EVALUATION OF THE ENVIRONMENTAL IMPACTS OF RENEWABLE ENERGY SOURCED ELECTRIC PRODUCTION FOR THE PROVINCE OF SINOP/ TURKEY

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Abstract: This paper is a report on the findings of a study conducted on a graduate level virtual conference summer school course. Discourse analysis techniques were used to examine the resulting transcript of texts for evidence of a democratic discourse within a community of learners. Findings indicate that gender is not masked in the text driven discussions on the Internet. Distinctive discursive styles are often sex class linked. Like face to face or classroom contexts, status is accorded unequally within discourse communities. Participants are not equal and are not equally attended or responded to. Educators need to take a serious and wary approach to accepting claims of ensured democratic participation in computer mediated communication formatted classes.

Keywords: Sinop province, Electric energy production, Renewable energy sourced, Environmental impacts

1. Introduction

Demand for energy is increasing day by day in our country and worldwide due to many factors, such as population growth, industrialization, technological progress, more people live in the city (Mann and Teilmann, 2013). From the perspective of our country, our energy production from domestic sources cannot meet the energy that we consume (Yüksel, 2010). In order to get to the level of the industrialized countries in the development process of our country, the need to increase energy production and energy consumption compared to the current situation (Acaroğlu, 2013). In developed countries, there have been made investments at a great rate in renewable energy sources, to meet the energy demand of electricity production and to minimize the damage to the environment (Kenisarina et al. 2006). Adding essence and affordable, environment- friendly alternative energy sources to our energy production policy, it is an inevitable necessity to reduce our dependence foreign countries (Yüksel and Kaygusuz, 2011). In addition, national and international legal and statutory contracts are also supportive of this orientation (Anonim1, 2016). It makes attractive alternative energy sources that they are unlimited, renewable and not cause environmental pollution. As a result of these developments in the energy sector in our country, a large number of theoretical and practical studies have been made on environmentally friendly energy sources (Akdağ and Güler 2010). Wind energy is the energy source that in the focus of this studies (İlkiliç, 2012). Wind energy stands out in terms of more economical, easy installation and operation of power plants when compared with other forms of energy (Güler, 2009). Researchers have done a lot of work for the regions where they thought it was the wind potential in sub-issues such as, cost, environmental impacts and site selection (Özgener, 2010). In our country, with increase of the support in the wind energy field of, increasing numbers of new wind power plants have been established every day without huge installed power capacities. In Turkey, annual production capacity of wind energy is 11 552 GWh at the end of 2015. The installed capacity of wind power plants in operation by the end of the year 2015 4.503 MW (Anonim2, 2016).

In this study it was analyzed and evaluated of the possible environmental impact of a wind energy power generation system with taking into account recent data that may be established in Sinop.

2. Evaluating The Environmental Impact Of The Wind Energy Plant For Sinop City

2.1 Electric Energy Production and Consumption in Sinop

Altınkaya, First Energy, Boyabat, Erfelek and Ayancık HPP plants provide the electricity for Sinop. Installed capacity of these HPPs except for Altınkaya HPP is 543 MW. Annual electricity production of these plants is 872 GW (Anonim3, 2016). Electricity distribution in the region is executed by a privileged company called Yesilirmak Electricity Distribution Co. (YEDAS). As seen in Table 1, electricity energy consumption in Turkey is increasing every year.

Table 1. Electric Energy Consumption in Turkey (2010-2014) (Anonim4, 2016).

Year	Government	Industrial	Commercial	Household	Illumination	Other	Total (GWh)
2010	4,1	46,1	16,1	24,1	2,2	7,4	172.051
2011	3,9	47,3	16,4	23,8	2,1	6,5	186.100
2012	4,5	47,4	16,3	23,3	2,0	6,5	194.923
2013	4,1	47,1	18,9	22,7	1,9	5,3	198.045
2014	3,9	47,2	19,2	22,3	1,9	5,5	207.375

When Table 2 is examined, the consumption of electric energy in Sinop has been increasing every year as much as in Turkey general.

Table 2. Electric Energy Consumption in Sinop (2010-2014) (Anonim4, 2016).

