

THE THERMAL POWER PLANTS WITH THE VIEWPOINT OF FARMERS: THE CASE OF AMASYA PROVINCE

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Abstract. Thermal power plants are facilities that convert the chemical energy of solid, liquid and gas fuels respectively into thermal, mechanical and electric energy. The presumption of establishing a fossil fuel plant on this fertile area is putting the security of the agricultural products of the area at risk. A face to face survey was carried out with the 90 of the farmers living close to the planned area for the establishment of the fossil fuel plant in Suluova county of Amasya province. According to the survey results 43% of the farmers stated that fossil fuel plant is a necessity but it should be established far away from the agricultural estates whereas 30% of them think that these kind of fuel plants should not be established on any account and 27% of them expressed no opinion about the issue. A total of 60% of the farmers think that the agricultural consequences of the planned fossil fuel plant are not considered adequately; and 73% of the farmers think that a presumed fossil fuel plant in the area will negatively affect the yield and the quality of the agricultural products and 56% say that the agricultural estates will be negatively affected by it. Majority of the farmers stated that they would try to prevent the establishment of the plant even if they knew they would not succeed.

Keywords: *farmer, agriculture, thermal power plant, Amasya, pollution*

Introduction

Thermal power plants are the plants that convert the thermal energy of solid, liquid and gaseous fossil fuels into electrical energy. In this context, there are coal power plants, fuel-oil power plants and natural gas power plants. On the other hand, the plants that produce electricity from biomass are considered as thermal power plants (Chamber of Mechanical Engineers, 2017). It is stated that thermal power plants are preferred to produce electricity because of their advantages like being established with low costs and rapid feasibility and making use of the low-quality coal (Karaca et al., 2005).

As of late 2016, electricity production was 273,387 GWh, and 184,889 GWh of it was produced by thermal power plants in Turkey, 67,268 GWh was produced from hydroelectric plants, and 21,230 GWh from other renewable energy sources. In the same period, the rate of the electricity that was produced by thermal power plants to total electricity generation was 67.6%. Coal-originated power plants ranked the first in this rate with a share of 33.74%, followed by natural gas + LNG-based power plants with a rate of 32.1%, and followed by hydraulic power plants with 24.6%. As of the end

of 2016, it was of great importance that the share of electricity produced in wind power plants increased in total production from 3.4% to 5.7% (*Table 1*).

Table 1. Distribution of electricity production of Turkey according to energy sources (GWh) (Ministry of Energy and Natural Sources, 2018)

Primary energy source		2014		2015		2016	
		Production (GWh)	Share (%)	Production (GWh)	Share (%)	Production (GWh)	Share (%)
Coal	Mineral coal + imported coal + asphaltite	39,647	15.7	44,830	17.12	53,778	19.67
	Lignite	36,615	14.5	31,336	11.97	38,460	14.07
Liquid fuels	Fuel oil	1,663	0.66	980	0.37	1,103	0.40
	Diesel oil	482	0.19	1,244	0.48	1,548	0.57
	LPG		0.00		0.00		0.00
	Naphtha		0.00		0.00	2	0.00
Natural gas + Lng		120,576	47.9	99,219	37.9	87,820	32.1
Renewable + wastes		1,433	0.57	1,758	0.67	2,179	0.80
Thermal		200,417	79.5	179,366	68.52	184,889	67.63
Hydraulic		40,645	16.1	67,146	25.6	67,268	24.6
Wind		8,520	3.4	11,652	4.45	15,492	5.67
Geothermal		2,364	0.9	3,424	1.31	4,767	1.74
Solar		17	0.01	194	0.07	972	0.36
General sum		251,963	100.00	261,783	100.00	273,387	100.00

According to the data provided by Energy Market Regulatory Authority (EMRA), the domestic coal-fired power plants that are in operation in Turkey with production license are 34 in number; and one of them works on asphaltite, one on hard coal and the other is a lignite-fired power plant. There are also 6 power plants that are still under construction. The total installed capacity of the domestic coal, lignite and asphaltite-fired power plants was 9,842 MW at the end of 2016. A total of 38,460,314,490 kWh electricity was produced in lignite-fired power plants in 2016 in terms of capacity in production (*Table 2*).

