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Investigation of origin plant and animal bioenergy capacity for Turkey

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ABSTRACT

The increasing need for energy day by day is directly proportional to the world population and the development of technology. Energy is among the indispensable for the sustainability of life and for this reason it has brought many problems to be solved. These; How can energy efficiency be achieved, what are the alternative energy options, the use of renewable energy sources and what are the environmental problems that may be caused by these. Accordingly, bioenergy has gained an important place among today's energy preferences; stands out with its energy efficiency, sustainability and environmentalist approach. Its total employment of nearly 11 billion worldwide is just one of its secondary advantages. However, considering the amount of plant and animal waste; Serious rates such as 96.451.594 tons / year (39.877.285 energy equivalent) of plant origin and 163.297.307 tons / year (1.176.198 energy equivalent) from animal sources stand out. All the studies mentioned, depending on the situation in Turkey bioenergy source of plant and animal origin, researched potential and has put forward proposals on the future.

Keywords: Bioenergy, Renewable Energy, Energy Efficiency

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1. Introduction

It is seen that the energy consumed in today's world is obtained from many different sources. Among these, fossil resources such as coal, natural gas and oil constitute 87% of all energy resources [1]. Facing the danger of depletion of fossil resources and environmental problems due to their excessive use, the search for alternative energy sources in countries has accelerated and changed the perspective of renewable energy.

Renewable energy refers to obtaining energy by using the current energy flow in natural processes that are constantly in operation. Therefore, the depletion of the resource is out of the question. It is possible to count titles such as biomass, hydroelectric, solar, wind, geothermal among the renewable energy types.

Biomass energy is one of the most popular energies of our age due to its advantages such as being renewable energy, being easily found in nature, having less harmful effects on the environment, being sustainable energy and reducing environmental damages by using materials that we can consider as waste.

Considering the developments in the field of alternative energy sources, the advances in fuels such as bioethanol and biodiesel are remarkable in the world. Unlike other energies, the fact that biofuel energy does not have a source to be cut off and is easy to store has recently made it even more popular. The fact that agricultural products are the raw material of biofuels makes the issue more important when we consider it in terms of producers and the agricultural sector. In addition, it degrades easily and rapidly in nature, does not cause toxic effects and does not increase the greenhouse effect [2]. All the studies mentioned, depending on the situation in Turkey bioenergy source of vegetable or animal origin, researched potential and has tried to put forward proposals on the future.

1.1. Biomass

Biomass is the name of non-fossil organic materials, although of biological origin. Biomass energy is produced by biological, chemical and physical reactions different from animal and agricultural origin products in nature, has commercial characteristics and is standardized in certain frameworks; are vegetable energy sources in gas,

liquid or solid form [3]. Biomass energy sources in liquid form; biofuels are bioethanol and biodiesel. For these resources, oils obtained from oilseed plants such as hemp, coconut, soy, rapeseed (canola), sunflower, safflower, animal oils and waste oils from domestic use are used and as a result of their reaction with a short chain alcohol with a catalyst and products that can be used are obtained. Biodiesel is obtained by using these products instead of fossil-based diesel fuel or by mixing and using a certain proportion of diesel fuel. On the other hand, bioethanol is formed by mixing them with a certain amount of gasoline.

In the last century, the rate of energy consumption in the world has increased approximately seventeen times, and accordingly, one of the efforts to meet this situation was in the field of biomass. The fact that it is the focus of attention day by day due to its many advantages, has made biomass energy the 4th largest energy source in the world. Bioenergy, which is among the energy resources of the future; With 16% in Sweden and 13% in Austria, it has an important percentage among the general energy rates [4].

1.2. Biomass energy resources

Biomass energy is a type of energy obtained by passing biomass through different biological, chemical and physical methods. It is possible to consider the biomass resources used in the production of this energy under four headings. These are as follows [5]:

- Urban wastes and industrial raw material wastes used for industrial purposes and food purposes,
- Starchy plants, sugary plants, oilseed plants and animal wastes produced in agriculture,
- Wood industry residues and forest residues from herbaceous and woody plants,
- They are reed plants, sea grasses, algae and some micro-organisms that have a high moisture and growth rate in lakes and seas.

