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The attitudes of farmers towards hydroelectric power plants (HPP): The case of Laleli, Turkey

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Abstract

This study aims to determine the factors that are effective on the producers willingness towards the construction of Laleli Dam. To achieve this, it will determine the expectations of the producers to "move their businesses to other regions", "carry the whole village to another location" or "moving to the city" if the dam is built. It will also investigate the factors that are effective on these expectations. There is a negative relationship between the demand for the construction of the Laleli Dam and the agricultural revenue, business type, number of the poplar trees, and agricultural production; whereas there is a positive relationship between the demand for the construction of the Laleli Dam and the producers possession of the title to the property and the number of fruit trees on the property.

Key words: Expectations, farmer, logit model, hydroelectric power, Turkey.

Introduction

In the developing and changing world, agriculture has a prominent role in meeting the food demand and improvement of the income level of the rural population [1]. It is also a crucial sector for provision of raw materials for the industry, contributing to national income and employment.

Although the world population is increasing continuously, the size of cultivated land on earth remains constant or even decreases. Therefore, the importance of cultivated lands is increasing every day. Due to the climate change, global warming and the increase in draughts, cultivated lands become more vital for food production, than it was before. However, increase in population also leads to an increase in the demand for energy. Electrical energy, which accounts for the biggest portion of the energy demand, can be provided through various resources. HPPs are one of these resources. Electricity production through HPPs started in Western Europe in 1869 and spread all over the world throughout the 20th century [2]. After the 1970s, the increase in the cost of alternative sources for electricity production increased the demand for HPPs, especially in countries that do not have advanced technology [3].

In 2000s significant regulations about HPPs were issued and this increased the attention of the private sector towards HPP projects [4]. Today 23% of the total electricity production in the world is provided through HPPs [5]. The percentage of electricity provided through HPPs is 12% in the US, 47% in Turkey and 100% in Paraguay. Brazil, Norway, Sweden and New Zealand are other countries where HPPs account for a significant portion of electricity production [6, 7].

HPPs have some advantages compared to the other types of electricity production methods. As opposed to the other power plants, they do not produce toxic waste. Although the initial cost of construction for HPPs is high, operation costs are significantly low. Artificial hydroelectric lakes help increase precipitation and vegetation in dry areas [8]. However, HPPs have also some disadvantages as well. Among these disadvantages are high initial construction costs, long construction time, loss of the cultivated lands in HPPs vicinity, creation of swamps underneath the artificial lakes, production of methane through these swamps and the damages to the bottom fauna of rivers due to changes in waterways and currents.

Construction of HPPs triggers migration of the agricultural producers by leading non-agricultural use of arable lands. Farmers, whose lands are expropriated, move to the cities with limited capital that is given as compensation for the expropriation of their lands. Once this limited capital is spent, these ex-farmers face economic hardship, giving way to socio-economic problems in the cities.

Biro has described and evaluated the enviromental inpact of Kayraktepe Dam and Hydroelektric Power Plant in Turkey [9] by using contingent evaluation method to estimate the projects local environmental cost. The average, local rural annual wilingness to pay for he restoration of the environmental impact of the Project was 300 USD per person. Aegerter and Messerli [10], Tung [11] and Crook [12] studied the socio-economic effects of HPPs. Han *et al*. [13] measured economic value of multiple environmental impact of large dam construction as a case study of Korea, using a choice experiment approach.

The cases in the present study were chosen from villages in Erzurum and Bayburt. The major economic activities in these villages are crop and animal production. The amount of input used for the production of these products is low; therefore the demand for the products from this region is high. The proximity of the villages to the Bayburt city district facilitates the marketing of

these products. Bayburt is among cities with the highest rate of outgoing migration. If the Laleli Dam is built, a significant portion of the cultivated land around Bayburt region will be covered with water. If the dam is built, it is important to determine the needs of the producers whose lands will remain under the water, in order to prevent the negative effects of the construction on the producers.

This study aims to determine the factors that are effective on the producers willingness towards the construction of Laleli Dam. To achieve this, it will determine the expectations of the producers to "move their businesses to other regions", "carry the whole village to another location" or "moving to the city" if the dam is built. It will also investigate the factors that are effective on these expectations.