The number of the plants in operation that have production license in Turkey with imported Coal is 10. There are also 7 other plants that are still under construction. The total established power of thermal power plants that run on imported coal is 7,571.4 MWe. A total of 53,777,704,022 kWh electricity was produced in 2016 in imported coal and hard coal-fired power plants. Although the number of natural gas-fired power plants that have production license is 326 in Turkey, those that are active are 252 in number. A total of 104 of these have over 10 MW capacity. The total established capacity of natural gas-fired thermal power plants was 22,156 MW as of the end of 2016. The total production of natural gas-fired power plants was 87,797,441,063 kWh in 2016 (EMRA, 2018).

The very fine ash particles, which are drawn upwards by the gases in chimneys because of the combustion in thermal power plants are considered to be important waste materials. It was reported that millions of ash, cinder and particles produced as waste by coal that is burnt in the power plants are stored at a certain height over a land of thousands of hectares and cause intense ash emission on forests, marquis, agricultural areas and residential areas (Pacyna, 1987).

Table 2. Coal-fired thermal power plants that have production licenses and 400 MWe and above capacity in Turkey (EPDK, 2018)

Fuel type	Name of the plant	City-county of plant	Established power (MWe)	Capacity in production (MWe)
Imported coal	Çatalağzı Thermal Power Plant	Zonguldak-Merkez	2,790.00	2,790.00
Domestic coal	Afşin - Elbistan B	Kahramanmaraş-Afşin	1,440.00	1,440.00
Domestic coal	Afşin - Elbistan A	Kahramanmaraş-Afşin	1,355.00	1,355.00
Imported coal	İskenderun Thermal Power Plant	Adana-Yumurtalık	1,210.00	1,210.00
Imported coal	İÇTAŞ Elektrik Enerjisi Üretim ve Yatırım Inc.	Çanakkale-Biga	1,200.00	1,200.00
Imported coal	Atlas Thermal Power Plant	Hatay- İskenderun	1,200.00	1,200.00
Domestic coal	Soma B Thermal Power Plant	Manisa -Soma	990.00	990.00
Coal	Kemerköy Thermal Power Plant	Muğla- Milas	630.00	630.00
Coal	Yatağan Thermal Power Plant	Muğla- Yatağan	630.00	630.00
Domestic coal	Çayırhan Thermal Power Plant	Ankara-Nallıhan	620.00	620.00
Domestic coal	Seyitömer Thermal Power Plant	Kütahya- Merkez	600.00	600.00
Domestic coal	Kangal Thermal Power Plant	Sivas- Kangal	457.00	457.00
Domestic coal	Tufanbeyli Thermal Power Plant	Adana -Tufanbeyli	450.00	450.00
Domestic coal	Yeniköy Thermal Power Plant	Muğla -Milas	420.00	420.00
Domestic asphaltite	Silopi Thermal Power Plant	Şırnak-Silopi	405.00	405.00

Numerous studies were carried out in the literature on thermal power plants. The importance of thermal power plants, environmental effects and their effects on the chemical properties of soil and microbial activity have been focused on in these studies (Adriano et al., 1980; Bunzl et al., 1983; Mejsrik and Suacha, 1988; Karaca, 1997; Onacak, 1999; Baba et al., 2003; Karaca et al., 2005; Deniz, 2010; Özcan et al., 2014).

In the present study, the awareness levels, judgments and attitudes of the farmers that continue agricultural activities in Suluova County in Amasya province where a thermal power is intended to be built were examined. Suluova County is a green plain that has fertile soils. The county is one of the locomotive regions of the city in terms of economic production with the factory that processes sugar beet, with four mine quarries, with onion and wheat cultivation, and with animal husbandry because the area is also suitable for agricultural production. Gürmin Enerji Madencilik Sanayi ve Tic. Inc. intends to build a thermal power plant within the boundaries of Merzifon and Suluova in the region with a total established capacity of 450 MW. The company made the application for the project in 2013, and EMRA approved the project. However, the objections on the power plant that would be established in the region where there was agricultural production, and the lack of the viewpoints of relevant institutions which failed to submit their investigation results at the 2nd Examining and Evaluation Commission meeting caused that the Environmental Impact Assessment (EIA) process were ceased on August 25, 2016. During the 13 months as of this date, the Ministry of Environment and Urbanization decided to terminate the EIA process when there were no revised reports and when the company did not present any data. This result was not revealed at the questionnaire stage of our study (April, 2016).

