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RURAL DEVELOPMENT DECISION SUPPORT USING ANALYTIC HIERARCHY PROCESS

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Summary: *This paper presents a decision model based upon community preferences to hierachise activities that support the development of a rural area in Chile. Local government of the region has tried to stimulate economic development for many years without success. The goals surrounding incentive programs offered are complex and conflicting. Often inconsistencies exist between community preferences, incentive programs, and stated goal. Measuring preferences is difficult and represents a form of multi-attribute decision-making. The Analytical Hierarchy Process (AHP), developed by Thomas L. Saaty, allows designing a hierarchical structure and weighing the trade-offs between decision criteria and alternatives to facilitate prioritization of activities to carry out to attain the desired district growth.*

1. Introduction

The development of a rural area must be planned within the framework of a general national strategy. This development consists of a combination of medium and long term planning, furthermore, if the region comprise a shore and possess a harbour. Under that circumstance, it is necessary to analyse short-term programs to improve the management of the facilities and its use. In Chile, there is a coastal zone that, now, it is debilitated at social-economic level, for this reason the regional authorities and their population reveal a great discouragement about the future of their community. Nevertheless, they are willing to find a way to take advantage of the available resources. Being aware of this reality and with social sensitivity, a study for the development of this zone is being held. Surprisingly, little research has examined community preferences for economic development outcomes. Frequently, the effect of the environment, perceived as complex, uncertain, dynamic, and finite, enable inconsistencies and conflicts among the community desires and stated goal. Besides, to measure community preferences are difficult and represent a form of multi-attribute decision-making. The critical component of such decision-making is determining the weights to confer to the different attributes. The Analytical Hierarchic Process (AHP) developed by Thomas L. Saaty (1990) is a versatile and proven decision support for multiple attribute decision-makings. It incorporates the subjective data enabling

decision makers to organize and to evaluate the importance of the alternatives, objectives, and/or solutions. The AHP is used to create weights for different local impacts of development outcomes. The results show a diversity of preferences that reflects, to a large degree, the physical and economic differences between the experts involved. Section 2 gives a description of the case study. Section 3 describes the application of the AHP to solve the problem and the pairwise results. The results given in section 4 generate information about the region that is not currently available. In section 5 the conclusions are provided.

2. The Problem Situation

The region, involves performing harbor, industrial, agricultural, fishing, tourism and commerce services activities. To pursue each one of these activities, many complex factors and objectives interfere and usually are in conflict among them. This fact involves that the profit of some of them is only obtained in deterioration of another one caused by the restrictions.

The problem situation consists of determining which of the activities would mainly contribute to the development of the region and their later impact in the community.

3. Community Preferences Assessment: The Analytic Hierarchy Process

The first step consisted in identifying the aspects and the sectors within the area in study. To initiate the work, local decision-makers experts and governmental representatives of the region were consulted about activities that mainly would affect the region progress. As a result, a great number of factors came up. In the second step, the critical impacts of undertaking certain activities are identified. Experts expressed preference for some of them according to their own expertise and knowledge. The final step involves applying the weights to the measured attributes of each activity to derive a ranking of activities to be work out and will, therefore, bring about local improvement. The application of AHP to the problem situation allows to integrate the diverse community judgements and preferences and therefore to obtain an overall result.

3.1-Structuring the Problem

Considering the overall goal as, “to promote region development”, a hierarchic structure was designed. A three level hierarchic structure based upon the information specified by the experts was formulated. Figure 1 shows the basic structure where the levels represents as indicated below.

- Level 0 stand for the global objective indicated as, "Development of the Region"
- Level 1 indicates the “Sectors” that will contribute to develop the zone.
- Level 2 comprise the aspects that would more explicitly have an effect on the sectors.

- Level 3 consist of those alternative activities to promote the growth of the aspects indicated in the previous level.