Materials and Methods

The data were acquired from face-to-face surveys conducted in 2010. Survey number was set to be 126 based on proportional sampling method (in 90% confidence interval and 7% mean deviation) [14, 15]. The questionnaire was implemented with a total of 126 randomly selected producers in the district of Bayburt and Erzurum Province.

In former studies, Limited Dependent Variable Regression Models were used to identify dependent variable. Dependent variable showing two conditions indicates the probability of existing and not, existing of an event. In the case that an event happens, dependent variable becomes '1', if it does not, it becomes '0' [16, 17].

Three methods were applied for estimation of such models. These models were Linear Probability Model, Logit Model and Probit Model. In Linear Probability Model, the estimated probability may fall out of the 0-1 interval, while it is reliable that those in Probit and Logit fall between these intervals. Since Logit and Probit are similar models, it was up to the researcher which one of two models to use [17, 18]. Binomial Logit Model was chosen for this study.

Results and Discussion

In many countries displacements of households, due to dam related artificial flooding and the socio-economic, socio-cultural problems that these displacements cause, are significant debate topics.

In this study, the mean age was 49.54 years and the mean of length of education 6.24 years for the producers. The average household size in the region was 5.79 persons, whereas it is 4.18 for Turkey according to the last census [19]. Of the producers in the region 27% were engaged in crop production, while the rest was engaged in both crop and animal production. In this study the producers, who will be affected by the construction of the dam, were divided into two groups; those who are for the construction (Y = 1) and those who are against it (Y = 0). Factors that affect the willingness of these producers for construction were presented through the Binomial Logit model. LR $\chi^2_{(9)}$ value of the logit model (p = 0.000) shows that the model is statistically applicable (Table 1). In this study statistically significant variables were considered. There was a negative relationship between construction of the Laleli Dam and agricultural income. Producers with a higher income than 20.000 TL were against the construction of the Dam. They opposed the construction because they believed that they will not be able to secure their current income if the dam is built. This relationship is statistically significant (p≤0.01). In this region, if the producers income was over 20.000 TL, the probability of being in the group for the construction was 85.35% lower than the probability of being in the group against the construction, compared to those with an income below 20.000 TL.

There was a positive relationship between the willingness of the producers towards the construction of the Laleli Dam and the existence of a title to the property. If the dam is built in this region, compensation will be paid to those properties holding a title, based on their value. However, for the properties without a title, in other words for the illegal buildings, no compensation will be paid. Therefore, producers who had properties with the title wanted the construction of the dam more than the ones without a title. This situation was statistically significant (p≤0.05). If producers had a title to the property, the probability of being in the group for the construction was 8.65 times higher than the probability of being in the group against the construction, compared to those without a title. There was a negative relationship between the willingness towards the construction of Laleli Dam and the type of business. In the region of the study, those who were engaged in irrigated crop production had a significant income level, compared to the rest of the region. Business owners with this income level did not want to leave the region. In addition to this, the strong attachment of the producers to their land makes it harder for them to leave the region. Since the producers did not want to leave the land on which they produce their crops, they confronted the construction of the dam. This situation was statistically significant (P≤0.01). Within this region, those who were engaged in crop production had 90.2% lower probability of being in the group for the construction of Laleli Dam, compared to those who were not engaged in crop production.

Table 1. Analysis of the factors effecting the willingness of the farmers fort he construction of the dam by logit model.