Biomass resources are also grouped as modern and classical. Classical biomass resources consist of wood obtained from forests, animal and plant residues used as fuel. Modern biomass resources consist of urban waste, animal waste, forest and wood industry waste, energy forestry [6], [7]. The distribution of our installed power by resources as of the end of September 2019; 31.4 percent hydraulic energy, 28.6 percent natural gas, 22.4 percent coal, 8.1 percent wind, 6.2 percent solar, 1.6 percent geothermal and 1.7 percent is in the form of other sources [8].

2. Biomass in Turkey

Most of the countries in the world and especially developed countries are trying to increase their renewable energy sources. Therefore, support and incentive programs are determined by laws. Recently, the use of renewable energy resources has increased significantly. Especially biodiesel is developing rapidly in the world. Biofuels have influenced the developments related to Turkey, and in this regard particularly biodiesel- work has accelerated. Foreign dependency in energy supply, which was 51.6 percent in 1990 and 67.2 percent in 2002, increased to 72.4 percent in 2018. Turkey's rapidly increasing energy import bill of $ 43 billion in 2018, was 41.6 billion dollars in 2019 [9]. Turkey is dependent on foreign energy is threatening the energy security and reducing the threat in terms of the future of the country is of vital importance. Especially, it is a great opportunity to produce biodiesel from oil seed raw materials such as canola and safflower and that our country has a high potential in this regard [10].

Biodiesel is relevant for the first time in 1970 after the oil crisis in Turkey has been the subject of scientific studies have been undertaken, a contribution could be obtained. However, the sector, which gained momentum in 2000, encouraged entrepreneurs in biodiesel. Biodiesel first time in Turkey 5015 "Petroleum Market Law" scope expressed as blended petroleum products, legal arrangements have been made in terms of the use of diesel mixed. However, biodiesel enterprises that increased rapidly caused an unfair competition and an SCT (Special Consumption Tax) was applied to biodiesel. With this application, the sector has come to a standstill in the following times. In order to revitalize the sector, mixing 2% biodiesel into a mixture of diesel and biodiesel compared to diesel is excluded from SCT. EMRA (Energy Market Regulatory Authority) obliged on 29 September 2011 to blend the biodiesel obtained from domestic agricultural products by 1% in 2014, 2% in 2015 and 3% in 2016 in order to keep the sector alive and to meet the energy needs in the country from internal resources. However, this regulation was abolished on June 25, 2013, before its implementation. The developments failed to meet the expectations in the biodiesel sector and once again demonstrated the need for new legal regulations [10].

Among the renewable energy sources, biomass energy stands out with its technical potential size and different advantages. Biomass energy is a clean, continuously renewable type of energy that is not dependent on climatic conditions. When looking at life cycle analysis in biomass energy sources, it is seen that CO_2 emission is neutral. Therefore, it is a correct step to evaluate biomass energy with the responsibilities of being a party to the Kyoto convention. However, the utilization of biomass energy resources may contribute to creating a workforce in the region where they are located. From this point of view, the 2018 employment potential created by the world's renewable energy sector reveals the issue strikingly (Table 1) [11]. In addition, biomass energy to be utilized at its source will not sustain the leakage and losses related to distribution and transmission.

Table 1. Renewable energy sector employment in the world

SUB-SECTOR / REGION	WORLD	CHINA	BRAZIL	USA	INDIA	EUROPEAN UNION
SOLAR PV	3.605.000	2.194.000	15.600	225.000	115.000	96.000
LIQUID BIOFUEL	2.063.000	51.000	832.000	311.000	35.000	208.000
HYDROELECTRIC	2.054.000	308.000	203.000	66.500	347.000	74.000
WIND	1.160.000	510.000	34.000	114.000	58.000	314.000
SUN (THERMAL)	801.000	670.000	41.000	12.000	20.700	24.000
SOLID BIOMASS	787.000	186.000		79.000	58.000	387.000
BIOGAS	334.000	145.000		7.000	85.000	67.000
GEOTHERMAL ENERGY	94.000	2.500		35.000		23.000
FOCUSED SUN T.	34.000	11.000		5.000		5.000
TOTAL (person)	**10.983.000**	**4.078.000**	**1.125.000**	**855.000**	**719.000**	**1.235.000**

That Turkey is unable to provide the energy requirements and fossil resources it can be seen that come attached to the outer case of fossil fuels in primary energy consumption in the coming year, it will spearhead know if Turkey could not remain still enough to meet it. Therefore, Turkey's use of renewable energy resources with nature superiority of its geographical location, it is necessary to increase diversity in the development, production and technical potential. Starting from this direction, if Turkey will look to the annual biomass resources and potential (Table 2) arises following cases [12].

