Social impact assessment of technological water projects

C. Mendoza¹ & C. Levi²
¹Anahuac University, Mexico
²Mexican Institute of Water Technology, Morelos, Mexico

Abstract

Water problems in the basin of Lake Pátzcuaro in Mexico mainly include the lack of sufficient quantity of high quality water, the uneven geographical distribution and quantity of existing adequate water supplies, and the degradation of the hydrological system due to natural and man-made stresses. To cope with these problems, in the last three years an overall rehabilitation program for Lake Pátzcuaro has been implemented, mainly consisting of infrastructure construction, technology transfer, and training projects for the use of technologies and infrastructure maintenance. Because social impact assessment of these projects is considered crucial for future water resources strategic planning in the basin, this paper proposes a methodological approach for this purpose. The basis for the social impact assessment is a model of five indicators of community change considered as social factors that lead to the appropriation of the technology or infrastructure by the community people. To make this possible, the engineers responsible for the project need to be aware of the social implications of the project from the beginning and consider the social participation of the community people for whom the technology or infrastructure is destined: before its implementation, during the process of implementation and in its future maintenance. The assessment is carried out by means of a survey considering three types of populations and the data thus obtained are analyzed through statistical hypothesis testing. This paper includes an example of the model’s application in one project carried out in the basin of Lake Pátzcuaro which is interesting due to the special social organization of its inhabitants.

Keywords: social impact assessment, strategic planning, technological water projects, environmental change, community change, Lake Pátzcuaro basin.
1 Introduction

In most cases in Mexico, when engineers decide to implement a water infrastructure or technology transfer project, to cope with an environmental problem, they seem to think only in terms of the technical efficiency needed to solve the problem at stake, neglecting the fact that both new infrastructures and technologies bear unexpected environmental changes which will directly or indirectly affect the inhabitants of the communities involved in the project. That filter determines the acceptability of the infrastructure or technology by these people, and explains their reticence to incorporate the latter into their everyday lives and eventually get involved in its future maintenance.

The implementation of water technological projects causes social and technical changes to actively interact and shape anew environments that hold together different social dynamics which are simultaneously a consequence of their existence and necessary for their survival. This fact led us to consider that social impact assessment of such projects is imperative for the strategic planning of programs focused towards the implementation of viable solutions to water problems. This paper proposes a methodological model for the social impact assessment of technological water projects which is useful for this purpose, and exemplifies its implementation in three case studies carried out in the basin of Lake Pátzcuaro in Mexico.

1.1 Basis for the development of the methodological model

For the development of the methodological model, more than 15 documents on the subject were analyzed. Among them we found three basic theoretical tendencies concerning the impact assessment of environmental projects.

First, some theoretical models describe methodologies for the evaluation of environmental, social or socio-economic impact, based mainly in cost-benefit principles, that is, solely in quantitative terms. The model we developed basically requires qualitative information.

Second, other documents refer to internationally recognized methodologies for the evaluation of environmental impact, and strategic planning of environmental projects, including specific applications to hydraulic problems. However all these models require a pre-evaluation of the problem situation in the planning stage, considering it as a starting point of the social or environmental impact evaluation, followed by several successive evaluations in predetermined periods of time to measure the consequences of the projects implementation, and finally seek, in the medium term, the impact effects. Our methodological model simulates a change situation in a short term period of time, by considering three types of population samples: target population, control population and comparison population; these will be defined in the section of this paper which refers to the statistical analysis of data.

Finally, a third group of models including the ones established by the European Community and the World Bank, do consider among the environmental sustainability variables, social data, but these are mainly
We did find five documents useful for the development of our methodological model. From documents edited by IRAH [1] and CIEDEL [2] we found the conceptual frame of reference concerning the assessment and impact assessment of development programs and the selection of indicators involved useful. We also found the methodology proposed by these documents useful and easy to adapt to the needs of our model. In Human Resources Development Canada [3] we found the solution to the methodological problems to assess projects with discrete data in which qualitative variables are basically considered. We also found the necessary sample population definitions which lead us to find a way to cope with the problem of attaining results in the short term making a simulation of the change process through a successive selection of three population samples that could represent the moment in which change has not taken place, an intermediate stage where change is in process and a the final situation one for the social impact assessment. Zeid et al. [4] contains a large list of water related indicators for social impact evaluation, and their corresponding parameters to measure them, and finally Stevenson [5] offers indicators for the development of public policies using social impact assessment methodologies, and thus suggested a way to relate social impact assessment with strategic planning.

2 The social impact assessment model

The social impact assessment model shown in fig. 1 establishes the methodological process followed to analyze the social impact of water projects for strategic planning purposes.