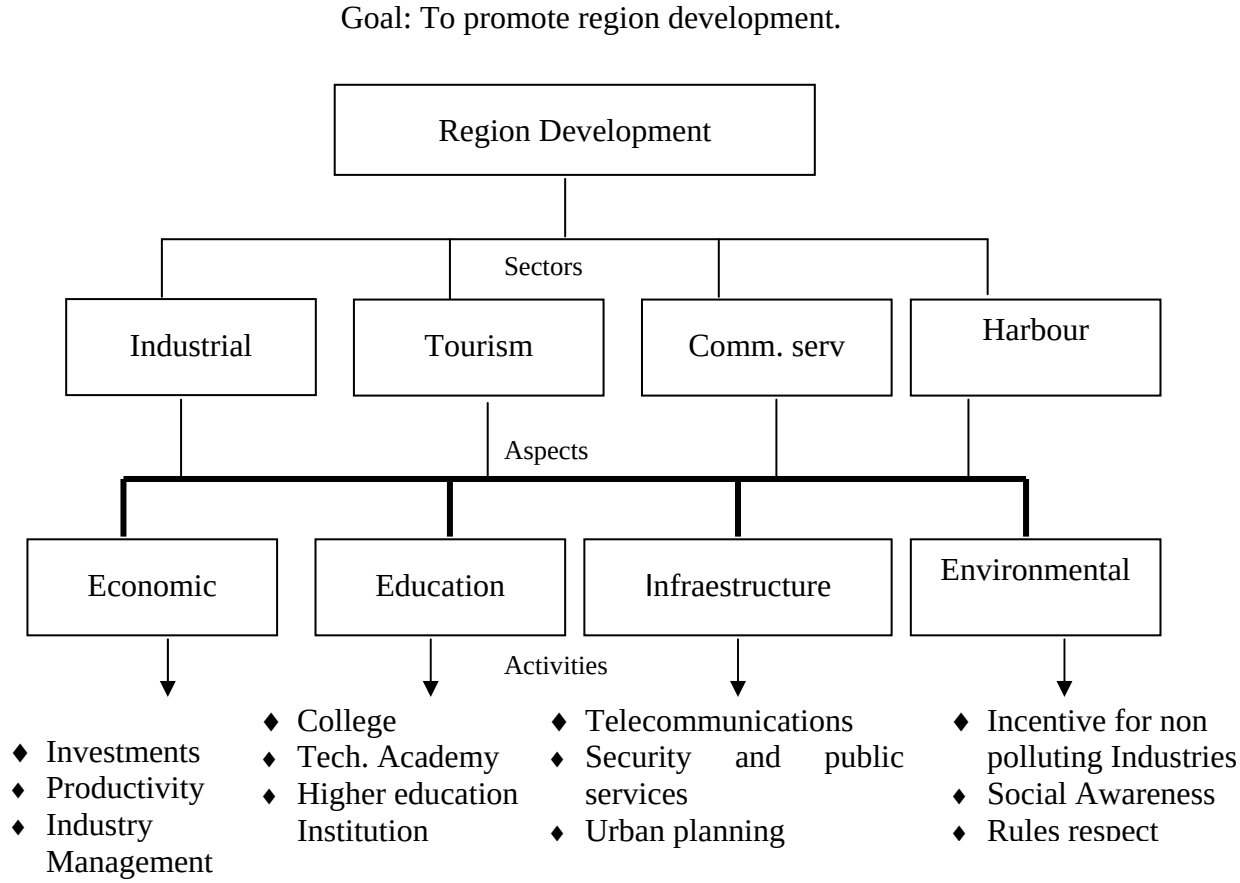

Figure 1: Hierarchic Structure

3.1.1 The Terminology

Before carrying out the pairwise comparison, it is essential to understand what stands for each of the elements included in the structure. A brief description is given for each level.

For the zone in study the sectors were grouped in four.

- The ***industrial-agricultural-fishing*** sector refers to all activities related to the construction and manufacturing industry; agriculture; artisan commerce, and fishing fisheries.
- The ***tourism*** sector: refers to all activities related to institutions for lodging; eating-places; tourist commerce and recreation services.
- The ***community services*** sector takes account of the basic services, financial, and banking, health, institutions, urban, and interurban transportation.
- The ***harbour*** sector involves port firm, customs agencies, and containers firms.

Four aspects related to each of the sectors are considered.

- The ***economic*** aspect represents to all productive activity or services which aspiration is the creation of capital.
- The ***education*** aspect consists of the delivery of knowledge, an aid to the understanding and gaining abilities and the encouragement of specific aptitudes.
- The ***infrastructure*** aspects talks about physical facilities that support the activities of the community.
- *The* ***environmental*** aspects talks about the preservation and protection of natural means of the contamination and irrational intervention of the society.

