AN APPLICATION OF AHP FOR SOCIO-ECONOMIC IMPACT ASSESSMENT

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Abstract: This paper illustrates the application of Analytic Hierarchy Process (AHP) for Socio-Economic Impact Assessment (SEIA). The assessment is carried out for a proposed LPG recovery plant in an industrially backward area in the state of Maharashtra in India. The likely socio-economic impacts due to the proposed project were identified by preliminary surveys. Then AHP has been employed for ranking the impacts in terms of their relative severity in affecting the socio-economics of the project area, as perceived by the different stakeholders of the project. Such a ranking is important because it helps the authorities to focus their attention on more important issues which can help to ensure a smooth co-operation of the stakeholders for building the plant.

Introduction

Environmental Impact Assessment (EIA) deals with assessing the positive and negative impacts likely to emerge as a result of initiation of developmental projects. Over the last two decades, EIA has become legally mandatory before large scale projects can be executed (Hills and Ramani, 1990; Ortolano and Sheperd, 1995).

Socio-Economic Impact Assessment (SEIA) deals with the impact on the socio-economic fabric of the project area (the locality that is expected to be affected by the project), and is generally a part of EIA. Specifically, SEIA studies deal with the effects of a project on socio-economic factors like education, housing condition, traffic, employment, structural changes in employment, health and sanitation conditions (Guidelines, 1995). However, while methods for conducting impact assessment on physical environment are well developed, there seems to be a relative negligence for the case of the impact assessment on socio-economic environment (Glasson and Heaney, 1993; Finsterbusch, 1995).

Traditionally, in all the SEIA studies, the SEIA team conducts an extensive study of the existing socio-economic profile of the project area, identifying positive and negative impacts likely to occur due to the project and suggests a plan (called the environment management plan) to minimize the negative impacts. Since most of the socio-economic impacts are abstract, the conclusions of all these assessments, without depending on numbers, are substantially based on the judgment of the assessment team. However, to be of more relevance for policy purposes, it is necessary that the relative magnitude of the importance of the impacts are captured in a quantitative framework. But, since the factors involved in SEIA are both quantitative and qualitative, it is very difficult to compare them in a quantitative framework: *e.g.* how to compare the relative importance of the impacts on housing and on traffic? A study of the literature shows no satisfactory methodology in addressing the subjective issues of SEIA (Ramanathan and Muraleedharan, 1994).

The potential advantages of using the Analytic Hierarchy Process (AHP) (Saaty, 1980) for EIA studies have been identified by Ramanathan and Muraleedharan (1994). Its use is more relevant for SEIA, as SEIA involves the subjective feelings of different stakeholders of the project. Hence, in this paper, an attempt is made to use AHP for SEIA. Specifically, AHP is applied to the problem of prioritizing the relative severity of socio-economic impacts of a developmental project. The project is described in the next section.

The Project

The project under consideration is a medium sized LPG (Liquefied Petroleum Gas) recovery plant which is proposed to come up in a village called Usar, situated in an industrially backward area (Raigad District) of the Maharashtra State in India. About 1,39,500 TPA (Tonnes per Annum) of LPG and 4.7 MMSCMD (million metric standard cubic meter per day) of lean gas are expected to be produced at the plant. The plant is expected to improve the supply of LPG in India, which is an item of mass consumption but is presently in short supply. Hence, from the national perspective, the utility of the project *per se* is high.

Stakeholders of Assessment

The stakeholders in the LPG recovery plant can be broadly classified into the following groups.

* The company.

* The people affected by the project. They include:

    - The population in the project area who are directly affected by the project.
    - Rest of the population in the villages nearby the project site.
    - Population in the two nearby towns - Alibaug and Revdanda. Alibaug is the major urban centre which can accommodate the managerial people of the project. Revdanda is mainly industrial centre which can supply the labour force.

* The local administration of the towns and villages who are responsible for the overall development of the area.

Spatial and Temporal Frameworks for Assessment

Socio-economic impacts have both space and time dimension. The spatial framework for socio-economic impact assessment has been defined on the basis of the identification of stakeholders. Thus the spatial dimension of the project is the area encompassed by the towns of Alibaug and Revdanda and the villages within the 10 km. radius around the site. The 10 km. radius has been chosen because it is the standard for impact assessment studies in India.

