Bioenergy Studies 2(2), 43-52
http://doi.org/10.51606/bes.2022.10

PROOF
REVIEW PAPER

BIOENERGY STUDIES

Generating Economic Value from City Waste and Marketing of Biomass

Abdullah Eravcı[1]*

[1] Sinop University, Boyabat Vocational Higher School, Department of Wholesale and Retail, Boyabat, Sinop, Türkiye

Article History
Received 21 June 2022
Accepted 02 November 2022
First Online 29 December 2022

Corresponding Author
E-mail: aeravci@sinop.edu.tr

Keywords
City marketing
Biomass
Bioenergy
City waste

Abstract

Today, the need for energy is increasing day by day and mankind is turning to bioenergy sources. City waste is a source of bioenergy and these wastes are not adequately marketed. The conversion of city waste into energy and marketing as biomass will contribute to keeping cities clean as a habitat. The emission standards of large cities reach dangerous levels for human health. Aware of this situation, cities are building facilities such as waste processing and waste gas. While generating energy from wastes, it is ensured that the city remains clean, and on the other hand, it contributes to meeting the energy needs of human beings. This study focuses on the conversion of city waste into energy and marketing as a source of bioenergy. Cities need to grow decently, contribute to employment and evaluate waste in the name of employment and economy for sustainable city. Bioenergy sources are increasingly important and biomass trade is being carried out that exceeds the borders of the city and country. Biomass trading is also an opportunity to evaluate vegetable wastes that have not yet gained economic value in and around the city. In this study, the literature has been examined and observations related to city wastes in Sinop province and its districts and vegetable wastes in Gökırmak and Kızılırmak deposits are included. The findings show that more research and studies should be done on bioenergy resources and that urban waste should be evaluated and marketed among biomass resources. In addition, it is suggested to dispose of plant wastes in urban areas by burning and to evaluate them as biomass instead of causing pollution in living areas.

Introduction

Bioenergy is a type of energy that is defined as biomass and obtained from organic materials based on plant, animal and forest products and requires the use of technology. Availability of resource diversity, adoption as an environmentally friendly and reliable type of energy; The fact that it is suitable for heating, motor fuel and power generation increases the interest in this type of energy (Üstün & Genç, 2015: 157). In the studies carried out in the context of urban wastes and biomass resources, it is understood that very important biomass resources ignored or are unconsciously disposed of. The driving force in bioenergy studies is marketing-oriented entrepreneurs. According to Drucker, entrepreneurship has two main functions as marketing and innovation (Wei et al., 2014). Marketing and sales organization is also necessary for energy

services (Kindström et al., 2017). As in other products, marketing and entrepreneurs have a driving role for businesses in bioenergy studies. With the assumption that it can be a pioneer for entrepreneurs, urban wastes, biomass and bioenergy marketing are discussed in this study.

Our lifestyle and consumption habits do not seem sustainable in terms of energy resources in the long run (Eichout, 2012). Each country has its own biomass resources as long as there is sun and the plant grows (Karayılmazlar et al., 2011). Today, biomass source is demanded as a sustainable and clean energy source. As long as there is source and demand, there is an energy market. The use of biomass resources on a European scale is described as a solution to reduce foreign dependency in electricity generation, heating/cooling, meeting the fuel needed for transportation, establishing new business lines and regional development (Carneiro & Ferreira, 2012).

Considering future generations in energy, it is necessary to control the energy market by converting urban wastes and biomass resources into energy according to the current and future supply-demand balance. The market has social and economic dimensions through its production and sales philosophy (Doğar & Tunçez, 2021). Due to its social and economic dimensions, the idea that urban wastes have an energy value and that biomass resources should be converted into energy is a fact that is valued and supported by many developed countries (Sergey et al., 2017). Countries are in an effort to increase their energy resources, to search for alternative energy resources and to use potential energy resources and to control prices (Rashidi et al., 2022). Countries such as Austria, Germany and Sweden have established a market dominance in their regions for using biomass energy and have opened up to pellet markets outside Europe (IRENA, 2019). In Turkey, it causes economic losses due to the direct use of solid biomass resources from which the pellet is produced as wood without processing. Other biomass sources, including urban waste, are mostly released into nature or disposed of without being converted to bioenergy.

Although it is more difficult to convert urban wastes and biomass resources into energy than fossil fuels, we need these resources for sustainability. When the transformation of biomass energy sources into bioenergy is analyzed with a marketing-oriented approach, three main market instruments emerge. The first is biomass resources and the bioenergy market. The second is the technology market needed for the processing of biomass resources. The third is the market formed by the agricultural culture of biomass resources. When the literature is examined, it is understood that biomass energy is a common subject of different disciplines such as marketers, energy experts, physicists, mechanical engineers and agriculturalists (Ruamsook & Thomchick, 2014).

In this study, attention is drawn to urban waste and the above marketing tools are focused on bringing biomass resources to the market. The Covid-19 pandemic, which has been experienced since December 2019, and then the Russia-Ukraine war that started in February 2022 has revealed the importance of renewable and sustainable energy sources (Yana et al., 2022). Countries have increased their efforts to produce renewable bioenergy sources from biomass and to meet their own needs in order to reduce foreign dependency. Cities as biomass resources and living spaces seem to be intertwined and affect each other.

Scope and Information Collection

The study covers biomass marketing and the bioenergy side of urban waste. Urban wastes refer to organic wastes such as food, fruits, vegetables, garden lawns and wood chip wastes, which are seen as bioenergy sources. Biomass marketing focuses on biomass resources and the bioenergy market and the market formed in the processes of transformation to bioenergy.

