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Estimating Residents' Preferences of the Land Use Program Surrounding Forest Park, Taiwan

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Abstract: This paper aims to build up a preference function to evaluate the public benefits of the type of agricultural farming, biodiversity, water provisions, land use type, ecotourism modes, and a monetary attribute (willingness to pay and willingness to work) associated with an ecosystem service and land use program in a forest park. This study used choice experiments to build a random utility model, analyze the average preference for the above land use attributes based on the conditional logit (CL) and used a latent class model to test the residents' heterogeneous preferences for land use planning in the forest park. We also estimated the welfare derived from various land use programs. The empirical result has shown that: (1) increasing organic farming area, increasing the surface water provision, increasing the area of custom flora, increasing the wetland area, and setting up an integrated framework for ecotourism increase the public's preference for the land use program; (2) farmer and non-farmers do not have the same land use preferences, attributes, marginal willingness to pay and willingness to work; and (3) the ecotourism development program incorporating biodiversity, organic farming, ethnobotany, and wetland area with integrated ecotourism has the highest values when compared to other land use program scenarios.

Keywords: land use preference; sustainable development; natural conservation

1. Introduction

Ecosystem services have been considered as the framework for a new science able to uncover the co-evolution of humans and nature [1] and human dependence on ecosystem processes and biodiversity [2]. This framework incorporates ecological, cultural and socio-economic aspects of ecosystems in current conservation policies [3,4]. Despite the political commitment to the designation of additional nature areas, ecosystems are still deteriorating [5]. These changes have received considerable attention in land use policy, urban economics, and geography literature. These research areas focus on supporting decisions related to land use changes, where a tradeoff has to be made between the benefits of increasing development of the environment and protecting or expanding the natural environment [6]. Policymaking can optimize the social welfare when applying the benefits of nature conservation into the decision-making criteria. To apply the concepts of nature and infrastructural elements to a land use program in a forest park, policymakers could seek to better understand the needs and preferences of the local residents. Monetary valuation of ecosystem services aims to provide information about the values that society attributes to nature, also taking into account uncertainty about future uses and the location specificity of values [6]. Furthermore, this kind of valuation could help the government to set up sustainable land use policy for the forest park based on the preferences of the local community, and also set the priority for the budget allocation in land use programs based on the estimation of the conservation value, which includes the ecosystem services in the forest park.

The values of ecosystem services are often strongly dependent on their spatial attributes, available substitutes and complements and the proximity to the population of beneficiaries [7]. Following studies of landscape attitudes, we can consider different spatial characteristics in land use planning, such as the presence of water and man-made elements [8,9]. Therefore, the important criteria of land use policy and ecosystem service value include: (a) relevant characteristics of both nature areas and the population of beneficiaries, and (b) control for spatial variables, such as the size of the area and distance to the respondent's home [6,10].

Choice experiments (CE) define hypothetical markets and disclose the respondent's preference for landscape preservation and development of nature. In addition to the respondent's awareness, attitudes, opinions, and perceptions, CE also measures their willingness to pay (WTP) for an ecosystems' goods or services. Therefore, WTP can be seen as an indicator of the strength of the measured public preferences [6]. In fact, the supplements provided by ecosystem services are spatially heterogeneous and the provisions are influenced by landowners' willingness to provide. Therefore, CE has also been used to estimate nature and land use change scenarios [11], such as the relationship between supply and farmer preferences and the welfare in afforestation projects [12]; evaluate the preferences for the different attributes of land use type and explore marginal willingness to pay (MWTP) towards land use scenarios in Spain [13]; develop a value function to evaluate the public benefits of amenities, recreation and biodiversity values associated with land use changes from agricultural land to different types of nature in Belgium [6]; analyze the farmers' contract preferences with an afforestation program in Germany [14]; and test the heterogeneity of preference for biodiversity in the United Kingdom [15]

From the above-mentioned research, we know that CE is a better evaluation method for establishing a multi-attribute utility function for natural resources and the environment, and estimating the economic value of environmental resources and goods and services. In recent years, CE has also been applied to nature reserves [16], forest ecosystems, urban land, afforestation projects and ecological compensation projects [12]. However, little attention has been given to the Danongdafu Forest Park (DFP). The only related case studies discussed resilience thinking in regard to the social-ecological system [17], and lowland plantation assessment using an ecological modeling method [18]. Additionally, related land use studies have used the CE method to evaluate values in Belgium [6], Japan [10], Australia [11], Spain [13], Chile [16], Germany [14], and the United Kingdom [15]. The above studies focused on protected areas, national parks, watersheds, wetlands, and afforestation areas. To our knowledge, no studies have investigated the relationship between ecosystem service and land use programs based on residents' awareness and the preference for forest parks. No land use programs or policies exist in the DFP area, nor has any policy or action been directed toward the social-ecological system surrounding local communities and the DFP [17].

The above discussion raises some interesting issues, such as whether or not the local residents support the new land use program in the forest park. Do different stakeholders have the same preference toward the land use program? Furthermore, will different land use programs result in different policy effects? If we could understand the key issues above, investigate the preferences of the stakeholders and estimate the value from a potential land use program associates with the ecosystem services, it would help the government to build up a suitable land use policy in the near future, and also set priorities for budget allocation in different land use programs. To sum up, the purposes of this study are to build up a land use preference framework based on the CE model, reveal how the local residents value the land use attributes of the forest park, and summarize the information and opinions for the land use management of the forest park. Based on the above research purposes, this paper estimates the local residents' preferences and the WTP and willingness to work (WTW) of farmers and non-farmers, and tests the issue of heterogeneous preferences for the land use planning in the forest park by comparing the demographic factors. Finally, this study discloses the economic values under different scenarios based on land use management with CE estimation results, and discusses the policy implications of land use management in the forest park.

The remainder of this paper is organized the four sections. Section 2 introduces the DFP in Taiwan and summarizes the seven communities' population surrounding the DFP. Next, this study draws the research framework for the land use program in the forest, and focuses CE design on land use preference. In Section 3, we estimate the land preference function, evaluate the marginal effects of the land use attributes between farmer and non-farmer, test the heterogeneity preference with difference community residents, and calculate the welfare effects of different land use programs of the forest park. Finally, the policy implications of the land use program are subjected to comprehensive discussion in Section 4.

2. The Research Framework of the Land Use Programs

2.1. Introduction to DFP and the Community Population

This study chose DFP as its research scope. This park is located in Hualien County, eastern Taiwan. The western part is the Central Mountain Range and the eastern part is the Coastal Mountain Range (Figure 1). This DFP is an afforestation area, and is designated as a forest park (i.e., DFP, 1250 ha), followed by agriculture land. The DFP has rich recourses within its social-ecological ecosystem service, and contains a variety of cultural resources and local customs of indigenous Amis people and Chinese-Han people [17]. In total, seven communities surround the DFP, each with its own unique and long term historical, social-economical, and natural resources associated with the land use program in the DFP area [17–19].

