



## A new look at the use of renewable energy in the agricultural industry

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### Abstract

Nowadays, the increasing need for energy consumption in the industry and agriculture sector and supplying this energy with fossil fuels has led to environmental pollutions and climate changes. Therefore, many countries are looking for energy with renewable resources. Due to the significant role of the agriculture sector in the countries' food security and the increased non-petroleum export of oil-producing countries, it is necessary to develop this sector more than in the past. The present research aims to study different renewable energy supply technologies in agricultural industries. The results showed that different types of renewable energies could be used in devices such as solar desalination system, solar dryer, solar seeder robot, water supply pneumatic pump, wind farm, Solid biofuels, biogas and biodiesel systems, greenhouse heating systems using geothermal water resources, and ground source heat pump. Using these systems can result in the significant reduction of fossil energy consumption, reduction of air pollutants, development of related jobs, energy security, and the decrease in the social costs of using fossil fuels. These findings can be widely used in designing and management of different energy systems in agricultural industries.

**Keywords:** Renewable energies, Solar energy, Biomass energy, Geothermal energy, Agriculture

## 1. Introduction

Countries decided to reduce fossil fuels and find alternatives for them following the rise in oil prices. They invested heavily in renewable energy in the research and operational dimension [1]. Human societies are shifting from dependence on fossil fuels to other sources of energy and renewable energies [2]. Renewable energy is essential in terms of job creation and regional economic development. These energies reduce the damaging effects of greenhouse gas emissions.

Agriculture, like economic sectors, needs energy in various forms for development. Its timely and cheap supply is of particular importance in increasing production, reducing production costs, and increasing non-oil exports of countries [3].

Due to the above; strict laws on environmental pollution, the need to use new and renewable energy sources in agriculture is felt [4].

The purpose of research is to study and identify various technologies related to the supply of renewable energy in agriculture.

## 2. Classification of energy types

### 2.1. Energy from the sun

#### 2.1.1. Solar desalination system

Reverse osmosis creates desalination plant creates high pressure by the pump, passes water through a membrane, and removes its impurities [5]. It is used only by

electricity and consumes less energy than other methods. The photovoltaic system can supply power to the pump. In multiple distillations, the cost is low, and the production capacity is high; the system is economically optimized by using a renewable system [12]. Such systems are preferred to conventional systems in remote areas far from the national grid that the cost of electricity transmission is high.

#### 2.1.2. Solar dryer

Indirect natural convection dryers with a 10 to 20 kg capacity are used for drying vegetables and spices, and the chimney type of this system can be used for a capacity of 1 ton [7]. Indirectly forced convection dryers are used for drying wood and agricultural products. Sometimes in this type of dryers, phase change materials are used to heat the flow. By adjusting the flow rate and temperature of the phase change material, the chamber temperature remains in a constant range to increase product quality and speed [8]. Big farms use commercial dryers. The entry and exit of materials are attached to it and are suitable for drying wood lumber and other similar commercial materials [9, 10]. Hybrid dryers use a secondary source such as electricity or biogas to control the temperature range [11].

#### 2.1.3. Solar seeder robot

Autonomous agricultural robots help to increase crop production efficiency and reduce energy consumption [12]. Researchers, with the help of robotics, have shown the high speed of action and the ability to sow seeds [13].

The whole seeding robot system works with batteries. As a result, they use a solar panel to charge the battery [12].

## 2.2. Wind energy

### 2.2.1. Water supply pneumatic pump

One of the problems with wind energy is its temporary nature. Therefore, in addition to all energy sources that are temporary, such as wind and solar energy, a controllable and permanent energy source such as combustion engine and mains electricity should be used. Wind energy is used directly to pump water, and a water storage source can be used to pump water into the tank when the wind flow is high, and the stored water can be used when there is not enough wind [14].

### 2.2.2. Wind farm

The economic advantage of wind farms is their ability to compete with existing conventional power plants [15]. The utilization of wind energy in susceptible areas is a good option for energy supply. Wind power plants prevent wind erosion of lands and reduce wind speed and thus increase crop yield [16].

## 2.3. Biomass energy

### 2.3.1. Solid biofuels

Briquetting of biomass increases density and energy per unit volume. Also, homogeneous products with a constant amount of energy per fuel unit are obtained from heterogeneous raw materials [17]. The use of agricultural wastes is the best way to supply raw materials for solid fuels. The advantages of this fuel include compatibility with the type of consumption, easy transportation, lower price compared to fossil fuels, etc. [18].

### 2.3.2. The use of biogas in poultry

Temperature control in poultry houses is susceptible and vital; therefore, it is better to use biogas as a second fuel. In the cold seasons of the year, biogas consumption is high, and its production is low due to cold weather. It is better to build the production system outside the poultry house due to health issues. Given that the system's input is poultry manure, it should be noted that poultry manure is not always available. Biogas is a clean fuel, and the remaining sludge is rich in fertilizer, free of parasites and weed seeds.

### 2.3.3. Production of biogas from the remnants of plants

Agricultural, industrial and sewage wastes cause severe environmental pollution. By producing biogas, the risks caused by these materials are reduced. Also, energy and fertilizer are produced [19]. Many plant residues are produced in Iran every year. 86% of provinces of the country burn the remnants due to the acceleration of the second planting to fight pests and weeds and prepare the land for planting. With proper management of this large volume of waste, a significant amount of energy can be produced [20].

### 2.3.4. Biodiesel fuel

The best alternative to diesel fuel is biodiesel. Biodiesel is mainly produced from vegetable oils derived from soybeans, canola, and palm [21]. Its economic

advantages include the added value of raw materials, the increase in the number of rural jobs, investment in facilities and equipment, the increase in income taxes for governments, etc. Increasing production and consumption of biodiesel, as well as allocating farms to grow oilseeds, will lead to greater economic prosperity in agriculture.

## 2.4. Geothermal energy

### 2.4.1. Greenhouse heating systems

Greenhouse heating systems are classified as soil, surface, hot air, waterfall, and hybrid systems [22]. In all these methods, the circulation of local natural hot water in the system causes the heat transfer to the greenhouse, then heating or temperature regulation. Due to the lack of fuel needed to heat the system water, fuel consumption is saved, and pollution is reduced to the same extent.

### 2.4.2. Ground source heat pump

The heat pump is used for heating, and the air conditioner is used for cooling. It exchanges heat with the ground. The temperature of the ground changes slightly on different days of the year [23]. Instead of using the energy of the center of the earth, it uses the constant temperature of the earth surface as a source of heat; therefore, it is possible to install this system in any area, while the geothermal system can be used only in areas where geothermal resources are available [24]. The heating or cooling of agricultural buildings is possible in this way.

## 3. Conclusions

The use of different renewable energy sources to provide energy in the agricultural sector has a vital role in reducing fossil energy consumption, reducing air pollutants, growing and developing related jobs, providing energy security, and reducing social costs of fossil fuel consumption. These sources can be used as solar desalination plants, solar dryers, solar panels, water supply pneumatic pumps, wind farms, biofuels, biogas, biodiesel, geothermal water resources, and ground source heat pump. These findings can be widely used in designing and management of different energy systems in agricultural industries.

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