Research articles, review studies, TÜİK and Sinop Provincial Directorate of Environment and Urbanization data were used as materials. Academic studies were used as literature to create the background and conceptual framework of the research. The data on the relevant web pages for urban wastes and agricultural wastes were consulted. Information was received by phone from Sinop University Faculty of Fisheries on macro and micro algae from biomass sources and from 19 Mayıs University, Faculty of Agriculture academicians on agricultural wastes.

Municipal Waste

Urban wastes have an important place among the total biomass resources for countries. According to a study conducted in Mississippi, the share of urban waste in biomass resources was calculated as 7%. In the calculations and studies, significant bioenergy gains have been obtained through municipal and non-municipal solid wastes, landfills and land application facilities (Prez-Verdin et al., 2009). The vast majority of urban waste is disposed of by being transported directly to landfills.

According to the information collected from the municipalities of the Turkish Statistical Institute (TÜİK) on urban wastes, household waste is 28 million 633 thousand tons for 2020 (TÜİK, 2021). This figure does not include biomass such as manufacturing industry, organized industrial zone wastes and other wastes, landscape wastes, vineyard, garden and chip wastes. According to the data of Sinop Provincial Directorate of Environment and Urbanization, the amount of waste in Sinop province and districts is 32 thousand tons for 2019. It is understood that wastes that can be a source

of biomass such as National Parks wastes and landscape wastes are included in the specified wastes (Sinop Province 2019 Annual Environmental Situation Report, 2020). According to the report, 44% of the waste consists of organic, 8% paper and cardboard, and 10% park and garden waste. In the research conducted by Doğar and Tunçez (2021), food and plant wastes worldwide are seen as 44% as in Sinop scale. The information given in the research shows that tree and grass wastes can be accepted as 4% in the city.

Apart from urban wastes, agricultural wastes, animal and forest wastes have a remarkable place in Sinop province and districts. Sinop is the leader in paddy production in the Black Sea Region with Samsun and Çorum provinces (UHK, 2011). According to the National Grain Council (UHK) data of 2010, the paddy produced throughout Sinop province is around 19 thousand tons. According to 2021 data, it is 32 thousand tons. According to the research conducted over the phone, half of the paddy produced is formed by paddy stalks. This stalk is destroyed by burning throughout Turkey. Since the paddy harvest is delayed to the autumn months, there is no temperature at which microorganisms that will rot the stem can grow and the winter season begins. For this reason, the agricultural producer finds the only solution in destroying his stalks by burning them. According to UHK, the solution is to add a stalk chopper to the harvesters and lay the ground stalk in the field. However, this requires additional expenses and the producer does not want to make this expense (UHK, 2011).

Biomass and Bioenergy Market

The concepts of biomass and bioenergy are interrelated concepts. Biomass; Apart from fossil fuels, they are organic substances of biological origin, including animal and vegetable (Sisman-Aydın, 2019). It is the only group of organic chemicals that can produce liquid fuel. Thanks to its energy density, it is accepted as an alternative fuel. (Zheng et al., 2022). Due to the continuous increase in energy costs in terms of competitive markets and in terms of the supply system, it is an easily available and renewable energy source (Ness & Moghtaderi, 2007). The continuous depletion of fossil fuels and the environmental pollution created in the process of their conversion to energy highlight biomass resources.

The bioenergy is the converted form of biomass for consumption. In the production of biofuels such as biodiesel, biogas, biohydrogen, bioethanol and biooil, the source is biomass (Sisman-Aydın, 2019). Bioenergy studies were initiated by the International Energy Agency (IEA) in 1978. Since it is produced from various biomass sources including forest, agriculture and animal residues, bioenergy depends on biomass resources (Toklu, 2017:). Organic urban wastes are also shown as a source of biomass (Doğar & Tunçez, 2021).

The biomass is produced directly or indirectly by living organisms. As stated by Doğar and Tunçez (2021), biomass, which is predominantly based on carbohydrate components, undergoes both physical and chemical processes and is converted into bioenergy in solid, liquid and gas forms with commercial properties. Plants use the energy from sunlight to convert CO_2 and water into carbohydrates (sugar, starch, cellulose and lignin) through photosynthesis. Animals that feed on plants or other animals also produce biomass through organic waste.

The geographical structure, biomass resources and different needs of the countries offer different marketing opportunities. For example; It is suggested that forest product wastes can be a solution to meet the energy needs of small settlements in forested areas (Sergey et al., 2017). Although the development and sustainability of these regions are considered important, the bioenergy resources available in the region, technology support is required for the consumption of these resources. According to the International Energy Agency (IEA), it may be more expensive for countries to produce their own biomass resources than to buy from other countries due to expensive technology (IEA, 2007). Turning low-grade wood waste into pellets and making them available to the consumer requires a simple pellet stove, a thermal power plant with advanced technology, and other equipment. Therefore, there is a need to encourage and encourage investors on biomass resources and bioenergy production. According to the IEA, the establishment of the international legal infrastructure and appropriate pricing can encourage entrepreneurs (IEA, 2007).

Biomass Product Market and Sustainability

Sustainable development is the common goal of businesses, cities and countries. Whether the biomass potential creates an advantage for sustainable development is the subject of research (Yılmaz, 2012). In the research by Beuchelt and Nassl (2019), the demand for biomass will increase as the governments turn to bioeconomy in the face of the gradual depletion of fossil fuels and climate changes. Global biomass potential is an important resource for sustainable development. It is foreseen that even food security will be endangered, assuming that the increasing demand on biomass resources will grow energy crops instead of food products in agricultural lands. This explains the future status of the biomass market as a product.

Biomass Technology Market

The biomass utilization technologies are divided into fuel conversion processes and energy production processes. In the fuel conversion process, the biomass is burned according to its type, converted to gas, left without oxygen and left to thermal decomposition (pyrolysis process) or biochemical processes are carried

out (Ness & Moghtaderi, 2007). In energy production processes, biomass is subjected to heating processes, fixed and mobile engines are used, evaporation, separation and transport processes are applied. According to the applied processes and processes, biomass usage technologies are developed on biofuel, biogas, heat and electricity. The process and applied processes to obtain energy from biomass are shown in Figure 1.

