Environmental impact assesment methodologies description and analysis and first approach to environmental impact assessment methodologies application

En: Development and application of appropriate environmental impact assesment and management methodologies / Fundação Estadual de Engenharia do Meio Ambiente Río de Janeiro, 1981

Leopld's Matrix

Titles

Original: A Procedure for Evaluating Environmental Impact.

Other: Leopold's Matrix

Source

Geological Survey have developed a system of matrixes of information ordered by: the United States Department of Interior, first published in 1971 in the Geological Survey 645 series.

Bibliographical and Index Card

Leopod, L.B., Clarke, F.E., Hanshaw, B.B. and Balsley, I.R. (1971). A procedure for evaluating environmental impact. Geological Survey Circular 645, Gobernment Printing Office, Washington.

Objectives and applicability

To identify the direct impacts of a series of activities in a given project and the respective quantification on two levels: magnitude and importance.

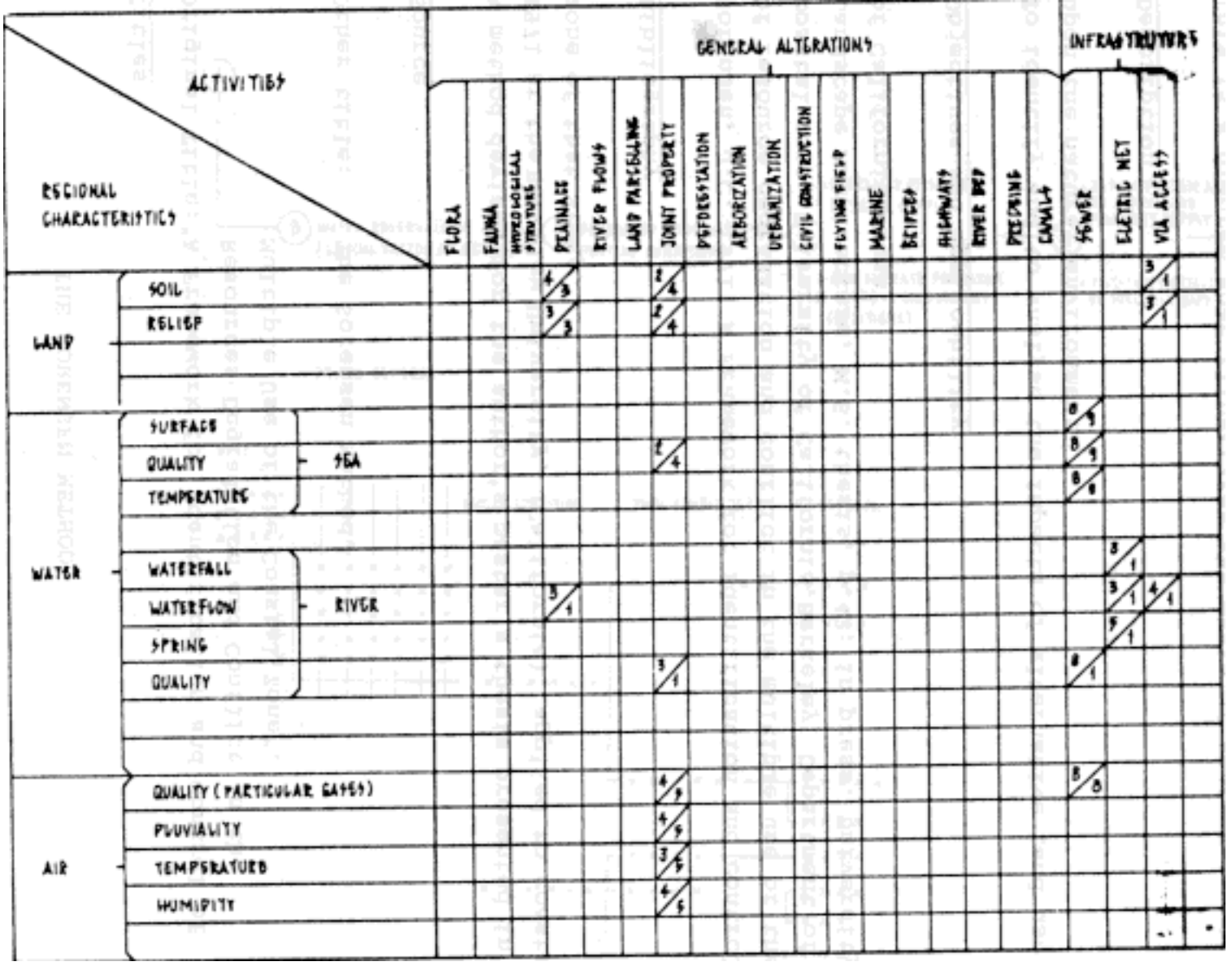
Description

This system consists of the listing, according to a method of matrixes, or the activities encompassed by a project (the colums), and the environmental features that are affected by such activities. The aspects are considered from de point of view of their physical and chemical characteristics, their cultural features, ecological relationships and any other factors that may be deemed necessary for the accomplishment of the undertaking.

The original matrix consists of eighty-eight lines and one hundred columns, the total being 8800 interaction cells.

The cells representing an interaction between project activities and the environmental aspects that are affected by such activities are crossed by a slanting line running from its upper right-hand corner down to the lower left-hand corner.

The upper portion is to be filled with the magnitude ratings and the lower, with ratings by order of importance according to the intensity of each impact, ranging from 0 to 10.



Critical Comments

The following are the main objections to this method:

- It only identifies first order impacts and direct impacts;

- It does not take the time factor into consideration;

- It does not compare the eventual project alternatives;

- In case different teams have to work on it, the results are likely to difer because the criteria are highly subjective;

- It does not take the participation of the community into consideration. In some instances this may be very serious because most of its aspects have a direct impact upon the quality of life of the population.

Conclusions and applicability

If, on one hand, there are strong objections to this method, on the other it may be very useful under certain circumstances.

