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Investigating the impact of land use change for bioenergy production with respect to value added cost and water quality in random conditions

Mahdi Yousefi Nejad Attari[1*], Taher Yazdan Panah[2], Zohreh Khalilpour[2]

1- Assistant Professor, Department of Industrial Engineering, Bonab Branch, Islamic Azad University, Bonab, Iran.
2- MSc, Department of Industrial Engineering, Bonab Branch, Islamic Azad University, Bonab, Iran.
* P.O.B. 5551857777 Bonab, Iran, mahdi_108108@yahoo.com

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Abstract

This study investigates the effect of land use change for bioenergy production by considering the cost of value added and water quality in random conditions using waste and wheat residues that have produced biofuels. Therefore, a linear model for land use change was presented with the aim of reducing total costs and increasing production efficiency. In random conditions, the model was solved using GAMS software and the computational results and comparisons show the optimal performance of the effect of land use change for biofuel production based on value added cost and water quality in different scenarios. By selecting Ajabshir city as a study area and selecting 9 different products and examining the products in terms of costs and added value of each product, we came to the conclusion that planting and producing wheat for biofuel production It is both cost-effective and cost-effective and has less of an impact on water pollution. Due to the need for less fertilizer, which leads to a lower amount of nitrate in the soil, which also reduces the percentage of water pollution during biofuel production, less damage to the environment and be economically affordable for the residents of Ajabshir city.

Keywords: biofuels, wheat, agricultural land use, gray water footprint, multi-purpose purposes

1. Introduction

Extended In the real world, biofuels are rarely used. Renewable fuel production from products such as wheat and grass is considered as a potential for environmental benefits that the use of wheat and grass replaces many benefits for biofuel production, including high biomass yield, climate and soil adaptation and low fertilization needs. Increases food consumption and has the reliability of replacing arable land with wheat and grass production for biofuels can improve the performance of local ecosystems by reducing water demand and pollution through fertilizer, including reducing nitrate loads in water. Improve groundwater and reduce the risk of groundwater pollution. Therefore, for the production of bioenergy, which is obtained from the conversion of crops to wheat and other crops, and due to durability and stability and low share in greenhouse gas emissions and strengthening the economy, as well as due to the reduction of nitrate in the soil that causes pollution. Less land and consequently water becomes very important and popular among the people [1]. For this reason, considering the value-added costs and water quality in bioenergy production, it has been studied that value-added costs include various costs, which by minimizing the total cost of the total costs. (1) Cost of opportunity and land opportunity to the amount of profit from agricultural land before the conversion of wheat (2) Cost of production and maintenance of wheat (3) Cost of harvest (4) Cost of transporting the produced product to conversion centers (5) The cost of building conversion facilities that convert the product into bioenergy fuel; and (6) the operating cost of the conversion facility, which includes biofuel production, using the average cost that reduces the total cost. It can be examined along with the quality of water obtained through the gray water footprint by measuring the amount of nitrate in the soil and the effect on the water. Decrease.

In this issue, the decision variables are: hectare of monthly harvested wheat from the type of land use conversion and the number of machines and working hours of machines and monthly wheat storage and finally the number of equipment used during the harvest, which ultimately obtains the amount of cost costs. Adding and measuring the amount of nitrate in the soil and using mathematical modeling at the same time as bioenergy production, which compares the value added costs and water quality in random conditions. By selecting five areas of Ajabshir city as the study area, considering 9 different products in 5 locations of agricultural lands, each of the products, including costs and profitability, has been examined, and finally the products, which in terms of It has both cost and profitability and less impact on water pollution and the environment. It is selected for biofuel production. Since water resources have been identified as an important issue for the future of biofuel systems, the use of biofuels from renewable sources will reduce greenhouse gas emissions, strengthen rural economies, and create environmental benefits. Because the use of commercial fertilizers in agricultural lands has increased nitrate in the soil, which causes waterborne diseases such as infant water syndrome, so alternative products are used that have many benefits for biofuel production, including water compatibility. It needs air, soil and low fertilization, which reduces soil nitrate and ultimately reduces the gray footprint of water and the amount of water pollution, which has a high reliability.