	Coef. (Std.Err.)		Odds Ratio (Std.Err.)	
Age	-0.2743		0.7601	
	(0.2499)		(0.1900)	
Education	-0.1289		0.8791	
	(0.4191)		(0.3685)	
Population	0.1344		1.1439	
	(0.1553)		(0.1777)	
Agricultural income 20000 TL>:1,	-1.9205	*	0.1465	*
(Other:0)	(0.6676)		(0.0978)	
Existence of a title for residence (Yes:1,	2.1579	**	8.6531	**
No:0)	(1.0836)		(9.3767)	
Type of farm (Crop:1, Other:0)	-2.3049	*	0.0998	*
	(0.8158)		(0.0814)	
The number of fruit trees	0.9444	*	2.5711	*
	(0.3224)		(0.8289)	
The number of poplar tree	-1.4321	*	0.2388	*
	(0.4731)		(0.1130)	
Communication among family members		*		*
and relatives related to the agricultural	-1.5326		0.2160	
issues	(0.4323)		(0.0934)	
	0.5907			
Constant	(1.7054)			
Log likelihood	-44.5129			
LR chi2(9)	44.4600	*		

Standart error values are shown in parenthesis.
*,**,*** 0.001, 0.05 and 0.10 shows the statistical siginificance, respectively.

There was a positive relationship between the willingness towards the construction of the Laleli Dam and the number of fruit trees on the cultivated land. As the number of fruit trees on the cultivated land increased, business owners willingness for the construction of the dam increased. Business owners were aware that the existence of fruit trees increases the value of their property; therefore they expected to get higher compensation payments for the expropriation of their lands. Due to this expectation, those with more fruit trees on their property wanted the construction of the Dam. This situation was statistically significant (P≤0.01). If the number of fruit trees on the property increased by 1, the probability of the producers being in the group for construction of Laleli Dam was 2.57 times higher than the probability of being in the group against the construction. There was a negative relationship between the willingness towards the construction of Laleli Dam and the number of poplar trees on the property. As the number of the poplar tree on the property increases, producers do not want the construction of the dam. Since the poplar groves in the region were established recently, they believe that the compensations for expropriation will be lower. Therefore, producers with a high number of poplar trees on their property did not want the construction of the dam. This situation was statistically significant (P≤0.01). If the number of the poplar trees on the property increased by 1, the probability of the producers being in the group for the construction of Laleli Dam decreased by 76.12% compared to the probability of being in the group against the construction.

There was a negative relationship between the willingness towards the construction of Laleli Dam and the existence of communication among family members and relatives related to the agricultural issues. As social entities, human beings wwre in continuous dialog with their environment. Therefore, producers are in need for keeping their relationships with their relatives and consulting with them about their crop and animal production. If the dam is built in the region, there is a risk that producers may not be able to migrate to same places together with their relatives. They believed that as a result their dialogs with their relatives will be interrupted and therefore they opposed to the construction of the dam. This relationship was statistically significant (P≤0.01). Those who were in continuous dialog with their relatives had a 78.40% lower probability of being in the group for the construction of Laleli Dam, compared to those without a continuous dialog with their relatives.

The producers in the research area were asked about their expectations regarding their businesses, in case the Laleli Dam is built. As a result of pre-interviews, it was decided to offer three options to the producers: "move their businesses to other regions", "carry the whole village to another region" and "moving to the city". Factors that affect the willingness of these producers to "move their businesses to other regions", to "carry the whole village to another region" or to "move to the city" were presented through the Binomial Logit model. Of the participants 77.80% objected to the construction of the Laleli Dam,whereas 68.30% of the producers wanted to relocate the entire village; 73.00% of them were not willing to move their businesses and 63.50% of them did not want to move to the city (Table 2).

The LR $\chi^2_{(13)}$ value (p = 0.000) of the logit model, which demonstrates the factors influencing the willingness of producers to move out, shows that the model is statistically applicable (Table 3). There existed a negative correlation between transferring the business to another place and education. The more educated a producer is, the more reluctant he is to transfer his business. This correlation was statistically significant (P≤0.10). As the educational level of the producers in the research area increased by one year, the possibility to fall into the group that is willing to move out was lower by 69.73% than the possibility to fall into the group that is not.

There existed a positive correlation between transferring the business to another place and the household size. The larger the family of a producer was, the more willing he was to transfer his business. This correlation was statistically significant (P≤0.01). As the number of people in the family of a producer increased by one person, the possibility to fall into the group that is willing to move out was 1.46 times higher than the possibility to fall into the group that is not. There existed a positive correlation between transferring the business to another place and employment in a non-agricultural sector. Majority of the people in the region who worked in non-agricultural sectors were employed as masons or plasterers. Since non-agricultural income had a significant proportion in their total incomes, the transfer of the business to another place will not have too much affect on them. These people believed that they will earn more money in case they move out, thus, the willingness to transfer the business to another place increased. This correlation was statistically significant (P≤0.10). The possibility for people working in a non-agricultural sector to fall into the group that is willing to move out was 2.80 times higher than the possibility to fall into the group that is not.

