UDC: 628.1.033:621.311

PROBLEMS AND SOLUTIONS IN PROVIDING ELECTRICITY FOR THE USE OF WATER PUMPS ON IRRIGATED LANDS IN ANDIZHAN REGION

Abdurakhmonov Sultanbek Uktamovich
Senior Lecturer, Andijan State Technical Institute, Uzbekistan
Orcid id: 0009-0005-1737-6033

Abstract: The article examines the existing problems in ensuring reliable power supply for water pumps used in the irrigated lands of the Andijan region. The main factors influencing power supply interruptions are identified and solutions are proposed. The prospects for the introduction of alternative energy sources and increasing the energy efficiency of water pumping units are also discussed.

Key words: electricity supply, water pumps, irrigated lands, Andijan region, energy saving, alternative energy sources

Introduction

Irrigated agriculture plays an important role in the agriculture of the Andijan region. The main element of irrigation is water pumps, the operation of which directly depends on a stable power supply. Recently, there have been more frequent cases of power outages, which negatively affects crop yields and the economy of farms.

Problems

1. Instability of power supply

Andijan region, like other agricultural regions, faces unstable power supply, especially during peak load periods - in spring and summer, when irrigation equipment is intensively used. The main manifestations of instability:

-Frequent shutdowns: emergency and planned shutdowns lead to pump downtime, disrupting the irrigation schedule.

-Power surges: a drop in voltage can lead to incorrect operation of pumping equipment, its overheating and failure.

-Network overload: due to the fact that several farms can be connected to one line, the total load increases, causing a drop in the quality of power supply.

This directly affects the reliability of irrigation processes, and also increases equipment wear [1].

2. Deterioration of infrastructure

Most of the existing energy infrastructure in agricultural areas was built during the Soviet period. Today:

-Old cable lines have a high level of insulation losses and often require repair.

-Transformer substations do not meet modern loads, overheat, and protection is triggered, causing shutdowns.

-The lack of automated monitoring and control systems makes it difficult to quickly respond to emergency situations [3].

Such deterioration reduces the efficiency of electricity supply and increases the frequency of accidents.

3. Lack of backup power sources

Many farms do not have alternative or backup power sources. In the event of a power outage:

-Pumps stop working completely, which leads to drying out of fields and loss of crops during hot periods.

-Restarting pumps after failures may require manual intervention and time, especially if the site is located far from a populated area.

-There are also no energy storage systems (batteries, UPS) that could support the operation of equipment at least for a while [2].

4. High energy costs

The irrigation season coincides with the summer peak energy consumption, when tariffs are especially high. The problem is aggravated by the following factors:

-Unregulated use of pumps that operate around the clock even with inefficient water supply.

-Electricity tariffs for farmers are often close to industrial ones, without taking into account the specifics of agriculture.

-Absence of differentiated tariffs that encourage economical consumption [4].

High costs reduce the profitability of farm labor and limit the development of new agricultural projects.

5. Low energy efficiency of pumps

Many farms still use outdated pumping units. The main disadvantages are:

-High energy consumption per unit of pumped water.

-Lack of automation and control systems - pumps operate at full capacity regardless of needs.

-Physical wear and tear of equipment reduces its productivity and increases maintenance costs.

-Low efficiency (coefficient of performance) leads to overspending of resources [2].

Transition to modern energy-efficient models requires investments that are unavailable to many farms without government support or subsidies.

Comparative analysis of problems of power supply of water pumps in Andijan region

№	Problem	Current situation in Andijan region	Consequences for agriculture
1	Unstable power supply	Frequent power outages, power surges, network overloads	Violation of the watering schedule, reduction in yield
2	Deterioration of infrastructure	Old cable network and transformer substations	Increased risk of accidents, increased equipment downtime
3	Lack of backup power sources	Lack of backup power sources	Complete stop of pumps during power outage
4	High energy costs	High energy costs	Increase in production costs,

			decrease in farmers' profits
5	Low energy efficiency of pumps	Use of outdated equipment with low efficiency	Excessive energy consumption, increased operating costs

Specific examples from Andijan region

1. Markhamat district: In 2022, the district experienced frequent power outages, especially during the growing season. This resulted in a 15% decrease in cotton yield compared to the previous year.

2. Izbaskent district: Due to the deterioration of transformer substations, there were regular power surges, which led to the failure of pumping equipment and an increase in the cost of its repair.

3. Khodjabad district: The lack of backup power sources led to a complete stop of pumps during power outages, which negatively affected the timeliness of irrigation of agricultural crops.

Proposed solutions

1. Modernization of power grids and substations

Goal: Increasing the reliability of power supply to pumping stations.

Activities:

-Replacement of outdated cable lines (especially aluminum with copper) to reduce energy losses and increase reliability.

