



Journal of Applied Sciences

ISSN 1812-5654

science
alert

ANSI*net*
an open access publisher
<http://ansinet.com>

Study on Effects of Water Conservancy Projects on Reservoir Immigrant Society and the Quantitative Model

¹Zhang Ying, ²SHEN Juqin, ³zhang Aimin, ¹Sun Fuhua

¹Business School of Hohai University, Nanjing, Jiangsu, China

²Asset Management and Administration Research Institution, Business School, Hohai University,
Nanjing, Jiangsu, China

³Yangzhou University, Yangzhou, Jiangsu, China

Abstract: On the basis of defining concepts of immigration and reservoir area, this study analyzed profit and loss effects of water conservancy projects on reservoir immigrant society and the quantitative model from 4 aspects which are social health care environment, infrastructures, urbanization and education environment of immigrants. Moreover, by taking a certain water conservancy project as an example it also studied monetary quantification for effects of water conservancy projects on infrastructure construction and urbanization process in reservoir area. The result shows that water conservancy projects will bring about some losses but at the same time it can also greatly improve the social environment. Besides, as a clean energy, hydroelectric power is the direction of electric power structure. This is favor to increase environmental benefit of water conservancy projects and realize sustainable development of human beings.

Key words: Water conservancy project, social environment, economic profit and loss, quantification

INTRODUCTION

With continuous acceleration of socialist modernization and improvement of people's living standard in China, demand of social production and life for electric power is growing with each passing day. Scholars are paying more and more attention to the problem of how to utilize the available resources scientifically and provide more electric resources for social production and life. Hydroelectric generation can produce renewable natural resources and it is the cleanest way. China is a country with rich water power resources and its water power resources that can be developed and utilized reach about 540 million kW (Chen *et al.*, 2009). Accelerating construction of water conservancy projects is an effective way to solve the problem of energy shortage in China and meet the growing electricity demand in production and life. However, construction of hydropower stations means entire change of resources, ecology, environment and economic structure in the river basin. As a result it's bound to affect natural environment and social environment to some extent.

In recent years, people have already kept in mind the strategic thought of sustainable development to build a harmonious socialist society. The cause of water conservancy project construction should also eliminate

the previous style of valuing economic benefit and ignoring environmental & social benefit. Instead it should pay attention to social, economic and cultural effects of water conservancy projects and carry out comprehensive measurement for effects of water conservancy projects on immigrants. Under such background it has important theoretical significance and practical guidance value to quantify effects of water conservancy projects on immigrant society. Its study can check profit and loss from the environmental influence of water conservancy projects; besides it can also enhance the level of analysis on economic profit and loss from the environmental influence theoretically. In practice, environmental cost of energy development can be expressed in currency. Therefore it can provide clear basis for energy development decisions of the state and lay a foundation for adjustment of electric power structure in China. Meanwhile it can increase environmental benefit of water conservancy projects and realize sustainable development of human beings.

DEFINITION FOR RELEVANT CONCEPTS

Immigration: According to different standards, immigration can be divided into different types. For instance, from the aspect of migration legality it contains

legal immigration and illegal immigration; in terms of national boundaries it can be divided into domestic migration and international migration; as for the motivation it includes survival immigration and development immigration. Petersen divided immigration into voluntary resettlement and involuntary resettlement on the basis of whether migration subject was voluntary or forced to move (Pearce 1999).

A Guide to the World Bank 4.30 defines involuntary resettlement as: organized population migration and community reconstruction activities in large amount caused by engineering projects (such as reservoir, railway, highway and airport). The World Bank (WB) holds that “involuntary resettlement” is the “process of increasing or at least recovering income and living standard of people who are under the negative effects of land acquisition (or whose original residence and livelihood are deprived by usage change of the original land). It covers compensation for the asset loss, subsidy for people and article relocation and other necessary economic arrangement measures, so as to improve or recover the living standard of immigrants” (The World Bank 2007).

Comprehensive analysis on the above definition shows that “involuntary resettlement” has characteristics of compulsivity and emphasizes political and economic reconstruction. Voluntary resettlement is corresponding to involuntary resettlement which involves population that realizes migration voluntarily by way of further study, marriage and work.

Reservoir area: Reservoir area is the social, economic and geographic area formed by construction of water conservancy projects. By analyzing and referring to the concept of Three Gorges Reservoir Region, we can define reservoir area in the following way: From the aspect of drainage basin, reservoir area means that gliding materials enter the reservoir area under water erosion and gravitational erosion and river substances shorter than 10 km directly flow into the reservoir area; in terms of the administrative region, reservoir area refers to the zone of reservoir inundation from the damsite to the terminal of backwater as well as the administrative region involved in immigrant relocation and arrangement.