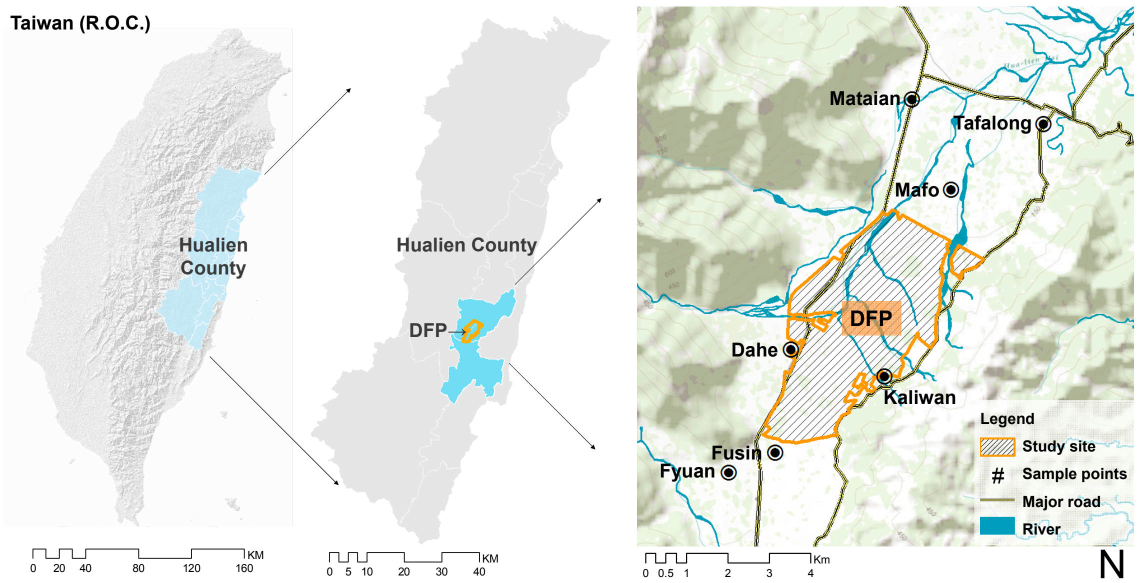


Figure 1. Study area and sample points. DFP: Danongdafu Forest Park.

As one of the few remaining forests in the intensively developed lowland areas of eastern Taiwan, DFP has experienced several large land cover changes because of economic development. For instance, DFP was covered by bush forests interspersed with rivers and ponds before 1895 [17,20,21]. From 1895 to 1945, sugarcane production became the major landscape and local economic activities in DFP, and a sugar plantation was established in 1921 [17]. In 2001, with the goals of enhancing the functions of environmental and natural resources, lowering carbon emissions, timber production, and increasing the leisure and tourism activities, Taiwan's government set up the afforestation policy area [17]. In the same period, Taiwan was facing the challenge of trade liberalization, the lower market competition for the sugar industry, and transforming agricultural policy. When the sugar industry collapsed in 2002, the forest bureau started to plant trees to fit the above policy goals in the DFP area [17,18]. DFP became a single-species forests, although the stands of different species are interlaced, forming a mosaic landscape [18]. Since 2007, according to the "extension of the Afforestation Policy" to plain areas, tourism and additional recreation facilities have been developed in the DFP. Today, forest park management and community-based ecotourism are developing simultaneously in the DFP [17–19]. For forest management to be able to deliver such a broad range of ecosystem services, it is necessary to move towards adaptive forest management [18,22]. The expected values from stakeholders point to a need for a multi-value approach to sustainable forest management in DFP, which is also supported by the growing environmental awareness of the public [18]. The Taiwanese government forestry agency sees the increase in biodiversity through the increased habitat diversity in the plantations as the main ecosystem service that the plain afforestation program should provide. Increased forest area in the lowland region will also increase its value for carbon sequestration, ecotourism and scenic services. As for the household surrounding the DFP (Figure 1), based on the information in Hualien County, the Mataian community was the highest number of household units with 1446, and Tafalong and Fusin communities were second and third 1308 and 302 household units, respectively, followed by Dahe (275), Fyuan (218), Mafo (203), and Kaliwan (79). Therefore, the total number of household units in the seven communities was in 3831 in 2015. Thus, we developed the onsite survey based on the population of the seven communities surrounding the DFP area. All these communities have their own culture, and use the natural resources and agricultural land surrounding the DFP area. Today, the manager of the DFP rents agricultural land to community residents, and hope to search for opportunities to develop community-based ecotourism with the local community.

2.2. Choice of Experiment Design for the Land Use Preference

Following Hanley et al. [23], we established the CE attributes and levels based on literature reviews and interviews with focus group discussions (FGDs) such as local residents and experts, including policymakers and scientists (i.e., hydrologists, ecologists and resource management) that have been working in DFP. Based the opinions from FGDs and the literature review of land use preference, we chose seven land use attributes in the DFP area. In addition, this study carried out pre-testing from August to September in 2015 and interviewed a total of 60 local residents. After the pre-test, minor modifications to the questionnaire were made. The distribution of the final CE questionnaire started in October of 2015. Based on the above discussion, seven characteristics were included as CE attributes in the design: agricultural farming type [24,25], biodiversity [6,16,26], water provision [12], land use type [6,10,13,26,27], ecotourism mode [13], WTP, and WTW [6,13,26,28], as well as the levels of the attributes in relation to ecosystem services, as shown in Table 1. Agricultural production provides nutrition and health for human society [29]. Agricultural farming types include conventional farming and organic farming. With the rising people's awareness of environmental protection and the issues of agricultural and food safety [29,30], farmers' requirements and willingness to participate in agri-environmental programs are important issues for land use planning [25]. In Taiwan, intensive production has long been the typical agricultural operation mode. Pest and disease attacks constitute one of the biggest sources of risk in agriculture [31]. Thus, we consider conventional farming and organic farming as the levels that represent the attributes of the agricultural farming type for the land use program in the forest park. "Biodiversity" means the variety of plant and animal species in a natural area [32]. For a valuation field, Birol, et al. [33] measured the marginal benefits of the biodiversity from the wetland management program in the protected area. Liekens et al. [6] used the CE method to develop a value function, and to estimate the public benefits from amenities, recreation and biodiversity values with land use function in Belgium. Therefore, biodiversity is an important attribute for the land use planning in a forest park. The "water provision" is an important resource for land use planning in a protected area [34]. In the Spanish semi-arid region, water constraints have shaped a local identity that includes the water provision and the need for diverse ecosystem services [13]. The water provision was also a key resource for an afforestation program in Denmark [12]. García-Llorente et al. [13] estimated the marginal WTP for river quality. Thus, the local manager could cooperate with the water agency, and the community manager to set up the underground water equipment, and the sink for the water provision surrounding DFP area [12,34]. Based on the above discussion, we chose the water provision as an attribute for land use planning.