The usefulness of the method resides in the support it provides in following up on the most frequent activities of a project and the environmental aspects it is going to influence.

Furthermore, the method is a low-cost one, it is multi-disciplinary, ready to identify the sectors requiring a deeper analysis with regard to any given activity likely to generate an important environmental impact. These positive features recommend it as a suitable method for a first evaluation of environmental impact of a project.

As far as its applicability in this project is concerned, this method is only useful in bringing together the main activities developed in the case study area and in listing the different points that are part of its environment. The method is best suited for undertaking the analysis of a specific project while its application to any area is affected by the size and multiple activities in the area being evaluated.

The Sorensen Method

Titles

Original Titles: "A Framework for Identification and Control or Resources Degradation and Conflict in the Multiple Use of the Coastal Zone".

Other title: The Sorensen Method.

Source

A method devised for the author's master's thesis presented in 1971 at the Berkeley University, (California), applied to coastal zone of that State.

Bibliography

Sorensen, J.C. 1971: A Framework for identification and control of resource degradation and conflict in the multiple use of the coastal zone. University of California, Berkeley Department of Landscape Architecture, M.S.thesis, p.42; in press. University of California Press.

Objectives and applicability

To identify and to analyse the impacts of alternative land use upon the natural environment.

Description

This is a diagram that illustrates the chain of environmental impacts generated by a variety of land use, such as agriculture, housing projects, etc. The method illustrates, in addition to the use, agents resulting from needs of the type of use to be made of the land, initial impacts resulting from the actions undertaken (direct impacts), subsequent impacts (indirect impacts) and the effect of such impacts together with corrective measures and/or mechanisms of controlling effects that were generated.

The method basically consists of two networks and one diagram. One of the networks concerns the land use and the surface affected while the other concerns actions and their first order (direct) impacts.

A diagram is built starting with direct impacts, then taking indirect impacts with their effects and respective corrective methods and/or control mechanisms.

To better illustrate the above, we are listing below a series of impacts created by a housing project.