PROFIT AND LOSS EFFECTS OF WATER CONSERVANCY PROJECTS ON RESERVOIR IMMIGRANT SOCIETY AND THE QUANTITATIVE MODEL

Profit and loss effects on health care environment of immigrant society and the quantitative model: Reservoir

areas involved in water conservancy projects, especially large-scale hydroelectric projects often lag behind in economic conditions. Houses for health center of counties are dilapidated, the health facility is backward, the equipment is simple and the technology strength is weak. Meanwhile, medical workers are insufficient. It is far from meeting the standards of central community hospitals. Besides, medical and health care institutions at village level are also incomplete. Therefore, though construction of water conservancy projects will affect production and life of immigrants it can change the poverty and backwardness of immigrants during relocation. After immigrants live together, the new community of immigrants will often be established in places with convenient traffic and complete living facilities like school, hospital and shopping center. Therefore, construction of water conservancy projects has positive influence on improvement of health care environment for immigrants. In another word, construction of water conservancy projects can bring more benefits to health care environment of immigrant society.

According to the above analysis, achievement reference method can be applied to benefits from effects of water conservancy project construction on health care environment of immigrant society. It can be measured by referring to planning schemes for medical institutions of other water conservancy projects. In addition, improvement of medical and health conditions can bring about more indirect benefits to immigrants which will not be considered here. The calculation Eq. is:

$$B_h = \alpha P \quad (1)$$

where, B_h is the benefit of health care environment brought about by construction of water conservancy projects; α is the correction factor; P is the investment in planning schemes for medical institutions of similar water conservancy projects.

Profit and loss effects on infrastructure construction and the quantitative model: Before construction of water conservancy projects, residential locations are relatively scattered. In order to take care of normal water use and electricity use of residents, water pipes and power supply wires are also in disorder. As a result, cost of water supply and power supply is high. After land acquisition for construction of water conservancy projects it will be more convenient to access water sources than before. At the same time, residents live together in one community, so water supply and power supply can also be concentrated. Water pipes and power supply wires will be simpler and shorter than before. As a result, cost of water

supply and power supply will decrease. In addition, infrastructures of road, bridge and communication in the immigration area will also be improved. These are all beneficial influences brought about by water conservancy projects. Of course, construction of water conservancy projects will submerge and move the original infrastructures of road, bridge, water and electricity and communication. This will cause some losses to immigrants and property owners. However, advantages exceed disadvantages on the whole.

Owing to improvement of infrastructures, development of social economy will be promoted in reservoir areas. Besides, life quality of local residents will be increased and safety and convenience of people's life will also be enhanced. Therefore, quantification for profit and loss effects of water conservancy projects on infrastructure construction in reservoir areas can be reflected from the above three aspects. The specific calculation Eq. is:

$$B_i = E + Q \quad (2)$$

where, B_i is the benefit brought about by infrastructure improvement owing to water conservancy projects; E is the benefit from economic development in reservoir areas; Q is the benefit brought about by life quality improvement of local residents.

Profit and loss effects on urbanization and the quantitative model: Construction of water conservancy projects can promote the urbanization process. The resettlement areas built by water conservancy projects are often combined with construction of cities and towns. According to relevant requirements of planning for cities and towns, infrastructures of site formation, water, electricity and street should be prepared well. As a result, living conditions of the masses will be improved greatly. Besides, public utilities of hygiene, medical treatment, education and market are complete and this has increased the urbanization level of local places. Therefore, construction of water conservancy projects can often promote the urbanization process.

According to the analysis, cost method can be used in effects of water conservancy projects on urbanization. By checking the urbanization cost it can measure the cost of local government reduced by construction of water conservancy project through promotion of the urbanization process in reservoir areas. This is the benefit brought about by promotion of the urbanization process. The calculation formula is as follows:

$$B_e = C_1 + C_2 + \dots + C_n \quad (3)$$

where, B_e is the benefit brought about by improvement of urbanization level owing to water conservancy projects; $C_1 \sim C_n$ are various costs required to increase urbanization.

Profit and loss effects on education environment of immigrants and the quantitative model: Economic conditions in reservoir areas involved in water conservancy projects are backward and the education often lags behind. The current situation of education is poor: firstly, most buildings of middle and primary schools are shabby, the layout is unreasonable, education conditions for children of immigrants are poor and the enrolment rate is low on the whole. Secondly, teacher resources are insufficient. They have no condition to introduce high-quality teachers and cannot retain teachers with rich teaching experience either. Thirdly, most immigrants are poor. Even if free education is implemented, some children still have to drop out.

