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ABSTARCT

The study's goal is to determine if it is possible to lower energy costs in the agriculture sector by using the Republic of Karakalpakstan's experience with the introduction of alternative energy sources. Farmers in the Republic of Karakalpakstan have started researching and analysing different strategies to increase the agricultural sector's energy efficiency. These strategies include nutrient management, which involves planting native vegetation species, timing fertilisation, liming, applying manure right after fertilisation, and using compost or liquid suspension produced, for instance, by anaerobic digestion of manure. All of these strategies lower soil processing, which is a well-known and successful way to lower energy consumption in arable systems. Reduced farming expenses and greenhouse gas emissions are often the associated benefits. Changes in irrigation, switching from traditional tillage to reduced or zero tillage, lowering fertiliser application rates, improving nutrient management techniques that minimise nutrient losses, lowering plant protection intensity and mechanisation level, early decommissioning of inefficient machinery, switching to crops that use fewer fertilisers and other energy resources, growing grass as part of crop rotation or as cover and intermediate crops, producing biogas on farms from plant residues and manure, and alternatives to livestock management in terms of feeding, housing, and manure treatment are examples of possible resource substitutions. Advanced technologies for land cultivation and harvesting must be used in line with the republic's zonal features in order to protect and improve soil fertility. It is found that political and agricultural changes, income diversification, land conservation, and more sensible resource usage are the primary instruments for the development of sustainable agriculture.

Keywords: organic farming, mechanised processes, natural and climatic circumstances, sustainable agriculture, economy, and alternative energy sources.

INTRODUCTION

The most crucial element of agricultural production is energy, which powers machinery, irrigates crops, fertilises the soil, maintains animals, and moves and prepares food. To keep up with the rising demand for food, agricultural output must rise in tandem with population growth. At the same time, effective agricultural production with low energy usage is necessary due to environmental and energy restrictions. Crop yields per unit area of land must be increased while preserving the environment's and soil's integrity. This delicate balance may be attained and maintained with the use of efficient energy management strategies. Fossil fuels today supply the majority of the energy needed for almost every function in the food system. The necessity of energy efficiency—using less energy to achieve the same level of output and services—is highlighted by the need to make efficient use of limited natural resources, lower greenhouse gas emissions, minimise energy costs, and boost the agri-food sector's competitiveness.

In the Republic of Karakalpakstan, increasing energy efficiency in the agri-food chain is a top goal and a crucial component of the green development plan. The energy consumption and potential for energy efficiency of food production systems vary greatly, mostly based on the particular activity and agroecological circumstances. This indicates that there are many options for energy conservation, but more study is now needed to find prospects. Concerns about the effects of high or fluctuating energy prices on production costs, competitiveness, the ultimate price of food for the consumer, and energy security are raised by the increasing reliance on energy consumption (mostly fossil fuels) across the food chain. In addition to these issues, the food chain's energy consumption may have negative effects on the environment, including greenhouse gas emissions. Despite the advancements, more may be done by the public and commercial sectors to guarantee that the food system's potential for energy efficiency is fully realised. One of the most important areas of the world economy is agriculture.

It promotes the development of regional industrial and service industries as nations grow. Numerous businesses rely on agriculture to survive. Agriculture will become an independent economic sector as technology advances. He will have the power to decide when to buy products and services. While on-site quality control solutions are

being developed, it is anticipated that certain manufacturing operations will be moved to agricultural facilities.

One of the Republic of Karakalpakstan's most significant economic sectors and one of the few where economic indicators are consistently rising is agriculture. Simultaneously, there are many issues in the agricultural industry that need attention at both the highest governmental level and the level of small farms. According to this perspective, some natural criteria are required for agriculture to fully flourish. The climate varies by location. The quantity of precipitation and sunny days determine the sort of crops planted and their production.

Among the goals of the reforms implemented in the electric power sector are increasing the proportion of energy produced from alternative and renewable sources in the nation's energy balance, guaranteeing the continuous supply of electricity to consumers, minimising technical and technological losses by establishing generation sources in areas near consumers, and efficiently managing the resources that are available. In farms of all kinds, using chances for electrification and energy conservation may boost output, save costs, and lessen environmental effects. The energy-efficient solutions listed below have been shown to save costs and save energy. Fossil fuels today supply the majority of the energy needed for almost every function in the food system. The necessity of energy efficiency—using less energy to achieve the same level of output and services—is highlighted by the need to make efficient use of limited natural resources, lower greenhouse gas emissions, minimise energy costs, and boost the agri-food sector's competitiveness. Growing resource shortages and accelerating climate change are placing previously unheard-of strain on the world community and might have detrimental effects on people's future well-being and the stability of important ecosystems. Nearly every kind of product and animal may be grown in the Republic of Karakalpakstan due to its diverse climate.