Figure 1: Social impact assessment model.
2.1 Description of the methodological process of the implementation of the model

The methodological process starts with the identification of water related community problems which may be diagnosed by governmental authorities, NGOs and other public or private organizations working in the area. Institutions deciding to cope with these problems then establish hydraulic projects: construction, rehabilitation or set in motion of infrastructure or technology transfer to optimize potable water quality or efficient use in rural communities or cities and for irrigation purposes. These projects need to be focused on the solution of community’s water problems, and thus the methodology of implementation has to consider social participation of the target population in all stages of the project’s implementation, from the beginning to the end.

Even though in some cases the decisions of the projects that need to be implemented are taken directly by governmental authorities and the technicians in charge, the target population needs to be at least informed about the objectives and expected results of the technological water project, the benefits which they can expect and the need for their involvement in the maintenance of the infrastructure or the technology transferred in the medium term.

Experience gained at the Mexican Institute of Water Technology has taught us that if people are involved directly in the planning and implementation of water technological projects they will not only willingly accept the changes brought about by the new infrastructure or technology in the environment and their lives, but will agree to participate in its maintenance using traditional social organization mechanisms. Also, in many cases, the population identifies the need to solve a specific water related problem, and thus organizes to seek its solution by working together with the local authorities.

In the methodological model there are two main subjects involved: the technicians fostering the project and the target population that receives its effects. To implement the model, information has to be obtained from both subjects. Data related to the project refers to the objective, methodology, results, target population and geographical area. This information is used to establish the frame of reference for the social impact assessment.

Information directly related to the analysis of water technological project’s social impact needs to be obtained through field work which in its initial stage includes carrying out a reconnoitering activity in the communities of the geographical target area. The information gathered upon completion of this activity is used to establish the environmental and social frame of reference of the project. It also serves to define possible answers in the design of the close ended questionnaire to be applied through a survey. The assessment is carried out by means of a survey considering three types of populations and the data thus obtained are analyzed through statistical hypothesis testing.

Finally the comparison between the objectives and attained results of the problem will serve to establish if the changes implied in the social impact assessment were expected or unexpected by technicians in charge of the project.
2.2 Definition of social impact

The social impact of a technological water project is established through the analysis of the effects of its implementation in the way of life of the people living in the geographical target area of the project.

Within the methodological model five indicators were established to enable a better understanding of this definition: presupposing the attainment of water related community changes, the five indicators refer to their characterization by the project’s target population as significant, positive or negative, sustainable, that affect the community’s way of life, and are a direct consequence of the implementation of the project. Additionally the model includes a secondary indicator deriving directly form the expected results considered in the project’s initial planning and those obtained after its implementation.

2.3 Social impact indicators

The definition of each of the following indicators of social impact assessment of the technological water projects, presupposes both: related community changes and the acknowledgement of their characteristics by of the population involved.

2.3.1 Significant changes
Changes are significant when they are the answer to the target’s population felt needs or problems.

2.3.2 Positive or negative changes
Changes are positive when they benefit the population; and likewise are considered negative when they don’t solve the problems of the community or are responsible for the development of conflicts in relation to water matters.

2.3.3 Sustainable changes
If changes are significant and positive, they are likely to be not only accepted, but adopted in a medium term by the population; and eventually included in their everyday lives. This characteristics account for their sustainability.

2.3.4 Changes that affect the community’s way of life
If technological water projects bring about changes that solve the water problems of a community, the way in which the population relates to water resources will change, and the community’s way of life will be different after the implementation of the project.

2.3.5 Changes that are a direct consequence of the implementation of the project
Direct or indirect relationship of changes to implementation of technological water problems has to be clearly established through facts that can be verified by experience.
3 Statistical analysis

The survey considers three populations which have the same characteristics and differ only in the opportunity they have of getting the project:

- the target population is under the influence of the project;
- the control population will receive the project in a near future (but has not received it) and
- the comparison population is not going to receive it ever.

The samples from each of the populations receive a different questionnaire but questions are similar to all of them because they are designed to obtain information concerning the five indicators of the methodological model. From the target population we get direct information on the social impact or the project. We use information from the control population to know if the social impact is due to the project. The comparison population serves us to know what the general impact is in the area comprised out of the area where the project is being implemented.

The statistical analysis aims to verify empirically if the elements of social impact are attained by the project. To have a social impact a project must:

- Address the water problems and needs of the community
- Include public participation in all stages of the project’s implementation.
- Have significant effects on the community.
- Have lasting effects on the community (sustainability).
- Change the life of the community or its environment.

We also want to know if the changes in the community are due to the project being assessed.

3.1 Survey data

The questionnaire is applied to adults (over 18 years old) living in the community for the past five or more years.

The answers to the questions are gathered as open questions and later classified into categories as if they were obtained in a closed form. We found that this is better than having personal in the field doing the categorization. The categories are made so that they can be compared across populations.

To begin the analysis the data are summarized in frequency tables. Each question in the survey’s questionnaire yields a frequency table for each of the samples of the three populations. The differences between this sample frequency tables will indicate if such differences are present amongst populations. Assuming that the control population is entirely alike to the target population, the differences between them are an indication of change brought about by the project.