Table 2. Annual Turkey's biomass resources and potential

Biomass resources		**Amount of waste (tons / year)**	**Energy equivalent (tep / year)**
Herbal Biomass	Oilseed plants (canola, sunflower, soybean, etc.)	96.451.594	39.877.285
	Sugar and starch crops (potato, wheat, corn, sugar beet, etc.)		
	Fiber crops (flax, hemp, sorghum, etc.)		
	Protein crops (peas, beans, etc.)		
	Vegetable and agricultural wastes (branches, stalks, straw, roots, bark, etc.)		
Forest Biomass	Wood and forest waste (energy forests and energy crops, various trees)	4.800.000	859.899
Animal Biomass	Wastes from cattle, horses, sheep and chickens, slaughterhouse wastes and animal products processing	163.297.307	1.176.198
Urban Waste	Sewage and bottom sludge, paper, industrial and food industry wastes, industrial and domestic wastewater, municipal and large industrial facilities wastes	31.331.836	2.315.414
TOTAL		**295.880.737**	**44.228.796**

2.1. Turkey's annual biomass energy potential and values

Turkey's annual biomass potential value and the percentage distribution in energy (Figure 1) when examined 46% of annual crops from potential maintenance, energy values can be seen that the highest proportion of condensed 47% maintenance. After the annual crops, forest waste with 17% energy value and 15% annual potential; Annual crops are ranked with 14% energy value and 13% annual potential. Agricultural industry wastes have an energy value and potential of 9% [13].

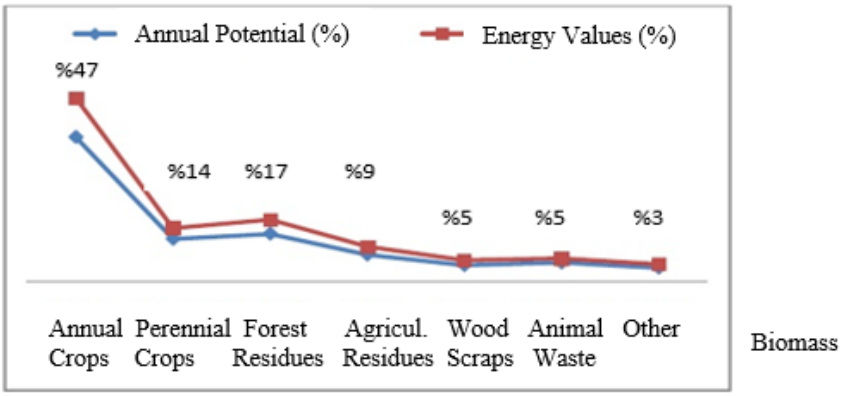

Figure 1. Annual Turkey energy and biomass potential value ratio (%)

2.2. Turkey's potential biomass products and energy values

Considering the energy distribution and potentials of our country's biomass products in terms of percentage within the scope of annual crop, forest waste and perennial crop (Figure 2); It can be seen that the energy value of wheat stalk, which has a 66% annual production potential, is 10.1 BTEP (One Thousand Ton Equivalent Oil) [14]. Wheat production is done in every region in Turkey. It ranks first among field crops in terms of production amount and cultivated area. Therefore, it is possible to obtain energy from wheat stalk. After wheat stalk, woody materials and wood rank second, with 30% of annual production. On the other hand, there are 5,358 BTEP energy values.