Selection for construction lands of water conservancy projects will fully consider the influence on education. It pays high attention to improvement of education level for youngsters among immigrants. Water conservancy projects have to expropriate lands, so it can also change the situation where location of the original school is unsuitable. Thus youngsters and children of the right ages will be able to accept education conveniently. In addition, teaching facilities can also be updated with campus reconstruction.

Therefore, influence of water conservancy project construction on education environment of reservoir immigrants is mainly reflected in hardware facilities like improvement of teaching environment and equipment as well as software facilities like increase of teacher resources and enhancement of convenience for accepting education. However it's difficult to calculate the effect on software facilities. Therefore, we mainly measured improvement for hardware facilities brought about by water conservancy project construction through cost method. The calculation formula is:

$$B_e = C_1 + C_2 + \dots + C_n \quad (4)$$

where, B_e is the benefit brought about by education environment improvement owing to water conservancy projects; $C_1 \sim C_n$ are various costs required to improve hardware facilities like teaching environment and equipment.

CASE ANALYSIS CASE STUDY OF A CERTAIN WATER CONSERVANCY PROJECT

Construction of engineering projects can not only bring opportunities to adjustment of industrial structure and economic structure in reservoir areas but also

promote infrastructure construction, improvement of urbanization level, increase of resident income and life quality and improvement of dwelling environment in reservoir areas. By setting effects of a certain hydropower construction scheme on infrastructure and urbanization process of reservoir immigrants as an example, this study quantified the social impact caused by construction of hydropower station via the above methods.

COST-BENEFIT ANALYSIS ON IMPROVEMENT OF INFRASTRUCTURES

Analysis on current situations of infrastructures in construction areas of water conservancy projects:

Infrastructure construction in construction areas of hydropower stations lags behind and the urbanization level is low. The location is remote and blocked, the economic foundation is poor and the infrastructure construction lags behind. Besides, standard and quality of the existing county roads are low, contradiction between road construction and maintenance and fund demand is prominent and main highways that run through this area cover National Road 214 and Provincial Road 226. The ecological environment of some areas has deteriorated, the anti-disaster ability is weak and problems of difficult access to electricity, water, traffic, hospitalization, enrollment and communication are prominent. The traffic environment is relatively blocked and there are few roads that connect with the outside. The transportation mode often relies on highways, mainly Level 3 and 4 highways and even substandard highways.

Result analysis on profit and loss from improvement of infrastructures: After land acquisition, the settlement points without corresponding facilities have been planned. According to the planning, 509.12 km of classified highway has been built, in which the secondary highway is 108.2 km, Level 3 highway is 227.76 km and Level 4 highway is 173.16 km, increasing by 22.1%. By combining with the requirements of immigrant settlement, the traffic network has been perfected. Meanwhile, facilities of village and town tap water, electric power, telecommunication facilities, school, health center, radio and television, village committee and gerocomium have been constructed. Except construction of infrastructures in the settlement points, corresponding planning has also been carried out according to requirements of new socialist countryside. Besides, wastewater treatment facilities have been considered in the settlement points (towns) and biogas digester or solar energy has also been taken into account. It is thus clear that after the power station is completed, infrastructures in the reservoir area will become more complete. Improvement of

infrastructures brought about by hydropower station construction will generate positive economic benefit and social benefit. Moreover, construction of new countryside for immigrants will be accelerated and life quality of residents will be increased greatly.

COST-BENEFIT ANALYSIS ON ACCELERATION OF LOCAL URBANIZATION PROCESS

Effects on urbanization in the project area: After the immigrants are settled, about 20% of them will be engaged in tourism, about 60% will take up horticulture and development of biological resources dominated by mountain resources, 10% will go into fishery and about 9% will be occupied in manufacture and construction industry. Thus a diversified industrial structure will be formed.

Under the support of long-term compensation policies, immigrants will be able to obtain long-term incomes from land compensation for hydroelectric generation. Thus the social pattern dominated by agriculture will transform into the social pattern dominated by power generation industry, to realize urbanization. After the project is completed, the overall urbanization level can be increased by about 5.8%.

Analysis on quantitative method for profit and loss from acceleration of local urbanization process: The benefit of reducing non-point source pollution was calculated via opportunity cost method and defensive expenditure method; the benefit of saving investment of local government was quantified via opportunity cost method.