Materials and methods

The main material of the present study consisted of the data that were obtained with face-to-face interviews that were conducted with the farmers who lived in the villages of Suluova County of Amasya Province. In addition, the data that were provided by Energy Market Regulatory Authority and the Ministry of Energy and Natural Sources were also made use of. The study was conducted in 4 villages. In selecting the villages, the reactions to the thermal power plant that was intended to be established in the region were taken into consideration, and the farmers were selected with the Purposeful Sampling Method to represent the region. A total of 90 questionnaires were conducted with the farmers who lived in these 4 villages. The questionnaire was carried out in March and April 2016.

The findings that were obtained in the study are presented in the study in tables after calculating the percentages. The 5-Point Likert Scale was employed in designing the questions on the judgments of the farmers, and the average scores were calculated.

Results and discussion

Information on the enterprises and farmers who participated in the questionnaire are given in *Table 3*.

Table 3. *Some information on the farmers and enterprises that were included in the study*

Average age	46
Average income (\$)	1,020.21
Number of individuals of the enterprise family (persons)	6
Educational status	
Literate	2.22
Primary School	12.22
Secondary School	31.11
High School	48.89
College, faculty	5.56
Income sources of the enterprise (%)	
Agriculture	76.67
Free	20.00
Paid public employee	2.22
Pension	1.11
Distribution of agricultural fields according to possession status (da)	
Property field	87.62
Partnership	12.22
Rented	84.99
Crops cultivated (%)	
Dry onion	31.11
Sugar Beet	26.67
Wheat	16.67
Corn	10.00
Potatoes	10.00
Barley	5.56

The average age of the farmers who participated in the study was 46. It was observed that farmers were mostly secondary graduates (31.11%), and high school graduates (48.89%). The income level of the farmers was determined to be 1020,21 \$. A total of 77% of the income sources of the enterprises that were included in the study came from agriculture, and 20% from free trade; and 88% of the farmers had property lands. In addition, they were also tenants at a rate of 85%. When the products that were grown in the enterprises were examined, it was seen that dry onion was grown at the highest rate with a rate of 31.11%, followed by sugar beet (26.67%) and wheat (16.67%).

The farmers were asked if they had heard the name “thermal power plant” before. It was determined that approximately 96% of the farmers knew thermal power plants (Table 4). Especially in recent years, they had intense discussions about thermal power plants. Despite this, 4% of the farmers stated that they did not hear the name “thermal power plant” before.

Table 4. Had the farmers heard of the name “thermal power plant” before?

	Rate (%)
Yes	95.56
No	4.44
Total	100.00

The farmers who had heard the name “thermal power plant” and who were considered to have information on thermal power plants were asked about the establishment of the thermal power plants in their region. The results on this are given in Table 5. A total of 42.53% of the farmers had the same idea, which argued that thermal power plants must be established in our country; however, the place selection must be done very well. The rate of the farmers who thought that the energy that had to be produced with other means was 30%. The rate of those who had no clear idea on this subject was 24%.

Table 5. Opinions of the farmers on establishing thermal power plants in our country

	Rate (%)
Establishing thermal power plants is compulsory, they must definitely be established	3.45
They must definitely be established, but place selection must be made more accurately	42.53
They must definitely not be established; other ways must be found to produce energy	29.89
I do not have a clear idea about this	24.14
Total	100.00

On the other hand, more than half of the farmers who participated in the questionnaire (51.72%) claimed that it was completely wrong to establish Thermal Power Plant in the region that was close to their living area where they performed their agricultural activities. The rate of the farmers who thought that the establishment of the power plant in the region was the right decision remained as 1%. The rate of the farmers who did not have any ideas on this subject was 24.14% (Table 6).

The farmers thought that the agricultural effects of the thermal power plant that would be established in the Suluova region were not considered fully, and the necessary

sensitivity was not considered (*Table 7*). As a matter of fact, the EIA process was terminated due to objections and the lack of the opinions of the relevant institutions.