Year	2010	2011	2012	2013	2014
Net Consumption (MWh)					
Household	106.853	119.894	127.491	128.209	136.943
Commercial and Public Services	65.414	71.266	73.438	78.980	94.977
Industrial	84.461	105.494	83.722	77.167	71.727
Agricultural Irrigation	605	1.293	1.269	1.732	1.894
Other	11.058	21.404	21.164	19.925	22.482
Total (MWh)	268.391	319.351	307.083	306.013	328.022
Number of Subscribers					
	133.231	135.808	140.564	144.845	149.699
Loss-Theft Rate (%)					
	14,9	11,1	9,7	8,4	7,5

The total number of subscribers was 154 225 in Sinop in 2015. The total power consumption was 339.499.562 kWh. Sold energy was 312.784.282 kWh (Anonim5, 2016). According to these data, theft-loss rate was 7.87% in Sinop.

2.2. Wind Energy in Sinop

Sinop is a city established in Mid- Black Sea region in north Anatolia at the narrowest part of Boztepe peninsula. Its location serves as a transition zone of between the West and the East of Black Sea region. The city is situated between 41.2 to 43.5 34.5 to 35.5 meridians and parallels. The city has a total border of 475 kilometers with 300 kilometers inland border and 175 kilometers marine border (Anonim6, 2016). Sinop is a city in the Central Black Sea Region with an average height of approximately 200 m. The height of the Küre Mountains, located behind the coast, is above 1500 meters. Seasonal temperature difference is not high in Sinop. The long term average temperature in the coastal towns of Sinop is 13-15◦C and 12◦-14◦C in the inland towns. Main wind direction is northwest (mistral) and the long term average wind speed is 3,5 m / sec. In inner parts, the dominant wind direction is west and the wind blows softer than the coastal winds with an average of 1.0m / s to 2.0 m / s . The population of Sinop is 204 133 (Anonim6, 2016). In Table 3, Sinop wind intensity and speed at a height of 50 meters have been shown. In addition, the total power capacity of the wind power plant that may be installed has been given. For an economic wind power plant (WPP) investment, a wind speed of 7 m / s or more is required. As seen in Table 3, dominant wind speed is between 6.8 and 7.5 m / s in Sinop; thus, it can be argued that it would be an economic investment

Table 3. Wind Power Plant Power Capacity that may be installed in Sinop (Anonim8, 2013).

50 m Wind Power (W/m^2)	50 m Wind Speed (m/s)	Total Area (km^2)	Total Power Capasity (MW)
300-400	6,8- 7,5	289,63	1.448.16
400-500	7,5- 8,1	8,59	42,96
500-600	8,1- 8,6	0,00	0,00
600-800	8,6-9,5	0,00	0,00
> 800	> 9,5	0,00	0,00
		298,22	1.491.12

2.3. Environmental Impact Assessment (EIA)

It is important to have an understanding of environmental issues in order to suggest solutions for these problems. Environmental impact assessment reports may suggest ideas on how to suggest solutions for environmental issues. These reports determine the possible positive and negative effects of environment-related plans and projects. EIA reports benefit from the studies on evaluation and supervision methods and measures to be taken so that environmental damage will be minimized (Anonim9, 2016). The power plants are used to produce electricity energy through energy conversion. In this conversion process, these power plants can have both positive and negative effects on environment. Wind power plants have positive aspects such as not polluting the air. Attention should be paid to location selection, field conditions, noise sequence, visual pollution and impacts on bird mortality in the wind power plants planning process.

2.3.1. Air Pollution Concerns

Industrialization, increasing number of motor vehicles, urban life and many other factors lead to increased air pollution. Moreover, in Turkey, coal-based thermal power plants operate on high sulphur brown coal. They are constructed via old-fashioned techniques. The absence of filter system or efficiency causes problematic sulphur dioxide (SO_2) emissions. These facilities are considered high level pollutants in power generation facilities category. Therefore, there are specific emission limit values decreed by environmental legislations (Yüksel and Sandalcı, 2011). In Table 4, the limit values by the International Air Quality Index have been given. This table is categorized according to airborne pollution levels in different colours. For example purple colour illustrates that there is a health emergency status and that this status is more likely to affect the entire population.