The third level corresponds to the activities/actions related to each aspect that would contribute to the improvement of the aspects of second level.
For the **e*conomic*** aspect the actions considered to move forward are:

- Investment activities as the use of supplies and financial commodities for the creation and expansion of goods.
- Productivity activities related to manufactured goods or final service.
- The Industry Management, in new businesses.

The activities related to the *education* aspect refer to category of educational preparation. College, Technological academy and Institution of high education.

For the *infrastructure* aspect the actions are in:

- Telecommunications. Connection and communicational handling between two points with Information and Communication Technologies (fixed or wireless).
- Security and public services refers to goods or means of well-being that allows the society to be developed.
- Urban planning applies to the diverse social and economic activities of a city.

In relation to the *environmental* aspects the activities in consideration are:

- The incentives for non-polluting Industries to support grants to companies (i.e. through tributary benefits, credits).
- The social awareness actions for social conscience generation about environment.
- The rules respect refers to the attainment of the environmental Norms in the execution of projects.

3.2 Experts Panel

Once the basic structure was stated, the effort was oriented to create a Team of Experts. This interdisciplinary Team included thirty people related to each of the productive sectors.

3.3 Pairwise Comparison

With the described basic hierarchic structure, a pairwise comparison was made, in such a way that all the elements of a same level are compared and weighed to each other.

This procedure is repeated for all the elements of the structure, obtaining a ranking, reflecting the preferences of the experts. In addition, it was possible to detect inconsistencies when experts emitted judgments. Under such situations, it was necessary to review them until obtaining an acceptable index.

3.4 Pairwise Results.

Through figure 2 is possible to appreciate the prioritization results for the sectors at level 1. It shows that the activities concerning the Tourism sector are more important for the community to be developed.

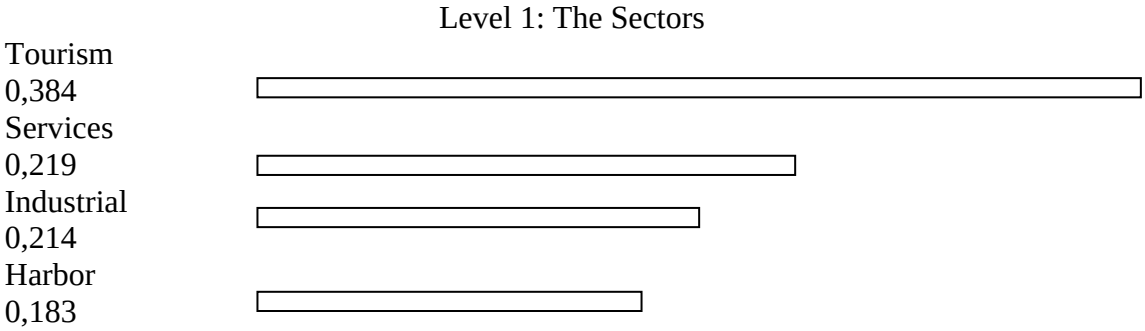

Figure 2. Sectors priotization

For the second level the aspects comparison result is shown in figure 3. The education obtains the first place. The second place is for the environmental aspect, indicating that community is interested in keeping good quality of life.