The SEIA study was carried out for all the three phases: construction phase of the project, operation phase of the project, and the long term impacts of industrialization of the project area. A series of preliminary surveys revealed that the construction phase will call for massive employment generation (mostly of unskilled labour) and traffic generation in the project area. These are likely to have significant socio-economic impacts on water supply, housing, transport, health and sanitation. The surveys also showed that the employment generation is very negligible during the operation phase, and hence, the corresponding impacts are also expected to be negligible. An assessment of long term socio-economic impacts requires a number of assumptions which usually reduces the reliability of the assessment. As a result only the construction phase has been chosen for the purpose of AHP model as it involves a number of significant impacts, and will be discussed in this paper. The temporal frame of the SEIA is about three years, which is the time period estimated by the company for the construction of the plant.

AHP For SEIA

The utility of AHP for the SEIA of the construction phase can be highlighted by the following arguments.

* In SEIA, the likely changes in the socio-economic patterns of the stakeholders of the project are of interest. However, the expected changes in the socio-economic factors such as employment, water supply, sanitation, health *etc.* cannot be forecasted in specific units, but can only be captured from the subjective feelings of the stakeholders. In such a case, it is essential that the opinions of the stakeholders are taken into account *objectively* using a structured methodology such as the AHP.

* The authorities responsible for the project would like not only to know the significant impacts due to the project, but also about the relative importance of these impacts. While the experts in the SEIA team can reasonably estimate the relative importance, it would be more desirable if the importance *as perceived by the different stakeholders* are also provided. This can help the authorities to decide about a suitable environment managemental plan. But, as said earlier, it is difficult to compare the different impacts using a particular measure as these are incommensurable. For example, it is not possible to propose a measure which compares the relative severity of the impacts on housing with the impacts on sanitation. Hence, this problem requires a methodology which captures perceptions of different people, and for the purpose of taking a decision, the perceptions should be converted to objective numbers. AHP serves exactly the purpose, and hence it has been chosen for the analysis here.

Existing Socio-economic Profile of the Project Area

The employment statistics of villages show that cultivation and agriculture are the two predominant occupations of the people at the project area. Persons working in construction, transport, storage and communication, and trade and commerce jobs are very small in number. Fish production is one of the major occupations in Raigad district, but the villages in the project area are not involved in fishing. Although agriculture is the most important profession in the villages, the villages are not served by any organized irrigation scheme and are solely dependent on monsoons. Thus it can be summarized that the project area is industrially backward and it has a large unskilled population.

Impacts during the Construction Phase as Identified from Preliminary Surveys

Before setting up of a model, the first task is to identify and understand the likely impacts during the construction phase. This has been done by carrying out several preliminary surveys in the project area. Main impacts of the project arise due to two very important issues: generation of employment, and the movement of materials. Salient features are described below.

Impacts due to Employment Generation

There will be generation of temporary employment of substantial number of personnel during the construction of the plant. It is expected that the number of personnel needed for the construction phase will peak to around 1000 at the middle of the second year. The influx of so many people (compared to the existing village population of around 700 at the site) will have impact both at the site of construction and off site, where these people will find their arrangements for stay. Since the transport facilities at the site are not efficient for labourers to operate on a daily basis, influx of labour on a semi-permanent basis to the site is certain.

Most of the jobs connected with erection and commissioning of LPG plant are highly skilled. Hence, there is almost nil possibility for the local population for getting the employment. Not more than 20% of the total labour requirement will be met from 10 km. radius of the site.

Around 100-200 managerial staff are expected to be involved in the construction phase. Since Usar and nearby villages do not have reasonable housing facilities, the nearest town Alibaug will have to take the burden on housing for the management staff. There will be pressures also on water supply and sanitation. The incremental car traffic due to transportation of staff from Alibaug to the construction site will not be much and will not have any major impact.

About 150-250 skilled labourers will be needed for the project. Generally, they will not bring their families to the project site. Around 300-550 unskilled labour force will be needed for the project at any particular point of time, and these labourers usually live with their families. These skilled labourers and the families of the unskilled labourers will be settling down in Usar and nearby villages. This is very likely to deteriorate the quality of life at the site. Hence, the population in these villages will face housing, water supply, sanitation and health problems. Usar presently has no infrastructural facilities (in terms of accommodation, water supply, sanitation, schools, transport, *etc.*) to meet the extra demands of more than 150 skilled labourers and 400 families of unskilled labourers. Hence the socio-economic impacts due to the settlement

of these labourers at the project area will be the most significant and have to be managed with careful planning.