The processes and ways to exploit biomass indicate the market infrastructure. Combustion, gasification, pyrolysis, hydrolysis, fermentation and digestion processes and the sub-processes for these, shown in Figure 1, show the ways of utilizing biomass. Biomass usage areas and processes give an idea in terms of marketing. The benefits produced are marketed to the industry and the final consumer. Technology is produced for the operations performed in these processes and the technology produced is also marketed. The environmental and human health damage during bioenergy production from biomass is sometimes a matter of discussion. Particles and gases emerging in wood smoke adversely affect human health and are claimed to cause lung, heart and vascular problems (Sözen, 2017). For this reason, the diversity in biomass resources is constantly being researched, and technology is developed and put on the market in order to prevent the damages and dangers that may arise.

Biomass Culture Market

Biomass resources consist of wastes of agricultural and forest products, energy plants, animal and urban wastes (Sivabalan et al., 2020). For the biomass culture market, it is useful to show the biomass resources in a way. The biomass sources produced by Sözen et al. are shown in the following figure (Figure 2):

Today's biomass resources existed in the past. Today, however, technical resources that can convert biomass resources into energy are more developed and technology is an advantage for bioenergy production (Yada et al., 2022). One of the energy sources in Figure 2 is algae. In a study conducted by Özdemir and Erkmen (2013) ten years ago, it is stated that 221 algae species are traded in 35 countries and used for different purposes in biotechnology, chemical industry and energy sectors.

Macro and Micro Algae

Algae; they are one of the most important sources of biomass, classified as macro and micro algae, and seen as oxygen and carbon dioxide converters. It is an important food source that contains fiber, fat, protein, potassium, magnesium, zinc, iron elements, vitamins E, B and K and can grow two or three times a day. They have characteristics in terms of morphological, cytological, biochemical properties, reproduction and life cycles. Thanks to their different properties, algae can be used for different purposes. It is used in agriculture and animal husbandry in terms of soil aeration, being rich in nitrogen, being a source of food for both humans and animals, and being useful against pests (İrkin, 2020). At the same time, it is stated that algae can be used in injection molding works in terms of resin. Bioplastics are obtained from renewable energy sources and in this sense, algae are used as one of the starch production sources (Özdemir & Erkmen, 2013). Algae is cultured on its various benefits and with this feature, it is accepted as an important food source in the future.

The macroalgae is multicellular organisms that can take on red, brown and green colors according to their pigments known as seaweed. Due to the fact that macroalgae are in the seas, they are shown as the food

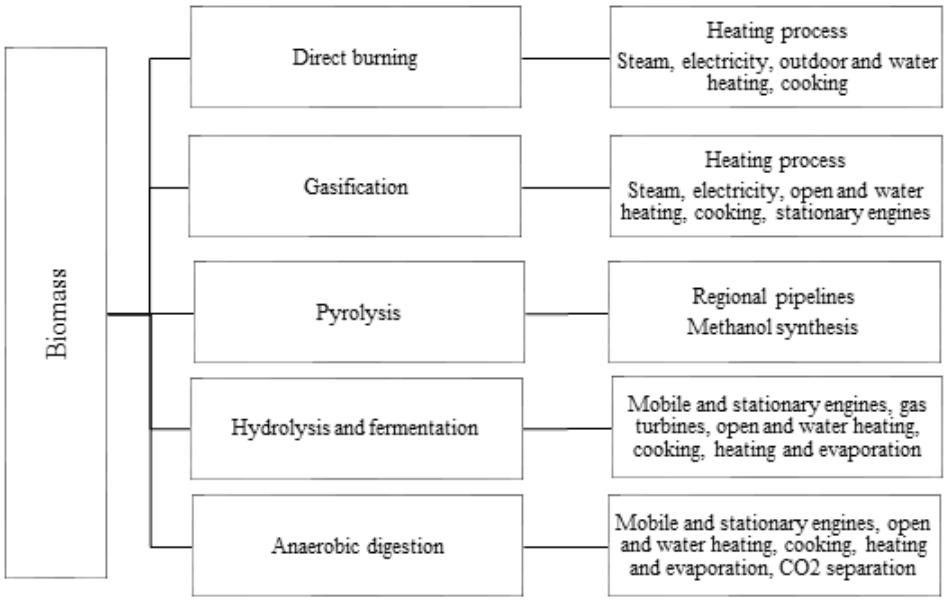

Figure 1. Processes of Converting Biomass into Fuel, Energy and Heat. (Ness & Moghtaderi, 2007)

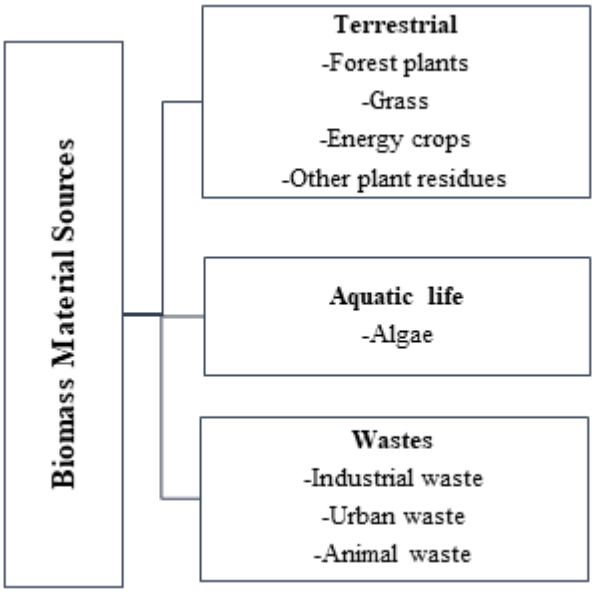

Figure 2. Classification of Biomass Sources (Sözen et al. 2017).

of the future in the face of food shortages in the Far East countries.