Critical Comments

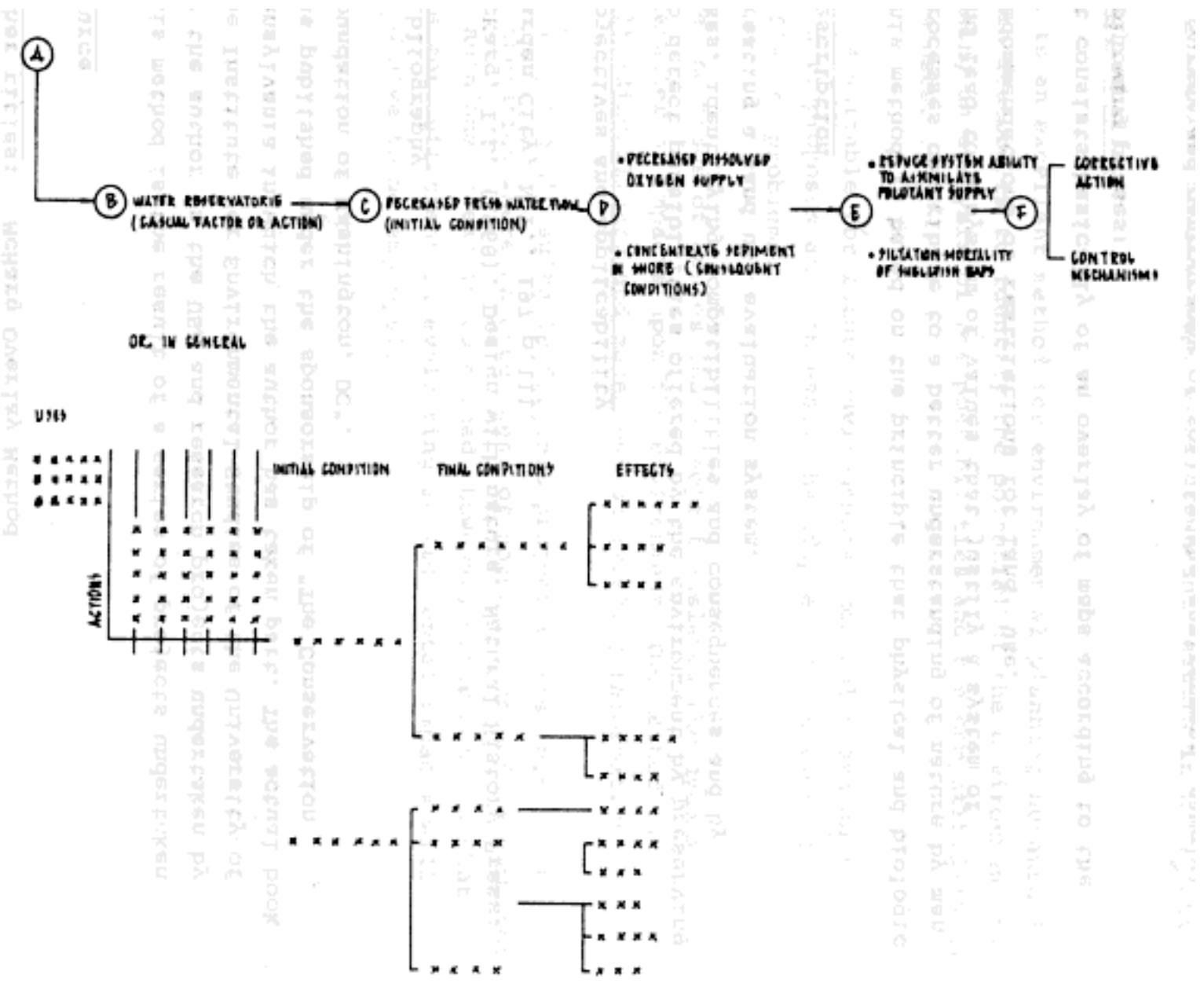
The following are the most serious criticisms of this method:

- it only considers physical and ecologic aspects and does not concern itself with social, cultural, aesthetic and other factors;

- it demands a large amount of information and considerable knowledge because it requires a large amount of impacts (direct and indirect ones) to be assessed, as well as the respective actions and corrective measures;

- it does not quantify the impacts that have been identified;

- it does not make a comparison among corrective or controlling actions and the effects generated by the impacts;



- it is highly subjective, particularly where the proposed corrective actions and/or control mechanisms are concerned;

- it does not consider any participation on the part of the community;

- is not flexible because of its scope or, in other words, because of the amount of impacts that it considers.

