Analysis on the Influence of Pumped Storage Power Station Serving Rural Revitalization

Wei Xu[1], Shucheng Cai[1], Yutong Han[2,*]

[1]Zhejiang Taishun pumped storage Co. Ltd, Wenzhou, Zhejiang 325500, China
[2]North China Electric Power University, Beijing 102209, China

*hyt990705@foxmail.com

Abstract. Pumped-storage power stations are often built in economically less developed rural areas due to the objective requirements of the project. Their construction and operation can create job opportunities for rural residents, improve rural infrastructure, promote the development of poverty-stricken areas, and have significant benefits for the economic, social, and ecological development of the local area. However, the specific impact pathways and promoting effects are not clear, and there is a lack of quantitative analysis. Taking the A Pumped-storage Power Station in Zhejiang Province as an example, conducting a field survey of the pumped-storage power station and surrounding rural areas can help clarify the impact pathways of the construction and operation of pumped-storage power stations on the implementation of the rural revitalization strategy in a comprehensive manner, and analyze the role of pumped-storage power stations in the rural revitalization strategy.

Keywords: Rural Revitalization, Pumped Storage Power Station, Questionnaire Survey.

1 Introduction

Pumped-storage power stations are often built in economically less developed rural areas due to the objective requirements of the project. Their construction and operation can create job opportunities for rural residents, improve rural infrastructure, promote the development of poverty-stricken areas, and have significant benefits for the economic, social, and ecological development of the local area. However, the specific impact pathways and promoting effects are not clear, and there is a lack of quantitative analysis. Taking the A Pumped-storage Power Station in Zhejiang Province as an example, conducting a field survey of the pumped-storage power station and surrounding rural areas can help clarify the impact pathways of the construction and operation of pumped-storage power stations on the implementation of the rural revitalization strategy in a comprehensive manner, and analyze the role of pumped-storage power stations in the rural revitalization strategy.

Q. Wu et al. (eds.), *Proceedings of the 2024 3rd International Conference on Public Service, Economic Management and Sustainable Development (PESD 2024)*, Advances in Economics, Business and Management Research 309,
https://doi.org/10.2991/978-94-6463-598-0_41

2 Research Status at Home and Abroad

Pumped storage power stations, as basic energy facilities, have a huge investment scale, and the construction of the geographical environment is relatively demanding, to meet the height difference between the upper and lower reservoirs of the power station and the natural conditions of natural water sources, so they are mostly located in economically backward rural areas. During the construction of the power station, it can effectively promote the revitalization of the countryside in the region and help the economic development of the region. Domestic and foreign scholars have carried out a series of studies based on this.

Foreign scholars believe that the construction of pumped storage power station can effectively promote the local economic, social and ecological development. Barros et al. (2017) used a probabilistic and analytical model to assess the direct employment generated by power stations over their entire life cycle, showing that renewable energy remains the most direct job creation option [1]. Zvirgzdins, and Linkevics (2020) assess the possibility of constructing pumped storage power plants and their contribution to the country [2]. Lu et al. (2021) propose that renewable energy supported by pumped storage can be a cost-effective solution for Southeast Asia's energy transition that can provide long-term, measurable environmental benefits [3].

Chinese scholars believe that the construction of pumped storage power stations can not only promote local economic growth, promote the development of tourism and the construction of new business models, but also improve the local ecological environment. Based on the "two mountains" theory, Huang Jian et al. (2021) pointed out that the development of industrial tourism by pumped storage power stations is a vivid practice to help rural revitalization, studied and analyzed the significance and challenges of the development of industrial tourism by pumped storage power stations, proposed development principles and safeguard measures, and provided new ideas for the development of industrial tourism by pumped storage power stations in the new era [4].

