prospects, and advanced environmental services such as biodiversity preservation and clean water provision. In fact, there are many cases worldwide including artificial wetland construction, which have led to provision of improved water quality and freshwater provision [42,43], whereas there are also paradigms where the construction of artificial lakes was accompanied by uncontrolled regional development, such as intense urbanization and industrial expansion. This eventually posed threats for water quality and loss of biodiversity in the areas of interest and, instead of serving as a strength for a better quality of life, they turned to have adverse impacts on their residents' lives [44].

Lake Kerkini is an important environmental landmark of Serres, with a high ecological value as it hosts a large number of important species of flora and fauna, and is also a habitat for rare bird species. Because of the findings, the statistical significance of economic value is an expected result, as the artificial lake is a source of income for a major part of the population in the broader area such as farmers, fishermen, and ecotourism professionals. In fact, important determinants of this attitude are demographic features and the respondents' perception of environmental or economic goods—deriving from the creation of the artificial lake. For instance, residents less satisfied with their income tend to be more satisfied with the artificial lake creation. This result may be attributed to their expectations that the existence of Kerkini Lake might generate employment opportunities and become a potential source for income for the local community. It is also indicative that the respondents' marital status shows a statistically significant result, something that it is not in line with the findings of Halkos and Matsori [27], for Plastiras Lake. The latter constitutes an artificial wetland in Thessaly, central Greece, with great environmental and recreational value. The current findings that differentiate Kerkini from Plastiras Lake could be related to the several entertainment opportunities provided to families in Kerkini. Although Plastiras Lake as a destination target offers more recreational activities, it is less preferred by families than Kerkini.

Regarding the Strymonas River project, on the one hand, it is conceptualized by the residents of Serres as an added value project. This is because of the fact that, far from the expected positive impacts on agricultural production, the river beds re-arrangement is thought to trigger the possibility of establishing a recreation park aside its banks. Vermat et al. [45] have stressed the social benefits in river restoration projects arising by their recreational uses such as hunting, fishing, kayaking, and nature-based activities.

On the other hand, the project is negatively correlated with industrial wastes. It is true that many rivers all over the world are under a high pollution risk because of the extensive pressure from receiving water waste of urban, agricultural, and industrial origin [46,47]. Surprisingly, in the case study, pollution risk from agriculture activities such as the use of fertilizers and pesticides is something assessed less rigorously by the residents. This could be explained by the fact that some of the respondents are farmers, and thus their judgment cannot be not unbiased. Explicitly, the use of pesticides is necessary and causes various negative consequences for the aquatic environment. Yet, it remains a paramount source of income for farming activity.

Another result that is quite impressive is the non-significant impact of the respondents' residence and river banks distance, raising questions on the reasons for this finding. A potential explanation is that either visitors (long distance) or residents (short distance) share the same perceptions on environmental or economic impacts.

Eventually, in both cases, education income satisfaction and marital status seem to have a statistically significant impact on the respondents' attitudes towards the aforementioned water resources management projects. In order to be able to deliver sustainable water management strategies and policies, policy makers should prioritize the creation of partnerships providing access in decision-making procedures and encourage the stakeholders' participation by the active involvement of administrative authorities, organizations, representatives from the private sector, and other relative stakeholders [19]. Last, but not least, the marital status should be taken into consideration in the

future functioning of the aforementioned project because provision of recreational alternatives should be prioritized based on this condition, while employment opportunities should also be available if families are to go to be permanent residents in those areas.

5. Conclusions

The present manuscript, with the assistance of primary data based on a 20-item questionnaire, constitutes an effort to analyze the determinants of the respondents' perceptions concerning two different wetlands projects, namely the Strymonas River bed re-arrangement and the artificial Lake Kerkini. It should be noted that both wetlands contribute to the regional development of Serres broader area.

Based on the environmental and economic benefits arising from the two water management projects, two logit models are proposed. The results are supportive in order to deepen our understanding on certain issues such as the respondents' level of environmental concern. Furthermore, the findings intend to unveil the community relationships created in the broader area affected by the use and non-use values arising from the existence of the wetlands projects. The two models and the findings provided in the previous sections can serve as a benchmark for the efficient public investment flow on wetlands projects. It should be noted that they take into consideration both economic and environmental values and, at the same time, both use and non-use ecosystem services. To this end, the two logit models were employed, with the assistance of which we determined the factors affecting the respondents and their perceptions on the wetland projects. A key finding is the way people change their attitude towards the values derived from the wetland projects in accordance with specific demographic characteristics such as gender, age, education level, and marital status.

Not to mention, environmental education has proven to be an important factor for both projects, revealing the need to advance its position on the curriculum followed in all educational levels. Besides, it should be taken into consideration that participatory skills in environmental decision-making presuppose the enhancement of public awareness in environmental issues, while environmental education serves as the vehicle to achieve such an effort. Stakeholders' participation in decision making is considered of outmost importance and could lead to improved and balanced solutions to deal with water pollution problems.

Moreover, the findings could be utilized in the design of effective policies to meet the residents' and recreational visitors' needs. Especially, for the case of Strymonas, re-arrangement of its bed could positively affect the reduction of pollution from either industrial waste or fertilizers. These kinds of measures are vital and should be combined with actions taken by the local communities. Meanwhile, for the case of Kerkini artificial lake, the protection of rare birds would be a challenging issue in case this ecosystem service is un-devaluated by the residents or recreational visitors.

Keeping in mind some of the objective environmental and economic impacts of the two water management projects, this study attempts to be the first step in providing valuable insights in the respondents' perceptions concerning two very important water projects in Serres. A subject of further research could be to evaluate the benefits (use and non-use) and costs of the projects under different scenarios or to estimate the willingness to pay for the artificial Lake of Kerkini. Since its establishment, this wetland has been a pole of attraction for visitors, offering several distinguished recreation alternatives and supporting local growth and rural development.

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