Conclusions and applicability

In some instances, this may be a highly useful method because, in addition to illustrating direct and indirect impacts and being easy to understand, it represents a network capable of listing the chain of impacts generated by the main features of any given project.

As far as its applicabilityu to this project objectives is concerned, we would recommend it for those activities that some other method will have

identified as the most harmful to the normal environment of the area under study.

Title

Original title: Design with nature

Other titles: McHarg Overlay Method

Source

This methos is the result of a series of projects undertaken by the author in the USA and research projects undertaken by the Institute for Environmental Studies of the University of Pensylvaia in which the author has taken part. The actual book was published under the sponsorship of "The Conservation Foundation of Washington, DC".

Bibliography

McHarg, I.L. (1968). Design with nature. Natural History Press: Garden City, N.Y., 197

Objectives and applicability

To detect possibilities offered by the environment by preserving uses, identifying compatibilities and consequences and by creating a land use evaluation system.

Description

This method is based on the principle that physical and biologic processes contribute to a better understanding of nature by man and lead to a system of values that justify a system of recommendations or restrictions for land use.

It consists basically of an overlay of maps according to the following phases:

- Survey and cartography of soil in the environment, namely: climate, geology and geomorphology;

- identification of physiographic areas based on the results or previous findings;

- Cartography of environmental landmarks for each area: hidrology, water courses, soils, plant and human communities, water problems.

- an assessment of the peculiarities in every area with an indication of significant peaks and noteworthy geologic sites, remarkable vegetation, likely recreation sites, historical landmarks, costly minerals, water mains, hills, access-ways, etc.

- the interpretation of the above factors will recommend the best use for each area;

- an interpretation with the aid of a matrix, of the compatibility between use versus use, use versus natural conditions and an assessment of the impacts resulting from the use. Also:

- designing a map to indicate the possibilities offered by the given area and to suggest a series of uses.

Critical comments

Among others, we want to mention the following objections to this method:

- it is not capable of absorbing impacts of social, economic and cultural nature;

- it does not identify the affected social groups;

- it does not consider the participation of the community in selecting alternative uses;

- it is highly subjective were the degree of compatibility and the selection of values are concerned;

- it requires several maps to be drawn and results in high cost.

Applicability

It is an excellent method for environmental planning because its main feature is to identify the potential of the environment by making an analysis of its possibilities and the compatibility of its uses.

It is suitable for future environmental control based on the uses it proposes and can easily be adapted to a series of different problems.

The knowledge of causes and effects translates the dynamic character of impacts upon the environment. The method is multi-disciplinary and makes use of existing information.

It is perfectly suitable for this project in its initial phase of operation where an assessment of potential use of nor-evaluated or abandoned areas is concerned. However, other methods that are more efficient in evaluating environmental impacts will also have to be employed.

Title:

Original title: Environmental Evaluation System (EES)

Other: The Battelle Method

Source

This method was developed by the "Battelle Columbus Laboratories" in the U.S.A.

Bibliography

Dee, N., et alli (1972) Environmental Evaluation System for Water Resources Planning. Final Report. Battelle Columbus Labs., Columbus, Ohio, USA

Objective and application

To compare alternative projects through the systematic evaluation of their impacts by selecting, among others, those likely to cause less harm to the environment. It is frequently used in the assessment of projects for water resources, plans for the management of the quality of water, roads, nuclear plants and other projects.