Air Quality Index (AQI) Values	Levels of Health Concern	Colors
When the AQI is in this range:	*..air quality conditions are:*	*...as symbolized by this color:*
0 to 50	Good	Green
51 to 100	Moderate	Yellow
101 to 150	Unhealthy for Sensitive Groups	Orange
151 to 200	Unhealthy	Red
201 to 300	Very Unhealthy	Purple
301 to 500	Hazardous	Maroon

Table 4. EPA (Environmental Protection Agency), International Air Quality Index (Anonim10, 2016).

Air Quality Index Levels of Health Concern	Numerical Value	Meaning
Good	0 to 50	Air quality is considered satisfactory, and air pollution poses little or no risk.
Moderate	51 to 100	Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution.
Unhealthy for Sensitive Groups	101 to 150	Members of sensitive groups may experience health effects. The general public is not likely to be affected.
Unhealthy	151 to 200	Everyone may begin to experience health effects; members of sensitive groups may experience more serious health effects.
Very Unhealthy	201 to 300	Health warnings of emergency conditions. The entire population is more likely to be affected.
Hazardous	301 to 500	Health alert: everyone may experience more serious health effects.

Table 4. EPA (Environmental Protection Agency), International Air Quality Index (Anonim10, 2016).

Air pollution reduces the quality of life by affecting human health directly or indirectly. There is an air quality monitoring station in the central town of Sinop. At the station, PM_{10}, $S0_2$, relative humidity, relative temperature, wind direction and speed, air pressure values are measured regularly. In Figure 1, airborne pollutants PM_{10} and SO_2 values from the previous year in Sinop are provided. Natural gas is not available in Sinop yet. Coal is used for heating. Therefore, air pollution in winter has usually been observed to increase due to coal use for heating.

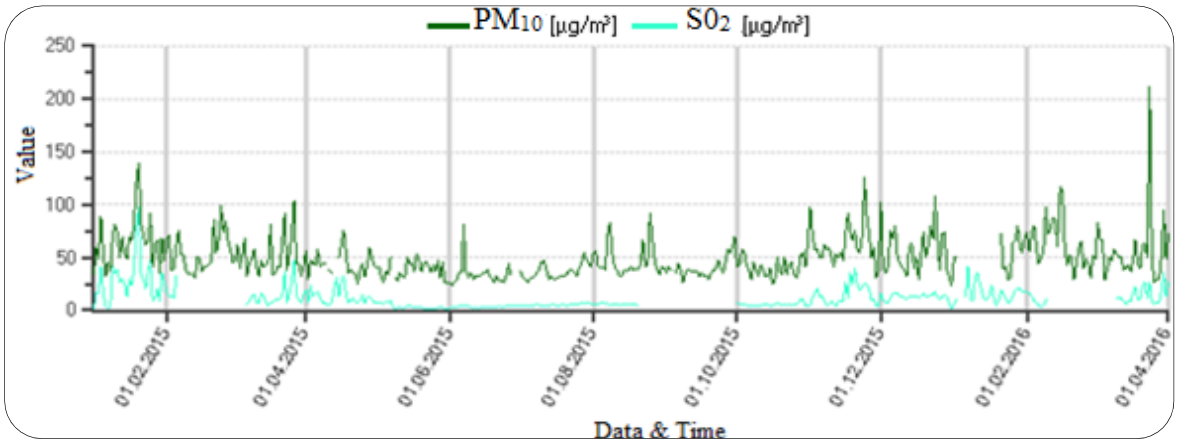

Figure 1. 2015 Air Quality Measurement Station Locations and Measured Parameters in Sinop (Anonim11, 2016).

Wind energy is one of the renewable energy sources and has a positive impact on the environment. Wind turbines are extremely important for reducing CO2 emissions. In table 5, it is shown that the harmful gas emissions into the atmosphere from wind energy production can be prevented by using 1 kW of energy.

Table 5. Prevention of emissions by 1kW wind power generation (Anonim11, 2016).