"Land use type" encompasses a variety land use scenarios in the protected area, and visual aids can be used to help respondents understand distinct nature types [6]. Shoyama et al. [10] designed the land use scenario, and integrated the natural forest, wetland, managed forest, and agricultural land into a program for biodiversity conservation and climate-change mitigation. García-Llorente et al. [13] showed that the best land use scenario for a semi-watershed integrates the attributes of cooperation, profit from selling forest products, such as timber, small trees for gardening, agricultural land, protected area, ecotourism, and river quality [18]. Thus, for the land use program in the forest park, this paper focuses on residents' preferences for the land use type. The "Ecotourism Mode" provides alternative recreation activities with low impact, which contain local customs and cultural tourism [35]. García-Llorente et al. [13] indicated that the local residents have a higher preference and WTP for a new ecotourism mode in a protected area. Juutinen et al. [32] found that tourists' preferences may increase by integrating travel information on a website and in a travel center. In addition, Lee [19] used a CE model to estimate tourists' preferences and the values of community ecotourism in DFP, and found the best combinations regarding the community ecotourism were experiential activities in the forest park. Therefore, based on the development of the forest park, this study integrates the ecotourism mode into the land use program.

We use environmental trust funds (FUND) as financial attributes (such as WTP and WTW) to evaluate the residents' preferences towards improving the land use quality in DFP. The financial attribute is an important indicator for eliciting respondents' WTP for valuing public goods, so this study estimates the land use attributes and the marginal effects by using WTP and WTW. Liekens et al. [6] used a mandatory annual tax to be paid for the creation and conservation of natural areas in Flanders. Furthermore, García-Llorente et al. [13] used a tax reallocation format as a payment vehicle. The results showed that the monetary attributes could be measured and were well understood by the public, and found that the WTP variable behaves as expected, even in those areas with low salaries and falling employment. "Willingness to work" means the labor contributed (hours) per person per month towards improving environmental quality in a protected area. Rai and Scarborough [36] pointed out that the respondent will increase the labor time to participate in an environmentally friendly program. Furthermore, past studies used the labor times as a tool, and found that households are more willing to contribute labor time than money [28]. Thus, we integrated the WTP and WTW into the CE set to measure the land use preference. The land use preference attributes and levels are shown in Table 1.

2.2.1. Agricultural Farming Type

There are about 50 hectares of agricultural fields in DFP, which are available for rent for from the administrator, and the current status is conventional farming. For the past two years, Fusin community has been trying to use organic farming to grow agricultural crops on two hectares. Based on the concepts of increasing food quality (i.e., provisioning services) and conservation of biodiversity and habitat quality (i.e., supporting services), and comparing the status quo of the conventional farming, this study added "increase organic farming area" to test the residents' preference at two levels by understanding the land use program options (Table 1).

Table 1. Attributes and levels of the land use preference in DFP.

Attributes		Levels	Variable Name *
Agricultural Farming Type		a. Status quo (conventional farming) b. Increase organic farming area	FA± FA+
Biodiversity		a. Status quo (244 nationwide plant, animal, fish, and insect species) b. Increase in populations of species	BI± BI+
Water Provision		a. Status quo (tap water or groundwater abstraction) b. Increase surface water provision	WA± WA+
Land Use Type		a. Status quo (artificial and mixed forest) b. Increase natural forestry area c. Increase ethnobotany area d. Increase wetland area	LU± LU1 LU2 LU3
Ecotourism Mode		a. Status quo (individual tourism) b. Integrated framework for the ecotourism	EC± EC+
Welfare foundation	(A) Willingness to Pay	a. Status quo (no payment) b. $500 NTD/year/person c. $1000 NTD/year/person d. $1500 NTD/year/person e. $2000 NTD/year/person	FUND
	(B) Willingness to work	a. Status quo (no contribution) b. 6 h/month/person c. 12 h/month/person d. 18 h/month/person e. 24 h/month/person	TIME

*: The attribute level describes the basic alternative. FA: agricultural farming; BI: biodiversity; WA: water provision; LU: land use; LU1–3: each alternative levels of land use; EC: ecotourism mode; FUND: willingness to contribute to the trust fund; TIME: willingness to contribute labor time; NTD: New Taiwan Dollar.

2.2.2. Biodiversity

DFP is an afforestation park, and the current status of the homogeneity of plants and species leads to a lack of biodiversity (no endangered species; Ground cover plants: 44 families, and 90 species; Mammals: two orders, four families, and seven species; Birds: 34 families, and 67 species; Reptiles: four families, and four species; Amphibians: five families, and 12 species; Fishes: two families, and two species; and Insects: four orders, 14 families, and 62 species). Therefore, we added "increase in populations of species" in the biodiversity attribute, and integrated into CE set of the land use program.

2.2.3. Water Provision

The communities surrounding DFP rely heavily on the agricultural industry, and the water provision is a key factor for the land use program in DFP. For daily needs, agricultural farming, and ecotourism, the local residents would use tap water, as well as groundwater abstraction by the water agency and community manager. Thus, compared with status quo, we added "increase surface water provision" to contribute to provisioning services and regulating services as part of the land use program (Table 1).

2.2.4. Land Use Type

The current land use type is artificial and mixed forest in the afforestation park. The local government and community manager could change the land use type to achieve better ecosystem function and ecotourism, according the FGDs' interviews. Therefore, to compare with the status quo of the artificial and mixed forest type, we added "increase natural forestry area" (related to supporting services; restoration of natural habitats), "increase ethnobotany area" (such as the aboriginal culture; recovering the landscape for the local, which is occupied by pigeon pea, millet, etc.), and "increase wetland area" (related to regulating services and cultural services; restoration of surface from previous periods) (Table 1).

2.2.5. Ecotourism Mode

Each community around the DFP has its own features and characteristic activities, such as agricultural features, cultural traits, ecological activities, local dishes, etc. However, the information and the activities related these features have not been integrated into the tour package for community ecotourism in the DFP area. Therefore, for this attribute of ecotourism mode and related experiential activities, we added "integrate a framework for ecotourism" to test the residents' opinions and estimate the WTP and WTW for the attribute.

2.2.6. Willingness to Pay

However, the monetary attribute in this study is an annual cost, which contributes to a trust fund for all residents. Moreover, this fund would be spent on the development and maintenance of the chosen alternative only. Based on the pretest by using an open-ended questionnaire interview 60 local residents in total, and the focus group discussion, we added four levels, 500, 1000, 1500, and 2000 New Taiwan Dollar (NTD), per person in one year (Table 1).