The microalgae are a group of algae with high energy production. Algae are seen as energy sources that should be commercially marketed (İrkin, 2020). Its biomass is produced and consumed as human food and animal feed, and biodiesel fuel, biogas and electricity are now obtained from biomass. Microalgae are also used in the cosmetics, health and pharmaceutical industries, apart from food, feed and energy, with their material properties such as fatty acids, protein, carbohydrates, glucose and starch they contain in the cell (Sisman-Aydın).

The microalgae are an organism that is consumed as food, contains chlorophyll, and can be unicellular or multicellular. There are specimens in blue, green, red, yellow-brown and brown colors. Spirulina, Dunaliella (green), Haematococcus (green), chlorella (green), Porphyridium (red), Ochromonas malhamensis (yellow-brown) and fibrocapsa japonica (brown) are some of the cultivars (Uzuner & Haznedar, 2020). In order to show their nutritional value, some microalgae are given in the table below (Table 1) as a comparison with some foods such as meat, milk and eggs.

According to the research conducted by Uzuner and Haznedar (2020), the global market value of microalgae is around 6.5 billion dollars. Although it is used in areas such as acid production and aquaculture, the blue-green and green types are mainly used in the food industry. It is stated that there is an increasing demand for fatty acids and pharmaceutical industry, which is used in soups, fruit juices, ice creams, biscuits, some beverages and some other products. According to Güner (2017), algae are consumed in countries such as Canada, Iceland and Ireland. In France, the use of algae in homes and restaurants is encouraged by the government. It is stated that the use of seaweed in salads and vegetables has become traditional in some coastal countries.

Promoting Biomass Use

It is known that renewable energy sources are constantly kept on the agenda and encouraged in the world. The US Department of Energy organizes biomass programs and encourages efforts to secure biomass raw materials (U.S. Department of Energy, 2011). Algae fuel production in the USA is commercially encouraged and efforts are made to develop the technology needed in this regard (T.C. Ministry of Industry and Technology, 2021). In the European dimension, public and private sector initiatives are encouraged and training programs are organized (Ballard-Tremer, 2007). It has been decided by the European Commission to produce projects to study and update biomass types and potential sources until 2030, to examine technically and economically and to calculate risks (European Commission Final Report, 2017). In 2002, the use of biomass was made a national strategy in Japan and the basic law was enacted in 2009. It has been adopted as a principle to develop the biomass industry in order to create a regional green industry and attain national energy resources (www.maff.go.jp, 2016).

Promoting the use of biomass means inviting entrepreneurs. Encouragement of production and marketing by governments in the world, encouraging the consumer to consume bioenergy, encourage investors and entrepreneurs who will invest in the field, and a marketing field is emerging.

Biomass Energy in Turkey

As in the world, the need for energy is increasing in Turkey, depending on the social and economic

Table 1. Nutrients of Algae and Certain Foods

	Spirulina	Dunaliella	Haematococcus	Chlorella	Egg	Milk	Meat
Protein(%)	63	7.4	23.6	64.5	47	26	43
Oil(%)	4.3	7.0	13.8	10.0	41	28	34
Carbohydrate(%)	17.8	29.7	38.0	15.0	4	38	1

development. Current energy sources are hydro and lignite (Toklu, 2017). As we enter the year 2022, although there are natural gas deposits in the Black Sea, there are no rich oil resources. However, according to researchers, Turkey is a country rich in biomass energy resources. The main energy resources are listed as sun, water resources, forest, livestock, organic urban wastes, agricultural areas (nutshell, straw, stalk, olive shell…) and assets dependent on climate conditions (Toklu, 2017: 237; İlleez, 2020: 319). According to Toklu, the highest share among biomass resources for Turkey seems to belong to forest products with 20% wood production.

As in the Bioenergy Studies Symposium, attention is drawn to biomass resources and the need for bioenergy use instead of fossil fuels. In 2015, the share of biomass energy in the global energy share was around 10%. In 2050, it is expected that 30% of the world's energy demand will be met by bioenergy (Thinktech, 2020).

The energy consumption in Turkey, which was around 103 Mtoe (million tons of equivalent oil) in 2009, reached 114.4 Mtoe in 2011 (Yılmaz, 2012). On the other hand, Turkey's biomass production potential is quite high and a potential equal to 10 to 32 million tons of oil is mentioned (Yılmaz, 2012; Toklu, 2017; Sözen, 2017). It is stated that Turkey has an annual biomass potential of 117 billion tons. This figure corresponds to 32 Mtoe. In some sources, this figure is increased up to 135-150 Mtoe (Karayılmazlar et al., 2011). Sözen et al. According to the research conducted by in 2017, while the share of biomass energy production in Turkey is 11%, its consumption is 3.1%. Electricity Production Inc. (EUAŞ) shows the share of biofuel and solar energy as 3.3% for 2018 (EÜAŞ, 2019). Only 7.9% of Turkey's biomass potential can be used. The difference between biomass energy production and consumption in Turkey shows that the consumption is less.

The largest share in biomass potential is given to annual plants with 14.5% Mtoe, followed by forest wastes (5.4% Mtoe), third perennial plants (4.1% Mtoe) and then animal waste (1.5-2% Mtoe) is coming (Yılmaz, 2012). Turkey's biomass potential is given in Table 2 below.

