The Value of the Cards in Water Basins with the Installation of Solar Power Plants in Yangiyul District of Tashkent Province of Uzbekistan

Ilhomjon Musaev[1,*], *Abdujalol* Bokiev[1], and *Mukhtaram* Botirova[2]

[1]Tashkent Institute of Irrigation and Agricultural Mechanization Engineers, 39, Kory Niyoziy, 1000000 Tashkent, Uzbekistan
[2]Sector of the master plan and transport. Research Institute "Uzogirsanoatloyiha" Tashkent, Uzbekistan

Abstract. The article considers the possibility of using the surface of various reservoirs characteristic of regions when allocating land for low-power solar power plants in Uzbekistan. When implementing low-power solar power plants in Uzbekistan, a certain amount of land resources is required (for installing solar panels). From the point of view of respect for natural capital (saving land resources), the method of installing solar panels directly above the surface of water basins based on the corresponding maps of water basins is technically and economically effective. The methodological basis of the research is the results of researchers work on the problems of land relations and land management. In the research, a systematic approach to the analysis of land use has been chosen, in which a variety of tools were used to determine the essence of the analyzed phenomena, processes and patterns. In recent years, industry has been rapidly developing in rural areas of the Yangiyul district of Tashkent Province of Uzbekistan. In this regard, the problems of effective use of land resources, especially targeted use of irrigated land, has become urgent. This means that in the future there will be problems when allocating land for the installation of low-power solar power plants.
Keywords. Land resources, irrigated land, seasonality, renewable energy sources, efficiency, resource conservation, water basins, map.

1Introduction

The purpose of the study is to develop proposals and recommendations for the use of the surface of various water basins, when allocating land for low-power solar power plants in Uzbekistan. To achieve this goal, the following tasks are set:

- Study theoretical and methodological issues of improving the rational and efficient use of agricultural land in accordance with current conditions;
- Study of land allocation features for alternative energy sources;
- Analysis of the state of the land Fund and the current state of its use;

* Corresponding author: ilkhommus@mail.ru

At the present stage of economic reforms in Uzbekistan, the problems of land and energy resources are being solved through the introduction of modern resource-saving and energy-efficient technologies. When implementing low-power solar power plants in Uzbekistan, a certain amount of land resources is required (for installing solar panels). From the point of view of respect for natural capital (saving land resources), the method of installing solar panels directly above the surface of water basins based on the corresponding maps of water basins is technically and economically effective.

Many researchers have worked in the theoretical and practical development of solar energy. Yandra Shivrat [1] in his article on "cost analysis of small solar and wind power systems" hypothesizes that in the next few years, when the cost of solar photovoltaic modules falls below $ 1 per Watt, Piyali Ganduli, Akhtar Kalam Aladin Zayeg [2] in their research note that a renewable energy system consisting of solar and wind energy is an environmentally friendly and cost-effective option for feeding rural areas compared to traditional sources. Sheriazov Saken Koishybayevich [3] in his dissertation work, as the object of research, chose a combined system of energy supply to agricultural consumers using solar and wind power plants. The methodological basis of the research is a systematic approach to the analysis of a complex power supply scheme. In the work of Tashimbetova M. A [4] the complex use of renewable energy in the Republic of Kazakhstan is considered. Based on the example of DJambyl region of southern Kazakhstan, a justification for the choice of a combined energy complex based on RES for the purpose of power supply of a rural locality with a required capacity of 100 kW was carried out.

In the work of Ahmed Torki and Ahmed Jailanp [5] the subject of research is to provide electricity to autonomous rural consumers based on the use of renewable energy sources in order to develop autonomous systems for combined electricity supply to farms in Egypt using renewable energy sources and a backup liquid fuel power plant. Yarmukhametov Ural Rashitovich [6] in his dissertation work, as the subject of research, chose the regularities of changes in the performance of ship power plants depending on geographical latitude, climatic conditions, design parameters and the degree of orientation of the receiving surface to the sun. In addition, we used a number of literature on the preparation of special maps and plans for energy facilities, in particular solar power plants by remote sensing methods of domestic and foreign [9,10,11,12,] scientists.

One of the most effective is the experience of great Britain, Japan, China and Lithuania in implementing a system for using alternative energy sources installed on the surface of water basins. For example, on a lake in the Berkshire region (Great Britain), rafts are launched on the water, on which 800 photovoltaic panels are installed. Their total power is 200 kW. Such structures are not tied to large areas of land, and they can be built on almost any reservoirs [13]. The state-owned enterprise Lietuvos Energijos Gamyba (LEG) will create an floating solar energy systems together with scientists from the Kaunas University of technology (KTU) LEG and KTU plan to install an experimental 60-kilowatt floating solar power plant in the upper basin of the Kruonisskoi PSPP. The total capacity of the future project should be 200-250 megawatts. [14]. Kyocera TCL Solar LLC launched a 13.7 MW floating power plant at the Yamakura Dam reservoir in Ichihara in 2018. Interest in floating solar power plants was aroused after the rapid development of alternative energy in Japan, and it became increasingly difficult to allocate space for new projects. The water surface is suitable for this purpose. [15] in early June 2017, China launched a photovoltaic plant capable of producing 40 megawatts of energy, which floats on an artificial lake in Anhui province in China are described in Figure 1 and Figure 2 [16].

Fig. 1. A floating photovoltaic plant at the Yamakura Dam in Ichihara

Fig.2. A floating photovoltaic plant on an artificial lake in Anhui Province in China

International experience of installing solar power plants on the surface of water basins shows that there are many effective methods of installing solar power plants on the surface of water basins. Floating photovoltaic installations can be divided into three categories:

- photovoltaic installations consisting of modules mounted on pontoons;
- photovoltaic modules mounted on plastic and galvanized steel rafts;
- Photovoltaic modules installed on rafts are made entirely of plastic.

At the Asian clean energy summit in Singapore (October 2017), the world Bank Group gave two figures for solar floating installations worldwide: 453 MW in 2017 and a forecast of 750 MW for 2018 [19]. With the right scientific-based approach, there are great opportunities in the Republic of Uzbekistan when allocating land plots for solar power plants. In Yangiyul district, there are many natural and artificial water basins (rivers, soybeans, channels), and their banks are very convenient for installing solar panels.

2 Methods

The theoretical and methodological basis of the research is the results of researchers work on the problems of land relations and land management. In the research, a systematic approach to the analysis of land use has been chosen, in which a variety of tools were used to determine the essence of the analyzed phenomena, processes and patterns.

In the experimental part of the study, calculation and analytical methods, correlation and regression methods were widely used. The use of methods that are adequate to the studied phenomena allowed to ensure high reliability of the results obtained. A special program called ArcGIS was also used to create land maps for low-power solar power plants

3 Results

The main land plots of the Yangiyul district of the Tashkent region are fertile, irrigated land. In turn, the efficiency of using these lands is higher than the average for the Republic.

In recent years, industry has been rapidly developing in rural areas, including in the Yangiyul district. In this regard, the issue of effective use of land resources, especially the targeted use of irrigated land, has become urgent. This means that in the future there will be serious problems when allocating land plots in the district for the installation of energy facilities, in particular solar power plants. Based on this, the studied territories of towns such as Gulbakhor, Bozsuv, Nov, Karsadok, Kovunchi, villages such as Khalkabad, Navbahor, Niyazbashi, Kushyagach, Shuralisoy and Eski- Kovunchi (Table 1).

Table 1. Water basins of Yangiyul district

№	Names (river, sai and canals)	Length (km)	№	Names (river, sai and canals)	Length (km)
1	Northern Tashkent Canal	10,1	11	Shuralisoy Canal	0,3
2	Boysen channel	4,8	12	Kesken Canal	9,7
3	Jun Channel	20,5	13	Tuyabugizsoy Canal	16,7
4	Upper Tashkent Canal	19,5	14	Canal B-45	6,8
5	Dam channel	5,8	15	Canal P-16	11,9
6	Niyozbosh Canal	11,7	16	Canal P-14	6,4
7	Kirtqurgon 1 Canal	12,1	17	Salargurunchi Canal	9,4
8	Kirtqurgon 2 Canal	7,6	18	Kichik Jun Canal	7,9
9	Chortoqshox Canal	5,9	19	Novoprokopevskiy Canal	5,8
Total:		**178.2**			

Table 2. Open drainage networks of the district

Names	Amount	Length (km)
Total drainage networks:	**531**	**1486.8**
- trunk drainage networks	38	106,4
- interdistrict drainage networks	72	201,6
- inter-farm drainage networks	146	408,8
- drainage networks on the balance of the water user association	275	770

Special attention was paid to the rivers and channels that flow through the district, and not only their banks, but also the possibilities of water surfaces were studied. For example, using 15-20% of the surface of rivers and channels flowing through the district, it will be possible to produce much-needed clean electricity.

The main attention was paid to the possibility of constant cooling of solar panels and cleaning their surfaces. Figure 2 shows a map of the most suitable areas of the banks and surface of rivers and channels flowing through the territory of Yangiyul district for installing solar power plants.

In carrying out the above-mentioned research works, it is of great importance to use geo-information systems data and their rational placement on agricultural crops, as well as to increase the projected volume of agricultural production and the volume of irrigated land. As a result of these studies, a map of the most suitable territories of the banks and surface of rivers and channels flowing through the territory of the Yangiyul district for installing solar power plants using GIS was compiled (Fig. 3). The results of studying the GIS database can provide an opportunity to conduct the following research:

- environmental and energy analysis based on data on irrigated land;
- development of long-term strategic plans;
- forecasting the size and yield of reserve land;
- implementation of construction in the area for installation of solar power plants with minimal costs;
- to prevent the process of salinization of the lands or save it in the same condition, to predict, etc.

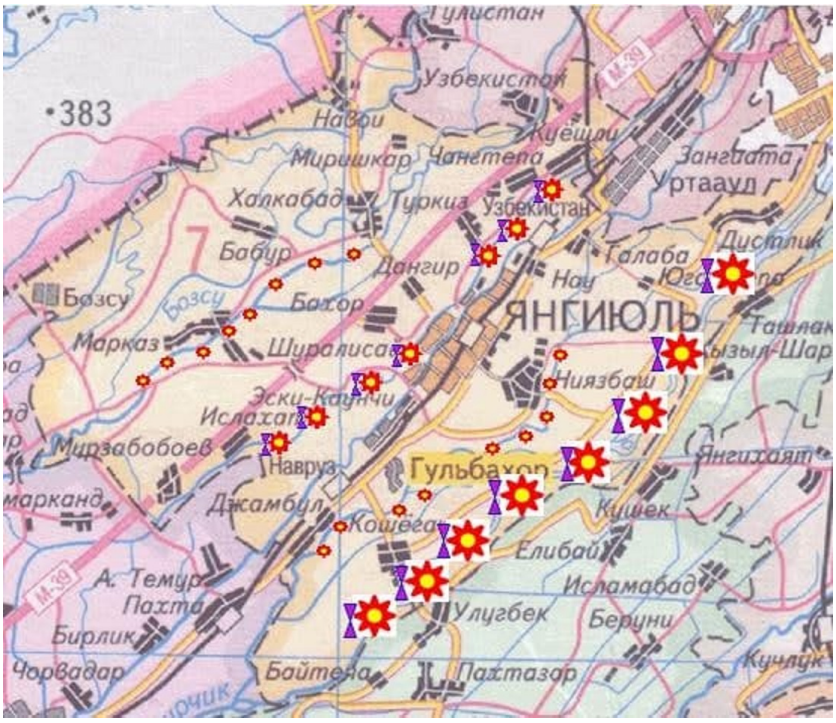

Fig. 3. Map of the most suitable territories of the banks and surface of rivers, channels flowing through the territory of the Yangiyul district for the installation of solar power plants.

From the above it is seen that on the banks of the river Chirchik, each of the protective tributaries can be installed 8 solar power plants with a capacity of 300 kWh, located on the banks local canal “Moscow” from the city of Tashkent in the North-Eastern side of the district 8 solar power plants with capacity of 50 kWh, directly on the banks of the canal Jun flowing through the city of Yangiyul 7 solar power plants with a capacity of 100 kWh.

In accordance with all environmental and other requirements, along the riverbed lines that flow through the settlements of Niyazbash and Gulbakhor, there are 9 solar power plants with a capacity of 30 kWh. The total output is 3770 kWh for the district. As a result, a three-stage program project and a corresponding map for 2020-2025 were developed to identify optimal zones for the construction of small solar power plants in the Yangiyul district.

Taking into account the above, the construction of solar power plants directly along or on the surface of the water basin (Fig. 4, 5 and 6) will eliminate these problems and create opportunities for the development of animal husbandry in these regions, processing of fruits and vegetables, and cereals directly in the field.

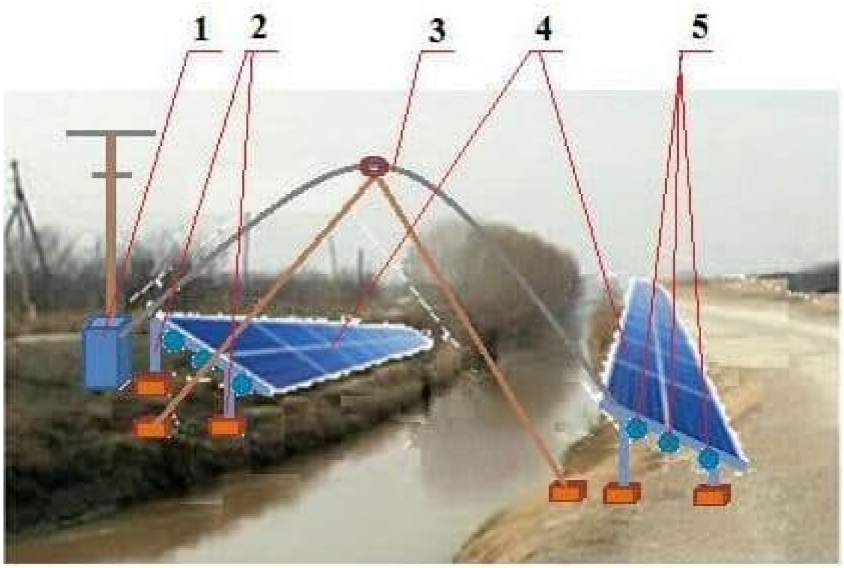

Fig. 4. Ways to install solar panels along the water basin. 1-control panel; 2-base frame; 3-jumper cables; 4-photovoltaic panels; 5-cooling system

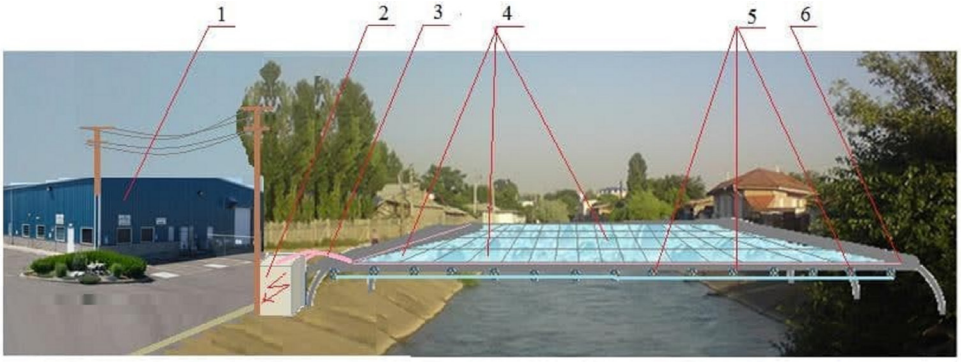

Fig. 5. 1-small enterprise; 2-controller (inverter); 3-jumper cables; 4-solar panels; 5-cooling system; 6- ground rods

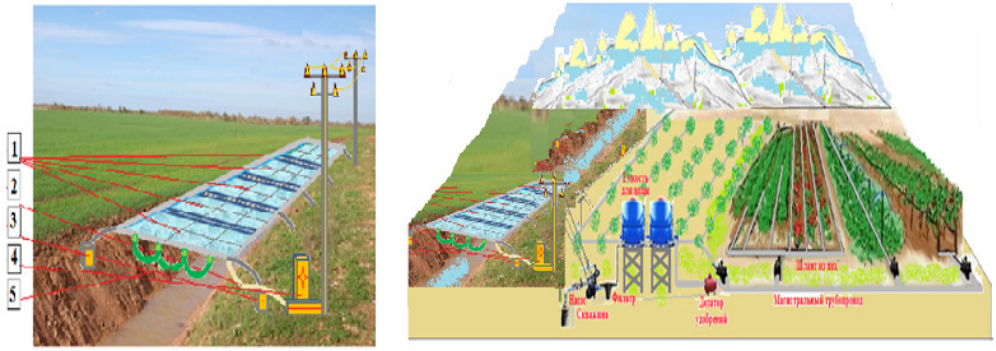

Fig. 6. 1-solar panels; 2-jumper cables; 3-ground rods; 4-controller (inverter); cooling system

4 Discussion

One of the promising areas of energy supply for decentralized remote agricultural facilities is the use of solar energy for heat supply by solar collectors and electricity supply by solar photovoltaic installations [6]. The gross potential of solar energy coming to the territory of Uzbekistan annually exceeds the energy potential of all the country's hydrocarbon reserves and amounts to 50973 million t. e [7]. The demand for food, agricultural products of humanity is growing from year to year in connection with growth of world population, the rapid development of industry, the environmental degradation of the planet as a result of global climate change, limited natural wealth, such as land and water resources, rational use of land resources, the development of agriculture.

In recent years, the Republic of Uzbekistan has been conducting research aimed at introducing renewable energy sources, in particular solar and wind power plants. In this sense, the legal framework for allocating land plots for these energy facilities requires improvement in terms of effective use of land plots. [8]

Photovoltaic power plants, sometimes centralized, distributed, tower, roof, and so on, but these are some ground-based photovoltaic power plants. After all, land resources on earth are limited, and the degree of their availability is limited. Therefore, there is a growing interest in floating solar photovoltaic power plants on water. The structural composition of a floating photovoltaic plant mainly consists of photovoltaic panels plus a floating structure. The cost of using a floating installation is about 1/4 of the cost of a steel bracket (the cost of a steel bracket is about 5% -6% of the total cost of a ground-based photovoltaic power plant). [17]

A 2018 World Bank report estimated that the global potential of floating solar panels on artificial water surfaces will exceed 400 gigawatts. [18]

In addition to funding public and private investment, the World Bank Group is committed to supporting the development of floating solar energy. Publications and tools planned for the "Where the sun meets the water" series:

- Report on the floating solar energy market
- Guide to floating solar energy for practitioners
- Global mapping of floating solar energy potential (geospatial tool)
- Proposed technical projects and project structuring. [20]

In Uzbekistan, the introduction of methods for installing solar power stations on the surface of water basins should be associated with the development of maps of water basins. This requires the association of scientists surveyors and power engineers to conduct joint research in this direction

5 Conclusions

Based on the conducted research, the following conclusions can be drawn:

- To improve land use efficiency, it will be important to locate alternative energy sources based on science-based methods, placing them on land that is not being used to the maximum extent possible.
- Installing such devices along or on the surface of water bodies in densely populated agricultural areas saves valuable land resources.
- It is necessary to develop science-based systems of measures for the implementation of water basin maps that provide for the installation of solar power plants on the surface of water basins, training of service personnel, etc. This, in turn, increases the level of reliability and efficiency of power supply, creates favorable conditions for the widespread introduction of modern resource-saving electrical technologies in remote areas.

- It is important to use data geographic information systems in the preparation of maps and plans in rational placing of agricultural crops, as well as an increase in the projected volume of agricultural production and the amount of irrigated land, most suitable areas of the coast and surface of rivers, canals flowing through the area to install solar power plants using GIS.

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