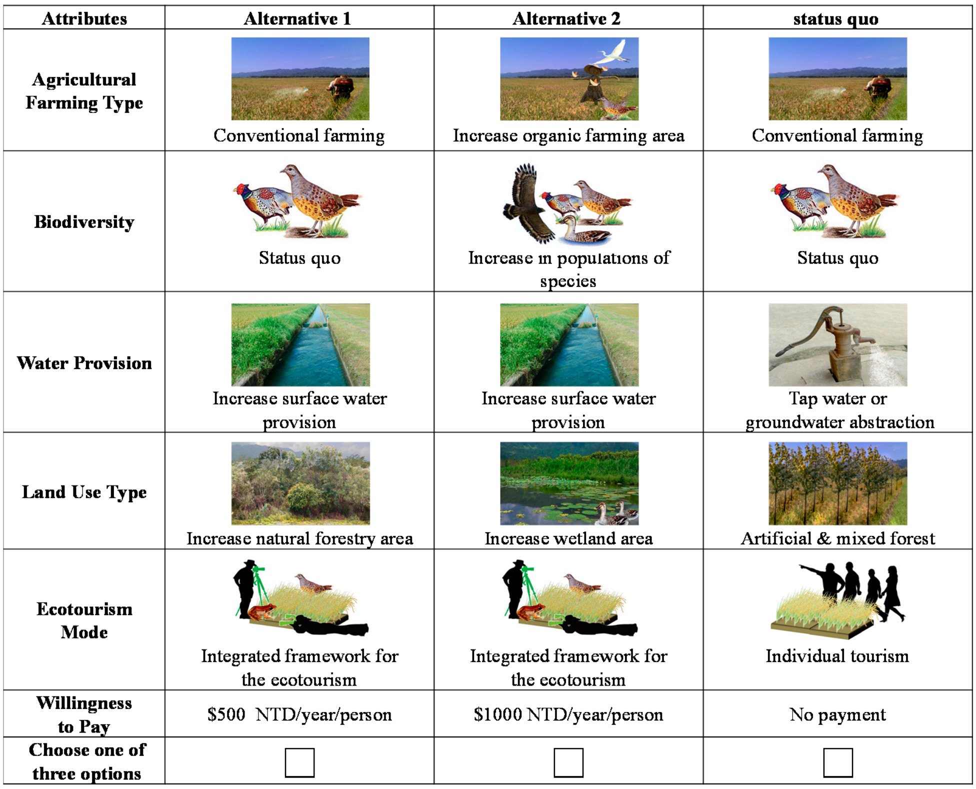
2.2.7. Willingness to Work

To assess welfare effects comparison with different financial attributes, this study not only focuses on the WTP estimation, but also uses TIME (WTW) as a payment vehicle to discuss the rural residents' willingness to contribute labor time towards improving environmental quality in DFP. Based on the pretest from the open-ended questionnaire, we added four levels, including 6 h, 12 h, 18 h, and 24 h, and the units of WTW are designated as per person in one month (Table 1).

2.3. The Choice Experiment for the Questionnaire Design

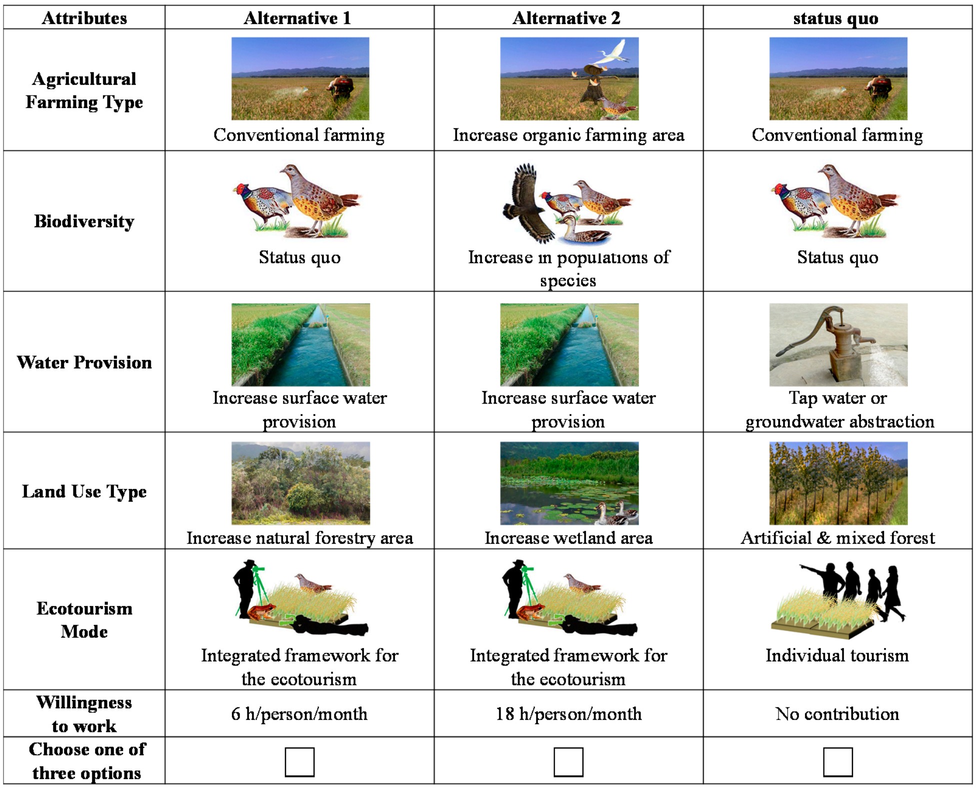
Based on the CE design of the land use preference, the first part of the questionnaire includes questions regarding respondents' socio-economic status, including the gender, age, education, income, membership in a conservation group, and agricultural land ownership. The second and most important part of the questionnaire contains the CE. It gives information about DFP and choice sets related to the ecosystem services and land use program of the park.

According to the number of attributes and levels of land use, planning gave rise to 320 possible profiles ($2 \times 2 \times 2 \times 4 \times 2 \times 5 = 320$). To develop the profiles presented by the respondents to the questionnaire, we applied an orthogonal main effect design and reduced the number of profiles to a level of 25 alternatives [37]. Upon further deleting of unreasonable combinations, the total number of choices was 13 after the procedure was repeated three times [32]. Thus, to get more potential alternatives, this study generates three combinations of each alternative. Finally, we had two versions of the questionnaire. This 'opt-out' can also represent the current situation or no land use change [6]. By comparing two financial attributes (WTP and WTW), we have two examples of the CE questions (see Figures 2 and 3). Each alternative was based on the same land use attributes, which contain a financial attribute, but with different values (attributes levels).