Table 6. *Opinions of the farmers on the thermal power plant that was intended to be established in Suluova*

	Rate (%)
The establishment of the power plant in the region is suitable, this is a righteous decision	1.15
This could not have been established in this region, but this is not a very wrong decision	22.99
The power plant must definitely not be established in this region, this is a completely wrong decision	51.72
I have no idea	24.14
Total	100.00

Table 7. *The opinions of the farmers on the sensitivity in place selection of the thermal power plant that was intended to be established in Suluova*

	Rate (%)
Yes, the place selection was very sensitive	3.45
No, the place selection was not very sensitive at all	59.77
I do not have any idea	36.78
Total	100.00

The opinions of the farmers on the negative impacts of the thermal power plant were examined and scored with a 5-point Likert scale. The farmers were asked to respond to the questions on the negative impacts as “very high-5”; “high-4”; “moderate-3”; “very low-2”; “none-1”. The average scores were calculated by considering the answers of each farmer according to the score next to each answer. In this way, the common decisions of all the farmers who participated in the questionnaire were determined. The findings on this subject are given in *Table 8*.

Table 8. *The opinions of the farmers on negative effects of the thermal power plant on their villages (%)*

Negative effects on...	Very high (5)	High (4)	Moderate (3)	Very low (2)	None (1)	Ave. score
the human health	45.35	44.19	6.98	3.49	0.00	4.31
the natural vegetation	27.91	47.67	19.77	3.49	1.16	3.98
the other creatures living in the region	36.05	44.19	15.12	3.49	1.16	4.10
the fertility of agricultural products	36.05	48.84	11.63	3.49	0.00	4.17
the quality of agricultural products	38.37	47.67	11.63	2.33	0.00	4.22
the image of the agricultural products	11.63	53.49	19.77	9.30	5.81	3.56
the air of the village	13.95	43.02	19.77	10.47	12.79	3.35
the environmental beauty of the village	17.44	44.19	24.42	11.63	2.33	3.63
the agricultural soils	32.56	48.84	13.95	2.33	2.33	4.07

As it may be seen in *Table 8*, the farmers thought that the thermal power plant will have negative impacts on human health, natural vegetation, the fertility of the agricultural

products, the quality and appearance of the agricultural products, the air and environmental beauty of the village and on agricultural lands at a high rate. As a matter of fact, in many previous studies, it was stated that the environmental pollution elements that stemmed from the thermal power plant were air, soil and water pollution (Goncaoglu et al., 2000). In one of the studies conducted on Afşin-Elbistan Thermal Power Plant, the effects of the ash caused by the power plant on the agricultural fields were examined, and it was determined that this caused the accumulation of heavy metals in the plants (Kahraman, 2011). It was determined that toxic dusts that contained CO₂, NO and SO₂ in the composition of the emissions coming from Afsin-Elbistan Thermal Power Plant chimneys caused burns in the leaves of the plants, and in this way, the leaves dried and eventually the trees dried (Özcan et al., 2014). Again, many researchers found that the emissions coming from thermal power plants had high heavy metal contents in the dominant wind directions, and that pollutant gases like Sulfur Dioxide (SO₂), Carbon Dioxide (CO₂) and Nitrogen Oxide (NO_x) had negative impacts on some tree species (Aydemir, 2008; Karaca et al., 2007; Deniz, 2010).

In the present study, the judgments of the farmers were determined with more detailed questions depending on the features and negative effects of thermal power plants. The findings on this subject are given in *Table 9*.

Table 9. Judgments of the farmers on the characteristics of the thermal power plants (%)

