Utilizing Wind and Solar Energy to Mitigate Desertification in Mountainous Landscapes

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Abstract: The article discusses the factors influencing the desertification process in mountain and foothill landscapes, as well as the possibilities of using wind and solar energy in mountainous areas.

1 INTRODUCTION

Presently, the phenomenon of desertification is extensive, affecting not only flat desert terrains but also foothills and mountainous landscapes. A key factor contributing to this issue is the increasing anthropogenic pressure on the local population. To illustrate this, we examine the case of mountain and foothill landscapes surrounding the Middle Zarafshan valley, where the desertification process is gaining momentum.

2 DISCUSSION OF KEY FINDINGS

The Nurata mountain system, encircling the Middle Zarafshan valley from the north, comprises Gobdin Mountain, Karachatagy, Aktag, and Karatags from east to west, along with the Nurata ridge. In the valley's south, you find Chaqilqalan, Qoratepa, Zirabulak, and Ziyovutdin mountains. The highest peaks in both ranges slightly surpass 2,000 meters. These mountains slope down from east to west, transitioning into high hills at the western edges. Many mountains feature streams and extensive karst springs, predominantly flowing on the northern and southern slopes, with surrounding villages varying in size based on water availability.

Due to moderate mountain heights, cattle can graze in most places. However, areas distant from villages with scarce and fragmented springs see minimal livestock grazing. Villagers near springs graze their livestock year-round. Considering an average-sized village with a hundred families, each having around ten sheep and goats, approximately 1,000 sheep and 300 cattle graze within a 5-6 km radius daily. Larger villages, such as Gos, Zinak, Qoratepa, Ohalik, Sazaghan, Aksay, Josh, Chuya, Jizmon, and Maidan on the northern slopes of the Chaqilqalan Mountains, have populations exceeding 10,000. As populations grow, cattle numbers increase, resulting in 5-15 times more livestock than pasture capacity. The rising goat population, particularly, poses a threat to shrubs and trees, causing substantial damage to the mountain environment.

Villagers in the mountain foothills utilize tree branches, shrubs, and mountain vegetation for baking bread in ovens. Additionally, they use bushes, trees, and livestock waste for cooking and heating homes in winter. Unfortunately, near villages, trees and shrubs have been completely cleared from mountain slopes.

In recent years, "woodcutter" groups have emerged in villages, selling truckloads of firewood at prices ranging from 1,000,000 to 1,500,000 sums. In the Samarkand region cities, firewood prices have surpassed 2,000,000 sums.

The extensive felling of trees, coupled with increased cattle numbers, is severely impacting mountain ecology. Erosion and soil loss occur on bare slopes, contributing to reduced spring water levels and drying springs. This process of mountain

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desertification is expected to intensify with population growth.

Mountains act as significant water accumulators, absorbing atmospheric precipitation. Some groundwater, formed through filtration, condensation, and siltation, surfaces as springs. To counter desertification, it is crucial to provide adequate heating and fuel to mountain communities, and the viable solution lies in harnessing unconventional energy resources.

Uzbekistan benefits from 290-320 sunny days annually, with a solar energy potential of 50,973 million tons of oil equivalent. Currently, only 0.3% of solar energy is utilized in the country. Solar energy applications in mountainous and foothill landscapes include electricity generation, heating houses, pumping groundwater, drying fruits, and irrigating hillsides.

While the cost of electricity from solar photovoltaic stations (FES) is currently slightly higher, installing solar panels in remote residential areas without power grids proves more economical. With village expansion and increased electricity usage, there's a growing need to expedite solar energy adoption to meet population demands.

Wind energy stands as an inexhaustible resource in Uzbekistan. The technical potential of wind energy is 9.9 billion kW/s per year at 10 meters above the surface. Globally, wind energy is a rapidly growing industry, accounting for varying percentages of electricity generation in different countries. The average annual wind speed in Uzbekistan's open plains ranges from 4-7 m/s, making wind energy viable, even in mountainous areas with constant wind paths.