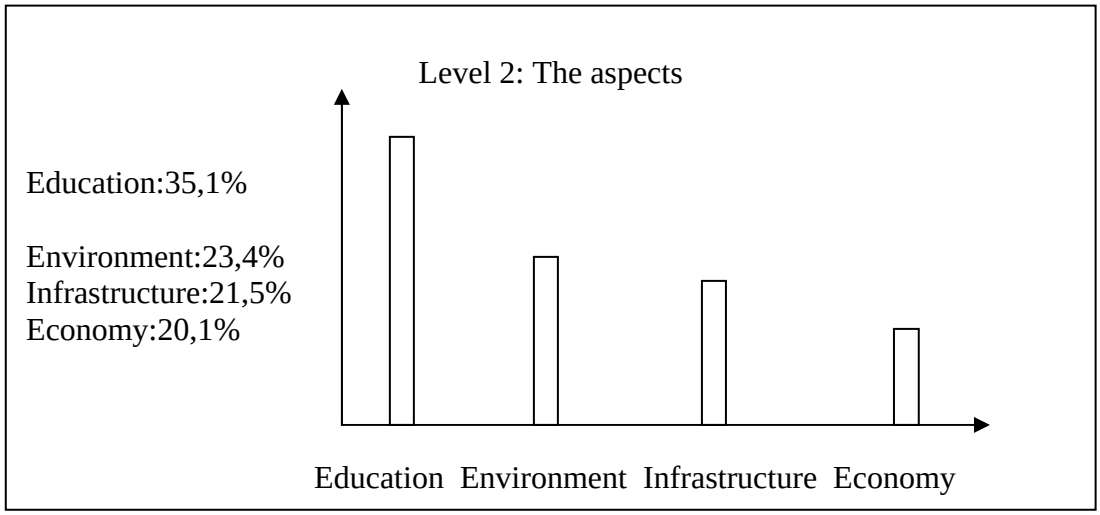

Figure 3. Aspects prioritization

The result for these two levels was initially unexpected for the experts since they would expect that all the efforts were to perform Harbor activities. Amazingly they concluded that the Tourism sector has to be developed in first place and the necessity for more

education in that aspect show up. For the environmental issues, actions leading the efforts to create a social conscience and incentives for non-polluting industries should be put into practice. With respect to the infrastructure, the efforts should be directed to an urban planning adequate for the zone and referring to economy aspect the investment and management to create companies were selected.

4. Optional Paths

The options to follow are several and stick to the natural tendency to choose those factors that contribute with a greater relative weight to the objective. In this regard, three possible options for the result of the hierarchy are presented.

1. To consider each one of the sectors with same weight, and the aspects according to the ranking obtained. For the third level, consider only the high-priority activity to be developed.

Sector	Aspect	Activities/Actions
Tourism	**1 Education** **2 Environmental** 3 Economic 4 Infrastructure	**1. College** **1. Produce Social awareness** 1. Investment 1. Security and public services
Services	**1 Education** **2 Economic** 3 Environmental 4 Infrastructure	**1. Institution of higher education** **1. Industry management** 1. Produce social awareness 1. Security and public services
Ind-agr-fish	**1 Education** **2 Economic** 3 Environmental 4 Infrastructure	**1. Technological** **1. Investment** 1. Produce Social awareness 1. Urban planning
Harbor	**1 Education** **2 Infrastructure** 3 Economic 4 Environmental	1**. Technological** **1. Urban planning** 1. Investment 1. Produce Social awareness

Figure 4. Hierarchy structure ranking

2. Another option may be to develop all sectors according to the ranking and weights obtained and select two aspects with higher priority. Then, choose the only the first rank activities for each of the two aspects..

3. Consider the whole structure and then pursue every activities according to the ranking obtained.

These options could be related to the assignation of financial resources, governmental norms, technological resources, governmental support or others.

4. Conclusions

As first conclusion, is worthy to mention a process that we could call adjustment of concepts, which is generated in the experts. This consists of; at the first contact, the expert emits informal judgments about what is asked. Nevertheless, when facing the comparisons through the matrix of judgments and obtain different results as what they expect, surprise the expert. This would indicate that the people current are emitting judgments that are unthinkingly. This is one of the great qualities of the method, because forces the people to be consciously when emitting judgments from their perspective and expertise.

To generate an interdisciplinary team of experts has the virtue to obtain collaboration to pursue an action in particular.

The application of this process helps the expert to analyse and be more explicit about the problem in study. This also helps to gain more knowledge about the situation giving a support for decision-makers.

In general, the participants were comfortable using subjective judgments based on experience, knowledge, and intuition to obtain a priority ranking of development impacts.

In relation to develop new business region governments need the ability to make decisions about which types of companies or industries they find most desirable and which fit best into their vision of their future. Concerning tourism sector, the Tourist corporations locations would, however, have impacts across a variety of dimensions, and comparing these diverse impacts can be difficult.

The AHP gives local leaders a way to include their **preferences** for economic, public, and environmental impacts that a new or expanding organization might have on the area.

Community leaders need to assess what resources are required or expected by the members of each sector and make a decision whether to provide the resources. These resources include local infrastructure, worker skills, and local services such as schools banks, security protection.

In this case study, contrary to popular perception, the harbour activities associated with a development event substantially turn out to be less important than the others.

This study helped decision makers to realise to dedicate their efforts to develop Tourism sector activities.

This process does not end yet and the obtained results may be considered as a first approach.

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