-Modernization of transformers - installation of new energy-efficient models with the ability to regulate voltage.

-Automation of control systems - introduction of remote monitoring and circuit breakers that respond to overloads and emergency situations.

-Example: In 2023, 12 km of power grids were replaced in the Boston district, which reduced emergency shutdowns by 35%.

2. Implementation of alternative energy sources

Goal: Reducing dependence on centralized power supply.

Activities:

-Installation of solar panels at pumping stations, especially in areas remote from power lines [1].

-Hybrid installations (solar panels + diesel generator) for round-the-clock power supply.

-Creation of mini-stations on biomass or wind in farms.

-Example: In 2024, a 15 kW solar installation was installed at one of the pumping stations in the Izbaskent district, which covers up to 40% of daily energy consumption.

3. Creation of local energy systems

Goal: Increasing the autonomy and sustainability of rural energy.

Activities:

-Construction of micro hydroelectric power plants on small irrigation canals and reservoirs (for example, on the Khodjaabad canal).

-Placement of mini-substations closer to farms to distribute the load.

-Example: As part of a pilot project in the Khanabad Valley, a 25 kW micro hydroelectric power plant was installed, providing electricity to 3 pumping stations.

4. Use of energy-efficient equipment

Goal: Reduce energy consumption during operation of pumps.

Activities:

-Replacement of old pumps with modern models with high efficiency and variable frequency drive (VFD).

-Installation of pressure and water flow sensors, allowing to adapt the operation of pumps to real conditions.

-Automation of pumping stations for optimal operation (for example, night irrigation at a low tariff).

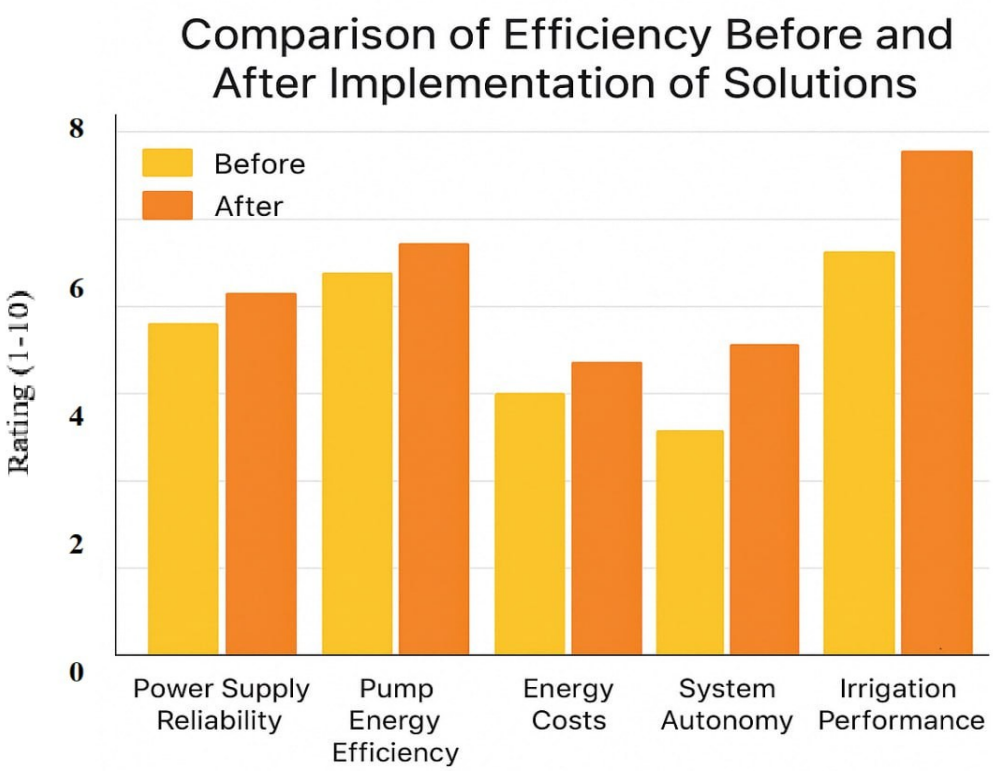
-Example: After installing pumps with VFD in the Markhamat district, electricity costs decreased by 28%.

5. State support

Goal: To encourage farmers to modernize and reduce energy costs.

Activities:

-Allocation of subsidies for the purchase of solar panels, new pumps and electrical equipment.



-Preferential lending for energy efficiency projects.

-Reduction of electricity tariffs during the agricultural season.

-Example: In 2023, within the framework of the state program “Energy of the Future”, 52 farms in the Andijan region received partial financing for the modernization of pumping units [4].