The value of electricity generated by wind farms decreases with increasing wind speed, making wind power competitive with coal-fired power plants. The use of wind energy, along with solar and biogas, can contribute significantly to meeting the energy needs of mountain and foothill communities.

Livestock herds, abundant in these areas, provide a valuable resource for biogas production. Biogas plants can utilize livestock waste, as well as other biomass like aquatic plants and tree branches. Biogas energy already plays a substantial role in some developed countries.

In addition to solar and wind power, small hydropower plants can generate electricity using rivers in mountainous and foothill regions. Numerous experiments with solar and wind power plants have been undertaken in the Zarafshan Valley, particularly in hospitals and villages, demonstrating the feasibility and benefits of renewable energy sources. Hand-made wind power plants have been successfully operating in Bulungur district for over a decade.

3 CONCLUSIONS

In mountain and foothill plains, the construction of solar and wind power plants in close proximity is advisable due to their complementary nature. Wind stations prove beneficial during winter and spring when solar panel activity decreases. Concurrently, efforts are underway to develop and promote small biogas plants. Methane, constituting 55-70% of cattle rot, can be utilised for cooking, heating, and electricity generation.

The implementation of non-traditional energy resources in mountain and foothill landscapes not only enhances local convenience but also creates opportunities for developing vast expanses of land. Currently, large foothill areas serve as pastures due to water scarcity, but with the use of wind and solar energy, groundwater extraction and drip irrigation technologies can transform these areas into orchards, vineyards, and fields for growing vegetables and melons on tens of thousands of hectares.

By employing solar, wind, biogas, and hydropower for heating homes in mountainous and foothill landscapes, there is a significant reduction in the population's reliance on firewood. This results in the restoration of natural trees and shrubs on mountain slopes, thereby improving the overall mountain ecology. Access to electricity in mountainous regions, coupled with the development of mountain gardening through irrigation from springs and streams using motors, contributes to the creation of picturesque landscapes. In essence, the effective use of non-conventional energy sources stands as a crucial tool in halting the rapidly accelerating desertification process in mountains and foothills.

The exploration of non-conventional energy resources represents a paramount task in contemporary geographical sciences. Maps detailing the distribution of these resources serve as a foundation for planning the installation of power generation equipment and the efficient utilisation of non-conventional energy resources.

A pivotal task for geographical sciences involves studying the wind and solar energy reserves in all regions and districts of the country. This exploration aims to assess non-traditional energy resources, conduct scientific research, and ascertain their strength and magnitude.

REFERENCES

Alibekov, L. A. (1991). Stripes of life: Between mountains and deserts. Moscow: Nauka.

Adilova, O. A. (2021). Problems of Protection and Reproduction of Trees and Bushes in Mountain Conditions of the Middle Zerafshan Valley. Nature and Science, 19, 13-17.

Adilova, O. A. (2021). Criteria for assessing the process of desertification in mountainous and foothill areas (on the example of Gubdintau). International scientific and practical journal, Economy of society, 4(83), 550-556.

Akramov, Z. M. (1961). Agricultural geography of Samarkand and Bukhara regions. Part 1.

Alibekov, L. A., & Nishonov, S. A. (1978). Natural conditions and resources of Djizzak region. Tashkent.

Suyarov, Y. E. (2010). Some issues of using non-conventional energy sources. Geography: history, theory, methods, practice, March 26-27, Tashkent.

Kholiqulov, Sh., Hamzin, Q., & Rahmatullaev, A. (2002). Meteorology and climatology. Short course. Samarkand.

Raxmatullaev, A. (1991). Landscapes of the Aktau Ridge, their rational economic use and protection. Tashkent: Fan.

Rakhmatullaev, A., Adilova, O., (2013). Desertification in mountain geosystems: a case study of the Ishmantupsay basin in the Gobduntau mountain range, Uzbekistan. Oecologia. International Journal of Mountain Ecology, 22, 26-30.

Rakhmatullaev, A., & Adilova, O. (2014). Methods of studying the process of desertification in the mountains with the help of experimental plots. Information of the Geographical Society of Uzbekistan, 43, 3-5.