Impacts due to Movement of Materials

There is one big national highway near the project site. This is the Alibaug - Roha road, having a width of 7.5 m. Estimates of the existing road traffic in this road have shown gross underutilisation. The road is mainly used by bullock carts, which are presently the main vehicles near the project site.

Construction of the plant involves movement of about 3 lakh m^3 of earthwork, 20,000 m^3 of concrete, about 2000 MT of steel, and about 600 MT of equipment. The transport of construction material to the project site will result in increased traffic in the area. Estimates have shown that on an average about 30 trucks will be needed per day for movement of the construction materials and peak truck movement will be about 90 trucks per day on the Alibaug-Roha road. This incremental traffic is insignificant considering the capacity of this road. But other socio-economic problems might be associated with the traffic, such as the following:

a. Queuing of trucks: If off loading of trucks takes time, then the trucks will lie on the road for extended periods of time and reduce the effective width of the road, causing traffic congestion.

b. Amenities for truck drivers and helpers: At present, there is little place for shelter, food, water and sanitation facilities for the truck drivers in the project vicinity. Hence, there might be a proliferation of Dhabas (semi-permanent eating joints) and other accessory service station for this staff.

From the above discussion, the major impacts can be identified as housing, transport, water supply, sanitation and health. As described earlier (section 3), the next and policy-wise more important task is to identify the relative importance of these impacts as perceived by different stakeholders. An AHP model is developed for the purpose, and the analysis is described in the next section.

The AHP Model For SEIA during Construction Phase

The AHP model is shown in Figure 1. It lists the stakeholders (whose opinions should be analyzed) at different locations likely to be affected, and the socio-economic impacts.

A separate set of surveys were conducted for the purpose of prioritizing the impacts using the model. These surveys required a detailed involvement of stakeholders. The stakeholders at the different localities were asked to compare pairwise the relative severity of impacts and to fill up a specialized questionnaire. A sample questionnaire is given in Appendix. This questionnaire had to be translated in the local language during the interview.

From the pair-wise comparisons of the impacts, a judgmental matrix was formed for each stakeholder. This matrix was used for computing the priorities (which will be proportional to the relative severities) of the impacts, and the usual consistency check is carried out. The priorities expressed by different stakeholders were combined using arithmetic mean (Ramanthan and Ganesh, 1994).

Table 1: Priorities indicating the relative severity of the socio-economic impacts

Impacts	Town average	Village average	Overall average
Housing	0.198	0.137	0.157
Transport	0.163	0.196	0.185
Water supply	0.304	0.448	0.400
Sanitation	0.205	0.111	0.143
Health	0.125	0.104	0.111

No effort was made to assign weights to stakeholders, and the priorities as expressed by each stakeholder were analysed separately. It was found that the priorities expressed by the company and the local administration of towns were similar to those expressed by the town people. Similarly, the local administration of villages perceived the severities similar to those perceived by the villagers. The averages