Attributes	Alternative 1	Alternative 2	status quo
Agricultural Farming Type	Conventional farming	Increase organic farming area	Conventional farming
Biodiversity	Status quo	Increase in populations of species	Status quo
Water Provision	Increase surface water provision	Increase surface water provision	Tap water or groundwater abstraction
Land Use Type	Increase natural forestry area	Increase wetland area	Artificial & mixed forest
Ecotourism Mode	Integrated framework for the ecotourism	Integrated framework for the ecotourism	Individual tourism
Willingness to Pay	$500 NTD/year/person	$1000 NTD/year/person	No payment
Choose one of three options	☐	☐	☐

Figure 2. An example of the choice experiments (CE) questions for willingness to pay.



Attributes	Alternative 1	Alternative 2	status quo
Agricultural Farming Type	Conventional farming	Increase organic farming area	Conventional farming
Biodiversity	Status quo	Increase in populations of species	Status quo
Water Provision	Increase surface water provision	Increase surface water provision	Tap water or groundwater abstraction
Land Use Type	Increase natural forestry area	Increase wetland area	Artificial & mixed forest
Ecotourism Mode	Integrated framework for the ecotourism	Integrated framework for the ecotourism	Individual tourism
Willingness to work	6 h/person/month	18 h/person/month	No contribution
Choose one of three options	☐	☐	☐

Figure 3. An example of the CE questions for willingness to work.

2.4. Sample Design and Data

Based on 3.8% estimation bias, 95% conference level, and assuming that agreement and disagreement are the same for the land use program, we determined that the total number of samples in DFP is 650. The formal surveys implemented from October 2015 to January 2016 were conducted in seven rural communities, i.e., Mataian, Tafalong, Mafo, Kaliwan, Dahe, Fuyuan, and Fusin (see Figure 1). A sample of 656 respondents (almost 17% of the approximately 3831 households in these communities) was taken in the formal survey. The respondents were selected randomly and were contacted by well-trained interviewers in the form of face-to-face with on-site interviews, allowing the local residents (respondents) to understand the meaning of the whole picture for potential land use policy in the near future.

The respondents' social-economic background information shows there was an almost even distribution between male and female respondents (male: 290 people, 44.1%; female: 366 people, 55.9%). In addition, 87.5% of respondents were married, and 49.8% were over 60 years old. Furthermore, 63.7% of respondents' education levels was junior high school graduate and below, and 76.6% of respondents' monthly incomes were less than $20,000 NTD. The respondents' occupations were agriculture (22.2%), service (21.4%), retired (17.7%), and housewife (17.1%); and 66.6% of the respondents own farmland. The average age of the respondents was 43.5 years (standard error of the mean is 0.844), and 55.8% of respondents were living in the area more than 41 years. Regarding their relationships with the study area, 88.9% of respondents were not members of the conservation group. In addition, 71.8% were not members of the local community organization, and there was an almost even distribution between those joining and not joining the activities of the local community organization (yes: 54.4%). Obviously, the respondents from the local communities surrounding DFP are relatively elderly, have lower income, and are permanent residents. Our survey is also supported by the work of Lee et al. in 2014 [38].

2.5. Theory of Preference Function and the Marginal Effect on Land Use Preference

2.5.1. Models

The CE methodologies are the only methods able to capture both use and non-use values of ecosystem services [39–42]. Stated preference methods use survey questionnaires to define hypothetical markets and ask individuals to answer questions about their preferences, such as opinions about landscape use planning and nature development. In addition, the CE can also measure the public's preference and WTP for the level change of environmental goods or services [6]. Since the 1990s, CE has become an acceptable method to design environmental policies and facilitate consideration of environmental impacts on decision-making [14,43,44]. CE allows us to evaluate multiple attributes of a landscape and enables multi-attribute preference elicitation [45].

In CE, a set of alternatives is shown to the respondents, who are asked to choose their most preferred alternative. The parameters associated with the assumed distributions are then estimated [46]. Data obtained from the questionnaires are analyzed with conditional logit (CL) and the latent class model (LCM). The CL is the basic model used in CE studies, and so it offers a baseline of the attribute and level changes for preference estimation. Since the CL model assumes that the parameters are constant among all individuals, it is suitable to estimate the average preferences and the average welfare effects [46], assuming that the parameters are constant [47]. In the LCM, preference heterogeneity is accounted for simultaneously in different groups with the behavior and background. Thus, preferences are assumed to not be homogenous groups. The groups can be used to estimate the membership probability. It is suitable to clarify systematic causes of taste variation in a single framework, rather than the random parameter logit (RPL) model [32]. This method can also find groups of respondents that have different preferences for considered features of ES and land use programs, and also can test the heterogeneity preference by dividing two or more individual groups [15] and group membership characteristics.

According to utility theory, an individual's decision is based on the utility of the attributes [48]; it is the level of preference that a representative respondent gains from an alternative option [49]. The random-utility model accounts for the unobservable elements by adding an error term [50]:

$$U_{ij} = \beta_i X_{ij} + \varepsilon_{ij}, \quad (1)$$

where the utility function U_{ij} is partitioned into two parts including the systematic and observable vector, X_{ij}, related to alternative j and individual i, which represents a vector related to the land use attributes and , which is a vector of coefficients associated with the land use attributes and an error term, ε_{ij}.

Following Hausman and Wise [51], the deterministic part of the estimated utility function, the empirical model of land use preference, can set the following equation:

$$V_{ij} = \text{ASC} + \beta_1 FA_j + \beta_2 BI_j + \beta_3 WA_j + \beta_4 LU1_j + \beta_5 LU2_j + \beta_6 LU3_j + \beta_7 EC_j + \beta_8 FUND_j. \quad (2)$$

V_{ij} is a determined utility function for the land use program, and is a function of the other dependent variables. An alternative specific constant (ASC) capturing the (systematic) utility of omitted variables is included. The ASC is modeled as a dummy that takes the value 0 if one of the hypothetical alternatives is chosen and 1 if the 'status quo' is chosen. Where β_1 is the coefficient of the agricultural farming type; FA_j is the effect coded variable for agricultural farming type at levels 2; β_2 is the coefficient of the biodiversity; BI_j is for biodiversity at level 2; β_3 is the coefficient of the water provision; WA_j is for the water provision at level 2; β_{4-6} are the coefficients of the land use type; $LU1_j$, $LU2_j$, and $LU3_j$ are for land use type at levels 2, 3, and 4, respectively; β_7 is the coefficient of the ecotourism mode; EC_j is for ecotourism mode at level 2; β_8 is the coefficient of the environmental trust fund; and the variable $FUND_j$ represents the cost attribute.