Analysis on unit price of profit and loss from acceleration of local urbanization process

Unit price of treatment for non-point source pollution:

Non-point source pollution in the project area is mainly caused by two aspects which are application of chemical fertilizer and pesticide and direct discharge of domestic wastewater. Studies of the research group led by Zhang Weili, Deputy Director of Soil and Fertilizer Institute, Chinese Academy of Agricultural Sciences show that non-point source pollution caused by chemical fertilizer and pesticide is the most important reason of water pollution in China and its influence rate on water eutrophication exceeds 50%. According to low value calculation, environmental cost caused in each year is about 73 billion Yuan, about 650 Yuan per hectare. After urbanization, this loss can be avoided. The cost of treating domestic wastewater is 0.75 Yuan m⁻³ according to the wastewater treatment price in main urban areas of Kunming City.

Table 1: Summary sheet for saved investment in treatment for non-point source pollution

Project Scheme	Cost of treating chemical fertilizer and pesticide pollution			Cost of treating domestic wastewater			Treatment amount (ten thousand Yuan/year)
	Submerge plowland (hm ²)	Unit price (Yuan hm ⁻²)	Treatment cost (ten thousand Yuan/year)	Total discharge amount (m ³ /d)	Unit price (Yuan/m ³)	Total amount (ten thousand Yuan/year)	
Scheme 1	12615	650	819.98	6514	0.75	178.32	998.30

Table 2: Detailed statements for saved investment of local government in urbanization

Project Scheme	Urbanization population (ten thousand people)	Unit cost of urbanization (ten thousand Yuan)	Saved amount (ten thousand Yuan)
Scheme 1	3.55	4.27	151585

Economic cost of urbanization: Some scholars estimated the economic cost of urbanization for Tianshui City of Gansu Province. They gained that economic investment to realize urbanization of one person was about 42.7 thousand Yuan (Zhen and Chen, 2005). This can be set as the economic cost of urbanization per capita.

Analysis on quantitative result of profit and loss from acceleration of local urbanization process

Saved investment in treatment for non-point source pollution: According to the quantity of land submerged by the project and the treatment cost saved for every hectare, the saved investment in treatment for non-point source pollution can be calculated. Meanwhile, according to total discharge amount of domestic wastewater among rural immigrants and wastewater treatment price, environmental loss reduced every year can be worked out. Table 1 for the benefit from saved investment in treatment for non-point source pollution in each year.

Saved investment of local government in urbanization: Table 2 for the benefit from saved investment of local government in urbanization due to construction of water conservancy project.

RESEARCH CONCLUSIONS AND PROSPECT

Research conclusions: The above analysis shows that construction of water conservancy project has greatly improved the local infrastructures and brought economic benefit and social benefit to local people. Besides it will save investment in treatment for non-point source pollution by 9,983,000 Yuan/year and meanwhile it can also save investment of local government in urbanization by about 1,516,000,000 Yuan. Therefore, though construction of hydropower stations will result in some ecological losses it can also bring about huge profit. It has important improvement effect on social environment and ecological environment.

Prospect: Quantitative analysis on effects of hydropower stations on social environment is still at a preliminary stage. It is a long-term and formidable task to perfect economic quantification for social environment influence. Many issues still need to be studied, such as how to quantify effects of water conservancy project on life quality of immigrants. All these should be further analyzed by scholars.

ACKNOWLEDGMENTS

This study was funded by one of the provincial key discipline, Resources and Environment Accounting (Business and Management, NO: 2084-H08002) of Jiang Su Province and Hohai University Fundamental Research Funds for the Central Universities (Grant No. 2013B13814).

REFERENCES

- Chen, K.Q., Z.N. Chang and X.H. Cao, 2009. Respect for the environment, the orderly development of hydropower construction [EB/OL]. September 19, 2009. [Http://www.iwhr.com/special/kcx/News_View.asp?NewsID=21363](http://www.iwhr.com/special/kcx/News_View.asp?NewsID=21363)
- Pearce, D.W., 1999. Methodological Issues in The Economic Analysis for Involuntary Resettlement Questions. In: The Economies of Involuntary Resettlement: Questions and Challenges, Cernea, M.M. (Ed.). The World Bank, Washington DC., USA.
- Zhen, Y.L. and H.L. Chen, 2005. Estimation for economic cost of urbanization: A case study of Tianshui of Gansu. Urban Res., 10: 57-61.
- The World Bank, 2007. The world bank resident mission in China, 2007.