Forest products have an important place among biomass resources. Different building materials such as decoration and furniture can also be produced from forest products. Wood fibers and particle boards are used and market areas are expanded by constantly improving their usage. When we look at the production and marketing areas, forest products constitute an important place. There are different products such as solid wood, wood pellet, bark pellet, rhododendron pellet, laurel pellet, chestnut pellet, wood briquette, pine chips, willow, olive waste, furniture, particle board, plywood, lignin, cellulose (Sözen, 2017). Although it can be said that products such as wheat, corn, paddy and barley are used as food and animal feed in agricultural areas, it is the subject of field experts how much can be benefited from their nutritional properties and how much can be evaluated in terms of quantity.

Biomass Potential in Sinop Province and Districts

There is a potential geography for biomass production in the Sinop region. The province of Sinop is geographically located on an area of 579.200 hectares, of which 7% is inhabited, 30% is cultivated and 63% is forested (Sinop Valiliği). Biomass potential means bioenergy potential that can be convertible. It is known that the biomass potential in Sinop province and districts shows diversity as well as throughout Turkey. In addition to urban wastes, agricultural and forest wastes, microalgae growing in marine and fresh waters are important biomass sources (Elcik & Çakmakçı, 2017). Municipal wastes are partially utilized through separation, and although the wastes of forest products remain in nature, they become useful by mixing with the soil.

The consumer characteristics of the population of the city center, the history of Ayancık district on forest products and hemp cultivation and use, the fact that it is a coastal region of the Black Sea that grows chestnuts together with Erfelek and Türkeli, and the fact that Sinop province and Gerze district are known for fishing show the diversity of biomass resources of the region. Starting from Dikmen district, the mountainous lands separating the inner districts from the coast are among the regions rich in forest products.

Sinop is among the leading provinces in the Black Sea in terms of paddy production. Two potentials draw attention in terms of bioenergy in paddy production. The first is the rice straw, which is wasted due to its lack of nutritional properties. After the rice is harvested, the straw is left in the field and generally burned. Rice straw is disposed of as it is not nutritious for animals (Kıvrak &

Table 2. Turkey's Biomass Potential (Yılmaz, 2012)

Biomass Types	Energy Value (Mtoe)	Annual Biomass Production (million tons)
Annual plants	14,9	55
Forest waste	5.4	18
Perennial plants	4.1	16
Agricultural industry waste	3.0	10
Wood industry waste	1.8	6
Animal waste	1.5	7
Other	1.3	2
Total	32.0	117

Başyiğit, 2012; Çelik & Akyıldız, 2018). The second one is the potential of microalgae due to the fact that rice production is grown in water. Microalgae are single-celled organisms that grow in an aquatic environment. They grow by utilizing inorganic nutrients such as sunlight, CO_2, dissolved nitrogen and phosphate compounds. They benefit the product by capturing N_2 in the air (Buyana et al., 2019: 20). While microalgae benefit the product, they are a good sustainable source of bioenergy (Reis et al., 2014).

Animal waste means animal manure. Small producers, who have agricultural lands in the villages, use the manure of the few animals they raise in agricultural lands and gardens. Producers who keep animals in barns around the city cannot utilize the fertilizers. It is also possible to talk about waste in fruit and vegetable waste. Especially in rural areas, especially in Erfelek district, fruits and vegetables left in place without being delivered to the consumer are witnessed.

Although rice obtained from paddy is among the most economical products of the region, paddy straw and husk are among the most wasted wastes. In the Gökırmak and Kızılırmak valleys passing through Boyabat, Durağan and Saraydüzü districts, paddy cultivation is carried out on an area of 42.301 decares. Sometimes due to fallow, paddy cultivation areas may vary from year to year. Rice was planted on an area of 35 thousand decares in 2021 and it was ranked 6th in Turkey with its rice income of 30 thousand 500 tons (TRT Haber, 18 November, 2021). Assuming that the straw is half as much as the paddy produced, it means that 15 thousand tons of straw was produced only in Sinop province in 2021.

Potential aquaculture and paddy straw wastes are wasted in agriculture, especially in paddy fields. Paddy fields remain filled with water from rice planting to harvesting, and it is seen as an area open to research in terms of growing microalgae as an energy source. Microalgae are among the important sources for biodiesel and biogas production (Reis et al., 2014). In addition, the paddy stalks are left in the fields and destroyed by burning together with the stubble (Kıvrak & Başyiğit, 2012). The fields where the rice wastes are found have not yet entered the bioenergy and biofuel market (Kaniapan et al., 2022).

Results and Discussion

In recent years, bioenergy-oriented symposiums, congresses, academic and other studies have clearly pointed to the energy market and the need for bioenergy. The bioenergy market leads to the biomass resources market. The main issues to be discussed about biomass resources are as follows (Prez-Verdin et al., 2009; Roszkowska & Szubska-Wlodarczy, 2022; Clancy et al., 2010; Yana et al., 2022):

- Importance of awareness and value of urban waste among biomass resources
- Biomass and bioenergy market
- Biomass technology market
- Biomass culture market

The studies draw attention to the bioenergy value of urban wastes (Prez-Verdin et al., 2009). However, it is an important problem that urban wastes, including organic wastes, are sent directly to the garbage and not separated. Another problem is the negative impact on urban living areas during the disposal of plant wastes in agricultural areas. Most of the investors live in cities. For this reason, the idea of starting bioenergy awareness from the city, spreading it to the countryside and encouraging entrepreneurs can be discussed. While some of the urban wastes are out of biomass sources, an important part of them is directly among the biomass sources (Yılmaz, 2012).