Emission Type	Quantity(gr)
Carbon dioxide (CO2)	0,7
Sulfur dioxide (SO2)	7,1
Nitrogen dioxide (NOx)	2,8
Carbon monoxide (CO2)	0,9

For example, wind power plant's contribution to the reduction of 1 MW carbon dioxide emissions has been calculated considering the wind data from Sinop province. As a result, it is seen that 1 MW Suzlon S64 / 1000 brand wind turbine produces 2,844,492.38614521 kWh of energy per year. Fossil fuels lead to an emission of 0.7 kg CO2 to produce 1 kWh energy. Therefore, using the above mentioned turbine, approximately 2.8 GWh energy may annually be produced and emission of 2000 tons of CO2 may be prevented. On the other hand, one acre (0.404 acres) forest (plant) clears 5 tons of CO2 from the atmosphere per year. Thus, generating energy with a 1 MW turbine, 400 acre forest (wooded with 152 000 trees) is equivalent with CO2 (2000 tons / 5 (tons / acre) = 400 acre = 162 acres) cleaning job (Özkaya et al.,2008, Özgener, 2002).

2.3.2 Noise Concerns

Noise is a major problem that results from unwanted sounds in their environment. Noise pollution is one of the environmental problems that are caused by factors such as development of technology, rapid population growth, unplanned urbanization and industrialization. There are different opinions about the noise from the wind power plants. Some argue that the quality of life in the city is affected adversely by wind turbines and it is disruptive for human health. Some others state that two types of wind turbine noise occur- mechanical noise and aerodynamic noise- and noise pollution is at a high level (Anicica et al., 2006). Many experimental and theoretical studies have been made in order to minimize the noise (Leea and Leeb 2016). According to the data, the noise level is 45 dB, 250 metres away from of a wind turbine. Insomnia is caused when the noise is beyond this level. Therefore, the distance between wind turbines and residential units should be arranged to be less than 500 m. In addition noise problems can be reduced significantly using insulation materials. Two locations in Sinop are suitable to install a wind power plant. These locations are outside the residential area. Thus, it can be argued that the wind turbine in the province of Sinop do not create a negative environmental impact in terms of noise level (Özkaya et al.,2008).

2.3.3. Bird mortality and Habitat Effects of Wind Turbines

In many countries around the world, projects and policies have been developed to rapidly increase the share of renewable energy sources in energy production in recent years. Wind power plants stand out among the renewable energy sources in the world with its increased production volumes with low costs, easy installation and operation (Dai et al., 2015, Dennis and Leung, 2012). However, the adverse environmental impact has been also increased together with the increase of electricity generation from wind energy. The disadvantages of wind turbines include impact on bird mortality and habitat (McDonald et al. 2009). In many countries around the world and in Turkey, various studies have been carried out in order to eliminate these problems (Larsen et al. 2007). In addition, some studies have been carried out to compare the impact on nature and bird mortality caused by wind energy production and fossil fuel energy production technologies (Sovacool, 2009).

In these studies have shown that the adverse impact on nature caused by wind energy production is significantly less than the adverse impact on nature caused by fossil fuel power plants. Sinop covers an area of 586 200 hectares. 37% of the 217 276 hectares of land is arable except meadows and pastures. Agriculture can be done on a total of 91 865 hectares of this area. The remaining 56% of non-agricultural areas are forested. 6% is settlement area and 1% is pastures and meadows. Available land for agriculture is rugged, very fragmented and 86 % of land is susceptible to water erosion (Anonim7, 2016). Sarıkum zone is located within the area of nature protection in Sinop. It is an area of 785 hectares, 20 kilometres from the city centre. Sarıkum Lake hosts various ecosystems and habitats. It is a convenient place for feeding and wintering for birds. RES map in Figure 2, there is also Sarıkum in areas cannot be established seen by grey colour. Short-term migration of various species of birds are seen every month.

7 m / s wind speed or over is required for an economic WPP investment. As can be seen in Table 3, dominant wind speed is between 6.8 to 7.5 in Sinop, WPP can be said to be an economic investment (Anonim8, 2013). When the wind speed at 50 m height and at the distribution of power are considered, the effect can be seen in the total number km^2 In the framework of this effect is shown in the total number of MW wind power plant can be built. As a result, the idea of wind power plant construction in Sinop is not been considered as a drawback in terms of bird mortality and agricultural areas.