The primary prerequisite for agriculture to be considered sustainable is that it must satisfy the demands of both the current and future generations, guaranteeing both profit production and the preservation of socioeconomic equality and environmental health. Therefore, it is essential to guarantee a considerable growth in the world's food supply against the backdrop of few land and water resources. And in order to achieve sustainable agricultural output, more intensive techniques and new technology must be used. Therefore, the primary strategy for improving global food security and lessening the detrimental effects on the environment is the broad use of contemporary technology and developments in agriculture. Reforms in this field must also be regularly implemented due to the expansion of food production, the sustainable use of land, and agriculture's adaptability to climate change. The Republic of Karakalpakstan's extensive agrarian reforms have resulted in a consistent agricultural growth rate. In all three aspects of sustainability—environmental, social, and economic—sustainable food production and agriculture help to increase the four key elements of food security: availability, accessibility, usage, and stability. The study's goal is to determine if it is possible to lower energy costs in the agriculture sector by using the Republic of Karakalpakstan's experience with the introduction of alternative energy sources.

The study's methodology and findings. Farmers in the Republic of Karakalpakstan have started researching and analysing different ways to increase the agricultural sector's energy efficiency: nutrient management, which includes planting local vegetation species; timing fertilisation; liming; applying manure right after fertilisation; using compost or liquid suspension obtained, for instance, as a result of anaerobic digestion of manure; all of these reduce processing soil is a well-known and effective measure to reduce energy use in systems that are arable. Reduced farming expenses and greenhouse gas emissions are often the associated benefits. The use of equipment, mostly for tillage and harvesting, is often the second greatest energy use in rain-fed agricultural systems. Using systems with little or no tillage is one method of lowering machine energy usage. Although the amount of fuel used depends heavily on the kind of soil, the depth of ploughing, and the quantity and kind of secondary cultivation, non-tillage always uses less fuel than typical arable systems.

Improving soil water permeability and lowering greenhouse gas emissions are two further benefits of not tilling. No-till techniques may sometimes cut the amount of fuel used for farming by 60–70% and the overall cost of equipment by 50%. They may also lessen carbon losses from the soil. When a no-till system is implemented, these cost savings often result in an instant rise in profitability, even in situations where yields, for instance, do not react favourably in the first few years. Large farms may also benefit from technical advancements like GPS-based precision farming and guided road maintenance thanks to the practice of no tillage, which raises energy and resource efficiency. Thus, the use of renewable energy generated by wind, solar, biofuels, biomass and waste, geothermal, and small hydraulic facilities, as well as methods and technologies that lower energy consumption per unit of output, are solutions in the area of sustainable energy. Agriculture has been developing and changing in the last several years. Farming systems have a wide range of energy requirements, which may be used to lower energy usage and increase energy efficiency. These include, in general, changes in the demand for agricultural products, resource substitution in agriculture, and technical advancements. When it comes to the energy efficiency of all main resource types, technological advancement is possible. More effective equipment, better agrochemical management (e.g., precision farming with targeted management of nutrients, pesticides, and water on site), more

effective irrigation systems, genetically enhanced plants and livestock, better insulation, efficient light sources, and more effective heaters are some examples of key tactics. Additionally, biomaterial and bioenergetic approaches may be used. For instance, a wide variety of isolated energy crops, plant residues, livestock manure, and agricultural processing byproducts can be transformed into energy or industrial material cellulose into biofuels; the development of improved crop varieties for the production of industrial oils and biopolymers aids in lowering consumption and reliance on fossil fuels.

By substituting inputs, current technology may also enhance energy efficiency and save energy on farms. The state of the economy, particularly the price of energy, is the reason for the replacement of input resources. The overall energy intensity at a given production level will decrease if the relative cost of energy rises. However, since energy is present in practically all agricultural inputs to varied degrees, the ensuing substitution consequences may be complicated. Variations in the demand for agricultural products have an impact on the overall output volume and, in turn, the total energy consumption in the food system. Market pricing, regulations, and customer preferences all influence demand. The human diet may shift toward fewer energy-intensive items as a result of these causes, and demand for renewable energy sources and goods may rise. Changes in relative energy costs are the most significant impact on the demand side. Increased energy costs push consumers toward eco-friendly products by widening the gap between them and energy-intensive ones. Changes in irrigation, switching from traditional tillage to reduced or zero tillage, lowering fertiliser application rates, improving nutrient management techniques that minimise nutrient losses, lowering plant protection intensity and mechanisation level, early decommissioning of inefficient machinery, switching to crops using fewer fertilisers and other energy resources, growing grass as part of crop rotation or as cover and intermediate crops, producing biogas on farms from plant residues and manure, and alternatives to livestock management in terms of feeding, housing, and manure treatment. By investing in more energy-efficient machinery and altering other aspects of their farming practices, farmers will eventually have more freedom to lower their energy use.