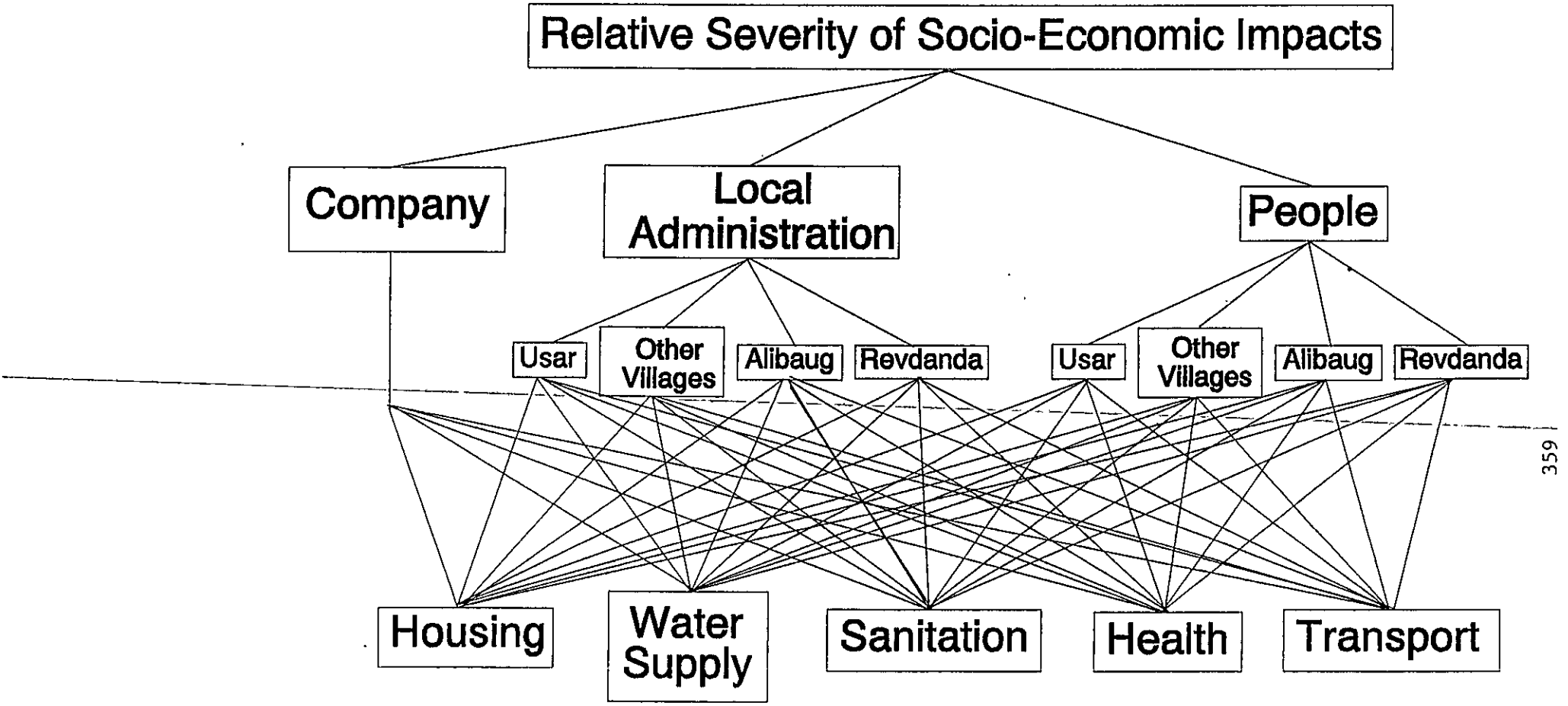

Figure 1: An AHP model for Socio-Economic Impact Assessment

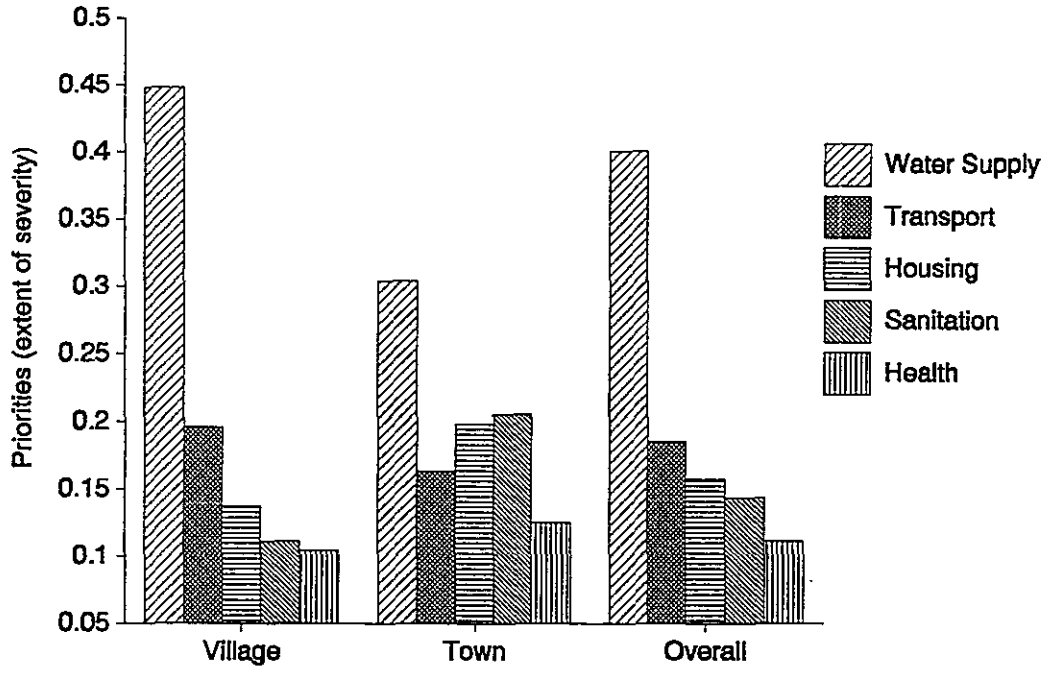

Figure 2 : Rankings in terms of relative severity of socio-economic impacts

for the stakeholders in villages and towns were calculated separately and the results are summarised in Table 1. The rankings in terms of relative severity can be seen from Figure 2. We wish to mention here that there were about 100 questionnaires in total, of which two thirds were from villagers.

From Figure 2, it is clear that the people both in towns and in villages have perceived the water supply problem to be the most severe impact during the construction phase. Town people have considered sanitation to be the next most severe impact, followed by housing, transport and finally, health. In the villages, transport has been expected to provide the second most severe impact, followed by housing, sanitation and health. The Figure shows that while the priorities are very close to each other in the case of town, the priority for water supply is much higher than that of the others in the case of villages. This means that the town people have perceived the impacts to be more or less of the same magnitude, while the villagers have perceived the impact on water supply to be the single most important impact.

These rankings were found to be similar to the perceptions of indicated to the interview team. The advantage of the AHP model is the cardinal measure of severity in the form of the priorities. The priorities also provide an approximate guidance for the allocation of total money available for the socio-economic management. For example, the AHP exercise indicates that, to get the full cooperation of the project affected people of the villages, it may be more prudent to allocate nearly half the funds (earmarked for minimizing the negative socio-economic impacts) to improve the water supply situation of the project area.

Summary and Conclusions

The use of the Analytic Hierarchy Process for conducting socio-economic impact assessment has been illustrated in this paper using a case study of an LPG recovery plant in the Maharashtra State of Western India. Different stakeholders of the project have different opinions about the seriousness of the socio-economic impacts due to the project. AHP helps in systematically capturing and synthesizing these opinions. Application of AHP has shown that that the stakeholders both at the villages and town perceived impact on water supply to be the most severe one. Further, it has been found that in the villages severity of this impact has been perceived to be of much greater magnitude than others, while in town the relative magnitude of the impacts are not substantially different from each other. Identification of the relative