The correlation between the relocation of the business and having social security was negative. Producers who had social security were less willing to transfer their businesses to another place than producers who did not have social security. This correlation was statistically significant (P≤0.01). The possibility for producers who had social security to fall into the group that is willing to move out was lower by 99.18%, compared to those who did not have social security. There existed a positive correlation between transferring the business to another place and presence of a health center in the village. Producers whose villages had health centers expect to move to regions that offer better standards.

Table 2. The relationships between the willingness for the dam and expectations (%).

Willingness fort he dam	Relocate the village as a whole		To relocate the farms individually		Move to the city		
	No	Yes	No	Yes	No	Yes	Total
No	17.50	60.30	54.00	23.80	50.80	27.00	77.80
Yes	14.30	7.90	19.00	3.20	12.70	9.50	22.20
Total	31.70	68.30	73.00	27.00	63.50	36.50	100.00

Table 3. Analysis of the expectations ofthe producers in case the dam is built by Binominal Logit Model.

	Relocating the farms		Relocating the village		Moving to the city	
	Coef. (Std.Err)	Odds Ratio (Std.Err.)	Coef. (Std.Err)	Odds Ratio (Std.Err.)	Coef. (Std.Err)	Odds Ratio (Std.Err.)
Age	-0.1267	0.8810	-0.2883	0.7495	-0.3097	0.7337
	(0.3111)	(0.2741)	(0.2336)	(0.1751)	(0.2485)	(0.1823)
Education	-1.1950 ***	0.3027 ***	-0.7016	0.4958	1.3782 **	3.9676 **
	(0.7028)	(0.2127)	(0.5694)	(0.2823)	(0.5965)	(2.3667)
Population	0.3783 *	1.4598 *	0.0258	1.0262	0.2417 ***	1.2734 ***
	(0.1546)	(0.2257)	(0.1248)	(0.1280)	(0.1363)	(0.1736)
Working outside agriculture (Yes:1, No:0)	1.0305 ***	2.8026 ***	-1.0341	0.3556	1.0783 **	2.9397 **
	(0.6095)	(1.7081)	(0.4801)	(0.1707)	(0.5583)	(1.6412)
Social Security (Yes:1, No:0)	-4.8070 *	0.0082 *	0.2918	1.3388	-0.5383	0.5838
	(1.4379)	(0.0118)	(0.8986)	(1.2031)	(0.9912)	(0.5786)
Investment outside farm (Yes:1, No:0)	-0.4369	0.6460	1.4828 *	4.4052 *	1.5676 *	4.7951 *
	(0.6260)	(0.4044)	(0.5924)	(2.6096)	(0.5729)	(2.7471)
Existence of a health center in the village	2.2059 **	9.0784 **	-0.9698	0.3792	0.4304	1.5379
	(0.9482)	(8.6077)	(0.6234)	(0.2364)	(0.5718)	(0.8793)
Residing in the village (Yes:1, No:0)	1.0701	2.9158	0.7418	2.0997	-0.3787	0.6847
	(1.1426)	(3.3315)	(0.7068)	(1.4841)	(0.6818)	(0.4669)
Having a title for residence (Yes:1, No:0)	1.5598	4.7577	0.6768	1.9675	-1.9479 **	0.1426 **
	(1.2326)	(5.8641)	(0.6697)	(1.3176)	(0.8129)	(0.1159)
Animal product income	-3.2981 *	0.0370 *	0.2904	1.3369	1.9845 **	7.2757 **
	(1.0623)	(0.0393)	(0.6724)	(0.8990)	(0.8778)	(6.3863)
Crop income	-0.0001 **	0.9999 **	0.0001	1.0001	-0.0001 *	0.9987 *
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Having İrrigated land	-0.0266 **	0.9738 **	-0.0034	0.9966	0.0114	1.0114
	(0.0117)	(0.0114)	(0.0097)	(0.0096)	(0.0105)	(0.0107)
Consulting with relatives on agricultural production	1.0568 *	2.8771 *	0.1460	1.1572	-0.5022 ***	0.6052 ***
	(0.3823)	(1.1000)	(0.2504)	(0.2897)	(0.2650)	(0.1604)
Constant	0.0564		-0.6060		0.1578	
	(2.5485)		(1.9023)		(2.1581)	
Log likelihood	-47.4749		-64.2688		-60.1948	
LR chi2(13)	51.9900*		28.9500*		44.9900*	