It is clear that the desired level on the biomass and bioenergy market has not been reached and clear targets have not yet been determined. This issue can be discussed as the driving force of marketing and

entrepreneurship. In biomass marketing, it is important how to search and mobilize potential resources. For example; Yana et al. (2022), Indonesia's agricultural lands and forests along with paddy lands are shown among the important biomass resources and attention is drawn to the issue. In Indonesia, bioenergy resources were mapped according to regions and provinces and raw material potentials were put into numerical data. Numerical data has a remarkable feature that is used in many countries, including Turkey. Biomass resources are researched in developed countries and adaptation possibilities are examined by looking at annual products (U.S. Department of Energy, 2011).

The inefficient use of biomass resources is a problem. Due to the lack of appropriate technologies and the fact that biomass resources could not be made more efficient, biomass resources in Turkey are consumed as they come from nature with traditional methods without processing (Yılmaz, 2012). The use of wood, animal and vegetable wastes, nutshells and rice husks are used directly or not at all (Toklu, 2017). Technology is required to prevent low-cost energy production (İlleez, 2020). Appropriate technology is also needed in order to convert urban wastes into energy and to obtain energy from biomass sources. Appropriate technology can contribute to the economic value of urban wastes by processing with the right method and to the energy production needed in microalgae habitats. It is understood that businesses that will invest in bioenergy should be financially supported with business plans, businesses should be encouraged and attention should be drawn to the market (Ojala, 2011). The fact that the necessary technology for bioenergy is in the development phase points to a niche market (Toklu, 2017).

For sustainable bioenergy, biomass culture and the economic value of urban wastes require innovative approaches. Two problems arise in front of biomass culture and growing energy crops in agricultural areas. The first is breaking the habits of the producers and turning to new products (Roszkowska & Szubska-Wlodarczy, 2022). The second is the concern that this new product search may put the food industry at risk (Clancy et al., 2010). However, for sustainable cities and societies, there is no problem in using urban wastes as biomass and bioenergy.

Conclusion

It is a necessity for oil-importing countries such as Turkey to turn to biomass energy sources. Although biomass resources vary according to geographies, there are urban wastes in every settlement, bioenergy resources that can be obtained from agriculture, forest, plant species and fisheries in every geography. Turkey is among the advantageous countries in terms of sun and biomass with its rich plant species. Besides pine and oak forests, there are suitable regions for fast growing trees such as eucalyptus, willow and poplar.

The wastage of paddy straw in the river beds of the Gökırmak and Kızılırma valleys in Sinop province, as it is throughout Turkey, draws attention. Although the rice product grown in Gökırmak and Kızılırmak valleys has an important economic return, rice husk, straw and microalgae potential in the fields are not utilized sufficiently. Rice straw is burned after harvesting, it creates pollution in living areas and the product that should gain economic value as biomass is wasted. It should be determined whether there are microalgae that can be a source of bioenergy in the paddy fields filled with water during the growing process of the rice product. If there are microalgae in the rice fields, the nitrogen it provides for the rice, its fertilization feature with other useful additives and whether microalgae can be cultured in these fields need research. While losses in biomass raw materials cause environmental damage on the one hand, they mean energy loss on the other. Leaving urban waste directly to nature without benefiting is both pollution and economic loss. Focusing on biomass and bioenergy can contribute to keeping cities clean on the one hand and producing clean energy on the other.

The existence of energy policies of central governments is observed. However, it is a problem that these policies are not reflected in local government policies. Local initiatives on bioenergy production have not accelerated as much as western countries. There is a need to develop market-oriented bioenergy policies. It is understood that in order to prevent unconscious destruction of biomass resources, legal regulations are needed and entrepreneurs should be encouraged in the field of bioenergy. Obtaining biofuel from biomass and producing bioenergy require technology.

The state and local governments can lead and guide businesses to provide the necessary technological support for bioenergy production. Studies on using biomass resources and obtaining bioenergy can contribute to local employment. With the production areas promised by environmental features, target markets can be studied and entrepreneurs can be encouraged. Local governments, entrepreneurs and universities can cooperate on the evaluation of organic urban wastes as a source of biomass, research of biomass sources, making agricultural culture and obtaining bioenergy.

Acknowledgements

First of all, I would like to thank the chairman and organizing committee of the 4th bioenergy studies symposium for this study titled Generating Economic Value from City Waste and Marketing of Biomass. I would like to thank Sinop University and local municipalities. It would be beneficial for universities and local governments to focus on biomass resources.

References

Ballarda-Tremer, G. (2007). *Opportunities for Biomass Energy Programmes Experiences & Lessons Learned by UNDP in Europe & the CIS*, Final Report. Ecoharmony, London.

Beuchelt, T. D. and Nassl, M. (2019). Applying a Sustainable Development Lens to Global Biomass Potentials. *Sustainability*, *11*, 5078, 1-26.

Buyana, N. T., Gofar, N. and Rohin, A. M. (2019). N Absorption in Nontidal Rice Fields Treated with Microalgae and Nitrogen Fertilizer Application. *Planta Tropika: Jurnal Agrosains (Journal of Agro Science)*, 7(1), 19-25.

Carneiro, P. & Ferreira, P. (2012). The Economic, Environmental and Strategic Value of Biomass. *Renewable Energy*, *44*, 17-22., doi: 10.1016/j.renene.2011.12.020.

Carneiro, P. , & Ferreira, P. (2012). The economic, environmental and strategic value of biomass. Renewable Energy, 44, 17-22. https://doi.org/10.1016/j.renene.2011.12.020

Clancy, D., Breen, J., Thorne, F. and Wallace, M. (2010). *Risk and the Decision to Produce Biomass Crops: a Stochastic Analysis*. The 84th Annual Conference of the Agricultural Economics Society Edinburgh, Scotland. 29th March to 31st March 2010.

Çelik, S. Ö. & Akyıldız, A. (2018). İnşaat Sektöründe Atıkların Kullanımı ve Sürdürülebilirlik Açısından Önemi. In Eds., A. A. Eker, F. İ. Türkdoğan, F. G. İskender, N. Tüfekçi & S. Övez, *Çevre-Bilim ve Teknoloji* (pp. 147-170). Güven Plus Grup A.Ş. Yayınları, İstanbul.