2.5.2. Welfare Measures for the Marginal Effects

As for the value measure of the MWTP and marginal willingness to work (MWTW) for the land use preference, we can measure the values based on the public's preferences [6]. MWTP (Equation (3)) and MWTW (Equation (4)) measures are calculated as the ratio of two parameters [52], and it is important that both parameters of the attributes are significant for the statistical criterion; if not, no MWTP and MWTW measure can be obtained:

$$\text{MWTP} = -\frac{\beta_{attribute}}{\beta_{fund}}, \quad (3)$$

$$\text{MWTW} = -\frac{\beta_{attribute}}{\beta_{time}}, \quad (4)$$

where $\beta_{attribute}$ is the attribute's coefficient for each land use preference [23], β_{fund} is the marginal utility of the willingness to pay [14], and β_{time} is the marginal utility of the willingness to work attribute. We calculate the MWTP and MWTW by estimating the coefficients of all land use attributes following Equations (3) and (4). The value function thereby reveals how the non-market benefits can estimate the land use characteristics of this design.

2.5.3. Hypothetical Land-Use Management Scenarios

Examples of valuation scenarios of the CE model include economic values of land use planning scenarios in Spain's semi-watershed [13], marginal willingness to stay of the recreational impact programs in Portugal [27], and MWTP for the community ecotourism programs [19]. These papers applied the estimation results and built up variety scenarios with the attributes successfully. Thus, we set the hypothetical land use scenarios based on the land use attributes in DFP. Based on the estimation results of the CL model, we calculated the MWTP and MWTW with the coefficients by using Equations (3) and (4), and carry out a given land use management scenario, comparing the utility of any alternative option to the reference alternative (the status quo). Evaluating the differential land use scenarios contributes more evidence and information for the policy making in the forest area. Three hypothetical scenarios were as outcomes of the implementation of particular land use policies are as follows:

- Scenario I—Natural conservation: The wetland area increases in size and a restoration effort is carried out by the surface water. Surface water and biodiversity increase. Land-use is devoted to ethnobotany and wetland areas. As for the agricultural farming type and ecotourism mode, we maintain the status quo.
- Scenario II—Environmental-friendly agriculture: The organic farming area and surface water provision increase. The organic farming area, biodiversity, surface water, and ethnobotany area increase. The ecotourism mode retains the status quo.
- Scenario III—Ecotourism development: The ecotourism package is integrated and the healthy environment area increases. The organic farming area and biodiversity increase, and an ecotourism package is integrated. Land-use is devoted to the ethnobotany area, wetland area, and integrated ecotourism. Water provision retains the status quo.

3. Empirical Results

3.1. Estimating the Land Use Preference Function

Considering the results of the CL model, increasing organic farming area (FA+), increasing surface water provision (WA+), increasing ethnobotany area (LU2), increasing wetland area (LU3) and integrating a framework for ecotourism (EC+) are significant at the 10% level in the choice of future land use management scenarios for both WTP and WTW (Table 2). Moreover, increasing the ethnobotany area is not a significant factor in the choice of a future land use program for WTW. The log likelihood value indicates that the model fit is acceptable for the land use preference model. The positive and significant signs of both ASC coefficients, assigned to the status quo option, indicate that the local residents would choose the current land use status. On the other hand, the negative and significant signs of the fund and time coefficients, assigned to the alternative program, indicate that the respondents are not willing to exert more effort. It is not possible to establish any consensus preferences for increasing the populations of species and increasing natural forestry area (LU1) for either attribute (fund or time) (Table 2). The complete database and definitions of FUND and TIME can be found in the Supplementary File S1 companion to this manuscript.

Table 2. The empirical results of land use preference.

Attributes and Levels	WTP		WTW	
	Coefficient	*t* Value	Coefficient	*t* Value
ASC	0.674	4.27 ***	0.407	2.67 ***
FA+	0.268	3.22 ***	0.155	1.87 *
BI+	−0.09	−0.76	−0.103	−0.87
WA+	0.363	4.66 ***	0.45	5.8 ***
LU1	−0.052	−0.42	0.063	0.52
LU2	0.252	2.29 **	0.133	1.23
LU3	0.408	2.65 ***	0.38	2.52 ***
EC+	0.194	3.63 ***	0.225	4.25 ***
FUND	−0.00079	−6.18 ***	-	-
TIME	-	-	−0.07473	−7.10 ***
Log-likelihood	−1895.60		−1928.60	

***, **, *: Significance at 1%, 5%, 10% level; ASC: alternative specific constants; WTP: willingness to pay; WTW: willingness to work; Coefficient: which is a vector of coefficients associated with the land use attributes in utility functions; *t*-Value: comparing the two regression coefficients and determining the significance of the regression coefficients.

Furthermore, to understand the differences between the land use preferences of farmer and non-farmer, we divided the respondents into two groups. As Table 3 shows, increasing the populations of species (BI+), increasing surface water provision and integrating a framework for the ecotourism are positive and significant factors for farmers in the choice of a future land use management scenario with an environmental trust fund. These factors are also positive and significant for willingness to work. Moreover, increasing the ethnobotany area is a negative and significant factor in the choice of a future land use program in the farmer group for willingness to work, indicating a negative utility impact. The negative and significant sign of the ASC coefficient, assigned to the status quo option, indicates a positive utility impact on any choice set that differs from the status quo. In addition, the negative and significant signs of the fund and time coefficients, assigned to the alternative program, indicate that farmers are unwilling to exert more effort.

Thus, increasing organic farming area, increasing surface water provision, increasing ethnobotany area, increasing wetland area and integrating a framework for ecotourism are positive and significant factors for the non-farmer group in the choice of a future land use management scenario vis-à-vis the fund and time attributes. Moreover, increasing populations of species is a negative and significant factor for the non-farmer group in the choice of a future land use management scenario when it comes to the fund and time attributes. In the non-farmer group, the positive and significant signs of both ASC coefficients, assigned to the status quo option, indicate a negative utility impact on any choice set that differs from the status quo. The state of fund and time coefficients are the same as those of the farmer group.

Table 3. The land use preferences among farmers and non-farmers.

Attributes and Levels	Farmer (*n* = 146)				Non-Farmer (*n* = 510)			
	WTP		WTW		WTP		WTW	
	Coefficient	*t* Value	Coefficient	*t* Value	Coefficient	*t* Value	Coefficient	*t* Value
ASC	−0.585	−1.81 *	−1.139	−3.59 ***	1.07	5.79 ***	0.843	4.71 ***
FA+	−0.089	−0.48	−0.176	−0.92	0.379	4.03 ***	0.255	2.73 ***
BI+	0.472	1.77 *	0.675	2.48 **	−0.253	−1.88 *	−0.299	−2.24 **
WA+	0.581	3.37 ***	0.825	4.62 ***	0.304	3.46 ***	0.366	4.19 ***
LU1	0.047	0.17	0.282	0.99	−0.077	−0.55	0.022	0.16
LU2	−0.111	−0.44	−0.449	−1.78 *	0.348	2.81 ***	0.276	2.24 **
LU3	−0.193	−0.61	−0.343	−1.05	0.597	3.34 ***	0.575	3.29 ***
EC+	0.215	1.82 *	0.427	3.66 ***	0.203	3.33 ***	0.202	3.34 ***
FUND	−0.002	−6.37 ***	-	-	−0.00049	−3.39 ***	-	-
TIME	-	-	−0.19	−7.5 ***	-	-	−0.046	−3.9 ***
Log-likelihood	−409.5		−401.2		−1467.50		−1491.80	

***, **, *: Significance at 1%, 5%, 10% level.

3.2. Welfare Analysis

For the welfare analysis of selected scenarios of land use management in DFP, we can follow the results of Equations (3) and (4) in Table 4 to estimate the MWTP and MWTW for each attribute in a particular scenario (the last row in Table 4). The second column in Table 4 presents the MWTP values for the considered attribute levels, and the third column in Table 4 presents the MWTW values for the considered attribute levels. These calculations are based on the coefficient of the CL model (Table 2) showing the average values of the respondents. Furthermore, we divided the respondents into two groups: farmers and non-farmers. We also analyze the willingness to contribute welfare in each group.