Standart error values are shown in paranthesis.
*,**,*** .001, .05 and .10 shows the statistical, respectively.

This correlation was statistically significant (P≤0.05). People whose villages had health centers were 9.08 times more likely to fall into the group that is willing to move out; compared to people whose villages did not have health centers.

There existed a negative correlation between transferring the business to another place and the income generated from animal production. As the income the producers earn from animal production increased, they were more reluctant to transfer their businesses to another place. This correlation was statistically significant (P≤0.01). As the annual income generated from animal production in the research area increased by 1 TL, the possibility to fall into the group that is willing to move out was lower by 96.30% than the possibility to fall into the group that is not.

There existed a negative correlation between transferring the business to another place and the income generated from vegetative production. As the income the producers earn from crop production increased, they were more reluctant to transfer their businesses to another place. In other words, the producers in the region do not want to abandon their fertile lands and, thus, to decrease their annual incomes. This correlation was statistically significant (P≤0.05). As the annual income generated from crop production in the research area increased by 1 TL, the possibility to fall into the group that is willing to transfer the business to another place was lower by 0.01% than the possibility to fall into the group that is not. There existed a negative correlation between transferring the business to another place and the possession of irrigated lands. Producers yield more in irrigated lands. Since they are not knowledgeable about the positions and types of the lands they will get in case their businesses are relocated, they are against the idea of moving out. This situation was statistically significant (P≤0.05). As the size of irrigated lands the producer possesses in the research area increased by 1 da, the possibility to fall into the group that is willing to transfer the business to another place was lower by 2.62% than the possibility to fall into the group that is not.

There existed a positive correlation between transferring the business to another place and the existence of communication among family members and relatives related to the agricultural production. Producers want to meet new people and share ideas with them in their new settlements. This correlation was statistically significant (P≤0.01). Those who share ideas with their relatives regarding agricultural production had 2.88 times more probability of being in the group that is willing to transfer the business to another place, compared to those who do not.

The LR $\chi^2_{(13)}$ value (p = 0.000) of the logit model, which demonstrates the factors influencing the willingness of producers to carry the whole village to another region, shows that the model is statistically applicable. There existed a positive correlation between the relocation of the village and the existence of an investment outside the business. People who invested outside their businesses rely on these investments. Besides, these producers, in case the Laleli Dam is built, are more in favor of the relocation of the whole village without damaging existing relations than others, who do not have investment outside their businesses. Those who have investments outside their businesses had 4.41 times more probability of being in the group that is willing to relocate the whole village, compared to those without any investment outside their businesses.

The LR $\chi^2_{(13)}$ value (p = 0.000) of the logit model, which demonstrates the factors influencing the willingness of producers to move to the city, shows that the model is statistically applicable (Table 3). There existed a positive correlation between the willingness to move to the city and the educational level. As the educational level of the producer goes up, his willingness to move to the city increases. Educated producers think that they will get different professional opportunities in the city. This correlation was statistically significant (P≤0.05). As the educational level of the producers in the research area increased by one year, the possibility to fall into the group that is willing to move to the city was 3.97 times higher than the possibility to fall into the group that is not. There existed a positive correlation between the willingness to move to the city and the household size. The larger the family of a producer is, the more willing he is to move to the city. It is expected that employment opportunities will increase in the city for each family member and, thus, the annual family income will increase. This correlation was statistically significant (P≤0.10). As the number of people in the family of a producer increased by one person, a possibility to fall into the group that is willing to move to the city was 1.27 times higher than a possibility to fall into the group without willing.