Some of the differences are crucial to show the social impact of the various projects because they show a change in the attitude of the populations.

The questionnaires for the three sample populations differ because each population has a differentiated relation to the project. As an example, consider
the questions referring to participation of the population in the project. The target population is asked to know if there has been an effective participation in the project and the extent of this participation. The questions for the control population are focused to gain knowledge of the features involved in a possible participation in a project that may be implemented in their community. Questions for the comparison population may indicate the general attitude of the population within the whole area concerning the participation in projects.

3.2 Hypothesis testing

Differences in the frequency tables of the samples form the populations may be the result of chance. So a standard chi-square test is done to see if the differences are significant. If the differences are statistically significant, they must be analyzed as for their practical significance and their meaning in reference to the social impact of the project being analyzed. This must be done by the person in charge of the analysis.

Considering the way the survey is conducted and the way in which the sample is obtained, we decided upon a simple and nonparametric approach to the analysis. That is the reason we chose the chi-square test.

For those unfamiliar with it, the test compares the observed frequencies with the estimated frequencies calculated under the hypothesis that the populations do not differ. The chi-square statistic:

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\sum \frac{(O_k - E_k)^2}{E_k}
\]

is then calculated and its significance is tested comparing with a critical value obtained from statistical chi-square tables. A higher value of the statistic indicates a difference among the frequency tables of the different populations. Some care should be taken in order to avoid obvious complications, but that is a technical matter which surpasses the scope of this paper.

Finally different tables have to be developed to assess the five social impact indicators of the water technological projects. Then, using the same technique, results must show that the environmental and community changes are due to the project, by analyzing the appropriate section of the questionnaire.

4 Results of the methodological model’s application

To validate the methodological model, we applied it to three projects pertaining to the Program for the environmental restoration of Lake Pátzcuaro’s basin implemented in the year 2003 by the Mexican Institute of Water Technology in Mexico. We are referring to one of them as an example.

Even though there are many natural springs within the basin of Lake Pátzcuaro, in the state of Michoacán, Mexico, water is scarce and its quality is poor. The objective of the technology water project implemented was the restoration of several springs by cleaning the water and protecting the water sources and tanks from animal trespassing by surrounding them with iron nets, thus regulating population’s access to water.
The decision to carry out the project for the target and control populations was taken by governmental authorities who designed the solutions to be implemented by the technicians. Technicians supposed that the authorities had informed the population about the spring restoration. However this was not so, and thus, after the implementation of the project in the target community pertaining to Tzintzuntzan, the population considered that their access to spring water was restricted by the iron net fences, the drinking tanks that were constructed to regulate animal drinking were not readily accessible and the laundry tanks which were built for women to wash clothes were too high to be comfortable to carry out this activity. People interviewed didn’t know who had decided to implement the project; they were not willing to participate in the maintenance of the spring works and thought that the project was not addressing their real water problems.

In the community pertaining to Erongarícuaro, the rehabilitation of a spring was somewhat different. The population has a water celebration every year, which presupposed the building of a hay roof on the side of the spring source where people congregate to listen to a religious service. The works in this site included the construction of a permanent roof and the protection of the water source with a cement cover that people have to open and close each time they go to the spring to get water. Because the water from the spring had been conducted through pipes towards the communities, several years before the spring restoration project implementation, people interviewed were somewhat indifferent towards the project’s results. The participation in the infrastructure maintenance was seen in terms of keeping their traditional sacred place clean. People responsible of this task were the traditional group in charge of the preparation of the water celebration each year.

Finally the location in Tzintzuntzan chosen to interview the comparison population faced the spring restoration in a totally different manner. The community is mainly composed of indigenous population, and therefore most of the time they are left out of governmental projects. Their social organization includes locally elected authorities which help the population decide democratically what to do with their common resources. In the year 2000 the rural community received money from the government to engage in social programs. However the inhabitants got together in a meeting and decided to use the social funds for their spring restoration. They sought the counsel of a local bricklayer, and they all took turns to participate actively in the project implementation. These people worship the Virgin of the Water, and therefore it was very important for them to protect the area of spring source preserving the natural wild landscape. Surprisingly even though in this community the work in the spring was done two years before, it is very similar to the one constructed by technicians. People interviewed are very proud of their spring; they take turns on a monthly basis to keep it clean and working well. People also claim that now they have enough water for different uses.
5 Final comments and conclusions

Applying statistical analysis to the survey data, a low significance value was obtained when comparing data from target and control populations. Results derived from the social impact assessment of the comparison population led us to conclude that the spring restoration project may be an excellent option to solve water scarcity and pollution problems. However low level of significance values obtained in the comparison of target and control populations seem to point to the fact that, in this case, public participation and respect for community customs, traditions and knowledge have to be considered in the strategic planning of future stages of the project if we want to obtain significant and sustainable effects which affect directly the environment and day to day life of the people involved in the project.

References