According to MWTP results of all respondents presented in Table 4, the respondents are willing to pay the highest fee for increasing the wetland area ($516 NTD/year/person), followed by increasing surface water provision, organic farming area, and ethnobotany area. The integrated framework for ecotourism was the lowest ($245 NTD/year/person). The results (Table 4) indicate that farmers were willing to pay the most for increasing the surface water provision ($290.5 NTD/year/person), followed by increasing populations of species while integrating a framework for the ecotourism had the lowest MWTP ($107 NTD/year/person). However, for the non-farmer group, respondents' highest MWTP was for increasing the wetland area ($290.5 NTD/year/person), followed by increasing the organic farming area, increasing ethnobotany area, and increasing the surface water provision. Finally, increasing populations of species was the most negative and lowest MWTP ($−516.3 NTD/year/person).

Table 4. Willingness to contribute estimates of different groups.

Attributes and Levels	All Respondents (n = 656)		Farmer (n = 146)		Non-Farmer (n = 510)	
	MWTP (FUND)	MWTW (TIME)	MWTP (FUND)	MWTW (TIME)	MWTP (FUND)	MWTW (TIME)
FA+	339.2	2.07	-	-	773.5	5.54
BI+	-	-	236	3.55	−516.3	−6.5
WA+	459.5	6.02	290.5	4.34	620.4	7.96
LU2	319	-	-	−2.36	710.2	6
LU3	516.5	5.08	-	-	1218.40	12.5
EC+	245.6	3.01	107.5	2.25	414.3	4.4
Total value	1879.80	16.18	634	7.78	3220.50	29.9

MWTP: marginal willingness to pay; MWTW: marginal willingness to work.

According to the MWTW of all respondents' results presented in Table 4, respondents would have contributed the most labor time for increasing surface water provision (6 h/month/person), followed by increasing wetland area and integrating a framework for ecotourism. Increasing the organic farming area was the lowest (2.07 h/month/person). The results (Table 4) indicate that farmers would have contributed the most for increasing the surface water provision (4.34 h/month/person), followed by increasing populations of species and integrating a framework for ecotourism. Please note that increasing ethnobotany area was the most negative and lowest MWTW (−2.36 h/month/person). On the other hand, the MWTW results presented in the non-farmer group show that respondents would have contributed the most for increasing wetland area (12.5 h/month/person), followed by increasing surface water provision, increasing ethnobotany area, increasing organic farming area, and integrating a framework for ecotourism. Please note that an increase in populations of species was the most negative and lowest MWTW (−6.5 h/month/person).

These research results show the positive information from a forest park management perspective of judgment. Enhancing the wetland area, increasing the surface water provision and organic farming area are beneficial for the development of the forest park, afforestation area and integration of an ecotourism framework. The land use program may lead to increases in wetland area, surface water provision, organic farming area, and integration of community-based ecotourism surrounding the DFP area.

3.3. Heterogeneity Test of the LCM Results

Since the respondents' attitudes and social backgrounds may not be homogenous, we incorporated the identified individual-specific characteristics into the LCM to find groups of residents that have different preferences for the considered features of the DFP. Table 5 depicts the results of the LCM analysis with two latent groups. It found out that the respondents' income [6,36,53], duration of residence, membership in the community group [6], land ownership [53,54] and occupation were significant [55]. The group membership characteristic included farmers and non-farmers. However, the income, membership in the community group and land ownership indexes were positive and significant vis-à-vis the fund (MWTP) attribute. As Table 5 shows, the higher monthly income (>$20,000 NTD), community group membership, and the land ownership characterizes in class 1 (probabilities: 0.673). In contrast, the residents in class 2 are likely to have lower monthly income (<$20,000 NTD), not be members of the community group and not have land.

Based on the LCM results, the two groups have different preferences for the land use program characteristics since the coefficients of the attributes are not the same. Furthermore, their positive and significant land use program preferences are increasing the organic farming area, increasing surface water provision, increasing ethnobotany area and integrating a framework for ecotourism. However, in class 2 (probabilities: 0.327), none of the coefficients were statistically significant with LCM results at 10%. In class 1, respondents' MWTP were for the increasing surface water provision ($402.3 NTD/year/person), followed by integrating a framework for ecotourism ($351 NTD/year/person), increasing ethnobotany area ($301.6 NTD/year/person), and increasing organic farming area ($229.7 NTD/year/person). Therefore, these two groups' characteristics and attributes of land use program preferences were heterogeneous. We found the differences in estimation between the set groups of local residents and explained the sources on heterogeneity based on social background characteristics [32]. Thus, we identified significant segmentation for the land use program. Moreover, it is worth mentioning that land use information increases local residents' preferences for potential land use programs.

Table 5. Parameter estimates and MWTP values of latent class model (LCM) in DFP.

Attributes and Levels	Class 1			Class 2		
	Coefficient	*t* Value	MWTP	Coefficient	*t* Value	MWTP
Class 1						
ASC	−0.44904	−1.29	-	17.46	0.001	-
FA+	0.3147	1.83 *	229.7	−12.65	−0.001	-
BI+	0.15644	0.57	-	21.54	0.001	-
WA+	0.55119	3.23 ***	402.3	17.55	−0.001	-
LU1	−0.02796	−0.09	-	3.13	0.001	-
LU2	0.41324	1.68 *	301.6	−15.65	−0.001	-
LU3	−0.23473	−0.64	-	−1.72	−0.001	-
EC+	0.48088	4.01 ***	351	1.22	0.001	-
FUND	−0.00137	−5.02 ***	-	−0.02	−0.06	-
Probability	0.673			0.327		
Class membership parameters: Class 1						
Constant	0.047	0.13				
Monthly income more than $20,000 NTD	1.085	4.13 ***				
Lived at location more than 50 years	−0.231	−1.39				
Joined the community group	0.549	2.55 **				
Land owner	0.993	4.98 ***				
Farmer	−0.329	−1.42				
Log-likelihood ratio	648.8 ***					
Chi Square	$\chi^2_{0.01}(24) = 43.0$					

***, **, *: Significance at 1%, 5%, 10% level. AIC = 3809.2, AIC/N = 1.936.

3.4. Welfare Changes for Hypothetical Land Use Management Scenarios

According to the MWTP evaluation results presented in Table 6, scenario III was the most preferred ($1419 NTD/year/person), followed by scenario I ($1293 NTD/year/person), and scenario II ($1116 NTD/year/person) was the least preferred. In contrast, scenario I was the most preferred 11.11 h/month/person), followed by scenario III (10.18 h/month/person). Scenario II (8.1 h/month/person) was still the least preferred scenario. Obviously, the best land use program on MWTP for the residents was to increase organic farming area, increase biodiversity, increase ethnobotany area, increase wetland, and integrate an ecotourism package. Moreover, the local residents prefer natural conservation, which includes increases in biodiversity, water provision, ethnobotany and wetland area based on MWTW estimation results. The results could help with the land use management program in the forest park.