Assessing the sustainable management of forest ecosystems function according to today's contemporary usage in Turkey is required. Considering the distribution of forest areas in total by geographical regions, a table appears as follows: South East Anatolia Region 6%, Eastern Anatolia Region 8%, Central Anatolia Region 11%, Marmara Region 14%, Aegean Region 18%, Mediterranean Region 19%, Black Sea Region 24% [15]. In the Aegean, Mediterranean, Black Sea and Marmara where energy consumption takes place intensely, it is possible to use the high thermal values of forest residues in environmentally efficient and efficient facilities and in modern energy production.

The share of annual total potential in producing hazelnuts and cones is 4% and the total energy values are 0.63 BTEP. Generating energy from cones can also be evaluated with forest potential. 60.2% of the hazelnut plantation area on the eastern Black Sea in Turkey. Hazelnut shell; Its high calorific value of 19.2 MJ / kg is considered to be an annual estimate of 3.5x105 tons among its energy resource potentials, and it is a resource that can be utilized in the Black Sea in terms of modern energy production [14].

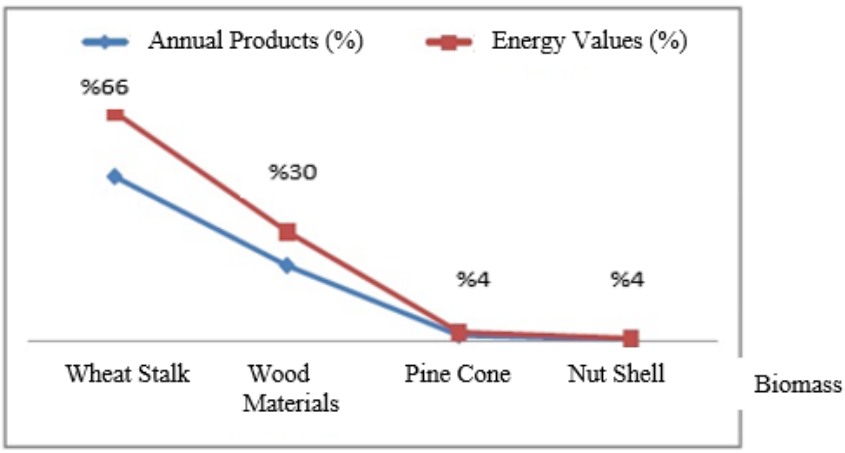

Figure 2. Turkey's potential annual biomass products and energy values (%)

2.3. Resource distribution of forest potential

Basic biomass products in potential and annual biomass potential of the frequency distribution (Figure 3) after the wheat straw, the most prominent alternative biomass sources woody material in position and wood for Turkey finds place within the forest potential. Considering the resource distribution of forest potential, it can be seen that high-yield forests are 13 times higher than low-yield forests [14]. Woodland has a large share in high-yielding and low-yielding forests. It is possible to obtain gas, liquid and solid products equivalent to alternative fuels to be used in energy forestry from non-wood forest residues and wood in wooded areas. In addition, this potential should be utilized in the region for cooling, heating and electricity in trigeneration and cogeneration systems in a way to meet the requirements in the region without loss and leakage [13].

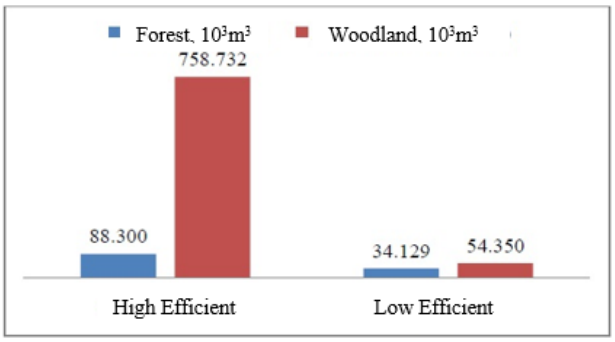

Figure 3. Resource distribution of forest potential

2.4. Agricultural waste and energy potentials

Among agricultural wastes and energy potentials (Figure 4), wheat stalk occupies the largest place in annual production with 49%. Next comes barley stalk with 25%, corn cob with 8%, cotton cone shell and sunflower husk with 5%, sugar beet waste with 4%, oat stalk and hazelnut shell with 1%. geographically distribution of the cultivated agro-industrial field in Turkey (Figure 5) achieved a Southeastern and Marmara are primarily [13]. The same percentage of agricultural residues in terms of percentage ratio of the size of the total area of agricultural land will be possible to say that Turkey and they will be an important resource in terms of biomass.