Doğar, F. N. & Tunçez, F. D. (2021). Effects of Biomass Energy on Recycling from a Sustainability Perspective., *Bioenergy Studies*, 1(1), 25-35. https://doi.org/10.51606/bes.2021.4

Eichout, B. (2012). A Strategy for a Bio-Based Economy. *Green New Deal Series*, 9, 1-52.

Elcik, H., & Çakmakcı, M. (2017). Mikroalglerden Yenilenebilir Biyoyakıt Üretimi. Gazi Üniversitesi Mühendislik-Mimarlık Fakültesi Dergisi, 32(3), 795-820. Https://Doi.Org/10.17341/Gazimmfd.337627.

European Commission (2017). *Sustainable and Optimal Use of Biomass for Energy in the EU beyond 2020*. Annexes of the Final Report. EC Directorate General for Energy Directorate C1 – Renewables and CCS policy. https://ec.europa.eu/energy/sites/ener/files/documents/biosustain_annexes_final.pdf Accessed 27.04.2022.

EÜAŞ-Elektrik Üretim A.Ş. Genel Müdürlüğü (2019). 2019-2023 Strateji Plan. https://www.euas.gov.tr/stratejik-plan Accessed 07.06.2022.

Güner, A. (2017). İzmir Körfezinden (Urla) *Toplanan Kahverengi (Halopteriz Scoparıa Sauvageau), Enteromorpha Lınza J. Agardh) ve Kırmızı Alg (Gracilaria Gracilis M. Steentoft, L.M.Irvine&W.F.Farnham) Türlerinin Hekzan, Kloroform ve Metanol Ekstrelerinin Biyolojik Aktiviteleri ve Protektif Etkilerinin İncelenmesi*. Ege Üniversitesi Fen Bilimleri Enstitüsü, PhD thesis

IRENA-The International Renewable Energy Agency (2019). Solid Biomass Supply for Heat and Power. www.irena.org Accessed 29.05.2022.

İlleez, B. (2020). Türkiye'de Biyokütle Enerjisi. *Türkiye'nin Enerji Görünümü* (pp. 317-346). TMMOB Makine Mühendisleri Odası, Ankara. ISBN: 978-605-01-1367-9

İrkin, L. C. (2020). *Akuakültürde Alglerin Önemi ve Kullanım Alanları*. İksad Publishing House, Ankara.

IEA- International Energy Agency Good Pratice Guidelines (2007). *Bioenergy Project Development & Biomass Supply. OECD/IEA*, nternational Energy Agency (IEA), Head of Publications Service, Cedex, France. https://www.iea.org/Textbase/about/copyright.asp Accessed 14.04.2022.

Kaniapan, S., Pasupuleti, J., Patma Nesan, K., Abubackar, H. N., Umar, H. A., Oladosu, T. L., Bello, S. R., & Rene, E. R. (2022). A review of the sustainable utilization of rice residues for Bioenergy conversion using different valorization techniques, their challenges, and techno-economic assessment. *International Journal of Environmental Research and Public Health*, *19*(6), 3427. https://doi.org/10.3390/ijerph19063427

Karayılmazlar, S., Saraçoğlu, N., Çabuk, Y. & Kurt, R. (2011). Biyokütlenin Türkiye'de Enerji Üretiminde Değerlendirilmesi. *Bartın Orman Fakültesi Dergisi*, 13(9), 63-75.

Kıvrak, S. O. & Başyiğit, C. (2012). Çeltik Sapı Külü Elde Edilmesinde Puzolaniklik Açısından Uygun Yakma Sıcaklığı Araştırılması. *SDU International Technologic Science*, *4*(3), 94-101.

Kindström, D., Ottosson, M. & Thollander, P. (2017). Driving Forces for and Barriers to Providing Energy Services: a Study of Local and Regional Energy Companies in Sweden. *Energy Efficiency*, 10(1), 21-39.

Ness, J. N. & Moghtaderi, B. (2007). Biomass and Bionergy. *Coal-Biomass Cofiring Handbook*. (pp. 1-36).: https://www.researchgate.net/publication/309127353 Accessed 01.04.2022.

Ojala, P. (2011). Business Plan Model for Bio-energy Companies. EE 2011// Cambridge, UK. https://www.academia.edu/34984324/Business_Plan_Model_for_Bio_energy_Companies Accessed 10.06.2022.

Özdemir, N. & Erkmen, J. (2013). Yenilenebilir Biyoplastik Üretiminde Alglerin Kullanımı. *Karadeniz Fen Bilimleri Dergisi*, *3*(8), 89-104.

Prez-Verdin, G., Grebner, D.L., Sun, C., Munn, I.A., Schultz, B. & Matney, T.G. (2009). Wood Biomass Availability for Bioethanol Conversion in Mississippi. *Biomass and Bioenergy*, 33 (3), 492-503.

Rashidi, N. A., Chai, Y. H., & Yusup, S. (2022). Biomass energy in Malaysia: Current scenario, policies, and implementation challenges. *BioEnergy Research*, *15*(3), 1371-1386. https://doi.org/10.1007/s12155-022-10392-7

Reis, C. E. R., Amaral, M. S., Loures, C. C. A., Ros, P. C. M., Hu, B., Filho, J. I., Castro, H. F., Gianesella, S. M. F. and Silva, M. B. (2014). Microalgal Feedstock for Bioenergy: Opportunities and Challenges. Biofuels in Brazil. In Edit.: S. S. da Silva & A. K. Chandel, *Biofuels in Brazil* (pp. 367-392). Springer International Publishing Switzerland. DOI:10.1007/978-3-319-05020-1_17

Roszkowska, S. and Szubska-Wlodarczy, N. (2022). What are the Barriers to Agricultural Biomass Market Development? The case of Poland. *Environment Systems and Decisions*, 42, 75–84.