Table 6. Welfare changes from land use management scenarios.

Attributes and Levels	Hypothetical Future Scenarios		
	Scenario I: Natural Conservation	Scenario II: Environmental-Friendly Agriculture	Scenario III: Ecotourism Development
Agricultural Farming Type	Stay the present	Increase organic farming area	Increase organic farming area
Biodiversity	Increase	Increase	Increase
Water Provision	Increase surface water	Increase surface water	Stay the present
Land Use Type	Increase ethnobotany area	Increase ethnobotany area	Increase ethnobotany area
	Increase wetland area		Increase wetland area
Ecotourism Mode	Maintain status quo	Maintain status quo	Integrated ecotourism package
MWTP (FUND)	1293.90	1116.40	1419.30
MWTW (TIME)	11.11	8.1	10.18

4. Discussion

To the best of our knowledge, this paper is the first CE methodology concerning a land use program with ecosystem services in a forest park, which estimated the local residents' preferences and the WTP and WTW of farmers and non-farmers. This study provides an important empirical contribution regarding the marginal effects of attributes for land use preferences. Based on the CE model, this study evaluates the residents' values for the type of agricultural farming, biodiversity, water provision, land use type, ecotourism mode, and a monetary attribute (WTP and WTW) associated with ecosystem service and the land use program in the forest park. We found that the local residents would support the new land use program in the forest park. The most important attributes found are increasing the wetland area and increasing surface water provision, followed by increasing the organic farming area, ethnobotany area, and integrating a framework for ecotourism in the estimation results of the MWTP and MWTW model. This indicates the importance of focusing on increasing potential environmental quality and the water demand in the forest park area. The MWTP estimation of conservation policy and river restoration in Spain [13], and the case of Belgium's nature development and land use policy [6] also support our results, suggesting that the function of the wetland land and the water provision are the key factors of the land use program in the forest park. Therefore, land use planning in the near future might be a focus on the above attributes, and encourage the local residents to join the new land use program in the forest park.

Farmer respondents differ from non-farmers when it comes to land use attributes. However, this is not true of other attributes. The results are same as in MWTP and MWTW. Farmers are more likely to focus on increasing biodiversity, but non-farmers have not mentioned this issue. The cases of an agri-environmental scheme for afforestation in Germany [14], and environmental stewardship in the United Kingdom [15] also indicate the importance of the biodiversity in land use policy [16]. Broch et al. [12] estimated farmers' willingness to accept ecosystem service in Denmark, and found that the farmers had a higher preference for protection biodiversity with compensation. However, the non-farmers seem more likely to support the increasing of wetland area, organic farming area, and ethnobotany area in the forest park; this may imply that the general local residents would focus on the ecosystem service of the land use program. Similarly, results of the nature tourism facility development in Norway [56] also support our results. However, farmer and non-farmer respondents both incorporate the water provision and ecotourism into their land use program. According to our CE analysis, the respondents have higher MWTP and MWTW for land use planning in DFP, indicating that land-use management has the potential to improve the quality of the forest park in the future. Increasing wetland area, surface water provision, ethnobotany area, organic farming area, and an integrated framework for ecotourism is the best program for land use management in the DFP forest park. Under water constraints, this result is similar to the land-use management of the semi-arid mountains in the Nacimiento watershed (southeastern Spain) [13]. The heterogeneity of land use preferences derived from our empirical investigation supports the need for more integration of agricultural issues with local land-use issues, and policy makers also could explore differential opinions (or attitudes) in focus group discussion [15].

Based on the results of LCM, we found different land use preferences among various resident groups, and therefore raised the preference's heterogeneity for the community near DFP. In particular, explaining the sources of heterogeneity involves taking socio-economic backgrounds and land use behavior into consideration simultaneously. We found that higher positive preference and MWTP on the land use program are affected by higher income, having a farm and community organization membership. Similarly, a previous study focusing on residents of the buffer zone of Chitwan National Park in Nepal and selected vehicle payment (annual membership fee or labor contribution) showed that the average household WTP of the monetary group is consistently higher than that of their neighbors who prefer to contribute labor [36]. A detailed and comprehensive analysis reveals the local residents' various preferences towards land-use management strategies for community conservation in a forest park. Analysing residents' heterogeneous preferences for the issues of land use planning in forest parks by combining qualitative and quantitative data would be an interesting topic for future research [15]. Thus, the local manager could invite these stakeholders (such as the local residents who have higher income, own the agricultural land, and joined the community organization) to join the land use program in the near future. This could offer a supplemental and feasible way to build up the new land use policy in the forest park. While a perspective based on local residents' preferences is important in land use policy, residents' preferences or opinions are also important information for public choice options.

Finally, this study built up the decision-making scenarios from the land use attributes in the DFP. For the MWTP on land use planning, the best scenario was ecotourism development followed by natural conservation and environmentally friendly agriculture. As an ecotourism case of rural communities adjacent to Kruger National Park [36] and the land use program of conservation policy and active ecotourism in Spain [13] suggest, higher MWTP could be achieved by increasing the environmental quality and setting up an integrated ecotourism package. For the MWTW on land use planning, the best scenario is natural conservation followed by ecotourism development and environmentally friendly agriculture. To sum up, the forest manager could think about a potential land use program which contains both ecotourism development and natural conservation based on the key attributes, and creates a better ecosystem service environment in the near future. Other issues included creating an initial mechanism for local residents with an agri-environmental program [13] and willingness to contribute to the land use program in the near future [28,36]. This pilot study could generate useful information to demonstrate possible land-use management programs in the forest park with respect to the ecosystem services. Further related research of land use preferences could use a more specific empirical method to increase the validity of the econometric model; this would help to make the estimator in the model more powerful.

Supplementary Materials: The following are available online at www.mdpi.com/2071-1050/9/4/598/s1, Supplementary File S1: complete database and definitions of FUND and TIME.

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