severities, especially as perceived by the local project affected people, will help in arranging suitable socio-economic environment management activities, which, in turn will help to ensure co-operation of the local people for the smooth running of the project. Thus, it is hoped that AHP will have more and more fruitful applications in socio-economic impact assessment of developmental projects in future.

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Appendix

Questionnaire for Comparing the Relative Severity of Socio-economic Impacts due to the Construction Phase of the LPG Recovery Plant at Usar

Place of Interview:

Please fill up the following table using your perceptions. As an illustration, consider the first comparison involving the two impacts on 'Housing' (in Column A of the first row) and 'Transport' (in Column B). The following statement describes the contextual relationship to be used for the comparison.

> "The impact of the proposed plant on 'Housing' in your locality will be _____ (equally/ moderately more/ strongly more/ very strongly more/ absolutely more) severe when compared to the impact on 'Transport' "

If you feel that the impact on 'Housing' will be strongly severe compared to 'Transport', you have to tick under the column '*strong*' in the left half of the table, under the caption 'Severity of A over B'. If your feeling lies in between the intensity specified by two different phrases of the verbal scale, for example, between strongly and very strongly, then you tick under the column lying in between the '*strong*' and '*very strong*' columns.

If the impact on 'Transport' is strongly more severe than the impact on 'Housing', then you will have to tick under the columns in the right half (under 'Severity of B over A').

Please note that only one tick is allowed in each row.

Column A	Severity of A over B							Severity of B over A							Column B
	Absolute		Very Strong		Strong		Moderate	Equal	Moderate		Strong		Very Strong		Absolute	
Housing																Transport
Housing																Water Supply
Housing																Sanitation
Housing																Health
Transport																Water Supply
Transport																Sanitation
Transport																Health
Water Supply																Sanitation
Water Supply																Health
Sanitation																Health

Please give your personal information here:

Name :

Designation and Address: