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RESEARCH PAPER

Assessing the non-commercial values of environmental resources by using CVM; Case study: Siberian Crane, Fereydounkenar international wetland of Iran

Ahmadreza Yavari [1], Behnaz Moradi Ghiasabadi [2]*, Shahrzad Khoramnezhadian [2]

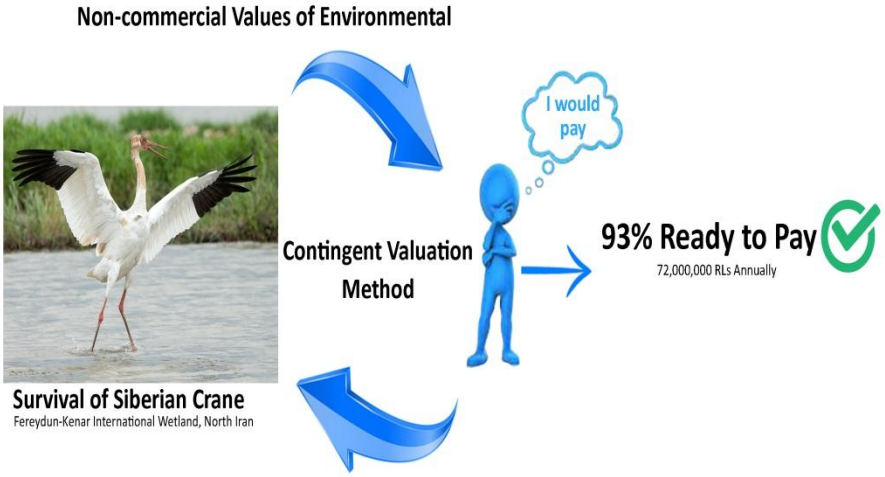
[1] Department of Environmental Planning, Management and Education, School of Environment, College of Engineering, University of Tehran, Tehran, Iran

[2] Department of Environment, Damavand Branch, Islamic Azad Univercity, Damavand, Iran

Highlights

- Through the involvement of local, conditional assessment (CVM) was considered as an economic evaluation and main modeling approach for this study.
- This study focuses on assessing social acceptability for biodiversity conservation In particular Siberian Crane.
- The gender, education and age level of Respondents have the positive influence on WTP and WTA.
- Three categories of non-use value indicators, was presented to quantify using CVM approach.

Graphical Abstract



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Abstract

Natural recourses play a significant role in human's well being but economists' attention is mostly taken only on the marketable value but nowadays the tends, is changing as economic Valuation intends to create outstanding changes in public awareness by the valuation of biological resources like aquatic and land habitats of plant and animal and also to create a stronger motive for protection because as everybody knows free goods do not worth so different methods have been innovated and researchers have been studied in this way. These researches had made considerable progress in the valuation of environmental and ecological services, which was afforded by ecosystems. Contingent Valuation Method (CVM) is one of economic valuation tools, is based on public viewpoints, measures of individual's willingness to pay (WTP)[2] and individual's willingness to accept (WTA)[3] and maximum likelihood (ML)[4] application. The result of a study on a measure of WTP shows that about 93% of the people are ready to pay monthly for protection and survival of Siberian Crane and only 7 % of them were not ready to pay only because of their low financial level. Results on the measure of WTA indicate that all 100% of people were not ready to accept money instead of annihilation of the Crane. The average willingness to pay for Siberian Crane protection is accounted 231723$ at the national zone and 57914270$ at the regional zone. Since the fisher test does not respond at the national zone and the difference was significant, extending the number of the samples to the national zone is impossible. It is merely possible to mention that about 1500 families in the country are ready to pay 40,000RLs monthly or 72,000,000 RLs annually only for the survival of Siberian Crain.

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*Corresponding author: moradighb@gmail.com (B. Moradi Ghiasabadi)

1. Introduction

Natural ecosystems provide human beings with many services, which fetch any market price. In recent years environmental economists have innovated methods for quantifying these kinds of functions, which indicate the general value of these kinds of the ecosystem to mankind. In this way, in more than 100 countries these kinds of valuations have been started. Valuation studies have uncovered the importance of natural resources and provided human beings with a deep perception of methods and they quantify the benefits from the ecosystem. Therefore the economist's attention was focused mainly on the values of the ecosystem in previous years. However today the nonmarket values are being appreciated and measured quickly. When the environment is influenced by changes created by a human being, the existence of some approach are necessary for taking decision. One of these approaches is monetary relation. This can be a connection between economists and ecologists that can be indicated by an increasing number of studies on non-use values at the global level.