Thermal power plants	I definitely agree (5)	I agree (4)	I do not have any idea (3)	I do not agree (2)	I definitely do not agree (1)	Ave. score
...may cause various diseases depending on the fuel types used in them	55.81	40.70	0.00	2.33	1.16	4.48
...may cause acid rains	26.74	40.70	26.74	4.65	1.16	3.87
The air pollution caused by thermal power plants damage the living that inhale this air	47.67	46.51	2.33	2.33	1.16	4.37
...damage forests	27.91	59.30	8.14	3.49	1.16	4.09
...the gasses produced slows down the development of the vegetation	29.07	51.16	16.28	3.49	0.00	4.06
...damages the agricultural fields	39.53	50.00	8.14	2.33	0.00	4.27
...causes soil pollution	47.67	41.86	8.14	2.33	0.00	4.35
...causes desertification	47.67	41.86	8.14	2.33	0.00	4.35
...causes drops in the yield of agricultural production	53.49	36.05	6.98	3.49	0.00	4.40
...causes disruptions in the quality of the agricultural products	47.67	40.70	8.14	3.49	0.00	4.33
...the water used for cooling and cleaning threatens the existence of the water presence in the region	36.05	53.49	8.14	1.16	1.16	4.22
...pollutes the waters	26.74	48.84	15.12	6.98	2.33	3.91
...the damages are exaggerated	3.49	8.14	33.72	32.56	22.09	2.38
...the information on negative effects are malevolent	0.00	4.65	34.88	34.88	25.58	2.19
...these plants are necessary and beneficial for our country no matter where they are established	0.00	9.30	32.56	23.26	34.88	2.16
...they do not affect agricultural production very negatively in the region	0.00	6.98	26.74	20.93	45.35	1.95

The judgment to which the farmers highly agreed at a high rate (56%) was that various diseases emerged in humans depending on the fuels used in thermal power plants. In actual fact, the concern of the farmers on this subject was not unreasonable. Because in previous studies conducted in Turkey, it was determined that 20% of the health problems that could be attributed to exposure to particulate matter were caused by the burning of the coal in the thermal power plants (Gacal, 2017). The presence of gases SO₂, CO₂, NO_x in the waste gas that was released from coal thermal power plants may be taken in either by inhalation, directly or indirectly, through nutrients and water. It was stated that when people were exposed to an intense amount of these gases, the nervous system was affected, lung and respiratory problems were experienced, and cognitive development was affected negatively in children (Peden, 1997; Rusnak et al., 1997; Gacal, 2017). Secondly, the judgment to which the farmers highly agreed at a high rate (53%) was that the reason that these power plants caused loss of fertility in the products that were grown in the regions where thermal power plants were located. This was followed by the judgment that these plants caused soil pollution, soil desertification and product quality disorders with a participation rate of 47.67%. The farmers also approved “other” thermal power plant responses (average score: 1.95) that their thermal power plant would not have negative effects on agricultural production. In brief, the judgments of the farmers on the features of thermal power plants generally concentrated on damaging the soil, plants and human health. In many studies that were conducted on this subject support the judgments of farmers (Goncaoglu et al., 2000; Aydemir, 2008; Karaca et al., 2007; Deniz, 2010; Kahraman, 2011; Özcan et al., 2014).

Conclusion and recommendations

It was shown in many previous studies that thermal power plants caused air pollution, water pollution and soil pollution and these impurities had negative effects on the living and agricultural products. Of course, the fuel used in thermal power plants was considered to be mostly coal, and the resulting damage caused by the gases that were produced in this process.

In the present study, how the thermal power plants were perceived by farmers was investigated with the sample case of the Suluova Region where the power plant was planned to be established. In the study, the majority of the farmers stated that it was important to establish thermal power plants to meet the energy needs of the country; however, the place of the establishment for these thermal power plants must be selected better. On the other hand, the farmers were also very concerned about the negative impacts of the thermal power plants on human health, agricultural lands and products, the vegetation cover, and all other living things. For this reason, the farmers who participated in the study wanted to stop the establishment of the thermal power plant in question. As a matter of fact, following the questionnaire stage of our study, the EIA process of the thermal power plant, which was planned to be established in the region by Gürmin Enerji Madencilik Sanayi ve Tic. Inc., was terminated with the justification that there were several shortcomings. Although it changes every year, the share of the thermal power plants in electricity production of Turkey is about 70%. It seems that the dominance of the thermal power plants in producing electricity with domestic sources will continue for a long time in Turkey which is dependent to external sources in terms of energy raw material. In this sense, the benefits of the thermal power plants must also be brought to the forefront. Especially the benefits like using domestic coal, the fact that

coal may be transported to all areas for installation, the resulting steam and water allowing low-cost electricity production may be considered. In this sense, increasing the efficiency of the existing thermal power plants, minimizing the damage that is given to the environment, providing maximum occupational health and work safety, prioritizing the use of domestic coal and biomass instead of the imported ones, and ensuring the establishment of thermal power plants with environmentally-friendly technologies are important.

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