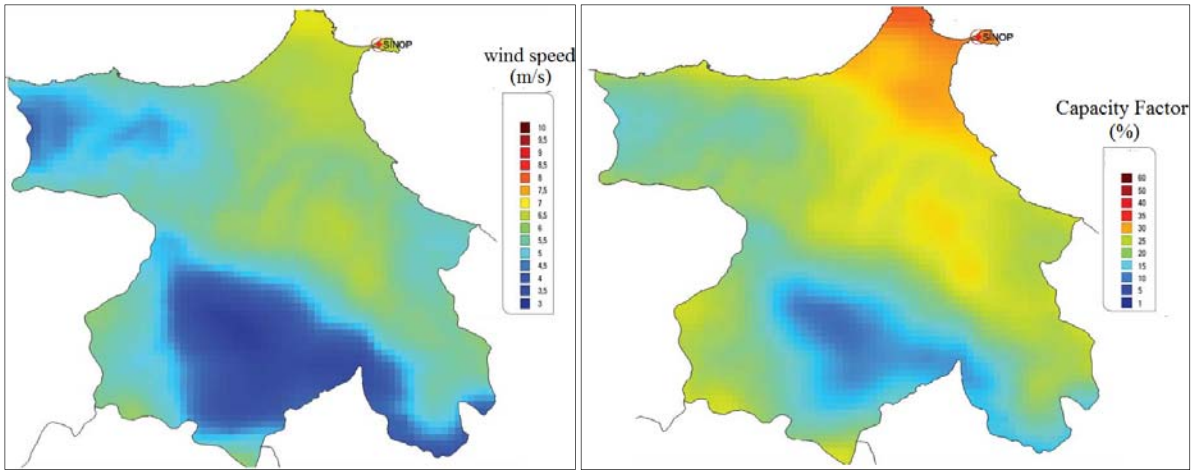

Figure 2. Sinop wind resource information.

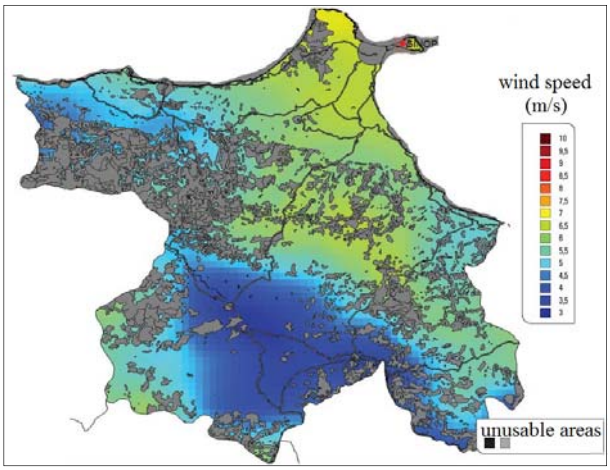

Figure 2. Sinop wind resource information.

Conclusions

Wind energy is a renewable alternative energy source that can meet growing energy needs in the world and in Turkey. Wind energy is indispensable, because it is an environmentally friendly and infinite source of energy that does not release emissions into the atmosphere.

Among the factors that are taken into account for a possible project of a wind power plant in Sinop environmental impact assessment; location selection, space requirements, air pollution, noise effect, impact of turbine presence or absence on habitat, bird migration routes and impact on the natural conservation areas can be listed. This study also provides an environmental impact evaluation for Sinop Province.

A wind speed of 7 m / s or over is required for an economic WPP investment. When the wind atlas prepared for the province of Sinop is examined, it can be assumed that the wind speed in Sinop is at a suitable level that can support an economic WPP investment. Today, any such investment has not been made yet. The region should benefit from this environmentally friendly and renewable energy sources as soon as possible.

Based on wind data from the province of Sinop, the construction of a possible 1 MW wind power plant will contribute 2.8 GWh per year to electricity production. Moreover, the wind power plant will help prevent approximately 2,000 tons of carbon dioxide emission per year.

In Sinop, air pollution is seen especially in winter due to absence of natural gas heating infrastructure and coal use for heating. In this regard, WPPs are promising because they don't cause air pollution.

The effect of the construction of a possible WPP on migratory birds should not be ignored. Therefore, taking into account WPP numbers of operations and migration time of birds at Sarıkum Lake, which is an important bird migration area in Sinop peninsula, will be helpful in preventing potential losses. It is expected that, if these studies done, harmful effects of WPPs on the environment will be eliminated.

Priority should be given to methods of electricity generation with renewable energy technologies as an alternative to nuclear and thermal power plants being considered to be established in Sinop.

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