In terms of the resettlement of power stations, Jia Peng (2018) analyzed the main problems existing in the planning of the resettlement of pumped storage power stations and the requirements and characteristics of new rural construction. Taking the Xidazhuang resettlement site of Henan Tianchi pumped storage power Station as an example, some thoughts on the planning of resettlement site are put forward [5]. Wang Zhigang and Dou Chunfeng (2022) took the resettlement work of Luoning Pumping and storage Power Station as an example, analyzed the resettlement policy and development process, summarized the successful experience and characteristics of the resettlement of this power station, combined with the characteristics and planning of hydropower project resettlement in the new era, and provided new resettlement methods and ideas for the resettlement work of other pumping and storage power stations [6]. Li Liangdong et al. (2024) examined the particularity of the resettlement mode of Jiufengshan pumped storage power Station from the perspective of rural revitalization, and proposed a new resettlement mode of "suitable relocation + suitable production + suitable beauty + suitable living + civilization" for land expropriation and resettlement of Jiufengshan pumped storage Power Station, which accumulated case experience for subsequent

large-scale land expropriation and resettlement of pumped storage power station projects in Henan Province [7].

In terms of power plant benefit evaluation, Ye Ze et al. (2020) analyzed the benefits of pumped storage in the power market from two aspects: the power market and the auxiliary service market, based on the functions of peak clipping and valley filling, peak regulation, frequency regulation and phase regulation provided by pumped storage power stations against the background of power marketization [8]. Wei Xinxu (2021) conducted a comprehensive evaluation and analysis of the benefits of pumped storage power stations based on the three dimensions of financial indicators, national economic indicators and social benefit indicators [9]. Xu Sanmin et al. (2021) evaluated and analyzed the carbon reduction benefits of pumped storage power stations under the background of "dual carbon target" [10]. The above evaluation mostly stays on the benefit improvement of the power station itself, and the benefit analysis of the service of rural revitalization is less.

From the above scholars' research on pumped storage power stations serving rural revitalization, it involves a wide range of dimensions, and the results are more concentrated in the macro field, but the specific impact path and improved benefits are rarely involved, and there are few studies in the micro field. In summary, in order to better understand the impact path of pumped storage power station serving rural revitalization, this paper takes A pumped storage power station in Zhejiang as an example to carry out field research on pumped storage power station and its surrounding rural areas, which is helpful to comprehensively clarify the impact path of the whole cycle of pumped storage power station construction and operation on the implementation of rural revitalization strategy. The role of pumped storage power station in rural revitalization strategy is analyzed.

3 Research Method

A pumped storage power Station is located in Anji County, Huzhou City, Zhejiang Province. The preparatory work started in June 1992, officially started on March 1, 1994, and the first unit was put into operation in January 1998, with a total construction period of eight years, and it was completed and put into operation at the end of December 2000. The installed capacity of the power station is 1.8 million kW, the storage capacity of the upper reservoir is 10.46 million kW·h, of which the daily cycle energy is 8.66 million kW·h, the annual electricity generation is 3.16 billion kW·h, and the annual pumped electricity consumption (valley filling electricity) is 4.286 billion kW·h, and the system undertakes the peak-valley difference task of 3.6 million kW. A Power Station is the one with the largest installed capacity and the highest water head among the similar power stations that have been built or are under construction in China. It is also the largest pumped storage power station in Asia and ranked second in the world, and the main equipment of the power station is imported from abroad. The power station hub mainly consists of upper reservoir and lower reservoir, water transmission system, central control building and underground powerhouse.

In this paper, the qualitative and quantitative investigation of A pumped storage power station is carried out by means of household interview and questionnaire survey. The interviewees involved all the departments of pumped storage power station (including office, Party building Department of the Party Committee, safety supervision Department, planning and contract Department, financial assets Department, operation and maintenance Department), Shangreservoir scenic area and Daxi Village and Yucun village governments; And 500 questionnaires were distributed to the villagers of Daxi Village in the form of questionnaire star. The questionnaire included 42 items, including the convenience of life, quality of life, satisfaction, happiness index and annual income and expenditure of villagers before and after the construction of pumped storage power station.