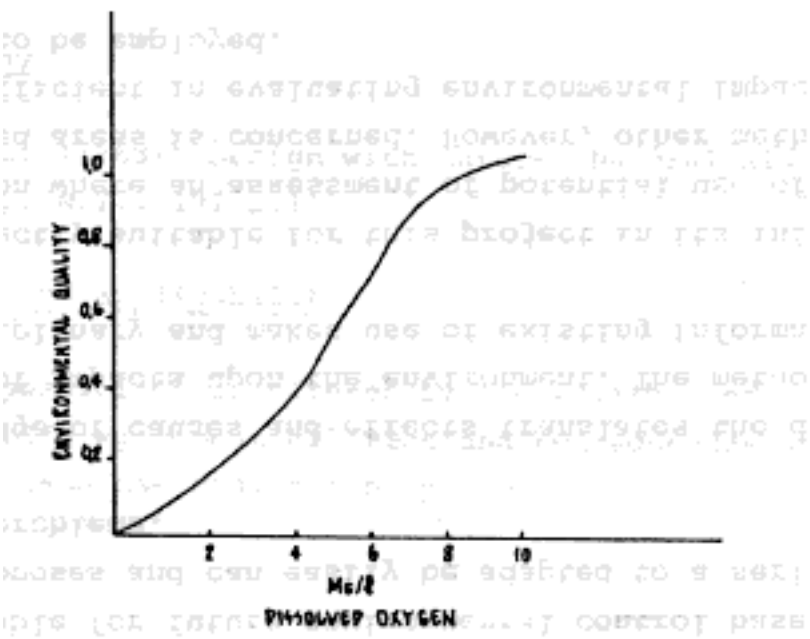
Description

The method lists seventy-eight enviromental, social and economic parameters such as, for instance, job opportunities, diluted oxygen and indian populations, according to the degree of their importance in the project under analysis.

These parameters are listed according to their importance, varying from 1 to 1000.

The importance of the parameters is assessed by different specialists and the final value for every parameter is an average of the assessment of every specialist. The following is an example of this system: in the author's project, parameters such as job opportunities, oxygen dilution and indigenous population were assessed as 13, 31 and 14, respectively.

The next step consists in defining the curves of quality of environment as compared to each parameter. It is necessary to adapt environmental quality to a scale ranging from 0 to 1. The following chart illustrates de estimation.



According to this method, human environment is assessed from four points of view (ecology, physical and chemical factors, aesthetic factors and human and social interest). These four factors are divided into twenty components and the components subdivided into eight-one parameters.

Based on the list of these categories and parameters that may vary in number and in type accordig to each project, the method is subdivided into the following phases:

1. An arrangement of the categories, components and parameters according to their importance in decreasing order. This arrangement is based on numbers based on the average ratings by different individuals for each of the parameters under consideration.

2. An estimate of the relative coefficients for each category, from 0 to 1, 1 corresponding to the relative importance of the most important category.

3. To establish a relationship between every parameter and "enviornmental quality", based on curves calculated to express the performance of the quality of environment whenever parameters change. In the event. of a decrease in DO level of 6mg/1 by 4mg/1 its impact on the quality of environment is reduced to approximately 0,7 by 0.38.

To determine which is the best alternative for the project it is necessary to multiply the figure corresponding to the importance of each parameter by the *environmental quality* that will have been estimated after the impact generated by each project (if we take the exemple of diluted oxigen, we shall have: 31 x 0,38 = 11,78). By comparing the balances for each project, we shall know what is the best alternative project or which will be less degrading to environment.

Critical comments

Among other objections, we can mention the following:

- it does not indicate which of the social groups are affected;

- it requires data and sound knowledge on a wide range of subjects;

- it does not require the participation on the part of the community;

- the method is not easy to understand, despite the fact that the end-result can be easily grasped;

- it requires considerable investment, specially if the recommendations of the nearly eighty parameters to be listed by specialist groups are to be followed to the letter.

Conclusions and applicability

The critics of this method have not arrived at a consensus of opinion. While some consider it to be a good method, others insist upon its drawbacks. One way or another, this method may be rated as reasonable, depending from what it is expected to accomplish.

As far as its applicability to this project is concerned, this may be rated as very limited. Two arguments are sufficient to justify this point of view, namely: the project is inclined towards the analysis of an alternative specific project and therefore not very useful in the analysis of a region with multiple applications and charateristics, as it is the case.

The second factor relates to the fact that the community would not take part in its execution and, if compared to the SONDHEIM Method it is definitely a second-rate proposal.

Title:

Original title : "An Approach to Assessing Environmental Impacts"

Other titles: The Fisher and Davies Method

Source

This method was developed by Fisher and Davies atthe Department of Man-Environment Studios of the University of Waterloo, Ontario, Canada in 1973.

Bibliography

Fisher, D.W. and Davies, G.S. - An approach to assesing enviro_n mental impact - Journal of Environmental Management 1, 207-227 1973.