The majority of the energy used in the manufacture, packing, and delivery of fertilisers is used indirectly rather than directly on the farm. Water, hybrid seeds, and animal feed are additional energy inputs. However, there are some drawbacks to decreased tillage. The most significant of them is the widespread use of herbicides, which are often employed to reduce the development of weeds that would otherwise be managed (at least in large-scale agriculture) by ploughing and other more intense tillage techniques. Energy is used in the actual manufacture of herbicides. On average, however, burning herbicides is said to use less energy than tillage. Second, a reduction in tillage may potentially result in lower crop yields, depending on soil and climate circumstances. Additionally, there was perhaps a greater reliance on mulching materials that compete with one another for use as animal feed. Which feeds are shifted determines the energy balance. Using accurate technology that determine the ideal quantity, time, and location of resource utilisation to reduce fuel and fertiliser consumption is another technique to improve agricultural energy efficiency. The advancement of remote sensing and information technology has made precision farming, a relatively new management technique, practical. This method of managing the whole farm aims to improve agriculture's environmental effect while maximising return on investment. However, the potential of various technologies varies, and the effects on energy efficiency and the environment must be particularly taken into account. The issues facing agriculture in assuring higher crop yields globally in more challenging settings with less availability of resources like soil, water, and nutrients and decreased usage of plant protection chemicals include climate change, the expanding global population, and the associated food demands. The social component of sustainable development should be considered while realising economic and environmental potential under suitable regional circumstances. Consequently, the integration of agricultural practices and technology should be linked to food production. Sustainable agriculture, which is increasingly "organic" in today's world, is one of the key components of the so-called "green" economy. Due to the tremendous wastefulness of this agricultural production system, agriculture in the contemporary world does not completely fulfil the demands of the global community. In this sense, the growth of organic farming and animal husbandry is emerging as a new trend in contemporary agriculture. Supporting educational initiatives, utilising economic innovations and developing new technologies to ensure stable access to food that meets human needs, ensuring access for impoverished groups, developing commodity production, lowering unemployment and raising income levels in order to combat poverty, managing natural resources, and protecting the environment are all necessary to solve the problem. In this sense, agriculture's sustainable growth is a pressing concern for both the nation and its many areas.

No sector of the economy has seen as significant changes in recent decades as agriculture. Special loans are needed for agricultural projects that will preserve natural biodiversity, cultivate monocultures on comparatively vast areas, and preserve natural landscapes like meadows, wastelands, and swamps in order to establish and promote sustainable agriculture. Fertiliser, animals, and feed should all be seen as a single equilibrium system. The agro-industrial sector, which employs the greatest number of people worldwide and is often engaged in global land usage, is a key player in the sustainable development of the agricultural sector. It threatens natural ecosystems,

contributes around 25% of greenhouse gas emissions worldwide, is essential to the world's food supply, and is susceptible to climate change. The Republic of Karakalpakstan's economy heavily relies on the agricultural and agro-industrial sectors. Because of this, investments in agriculture have some of the finest results, boosting economic expansion, enhancing food security, and combating poverty. Despite a steep decline in the number of farmers, particularly in wealthy nations, agricultural productivity has expanded considerably. The economic, social, and environmental imperatives of sustainable development are widely acknowledged. The economic plan calls for the development of a "green" economy and the efficient use of finite natural resources. Social: seeks to eradicate poverty, lessen harmful conflicts, and protect cultural and social structures. From an ecological perspective, sustainable development should guarantee the survival and integrity of biological and physical natural systems. It should be mentioned that unsolved global issues are the objective precondition for the creation of the idea of sustainable agricultural development. Global warming, depletion of land resources, contamination of rural groundwater, devastation of natural habitats, etc. are particularly pertinent issues.

When creating energy-saving strategies, it is essential to increase understanding of how and where energy is consumed. It is crucial to have accurate data about the net advantages of energy savings in order to determine if large-scale energy efficiency expenditures to lower energy demand are more lucrative than the cost of new energy suppliers. This covers the programs' expenses, the energy saved, and any related advantages. Energy efficiency was not given much consideration by manufacturers or consumers until recently. For instance, the food sector prioritises the given product's safety, quality, and cleanliness. Energy efficiency is often not seen as a requirement, but rather as a priority when energy costs are high. In conclusion. From the foregoing, it can be inferred that the development of sustainable agriculture and the advancement of environmental policy can result from the establishment of favourable conditions through the use of energy-saving technologies and alternative energy sources. Advanced technologies for land cultivation and harvesting must be used in line with the republic's zonal features in order to protect and improve soil fertility. In order to meet the demands of an expanding population, it is necessary to: establish a program for the introduction of cutting-edge technologies; provide information support for farmers and agricultural enterprises; raise awareness of the need to conserve and maximise the potential of the most fertile agricultural lands. To keep anthropogenic strain at a sustainable level, low-yielding areas must protect and restore their natural resources. Based on this, we believe that agricultural reforms, improving soil fertility, conserving land, and making more sensible use of water and land resources are the primary instruments for the development of sustainable agriculture in the Republic of Karakalpakstan.