4 Results and Analysis

4.1 Influence Path

After in-depth interview, the influence path of A pumped storage power station serving rural revitalization is mainly divided into the following two aspects:

The construction of power stations and roads has greatly increased the convenience of residents' production and life (such as entertainment, education, medical care, etc.), and greatly promoted the development of tourism industry and the rise of farmhouse music. The tourism industry includes Tianchi scenic area, hotels, hot springs, ski resorts, observatories and so on. The scenic spot provides about 150 jobs and now has about 100 long-term employees. Ski resort holidays will hire temporary workers, about 30-40 people; Among them, returning students can earn about 2,000 yuan in 15-20 days. Employees of the scenic spot are basically residents around the mountain, with an average monthly salary of about 4000-5000 yuan; Among them, the monthly salary of the department manager is about 10,000 yuan, the technical staff is about 4,000 yuan, and the room cleaning is about 3,500 yuan. Due to the current epidemic, the annual turnover of the scenic spot is about 30 million yuan. Among them, the ski resort receives 60,000-70,000 people a year (100,000 people/year before the epidemic), and the ticket price is 300 yuan/two hours.

The construction of the power station promotes the employment of local residents (such as property management, transportation, material procurement, security, fire fighting, etc.), and the power station will carry out fund assistance and foreign donation projects for local villagers every year, and help the disabled and students in danger and distress.

4.2 Survey Results

The Office is responsible for the promotion of rural development in the areas of property, transportation, material procurement, etc. In terms of property, the property includes cleaning, deworming, meeting arrangement, scattered maintenance, garbage removal and green plant maintenance, etc., which can provide about 86 jobs with a salary of about 400-5000 yuan, and the local people account for about 2/3. Afforestation costs

about 500,000-600,000 yuan per year. In terms of food distribution, the food distribution contract is generally signed with local large supermarkets or individual businesses, and the annual procurement fee is about 3 million yuan, 20 of the 30 canteen staff are local, and the pre-tax salary of basic staff is about 4,000 yuan, and the chef is about 6,000 yuan.

In the business of the Party Building Department of the Party Committee, the foreign donation project involves the promotion of rural development. The power station has been supporting the She minority in the town for nearly 16 years, and officially registered the She minority Charity Donation Fund in 2016. Donated a computer room, the fund is about 500,000-600,000 yuan; Pairing to help Maying Village, Zhanjia Town, Zhejiang Province, spent about 6 million yuan to establish a new type of farmers' market and common rich building, 200,000 yuan a year to low-income farmers subsidies, this year added two 900,000 yuan of help funds. In terms of party building assistance, there is a heart-to-heart service team with Yu village. On the 15th of every month, we cut the hair of the elderly, cut their nails, take their blood pressure, and clean up the garbage.

Among the operations of the Department of Safety Supervision, security and fire protection are related to the promotion of rural development. The firefighting team consists of 13 firefighters, 2 water tankers, and 1 emergency vehicle, and until 2017, participated in local fire brigade rescues. Responsible for fire prevention publicity in schools and primary and secondary schools, local compulsory fire prevention work, and participate in cleaning up debris flows in mountainous areas; Signed a fixed fire facilities maintenance contract with Hangzhou maintenance unit; Fire rescue has made a great contribution to the protection of local property. Most of the security staff recruited are local residents, with an average age of 54.

The Ministry of Financial Assets is primarily concerned with tax collection related to rural revitalization. The power station lost money in the first two years of construction; After that, it is profitable every year, and the annual income tax and value-added tax are about 200-300 million yuan, of which 150 million yuan of value-added tax is paid locally.

The operation and maintenance department is mainly responsible for operation and maintenance. The maintenance cost is about 50 million, and the technical transformation cost is about 50 million. Auxiliary operation and maintenance personnel have a variety of positions, such as system maintenance, ventilation and air conditioning, all auxiliary operation and maintenance personnel of about 300 people, can solve the employment problem of more than 100 local residents; During the repair period, the repair period of A is 72 days, B is 30 days, and C is 21-24 days. The foreign lodging personnel basically live in local hotels, about 800 yuan per month, and about 100 yuan per person per day. The accommodation expenses shall be borne by the winning bidder. Professional technical service staff are mostly local people. In terms of environmental protection work, through the oil-water separator project to ensure that the discharged water is up to standard, sampling testing will be carried out manual testing; Factory noise monitoring will be carried out, and employees will have production condolences and occupational health check-ups. Fire training, occupational health training for the whole company.