Li et al. (2021) in a study on integrated life cycle and evaluation of non-food water footprint based on bioenergy production. For this purpose, they used a life cycle assessment model to analyze actual performance along with water footprint assessment methods. The unbroken exchanges between the three representative energy production technologies based on three categories of non-food crops (corn, sorghum and hybrid pennisetum) grown in marginal fields have been studied. The results of water footprint show that the combined penistome system has the greatest impact on water resources, while the other two technology options show the characteristics of environmental sustainability [2]. Many countries that draw their energy from fossil fuel sources have turned to renewable and environmentally friendly sources to alleviate growing concerns about global warming and environmental issues. Bioenergy technology is one of the potential alternatives to renewable energy systems.

In a study, Abdel-Basset et al. (2021) evaluated sustainable bioenergy production technologies through a case study in Egypt. The results of a case study showed that the conversion of agricultural and municipal wastes into biogas is the most suitable sustainable bioenergy technology weighing 0.996, followed by petroleum products to biodiesel technology weighing 0.539 [3].

2. Material and Method

The purpose of modeling is to minimize the total cost of wheat for the biofuel supply chain, including upstream or inlet flow components (ground) and intermediate flow components (change facilities). It is also considered that the combination of private costs and environmental benefits, in the form of reducing the nitrate load in groundwater in the design of wheat supply chains, could lead to increasing social projects.

$$\text{Min TC} = C_{opportunity} + C_{production} + C_{harvest} + C_{storage} + C_{transportation} + C_{investment} + C_{operation} \quad (1)$$

$$C_{opportunity} = \max \begin{cases} \sum_{ipm}[(Price_{ip} \times Yield_{ip} - PC_{ip}) \times AH_{mip}] \\ \sum_{ipm}[(LR_{ip} \times AH_{mip})] \end{cases} \quad (2)$$

$$C_{production} = \sum_{mip}((Est + AM) \times AH_{mip}) \quad (3)$$

$$C_{harvest} = \sum_{ipm}(\sigma \times AH_{mip}) \quad (4)$$

$$C_{storage} = \sum_{mi}(\gamma_i \times NXS_{mi}) \quad (5)$$

$$C_{transportation} = \sum_i(\theta_i \times (\sum_{mipj} XTN_{mij} + \sum_m XTO_{mijp})/(1-DML^{trans})) \quad (6)$$

$$C_{investment} = \sum_{I,cap}(\omega_{cap} \times CBB_{CAP,I}) \quad (7)$$

$$C_{operation} = \sum_{cap,i}(\alpha \times Q_{cap} \times CBB_{cap,i}) \quad (8)$$

$$\sum_m AH_{mip} \leq Aa_{ip} \quad ,\forall i,p \;\; Nov \leq m \leq Feb \quad (9)$$

$$Numb_m^k \times Avehour_m - \sum_i(Mtb_i^k \times AH_{mip}) \geq 0, \forall k,m \quad (10)$$

$$\sum_p AH_{mip} \times Yield_i^{whe} = XTN_{mij}/(1 - DML^{trans}) + NXS_{mi}, \forall m,i \quad (11)$$

$$XS_{(m+1)i} = (1 - DML_m^{stor}) \times XS_{mi} + NXS_{(m+1)I}, \forall m,i \;\; Nov \leq m \leq Feb \quad (12)$$

$$XS_{(m+1)i} = (1 - DML_m^{stor}) \times XS_{mi} - XTO_{(m+1)ijp}/1 - DML^{trans}), \;\; \forall m,i \;\; March \leq m \leq Oct \quad (13)$$

$$ƛ(\sum_i XTN_{mij} + \sum_i XTO_{mijp}) - Q_m = 0, \;\; \forall m \quad (14)$$

$$AH_{mip}, XTN_{mij}, NXS_{mi}, XS_{mi}, XTO_{mijp}, Numb_m^k \geq 0 \quad (15)$$

In Equation 1, the goal is to minimize the total cost of wheat.