One of the key elements of ecologicaly sustainable development is to ensure that the values of environmental resources are estimated correctly. This principle can respond the concepts of many questions (about situation and extension of environmental constancy in financial regulation) (Marshall et al., 2018). Efforts taking to achieve financial (monetary) values of the ecosystem functions play significant role in the management of relations between human beings and natural systems. At the microlevel, valuation studies present information on the structure and function of an ecosystem and evaluate its various roles in creating welfare. At the macro level ecosystem valuation evaluates the link between human beings welfare indicators and sustainability (Duffield and Patterson, 1991). Economic valuation has a very important role in evaluation and examination of environmental policies. Environmental systems include a plenty of benefits for human beings who are presented in the shape of material and energy. Quantification of these benefit is necessary. Therefore natural resources valuation is important for the following reasons:

a) The presentation of environment situation and problem to the decision makering country to improve the relationship between economic and environmental policies.
b) Adjusting the national calculations like GDP.

The total economical value is the sum of use and non use values. The non use value is the sum of the bequest V., existence V., and optain value (Wang et al., 2017).

Total value= Use V. + None use V. (1)

Non use value = Optain v. + Bequest v + Existence v. (2)

1.1. Obtain value

Since we face uncertainty matters in the future and we are not aware of what would be happened in future, There is no charge for visiting the area at the moment but it would be paid for keeping our right to go there whenever we want. in another word, it is something like premium.

1.2. Bequest value

The present generation pays for the protection and preservation of natural resources for future generations. In another world, it is the measure of a person's willingness and satisfaction to protect environmental resources for future generations (Mudrik et al., 2014).

1.3. Existence value

It is the measure of individual's willingness to preserve natural resource as the habitat of other animals. In other words, the conservation of special habitats or unique animals with the aim that these habitats should remain because they are a breeding ground for other organisms. If they are destroyed, the biodiversity will be destroyed, or if a certain species is destroyed, its genetic composition will be destroyed forever. This value can be known as the strongest natural value, because it is related exclusively to the species or natural resources and there is not related to its benefit for human being at all (Breitenmoser et al., 2009).

2. Materials and Methods

2.1. Description of Siberian the Crane

Cranes are the oldest species of the birds .They are classified as the extinguish endangered species according to CITES. Siberian Crane owns one of the most beautiful voices among other species of this bird. The loud flute like voice of this bird is used alternately for making connection with other member of the group. They have a beautiful common dance. There are three populations of Siberian Crane. Eastern population (about 3000 pieces) spends winter in puyang Lake in south of Chine. Central population (1-3 pieces) spent winter in Keolado national park in north of India that they are extinguished now. Western populations (2 pieces in 2005) flew about 3700 miles to get Freydoonkenar wetland to be able to spend the winter Currently, only one bird travels this route alone that called Omid. On his way, rests in Narzom wetland in Kazakhstan and in Astrakhan biosphere reserve in Russia in origin of Volga River, reaches the place of wintering stay in February. Whole populations of this species reproduce in Russia at the time of hatching. On the purpose of increasing the population in 2003, 3 chickens and in 2004, 2 chickens grown up in Oka biosphere reserve transferred to Iran to join the Ciberian Crane in Iran and migrate with them to their breeding areas. In spite of all these actions the population of Siberian Crane is still slight and the efforts are being made continually for increase of this population (Zhang et al., 2015).

2.2. Describing the existing situation

2.2.1. Position of region

In Fig. 1, the main place of wintering stay of the Crane is the non shooting area of the Freydoonkenar wetland vastness of 5427 hectares and geographical position 52°37'23" E and 36°27'53" N, was showed (Roche et al., 2010).