In this paper, a total of 500 questionnaires were distributed to the villagers of Daxi Village in the form of online questionnaires, and qualitative and quantitative investigations were conducted on the annual household income and expenditure of the villagers of Daxi Village, the convenience of life, the quality of life, various satisfaction and happiness index of the villagers before and after the construction of pumped storage power station. The survey results are as follows:

The villagers of Daxi Village believe that compared with the construction of pumped storage power station, the willingness to work and start businesses in the local area has increased (66.4%), the impact of income (47.2%) and expenditure (43.4%) has increased, and the impact of old-age care (47.8%), marriage (38.8%) and funeral (34.4%) has been positive. The convenience of travel (50.8%), schooling (45.8%), medical treatment (41.4%), employment (47.4%), shopping (43.0%) and eating (43.0%) increased. In the village, sewage treatment (53.2%), garbage treatment (54.6%), greening (50.8%), beauty (52.8%), agricultural facilities (53.0%), power supply and water supply (57.0%), spiritual appearance (51.6%), and safety (51.0%) improved. The level of environmental protection publicity (69.4 percent), cultural and entertainment activities (58.6 percent), happiness (62.8 percent), confidence in the future life (65.6 percent), confidence in policies that benefit farmers and people (60.4 percent), attention to news and current affairs (58.2 percent), and pride in being Chinese (67.8 percent) increased. 37.4% of the villagers think that the construction of the power station does not pollute the local environment, 29.2% of the villagers think that there is pollution but no impact, 29.6% of the villagers think that there is pollution and slightly impact. Due to the construction of pumped storage power stations, the most training that villagers participated in was catering (15.6%), transportation (14.2%) and construction (12.6%).

4.3 Current Problems and Future Improvement Directions

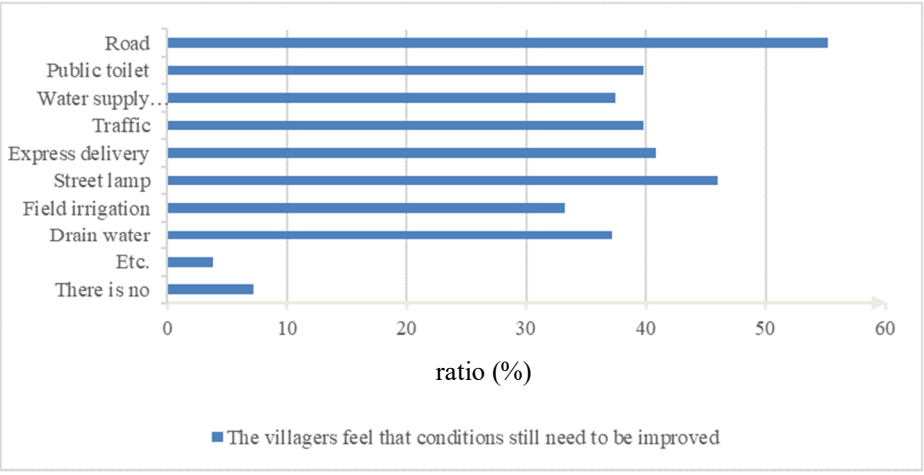

Fig. 1. Conditions that villagers think still need to be improved.

In the survey questionnaire, Daxi villagers believed that roads (55.2%), street lights (46%), express delivery (40.8%), transportation (39.8%), public toilets (39.8%), water supply and power supply (37.4%), drainage (37.2%), farmland irrigation (33.2%) and other (3.8%) in the village still need to be improved. Also, 7.2% of the villagers think there is no need for improvement(see Fig. 1).

