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Evaluation of Different Statistical Techniques For Developing and Experiment of Derivation Micro Hydro Power Plants

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ABSTRACT: The ministry of energetic of Uzbekistan has proposed the SHP (Small Hydro Power) scheme to achieve a cumulative capacity of 778 TW·hour from small and micro hydro projects (MHPs) till 2030. Initial stage investigation of these projects require accurate investment cost estimates to carry out the feasibility studies. Although many previous research studies developed various cost estimation models for SHPs, they can't be directly employed for cost estimation of micro hydropower as well without their comprehensive evaluation. Therefore, this paper focuses on estimation of cost correlations for MHPs using different statistical methods to test the viability of these methods and to present a distinctive approach for more accurate cost estimates. This study meticulously analyzes a total of three methods; the former two methods utilize the existing approaches to evaluate each cost component individually in order to derive the respective cost expressions. And, the third method explores the effects of employing multivariate polynomial regression model for the development of cost correlations, which is validated further on the basis of MAPE (mean absolute percentage error). The proposed method yields an MAPE of less than 5% for total project cost of MHPs while it is found more than 20% using aforesaid methods.

KEY WORDS: Micro hydro projects, Project cost, Electromechanical equipment cost, Civil works cost.

I. INTRODUCTION

The first stage of construction of the first small hydroelectric power station was carried out from the 18th century. In this case, it was necessary to install small hydroelectric power stations in areas with permanent water flows. It was mainly intended to supply electricity to small enterprises and small residential areas. Since installed small hydroelectric power stations were not very powerful, they were supplanted by small thermal power plants, which could be located anywhere [2].

The second stage of construction of small hydroelectric power stations corresponded to the years 1940-1950. In the CIS, the USA, Japan, France and other countries, its number was more than 1000 [9, 26]. However, attention to small hydroelectric power plants has decreased, and many countries have decommissioned more than 100 small hydroelectric power plants. The main reason for this is the construction of large-scale hydroelectric power plants, thermal power plants (PPPs), nuclear power plants (NPPs) and transmission lines for the delivery of electricity to remote areas [3].

The third stage of the development of small hydroelectric power plants has reached a new level in terms of quality over the past 15 years. For example, if we look at the example of Russia, it should be said that here too, small hydropower is included among local and regional objects. Accordingly, financing of their construction was carried out by republics, autonomous districts, regions, relevant enterprises, farms and individuals within the Russian Federation. Small

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hydropower has taken a stable place in all countries with water resources. The use of small hydroelectric power plants has been used as an environmentally friendly device and, in turn, has led to the saving of traditional fuels [4].

II. LITERATURE SURVEY

Today, the share of large and small hydroelectric power stations in the world in electricity production can be seen in table 1 [1].

Table 1

Energy source	Annual electricity production, TW·hour		Percentage, %		Growth rate, %
	2006	2030	2006	2030	2007-2030
Large HPP	2725	4383	14.4	12.4	2.0
Micro HPP	252	778	1.4	2.2	4.7

As can be seen from the table 1.1, the demand for small hydropower plants in the world will increase by almost 3 times by 2030. We can see that their share will increase by 0.8% [1].

Within the framework of the adopted program on measures for the further development of hydropower in 2017-2021, it is envisaged to increase the ecologically clean hydropower production capacity of our republic by 1.7 times by 2025 due to the construction of 42 new hydroelectric power stations and the modernization of 32 operating hydroelectric power stations [5].

III. SYSTEM ANALYSIS

Derivative aqueducts (canals, tunnels, pipes) transport water with low hydraulic losses and serve to generate pressure due to the difference in the natural bed and the gradient of the aqueduct.

Derivative channels are the most common and common in terms of their construction. It is used in the derivation scheme without pressure. Canals with a trapezoid cross section are common. The channel can be aerated, thrown or half-aerated and half-abandoned [6].

Exponential tests are common in industry for verifying that tools, systems or equipment are meeting their reliability requirements for mean time between failure (MTBF) assumption is that the system has a constant failure (or repair) rate, which is the reciprocal of the MTBF. The waiting time between failures follows the exponential distribution model [7].