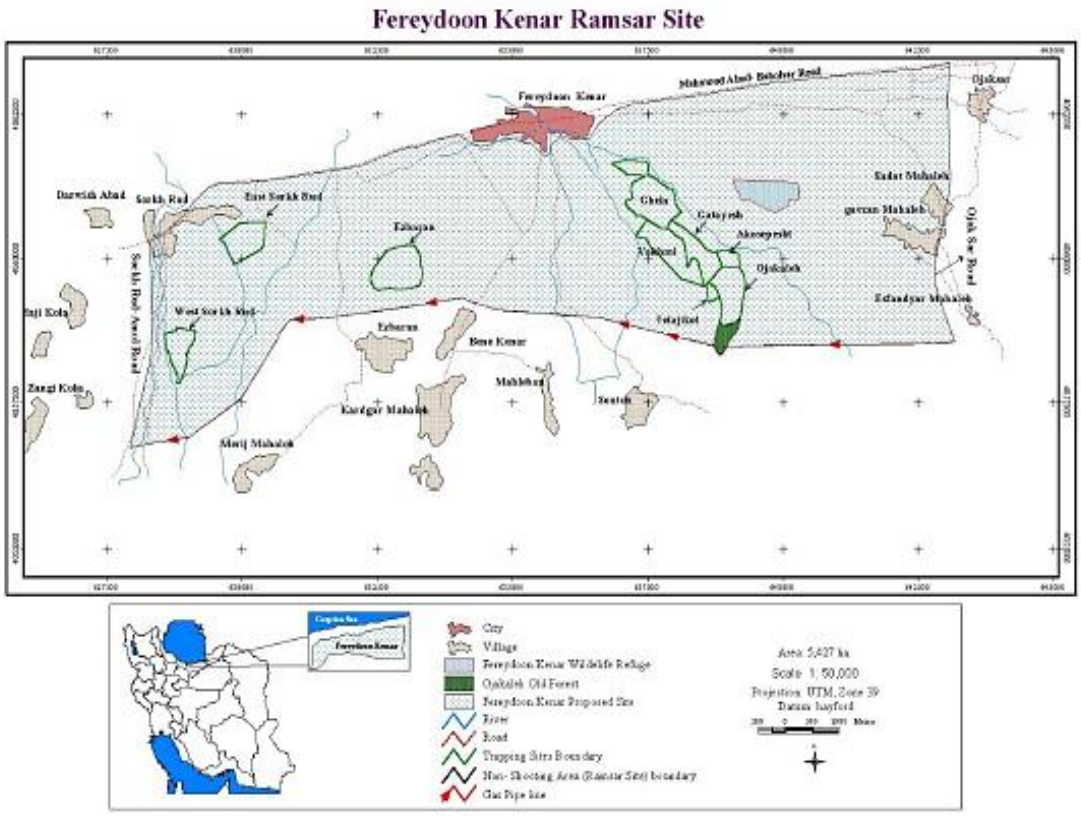

Fig. 1. Location of the study area (Source).

2.2.2. Ecological resources

It include study on climate, underground and surface water resources plants and animals of the region.

2.2.3. Socio-economic resources

It includes study on population, unemployment rate, main occupation and general economy by three fields. Fereydunkenar wetland complex with the full name of Fereydunkenar, Ezbaran, and Sorkhrood dams with an area of 5427 hectares and the average height of 23 meters below the surface of the high seas in the geographical range of 52'26" to 52'36" E and 36'38" to 36'39" N. The area is bounded on the east by Ajaksar road, on the west by Sorkhrood-Amol road, on the north by Mahmoudabad-Fereydunkenar main road and on the south by Gaz road. This area is one of the twenty tow registered sites.

2.3. History of CVM

CVM is designed and established for the first time in 1947 by Ciriacy and Wentrup. They calculated the value and benefits gained from goose hunting through interviewing hunter (Carson, 2000). This method has become very common since non-consumption values (Existance V., Bequest V., and Option) were invented because it is the only method that can calculate the sum of consumption and non-consumption values (Hadker et al., 1997).

2.4. Contingent method

2.4.1. CVM

CVM is commonly used as one of the standard and flexible tools and approaches in economic valuation. This method is based on a questionnaire and face-to-face interview in order to estimate the economic value of non-market goods (Song et al., 2016).

2.4.2. WTP

It is performed by setting up a hypothetical market in, which people are asked about the value they are willing to pay for environmental goods or services (the complete and accurate information is presented to interviewees) (Song et al., 2012).

2.4.3. WTA

Asking the people about their maximum monetary willingness to accept compensation for relinquishment the definite goods or service. These people are selected as random samples (Jin et al., 2006). In another word the people are asked about the measure of their maximum willingness to pay to forestalling of ecosystem probable changes or for relinquish or tolerance the changes of them (Wiser, 2007).

For example how much are they ready to pay for having clean air in Tehran (changes that have been made) or for preventing air pollution (changes prevention) (concept of WTP). How much are they ready to be paid for having no changes in air pollution (relinquishment or tolerate) concept of WTP (Zhang et al., 2011). At the first over view, the CVM may seem straight forward but this method has details and drawbacks that failure to follow will lead to incorrect answers. It is needed to consider that CVM is in fact a tool based on interdisciplinary view so it is not established only on economic theory, but also on sociology, psychology, statistical and research method and the interviewer should consider all of them (Zhu et al., 2019).

An important and interesting advantage of CVM is that it is able to evaluate and calculate values from a natural resource that even people have not seen (Obtain value). In another world CVM can account the non use values (Mutaqin and Usami, 2019).

2.5. Sample size determination

According to Newman, who believes that methods such as Cochran and Morgan table, etc. can not be a good scientific indicator for the sample, used test-based methods. Using G.Power and sample power software, in the hypothesis that its inferential statistics are performed by one-sample t-test, from a directional hypothesis and the effect size is 0.3, alpha 5%, accuracy 95%, beta 15%, and power He used the 81% test, which actually shows

the generalizability of a task in the target population, and estimated the minimum sample size as 26 samples and the maximum as 30 samples, which can be seen in the diagrams below (Fig. 2).

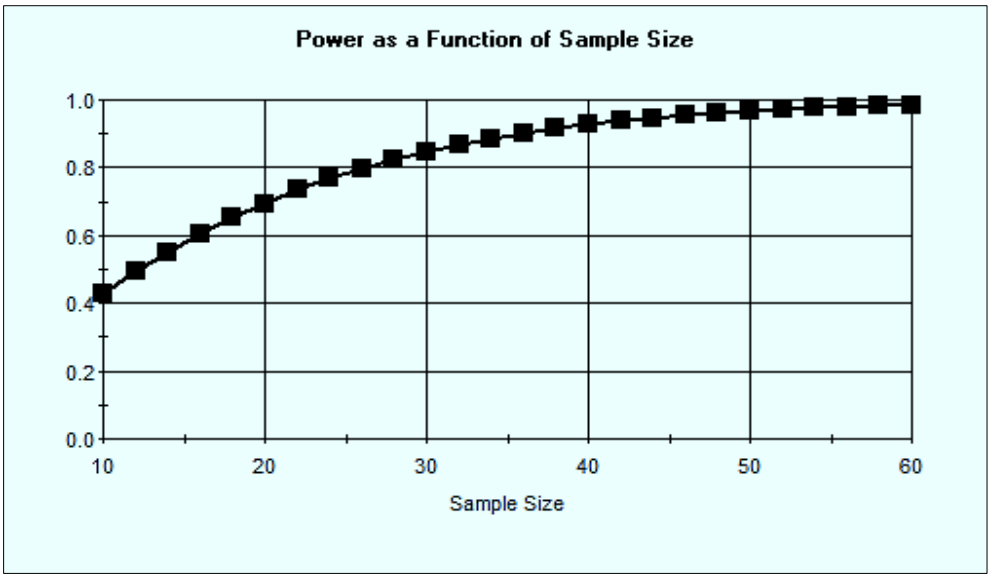

Fig. 2. Sample Size Determination by Sample power software.
Alpha= 0.050, Tails= 1, Mean 1= 330.000, Mean 2= 330.500, SD= 1.000

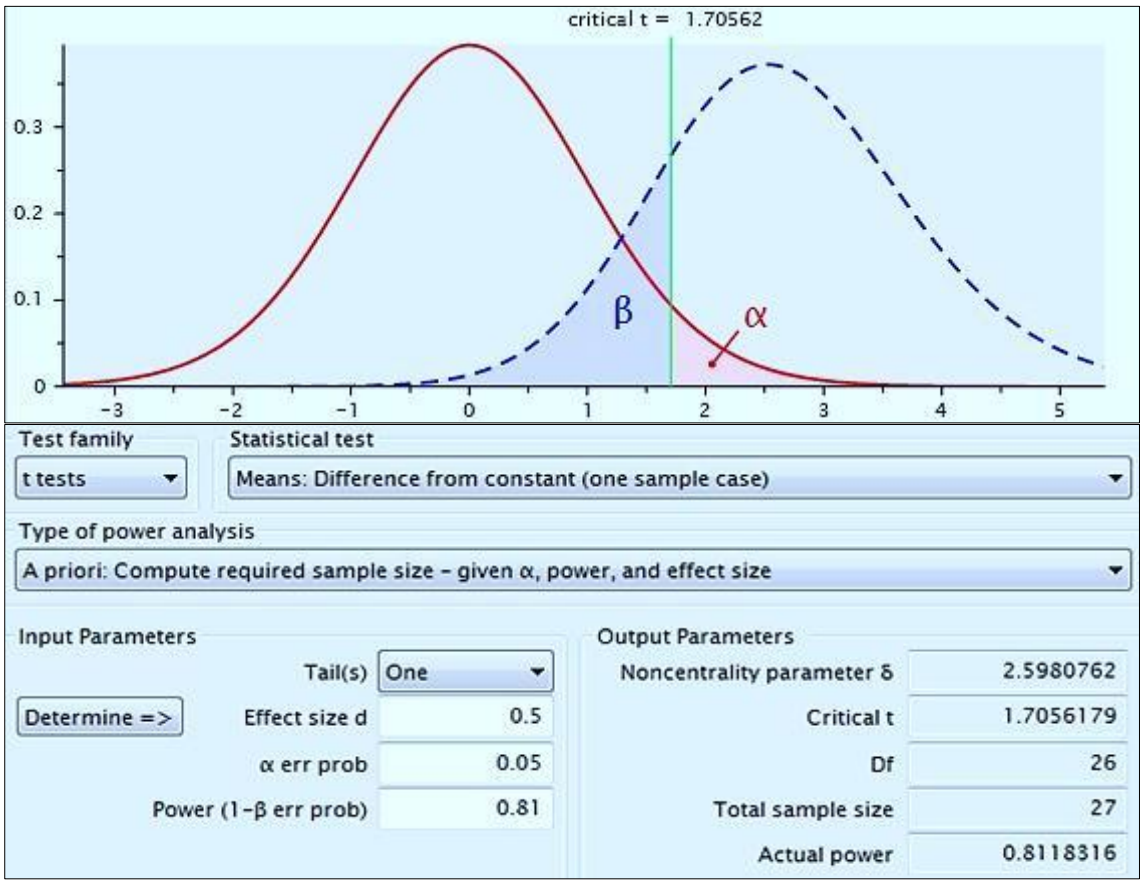

Fig. 3. Sample size determination by G-Power software.

One goal of the proposed study is to test the null hypothesis that the population mean is 330.5. The criterion for significance (alpha) has been set at 0.050. The test is 1-tailed, which means that only an effect in the expected direction will be interpreted. With the proposed sample size of 31 cases, the study will have power of 85.9% to yield a statistically significant result. This computation assumes that the population from which the sample will

be drawn has a mean of 330.0 with a standard deviation of 1.0. The observed value will be tested against a theoretical value (constant) of 330.5. This effect was selected as the smallest effect that would be important to detect, in the sense that any smaller effect would not be of clinical or substantive significance. It is also assumed that this effect size is reasonable, in the sense that an effect of this magnitude could be anticipated in this field of research (Table 1).

Table 1. Determination of the volume of the sampling in different levels of study.

	Local			Regional	National
	Sorkhrood	**Ezbaran**	**Fereydoonkenar**		
Standard Devision	2110074.73	2780003.31	2532711.785	1425371.931	1560774.301
Mean	211142.8571	101842.1053	96000	396470.5882	595681.8182
Variance	$4/4\times10^{12}$	$7/7\times10^{12}$	$6/4\times10^{12}$	$2/03\times10^{12}$	$2/45\times10^{12}$
N	35	38	30	120	110
	103				
Ni	25	31	37	49	68
N	131	136	127	550	1500
	394				

2.6. Precision for estimating the effect size

A second goal of this study is to estimate the mean in the population. On average, a study of this design would enable us to report the mean with a precision (95.0% confidence level) of plus/minus 0.30 points. For example, an observed mean of 330.0 would be reported with a 95.0% confidence interval of 329.70 to infinity, or (alternatively, per the a priori hypothesis) of minus infinity to 330.30. (Since the confidence interval has been defined as one tailed, only one boundary is meaningful). The precision estimated here is the median precision. Precision will vary as a function of the observed standard deviation (as well as sample size), and in any single study will be narrower or wider than this estimate. Regarding to the above mentioned items the number of samples (volume of the samples) that is indicated by "n" is calculated in the following table at local, regional and national levels.

2.7. Classification (zoning)

a) Local zone: (The immediate area), 3 trap places of wintering stay for Siberian the Crane are Freydoonkenar, Ezbaran, and Western and Estern Sorkhrood.
b) Regional zone: (direct effect area), Mazandaran province.
c) National zone: (indirect effect area), all provinces of the country.

2.8. Data analysis

Determination of general equation of the research and analysis of the correlation coefficient: as it has been mentioned before the final value is the sum of optain, bequest and existence values. The sum of the figures can not be helpful and the definition of a equation is necessary in which the relation between independent and dependant factors is determined. Independent factor means the measure of WTP and dependant factors are: the age, the education, the income, and etc (Table 2). As it is shown in the Table 2 the results of correlation analysis of dependant factors, WTP is high only with the factors of age, income and educational level and the correlation of other factors such as general and number of families with independent factors is very low, so that they can be omitted. (It has been performed using the defined indicators in correlation coefficient test) (Maghsood et al., 2019).

High correlation is in the range of _+0/7 –1 (3)
Average correlation is in the range of _+0/5 –0 (4)
Low correction is < 0/5 (5)

Table 2. Correlation coefficient of independent factors to the dependent factors.

Independent factors	Income	Education Level	Age	Gender	Number of Families
Correlation coefficient	0.71	0.99	0.88	0.07	0.008

It means if the calculated "R" is lower than ±0/7, there isn't any direct relation between them. The negative figure in age indicates as age increases the measure of willingness to pay decreases. It is also indicated, as the number of family's increases, the willingness to pay decreases. After deterioration of dependant factors, it is necessary to determine their relation with sum of nun use values and to calculate the amount of total value. The formulas have made three levels of research (Table 3).

Table 3. the calculated formulas for calculation the preposition between independent and dependant factors.

Zone	**Correlation efficient**	**Regression**	**Equation**
Local	0.752	0.821	$F=3338.4X_1+619X_2+0.83X_3$
Regional	0.835	0.793	$0/11\ x_3+F=2143/7\ x_1+588\ x_2$
National	0.847	0.837	$0/24\ x_3+F=5201/6\ x_1+312\ x_2$

2.9. Fisher Test

The fisher test shows whether the number of the sample can be extended to the population. On this purpose the Minitab software was used "F" in table that was calculated based on freedom degree, should be compared with the calculated "F" of each data (Zou et al., 2021). In this regard the following relation was used:

a) If Fm (table) < Fc (calculated) H0 hypothesis is refused.
b) If Fm (table) <Fc (calculated) H0 hypothesis corrected.
c) H_0 hypothesis = the extensible statistical society.

In order to identify which Fc should be compared with Fm, it should be performed only in the trusty area of the curve. The 100% trust is impossible because there is fault in margins of the curve of both plus and minus sides .so the maximum percentage of trusty is 95% (Like stretch in Idrisi software or in GIS). At the trust level of 95% only Fc which are p_0 value < 0.05 were compared with Fm. Fm was calculated through freedom degree which was in the area between X and Y (27). In this respect:

a) The Local zone: According to the Fisher test Fc=2/59 and Fm=3.85 (table of trust level of analysis and variance) indicates that the difference is not significant and statistical society for residents of three cities can be considerable as the sample of total society in the habitat of Cranes.
b) The Regional zone: According to the Fisher test Fc=3/81 and Fm=3/85 (table of trusty level of analysis and variance) indicates that the difference is not significant and statistical society can be extended to the total regional area of three cities: Mahmoodabad, Babolsar, Amol.
c) The National zone: According to the Fisher test Fc=3/85 and Fm=1/01 (table of trusty level of analysis and variance) indicates that the difference is significant and statistical society can not be extended to the country (Hoehn and Randall, 1987).

3. Results and Discussion

Statistical result of questionnaire analysis in 3 different zones states that: 2444 respondents aged 18 or more. And more than 78% were male. Classification of respondents on basis of their education shows that 10.7% are MSc or higher and 35% BSc, 24.9% had a higher secondary certificate, 19.4% had less than 12 years of schooling and 9.8 were illiterate. About 30.5% of the samples had not visited Siberian the crane (Tussupova et al., 2015). Classification of respondent on basis of their monthly incomes shows that 14.9% between 100-200$, 32.9% between 200-300$, 15.6% between 300-400$, 13.7% between 400-500$, and 25.5%, 500$ and more. Measures of WTP states that only 16.4% of the people (from local zone) do not willingness to pay to protect the Crane and it is seen that for the low income (author`s opinion) (Table 4). When respondents were presented with scenarios of miss of damage 85.7% were concerned and 14.3% claimed that they were "not concerned" but when they asked

how much will you accept if the Crane miss?(WTA concept) 100% of the people do not willingness to accept the money in lieu of giving of the Siberian the crane (Table 5). 86.2% of the samples agreed with environmental protection and development planes. Result of the investigation from environmental attitudes of respondents that were derived from 3 different items including agree, neutral, and disagree are shown in Table 6.

Table 4. Measure of WTP.

	Question	1-5 (%)	5-10 (%)	10-20 (%)	15-20 (%)	20-50 (%)	>50 (%)	Dissagree to pay (%)
Local	Ob.V	79	9	-	-	-	-	14
	Be.V	64	21	-	-	-	-	14
	Ex.V	61	23	-	-	-	-	14.3
Regional	Ob.V	17.6	35.3	26.5	5.	5.9	8.8	-
	Be.V	17.6	44.1	20.5	5.9	8.8	2.9	-
	Ex.V	26.5	32.3	14.7	8.8	11.8	5.9	-
National	Ob.V	11.8	13.6	60.9	7.3	2.7	3.6	-
	Be.V	13.6	8.2	57.3	9.09	6.4	4.5	-
	Ex.V	10.9	8.9	10.9	6.4	57.3	5.4	-

Table 5. Measure of WTA.

	Question	1-5 (%)	5-10 (%)	10-20 (%)	15-20 (%)	20-50 (%)	>50 (%)	Dissagree to accept (%)
Local	Ob.V	-	-	-	-	-	-	100
	Be.V	-	-	-	-	-	-	100
	Ex.V	-	-	-	-	-	-	100
Regional	Ob.V	-	-	-	-	-	-	100
	Be.V	-	-	-	-	-	-	100
	Ex.V	-	-	-	-	-	-	100
National	Ob.V	-	-	-	-	-	-	100
	Be.V	-	-	-	-	-	-	100
	Ex.V	-	-	-	-	-	-	100

Table 6. Willingness to environment protection.

	Question	Agree (%)	Disagree (%)	Neutral (%)
Local	Q1	92	7	0
	Q2	69	30	1
Regional	Q1	82.35	11.76	5.88
	Q2	45	47	8
National	Q1	85	10	3
	Q2	62	2	14

Q1= What is your idea a bout environment protection along with development? (We should not pursue development programs that damage the environment regardless of much fund benefit).

Q2= Do you think the program of Siberian the Crane protection would be influence on your live? (Directly or indirectly) In this case what is your opinion about the implementation of this program?

3.1. Value of Siberian Crane

3.1.1. Local zone

The value of Siberian Crane during 10 years (without inflation rate consideration) in local area considering 394 questioners is as follows. Since the Fisher test answered correctly in the local zone, the number of the sample can be extended to the population of three areas (Ezbaran, Freydoonkenar, Sorkhrood) and the value of

the Siberian Crane is calculated according to the real population of three areas (the estimation of population in 2005 according to statistical center of Iran): Ezbaran=2349, Freydoonkenar=30498, Sorkhrood=36610 average of the number of families: 5 people. The price of Siberian Crane in local zone is approximately 2000, 000,000Rls and 200,000$ (Table 7).

Table 7. The value of Siberian the Crane in local zone.