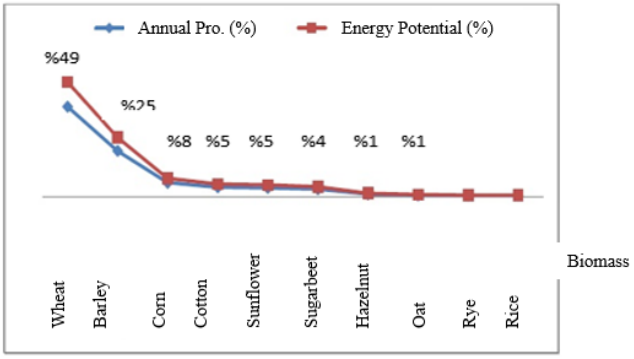

Figure 4. Turkey's Annual agricultural waste generation and energy potential ratios (%)

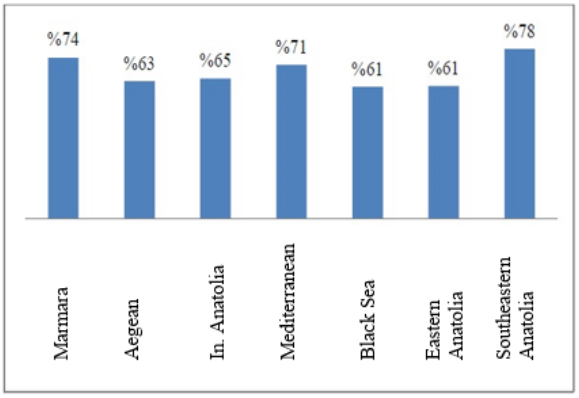

Figure 5. Percentage distribution of planted area of cereals and other crops in the total area (%)

2.5. Traditional and planned modern biomass energy generation

Turkey in years planned energy sources based on biomass modern techniques and traditional way power generation projection values (Table 3) the intended values was examined only seen to be achieved is satisfied transformation that best potential supra. Within the scope of this purpose, in order to evaluate the potential in accordance with the development of the region and to make possible biomass potential applications widespread, relevant scientific studies should be supported and appropriate actions should be determined [14].

Table 3. Conventional and planned modern biomass energy production

Year	Traditional Biomass (MTEP)	Modern Biomass (MTEP)	Total (MTEP)
1999	7,012	0,005	7,017
2000	6,956	0,017	6,982
2005	6,494	0,766	7,260
2010	5,754	1,660	7,414
2015	4,790	2,530	7,320
2020	4,000	3,520	7,520
2025	3,345	4,465	7,810
2030	3,310	4,895	8,205

2.6. Animal potential in biogas production

In addition to forestry and agricultural products, waste from turkey, chicken, ovine and bovine animals is also suitable for biogas. These animal wastes also need to be evaluated in line with regional production values (Table 4) [15].

Table 4. Regional distribution of animal species in biogas production

REGION NAME	Beef (pieces)	Sheep-Goat (pieces)	Poultry (pieces)
Aegean	175.309	3.425.713	45.541.311
Mediterranean	96.094	2.876.176	11.832.090
Southeastern Anatolia	463.264	5.307.449	3.504.968
Marmara Region	155.533	3.156.199	162.645.154
Central Anatolia Region	355.751	4.788.428	27.192.890
Black Sea region	726.198	1.550.279	12.690.660
Eastern Anatolia Region	1.345.027	10.644.407	10.141.416

The geographical distribution of the total quantity of animal species is suitable for biogas production examined (Figure 6) shows where Turkey herein Marmara portion of 54%. Electricity consumption in industrial enterprises in Marmara constitutes 45% of the industrial enterprises in the country [15].

In Marmara, where the industry is most developed, if animal wastes are used to meet this energy requirement, the energy requirement in the region will be met significantly [13].