There existed a positive correlation between the willingness to move to the city and employment in a non-agricultural sector. Most of the people in the region who work in non-agricultural sectors are employed in big cities as masons or plasterers. Since they are away from their families for 6-7 months of a year, they think that they could live in better standards by bringing their families with them; in case the dam is built. Thus, the willingness to move to the city increases. This correlation was statistically significant (P≤0.05). Those who work in non-agricultural sectors had 2.94 times more probability of falling into the group that is willing to move to the city, compared to those who do not work in non-agricultural sectors. There existed a positive correlation between the willingness to move to the city and the existence of an investment outside the business. This correlation was statistically significant (P≤0.01). Those who had investments outside their businesses had 4.80 times more probability of being in the group that is willing to move to the city, compared to those without any investment outside their businesses. There existed a negative correlation between the willingness to move to the city and the existence of a title to the property. People who had the titles of their houses in the research area will be paid compensation. However, producers estimated that they will not be able to purchase a house with the compensation amount and they will trouble financially. Therefore, those who had titles did not want to move to the city. This situation was statistically significant (P≤0.05). Those who had the titles of their houses had 85.74% lower probability of being in the group that is willing to move to the city, compared with those who do not.

There existed a positive correlation between willingness to move to the city and the income generated from animal production. As the income the producers earn from animal production increased, they were more willing to move to the city. This correlation was statistically significant (P≤0.05). As the annual income generated from animal production in the research area increased by 1 TL, the possibility to fall into the group that is willing to move to the city was 7.28 times higher than the possibility to fall into the group that is not.

There existed a negative correlation between the willingness to move to the city and the income generated from crop production. As the income the producers earn from crop production increased, they become more reluctant to move to the city. In other words, the producers in the region did not want to sever their connections with their lands. This correlation was statistically significant ($P \leq 0.05$). When the annual income generated from crop production in the research area increased by 1 TL, the possibility to fall into the group that is willing to move to the city was lower by 0.13% than the possibility to fall into the group that is not.

There existed a negative correlation between the willingness to move to the city and the existence of communication among family members and relatives related to the agricultural production. Producers believe that their connections with their lands will decline and they will not be able to maintain their relationships with their relatives in case they move to the city. Therefore, those who share ideas with their relatives regarding agricultural production were recultant to leave their businesses behind and move to the city in case the dam is built. This correlation was statistically significant ($P \leq 0.01$). Those who share ideas with their relatives regarding agricultural production had 39.48% lower probability of being in the group that is willing to move to the city, compared with those who do not.

Conclusions

HPPs have an important role in providing the demand for electricity in the country. They have advantages such as low operation costs, lower technological requirements and positive effects on geography and climate. However, they also have disadvantages such as damage to the environment, non-agricultural use of the arable lands and the harm to the bottom fauna of the rivers that they are built on.

Producers attitudes towards the construction of the dam is related to the income level of the producers, the existence of the title to their properties, the existence of crop production on the properties, the number of fruit and poplar trees on the properties and their relationship to their relatives.

If the dam is built, the producers expect migration of the whole village to another place in the vicinity of the research area. Producers are not likely to accept land far from their current region or in the city.

Investments outside for business producers are the only determinants that are effective on the expectation of the migration of the village as a whole. Producers who own property outside their business, such as a house or a plot of land, are more likely to accept the migration of the whole village to another place. The willingness to move to the city is significantly related to the education level, household size, employment in a non-agricultural sector, existence of an investment outside the business, existence of a title to the property, agricultural income and the relationship with the relatives. There is also a negative relationship between the expectation to move to the city and the level of income from crop production, and the existence of a title for the property.

The results of the analysis show that policy makers should consider if there are real social benefits in the construction of HPPs before the dams are built. If the constructions of HPPs are inevitable, then it is important for the policy makers to consider the above mentioned characteristics of the producers listed in this study, during the process of their policy-making to avoid social problems on the part of the farmers.

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