In Equation 2, opportunity cost is defined as profit from alfalfa crops or pasture production activities that occur before the land is converted to perennial wheat production. Biomass yields, production costs, and land available to change agricultural land use (corn, cotton, clustered corn, soybeans, wheat, and alfalfa / pastures) and perennial wheat vary across space units. Therefore, opportunity cost is defined as net income from initial land use or land rent.

Equivalent to the 3 costs of perennial wheat production, it includes the creation of perennial wheat on each type of arable land and annual maintenance costs.

In the equation of 4 harvest costs, the harvest of perennial wheat using a large sowing system is rectangular.

Equation 5 includes the cost of storing wheat, including the cost of materials, equipment, and labor for packing and storage operations with sacks.

Equivalent 6 to the cost of transportation is the use of semi-trailer trucks and trailers to transport wheat from storage to facility centers.

In the equation of 7 annual investment costs, the capacity conversion centers are multiplied by the number of capacity conversion centers.

In the equation of 8 operating costs of biomass being produced in each change center is calculated based on the capacity of that center.

Equation 9 sets out the limitations that apply to the requirements and practical operating rules of mass balance.

In the equation of 10 available areas, based on wheat yields for forage production, lignocellulose biomass is limited per use source per month.

Equivalent to 11 working hours per month based on harvest days due to weather during the growing season.

In Equations 12 and 13 requires wheat, which must be provided during the harvest season and is equal to the sum of direct delivery after adjusting the transport of dry waste and indirect transport to the warehouse.

In Equation 14, the stockpile equilibrium of wheat realizes dry matter after consideration. Finally, it shows the deliveries of raw materials to the conversion centers during each month that are needed to meet the demand for biomass production.

In Equation 15, all parameters and variables in the model are limited to non-negative.

For the production of renewable fuel from renewable sources, Ajabshir city has been selected as the study area. The selected areas of this city are: Shiraz village, Shishvan village, Razian village, Nabrin village and Khezrloukeh village, one hundred and twenty agricultural lands from these villages, all with an area of two hectares with 9 different products: 1- corn 2- rapeseed 3- wheat 4- onions 5- barley 6- potatoes 7- Alfalfa 8- big chicken 9- Ln thy sky, which were selected for 12 months, which were produced with the availability of two location centers for conversion facility centers in Ajabshir city. Biofuel production was carried out.

By examining the crops of previous years, agricultural lands, including water pollution and its impact on the environment, and at all costs, wheat was planted in all agricultural lands. Due to the fact that wheat requires less fertilization, spraying and other chemicals, the amount of nitrate in the soil is low, and the low amount of nitrate in the soil leads to less pollution of water and the environment. Silos and transportation treatment that takes place next to the Wheat Palace produce biofuels (ethanol).

3. Results and Discussion

The production of renewable fuels from proprietary energy products is considered as a potential for generating environmental benefits, so replacing the use of fossil fuels with biofuels from renewable sources emits greenhouse gases, strengthens rural economies and creates environmental benefits. Be. In this study, 9 different products for biofuel production were studied from all angles. Because farmers use pesticides and commercial fertilizers to grow and harvest some crops for higher yields, which is also very damaging to soil and water. Among the applications of fertilizer for low consumption of excessive nitrogen causes runoff in surface water or is retained in the soil or sinks in groundwater and what about the inhabitants of those villages through the use of this water? Directly or indirectly, they are at risk for neonatal aqueous syndrome with an increase in nitrogen concentration. The method of selecting 9 different products is that in the agricultural areas of Ajabshir city, more of these products are used for cultivation and harvest.

More products with new conditions can be used for future research, and the amount of contamination in terms of potassium in water can also be examined.

4. Conclusions

The use of wheat for biofuel production has many advantages, including: (1) high biomass yield, (2) adaptation to water, air and soil, and (3) low fertilization requirements, increased food consumption and high reliability. Therefore, replacing arable land with wheat production for biofuel production can reduce the performance of local ecosystems by reducing water demand and pollution pressure through fertilization, including reducing the nitrate load in groundwater and reducing the risk of groundwater pollution. Improve. In this study, different crops and their effects on the environment were studied, and because wheat requires less irrigation during the period of water shortage and less fertilizer and toxins, both of which prevent water shortages and water pollution. Therefore, wheat was used to produce biofuels.

5. References

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