In addition to animal wastes, energy can be generated from domestic wastes stored within the framework of regular storage standards. Its capacity reached 40.12 MW installed power in April 2009. On the other hand, the amount of solid wastes collected according to the municipal solid waste basic indicators in 2006 is 25.280 thousand tons. Only 9.428 thousand tons of these could be taken to regular storage. However, there are 22 units in Turkey landfill capacity is 376 974 thousand tons in 2006 [13].

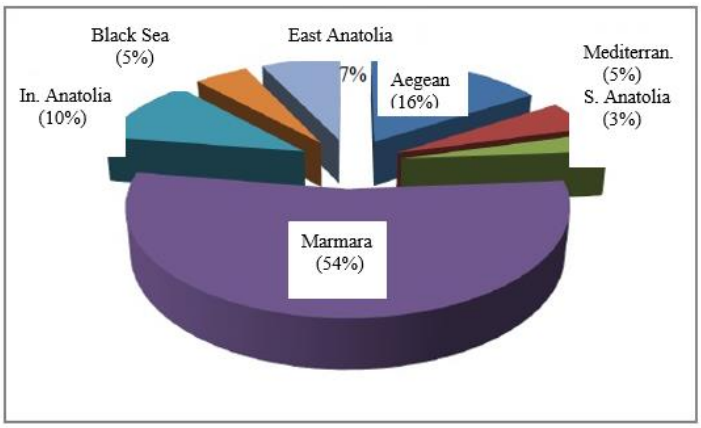

Figure 6. Geographical distribution of the number of animals suitable for biogas production (%)

3. Conclusion

Suitability posed to Turkey's bioenergy concerned, the reliance on fossil fuels and as much as possible to reduce the damage to the environment, ensuring development in biomass technologies in the world to achieve competitiveness, thousands of providing new job opportunities for people and many main target serving bioenergy such as the enrichment of the economy subject has great importance and future for our country. Its total employment of nearly 11 billion worldwide is just one of its secondary advantages. However, considering the amount of plant and animal waste; Serious rates such as 96,451,594 tons / year (39,877,285 energy equivalent) of plant origin and 163,297,307 tons / year (1,176,198 energy equivalent) from animal sources stand out. Therefore, it is essential to preserve its place among the important dynamics of our country.

In the past, the impact of energy consumption on the environment was not taken into account, and the energy policy was based on the objectives of ensuring and maintaining economic growth. Today, it has become mandatory to consider the environmental impact of the use of each resource in the selection of energy resources as well as for economic purposes. A holistic approach is required to increase the use of bioenergy. With the Electricity Energy Market and Supply Security Strategy Document dated 18 May 2009, it is aimed to reach a 30% share of renewable resources in electricity generation by 2023. However, there is no specific goal to generate electricity from bioenergy sources. This deficiency must be corrected. Likewise, there is no specific target for the use of biofuels in transportation. The intended use of biofuels in transportation until a certain date should be determined and explained together with intermediate targets. Turkey to boost investment, also need a practical and transparent support system. The boundaries of the purchase guarantee to be given to each renewable energy source should be drawn. It is possible to do this by determining the share of each resource within the expenditure to be made for renewable energy resources or by determining the upper limits of the total expenditure to be made for each resource. These practices are necessary in order not to complete the support programs as in many OECD (Organization for Economic Development and Cooperation) member countries, as the money allocated for the promotion of renewable resources ends immediately. Support systems need to show investors their way forward and be flexible.

That does not cause ecological damage biomass detailed studies need to be done as soon as possible on issues such as the production and use of energy, it is of vital importance for Turkey's future. The use of biofuels must be supported and programmed in a way that does not affect the domestic feed and food needs. Environmental protection is accepted as the basic principle, biodegradable wastes should be evaluated within the scope of biomass energy and an effective waste management should be provided. Environmental problems, health and safety threats created by these wastes will thus be prevented. such as energy production sector in developed countries should be directed at evaluating the potential of biomass in Turkey. The availability of biomass energy resources in industrial establishments with auto producer licenses should be evaluated in their current cogeneration facilities. In summary, the planned and systematic working methods for the future and the clear determination of time-dependent goals will bring the most important gains.

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