A typical test situation might be: a new complex piece of equipment or tool is installed in a factory and monitored closely for a period of several weeks to several months. If it has no more than a pre-specified number of failures during that period, the equipment "passes" its reliability acceptance test.

This kind of reliability test is often called a Qualification Test or a Product Reliability Acceptance Test (PRAT). Contractual penalties may be invoked if the equipment fails the test. Everything is pegged to meeting a customer MTBF requirement at a specified confidence level [8].

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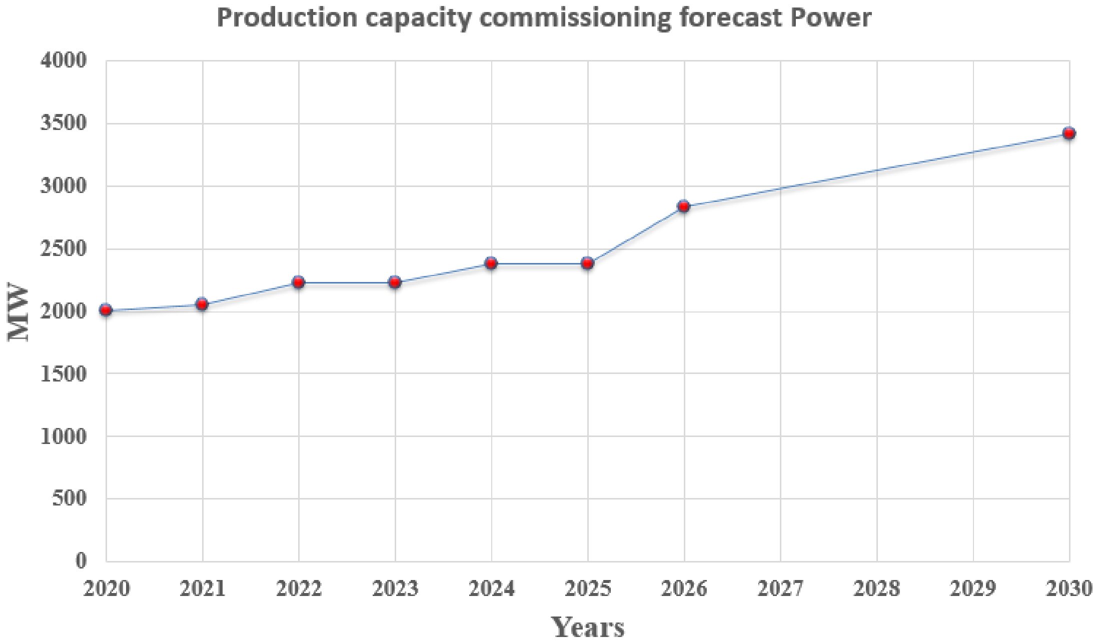

Fig. 1 Production capacity commissioning forecast power within 2020 and 2030 years.

Marketing research conducted to study the countries producing micro hydroelectric power plants, as well as the analysis of literature and Internet resources, showed that currently, in practice, microhydroelectric power plants with a hydraulic head of 3-18 meters are used mainly for plot, derivation, plot-derivation and free flow [10].
At the upper level of the dam, there is a water receiver, from which the water pressure is directed to the derivation emitter (tunnel or pipe). At the end of pressurized water heaters, a pressure-limiting, equalizing tank is often installed in the derivation of hydro-hammer. The water coming from the equalization reservoir to the HPP building is brought in the turbine water separator [9].

IV. CONCLUSION

This article focuses on estimation of cost correlations for MHPs using different statistical methods to test the viability of these methods and to present a distinctive approach for more accurate cost estimates. This study meticulously analyzes a total of three methods; the former two methods utilize the existing approaches to evaluate each cost component individually in order to derive the respective cost expressions. And, the third method explores the effects of employing multivariate polynomial regression model for the development of cost correlations, which is validated further on the basis of MAPE (mean absolute percentage error). The proposed method yields an MAPE of less than 5% for total project cost of MHPs while it is found more than 20% using aforesaid methods.

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