Real value		Value (Based on surveys)		Willingness to pay		Currency
Annually	Monthly	Annually	Monthly	Annually	Monthly	
1,976,940,000	140,644,000	100,638,000	7,880,000	270,000	20,000	Rl
231,723	15,831	11,500	851	1,29	1,2	$

3.1.2. Regional zone

This was the value of the Siberian crane over 10 years (excluding inflation) in the region with 550 respondents: Since the Fisher test respond on area correctly in regional area the number of the sample can be extended to the computer population of the area that means the population of Mazandaran province. In another world the value of Siberian Crane can be calculated according to the real population of the province: (It is necessary to mention that the population of Ezbaran, Freydoonkenar, and Sorkhrood has subtracted from the population of the Mazndaran province to prevent its double calculation). The population of the Mazandaran province as the regional area (Based on census of people and dwelling in 2006), 2983000. The population of the province subtracted the local area: 2946390, the average of the family number: 3/3 The price of Siberian Crane in Mazandaran province is calculated 580,000,000,000 Rls. Although this figure may seems to be much exaggerated it means in Mazandaran province each family is ready to pay 50,000Rle monthly and 600,000Rle annually for Siberian Crane protection (Table 8).

Table 8. Value of Siberian the Crane in regional zone.

Real value		Value (Based on surveys)		Willingness to pay		Currency
Annually	Monthly	Annually	Monthly	Annually	Monthly	
535,707,000,000	44,642,250,000	330,000,000	27,500,000	600,000	50,000	Rl
57,914,270	4,826,189	35,676	2,973	65	4,5	$

3.1.3. National zone

Since the Fisher test did not answer in national area and the difference was significant the number of sample con not be extended to the country. It can only say that 1500 families in the country are ready to pay 400,000 Rls monthly and 480,000 Rls annually to protect of Siberian the Crane (Table 9). The existing research is established on the purpose of estimating the nonuse value of Siberian Crane based on economic and social indicators. Therefore people were placed in a hypothetical market and asked whether they were ready to pay for protection and survival of Siberian Crane? In another world, this research is established on quantifying the measure of individual's willingness for purchasing non value endowments of Siberian Crane. It is the same function of CVM that means the estimation of non use value of goods using the accurate information. This research shows, although Iran is a developing country with a low level of income, it has people who are ready to pay for environment protection. According to the result of the research 62% of the people had seen the Crane or its pictures or its film, 38% had not even seen the Crane (but they were received information brochures). How ever 93% were ready to pay for the Crane protection and only 7% of the people were not ready to pay and it was only for their financial problems.

Table 9. Value of Siberian the Crane in national zone.

Value (Based on surveys)		Willingness to pay		Currency
Annually	Monthly	Annually	Monthly	
720,000,000	60,000,000	480,000	40,000	Rl
28,540	2,348	51	4	$

According to the result of the research 100% of people were not ready to accept money to annihilation of Siberian Crane (Shang et al., 2012). As it was shown, these values can be extended only to the Mazandaran province merely and because of the low number of questionnaires (1550) the difference of Fm and Fc was significant at the national zone that could be for time and financial shortage that researcher hadn't be able to have more than 1550 surveys and distribute them at the national zone. Hopefully it can be performed practically and at national level in future. This research as a small sample of a great achievement shows that people are ready to pay for environment. It indeed shows their interest to the environment protection. It means they are ready to dedicate part of their salary for protection of environmental resources even if they have seen that resource and it is so important (Jin et al., 2019).

In this research the level of education and willingness to pay had a high correlation and after that, factor of age and income were correlated to the willingness to pay respectively. It is necessary to mention that the correlation coefficient of the age increase the willingness to pay was negative and as age increases the measures of willingness to pay decreases. Results show that the Iranian people are sensitive to the situation of the environment .therefore the government should appreciate the people's interests and attention and consider much more financial protection in this regard. About 50% of all people knew that management program for the Siberian the Crane's protection will affect on their lives. 33% of the people found it is not much effective and 17% of them found it an effective. It is also necessary to mention that these interviews were performed at national level and even the southern provinces found the management program for Siberian Crane very effective on their lives.

Conclusions

From the Crane management point of view, the studies have had two important results: First of all, it proved that the people in Iran were aware of the environment and their important roles in their life even if they have never felt them. Second, it was clear that a high willingness to pay in terms of both cash and kind exist in Iran for contributing towards the upkeep and improvement of Siberian Crane.

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