Based on the above survey results, pumped storage power stations can take the problems with a high proportion of roads (55.2%), street lights (46%) and express delivery (40.8%) as the direction of future improvement, first improve the living experience and satisfaction index of villagers, and then gradually improve the problems of transportation, public toilets, water supply and power supply, drainage, and farmland irrigation.

At the same time, more than half of the villagers still believe that the construction of the power station has polluted the local ecological environment. The power station should continue to follow up the pollution control work, increase the capital and manpower investment in pollution control work, and regularly investigate the source of pollution.

5 Conclusion

Through in-depth interviews and questionnaire survey results of A Power Station and surrounding rural areas, it can be seen that pumped storage power station serves rural revitalization mainly in the following two aspects: First, the construction and road construction of the power station greatly increases the convenience of residents' production and life (such as entertainment, education, medical care, etc.), and greatly promotes the development of tourism industry and the rise of farmhouse music; Second, the construction of power stations promotes the employment of local residents (such as property, transportation, material procurement, security, fire protection, etc.).

After the completion of the A Power Station, the villagers' willingness to work and start businesses in the local area has increased, the impact of income and expenditure has increased, and the impact of pension, marriage and funeral has been positive, and the convenience of traveling, going to school, seeing a doctor, employment, shopping and eating has increased. The village has improved in terms of sewage treatment, garbage disposal, greening, beauty, agricultural facilities, power supply and water supply, spiritual outlook, and safety conditions, as well as environmental protection publicity, cultural and recreational activities, happiness, confidence in future life, confidence in policies that benefit farmers and people, attention to news and current affairs, and pride in being Chinese.

At the same time, the villagers believe that the village roads, street lights, express delivery, transportation, public toilets, water supply and power supply, drainage, farmland irrigation and other conditions still need to be improved, and more than half of the villagers still think that the construction of the power station pollutes the local ecological environment. The power station should continue to follow up the pollution control work, increase the capital and manpower investment in pollution control work, and regularly investigate the source of pollution.

Acknowledgement

This work was supported by grants from the Science and Technology Project State Grid Xinyuan Company LTD. (SGXYKJ-2022-120)

References

1. Juan José Cartelle Barros, Manuel Lara Coira, María Pilar de la Cruz López, Alfredo del Caño Gochi, Comparative analysis of direct employment generated by renewable and non-renewable power plants, Energy (2017).
2. J. Zvirgzdins, O. Linkevics. Pumped-storage hydropower plants as enablers for transition to circular economy in energy sector: a case of Latvia[J]. Latvian Journal of Physics and Technical Sciences (2020).
3. Bin Lu, Andrew Blakers, Matthew Stocks, Thang Nam Do,Low-cost, low-emission 100% renewable electricity in Southeast Asia supported by pumped hydro storage, Energy (2021).
4. Huang Jian, Zhang Jikun, Gao Xinping, et al. Discussion on the development of industrial tourism in pumped storage power stations [J]. China Electric Power Enterprise Management (2021).
5. Jia Peng, Hou Yongchao. Dip a pumped-storage power station of resettlement planning thought [J]. Journal of jilin water conservancy (2018).
6. Wang Zhigang, Dou Chunfeng, LAN Yan et al. Practice and exploration of resettlement in the new era based on Luoning pumped storage Power Station[J]. People's Yellow River (2022).
7. Li Liangdong, Yu Gang, Liu Chao. Study on resettlement model of Jiufengshan pumped storage Power Station from the perspective of rural revitalization[J]. Yellow River (2024).
8. Ye Ze, Huang Shanshan, Wang Yali. Electricity market reform under the background of pumped storage power plant electricity price mechanism study [J]. Journal of price theory and practice (2020).
9. WEI Xinxu. Comprehensive benefit evaluation and analysis of pumped storage power station [J]. China Science and Technology Information (2021).
10. Xu Sanmin, Zhang Gong, Wang Fang, et al. Carbon emission reduction calculation method of pumped storage based on CCER rule [J]. Electric Power of China (2019).