Ruamsook, K. ve Thomchick, E. (2014). *Market Opportunity for Lignocellulosic Biomass*. Supply Chain Research, NEWBio, Pennsylvania State University.

Sergey, Z., Gaalina, A., Anton, O., Natalia, P., Roy, D. and Mikhail, K. (2017). Marketing Research Prospects for Bioenergy Development Based on Use of Wood Fuel.

Advances in Economics, Business and Management Research, *38*, 736-740.

Sinop İli 2019 Yılı Çevre Durum Raporu (2020). ÇED ve Çevre İzinleri Şube Müdürlüğü, Sinop Çevre ve Şehircilik İl Müdürlüğü. https://webdosya.csb.gov.tr/db/ced/icerikler/s-nop_2019_cdr-20210315133413.pdf Accessed 30.05.2022.

Sinop Valiliği (2022). Arazi Durumu. http://www.sinop.gov.tr/tarim, Accessed 22.04.2022.

Sisman-Aydın, G. (2019). Mikroalg Teknolojisi ve Çevresel Kullanımı. *Harran Üniversitesi Mühendislik Dergisi*, *4*(1), 81-92.

Sivabalan, K., Hassan, S., Ya, H. & Pasupuleti, J. (2020). *A review on the Characteristic of Biomass and Classification of Bioenergy through Direct Combustion and Gasification as an Alternative Power Supply*. International Conference on Robotics and Artificial Intelligence (RoAI) 2020, Journal of Physics: Conference Series, 1831.

Sözen, E., Gündüz, G., Aydemir, D. & Güngör, E. (2017). Biyokütle Kullanımının Enerji, Çevre, Sağlık ve Ekonomi Açısından Değerlendirilmesi. *Bartın Orman Fakültesi Dergisi*, *19*(1), 148-160.

T.C. Sanayi ve Teknoloji Bakanlığı (2021). *İstanbul İli Atık Su ve CO2 Arıtımı ile Mikroalgal Biyodizel Üretimi Öz Fizibilite Raporu*. İstanbul Kalkınma Ajansı. https://www.yatirimadestek.gov.tr/pdf/assets/upload/fizibiliteler/istanbul-ili-atik-su-ve-co2-aritimi-ile-mikroalgal-biyodizel-uretimi2021.pdf Access 15.04.2022.

Thinktech (2020). Biyoenerjinin Geleceği. https://thinktech.stm.com.tr/tr/biyoenerjinin-gelecegi, Accessed 10.04.2022.

Toklu, E. (2017). Biomass Energy Potential and Utilization in Turkey. *Renewable Energy*, *107*, 235-244.

TRT Haber (2021). Sinop Çeltik Üretimiyle Türkiye'de 6'ncı Sırada. 18 Kasım 2021. https://www.trthaber.com/haber/ekonomi/sinop-celtik-uretimiyle-turkiyede-6nci-sirada-627476.html Accessed 13.06.2022.

TÜİK-Türkiye İstatistik Kurumu (2021). Atık İstatistikleri. https://data.tuik.gov.tr/Bulten/Index?p=Atik-Istatistikleri-2020-37198 Accessed 11.06.2022.

UHK-Ulusal Hububat Konseyi (2011). Ulusal Hububat Konseyi Çeltik Raporu. http://uhk.org.tr/dosyalar/UHK_celtikraporu.pdf Accessed 25.05.2022.

U.S. Department of Energy (2011). U.S. Billion – Ton Update: Biomass Supply for a Bioenergy and Bioproducts Industry. U.S. Department of Energy Energy Efficiency and Renewable Energy Office of the Biomass Program. OAK Ridge National Labıratory, Tennessee. https://www1.eere.energy.gov/bioenergy/pdfs/billion_ton_update.pdf Accessed 16.04.2022

Uzuner, S. & Haznedar, A. (2020). Fonksiyonel Gıda İçin Sağlıklı Takviye: Mikroalgler. *Sinop Üniversitesi Fen Bilimleri Dergisi*, *5*(2), 212-226.

Üstün, G.E. & Genç, B. (2015). Dünya'da ve Türkiye'de Biyoyakıtların Durumu. U.Ü. *Ziraat Fakültesi Dergisi*, *29*(2), 157-164.

Wei, F., Zhou, J., & Ren, X. (2014, November). Research on Green Marketing Driving Force and Implementing Route Based on Innovation perspective. In *2014 International Conference on Social Science (ICSS-14)* (pp. 114-119). Atlantis Press.

www.maff.go.jp (2016). Biomass Policies and Assistance Measures in Japan. https://www.maff.go.jp/e/pdf/reference6-8.pdf Accessed 27.04.2022.

Yana, S., Nizar, M., Irhamni, & Mulyati, D. (2022). Biomass waste as a renewable energy in developing bio-based economies in Indonesia: A Review. *Renewable and Sustainable Energy Reviews*, *160*, 112268. https://doi.org/10.1016/j.rser.2022.112268

Yılmaz, M. (2012). Türkiye'nin Enerji Potansiyeli ve Yenilenebilir Enerji Kaynaklarının Elektrik Enerjisi Üretimi Açısından Önemi. *Ankara Üniversitesi Çevrebilimleri Dergisi*, 4(2), 33-54

Zheng, Y., Wang, J., Wang, D. & Zheng, Z. (2022). Advanced Catalytic Upgrading of Biomass Pyrolysis Vapor to bio-aromatics hydrocarbon: A Review. Application in Energy and Combustion Science, 10, 1-24. https://doi.org/10.1016/j.jaecs.2022.100061