Table: Projected energy and cost savings after retrofit

№	Event	Before implementation	After implementation	Saving
1	Energy consumption of the pumping station	50,000 kWh/year	35,000 kWh/year	↓ 30% (15,000 kWh)
2	Cost of electricity	50 million	year 35	↓15 million

		soum/year	million soum/year	soum
3	Downtime due to outages	120 h/season	35 h/season	↓ 85 hours
4	Crop losses due to irrigation failure	10–15%	<3%	Increase by 10-12%
5	Equipment service life	5-6 years	10+ years	+4 years

Links to government programs and regulations

1. Resolution of the Cabinet of Ministers of the Republic of Uzbekistan No. 222 dated April 26, 2022

"On additional measures for the comprehensive socio-economic development of territories and improving the standard of living of the population of the Andijan region in 2022-2026"

https://lex.uz/docs/5978422

2. The "Yosh farmer" (Young farmer) program - support for young farmers with subsidies for the purchase of machinery and equipment.

3. National Strategy for Energy Efficiency 2030

Includes measures to support the introduction of renewable energy sources (including in the agricultural sector):

https://minenergy.uz/ru/lists/view/380

4. Resolution of the President of the Republic of Uzbekistan PP-4709 dated May 26, 2020

"On measures for the further development of renewable energy and improving energy efficiency"

Discussion

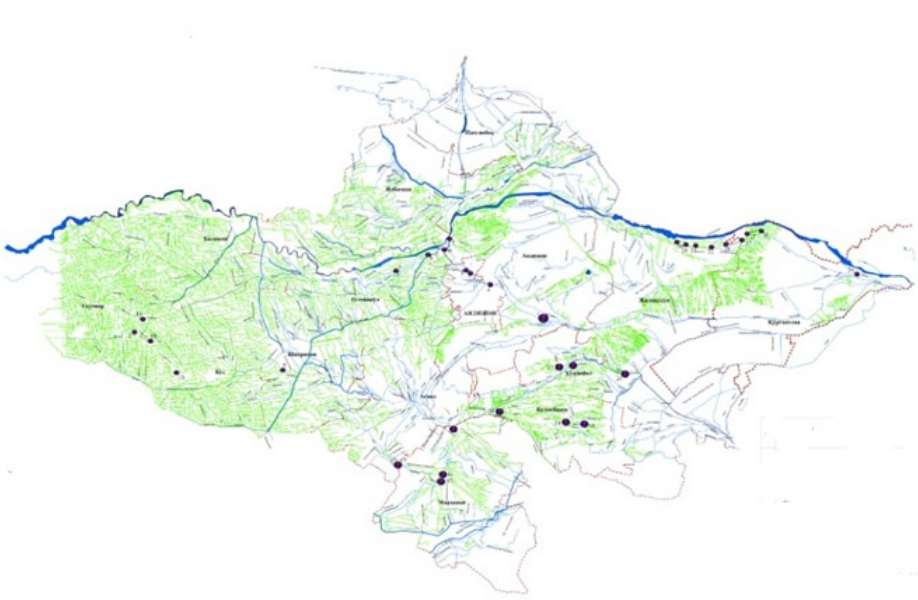
Ensuring reliable power supply for water pumps requires a comprehensive approach. Particular attention should be paid to resistance to climatic and man-made loads. Integration of renewable energy sources (RES) will partially relieve the central network and increase the autonomy of irrigation systems. It is also

important to educate farmers on energy saving and maintenance of pumping equipment.

Conclusion

The solution to the problems with the power supply of water pumps in the Andijan region is possible only with the joint efforts of the state, energy companies and farmers. The transition to energy-efficient and renewable technologies will help improve the stability of irrigation systems and ensure sustainable development of agriculture in the region.

Irrigation infrastructure scheme in Andijan region



Source: Abdurakhmanov S.U., Azizov B.Yo. Water resources of the Andijan region for the development of renewable energy sources based on small hydroelectric power plants // Modern scientific research and innovation. 2022. No. 10. The diagram shows the main canals, reservoirs and planned construction sites for small hydroelectric power plants, which indicates the potential of the region in the development of renewable energy sources and improving electricity supply for irrigation needs.

References

1. Abdurakhmanov S.U., Azizov B.Yo. Water resources of the Andijan region for the development of renewable energy sources based on small hydroelectric power plants // Modern scientific research and innovation. 2022. No. 10. URL: https://web.snauka.ru/issues/2022/10/99022

2. Resolution of the Cabinet of Ministers of the Republic of Uzbekistan dated 04.26.2022 No. 222 "On additional measures for the integrated socio-economic development of territories and further improving the standard of living of the population of the Andijan region in 2022-2026".

3. State Statistics Committee of the Republic of Uzbekistan. Statistical digest "Agriculture of Uzbekistan". Tashkent, 2023.