Objectives and applicability

The objective of this method is to prevent and to minimize adverse impacts resulting from the actions of man upon the environment.

Description

The purpose of developing this model resides in the evaluation of impacts upon the environment instead of its administration. According to the authors, the reason for this approach is that every country or every region possesses its own forms of politics, legislation and customs.

The development of the model consists of four main phases:

1. To identify the planned and induced activities of a project

2.To identify the characteristics of the environment likely to be affected;

3. To assess initial and subsequent impacts from activities encompassed by any project;

4. Management of benecifial or adverse environmental impacts that have been generated by activities planned or executed in the course of a project.

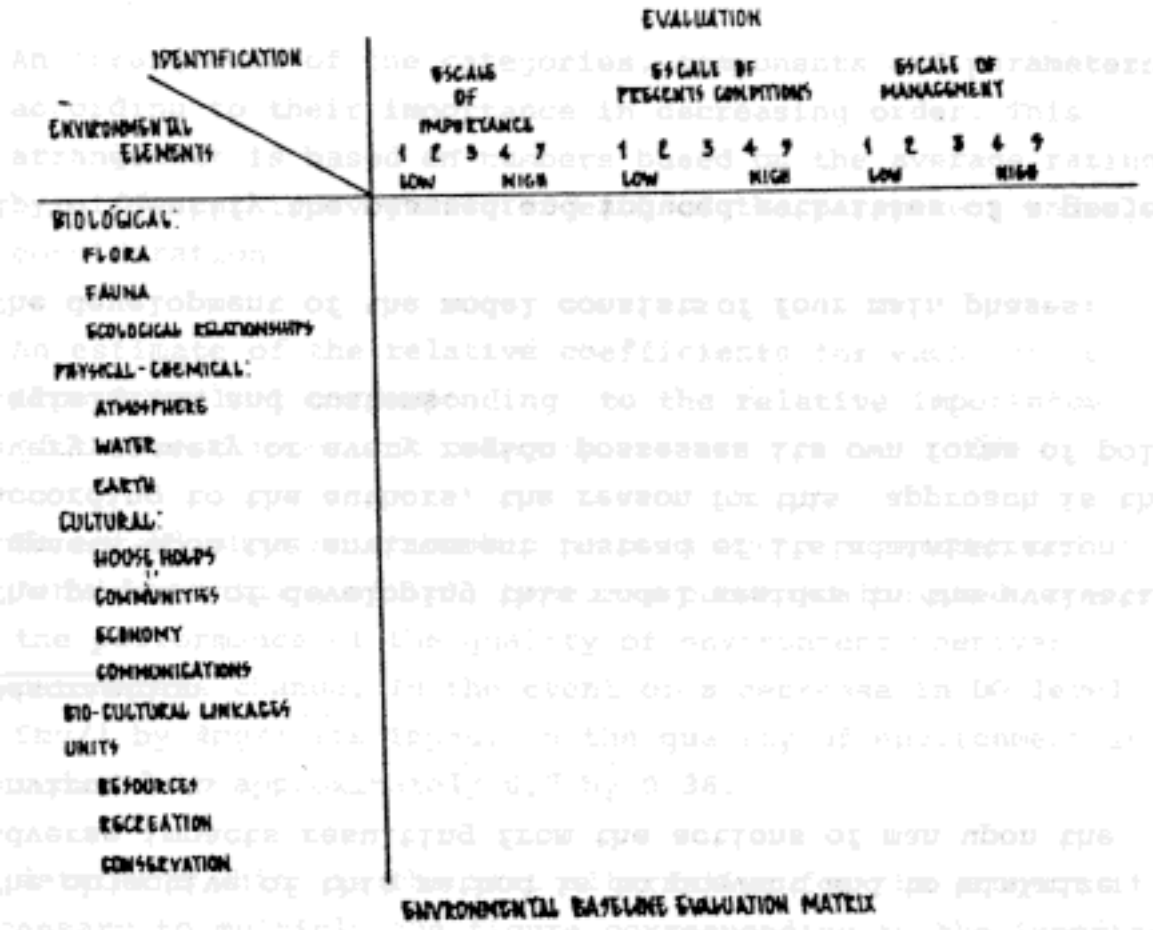
As the method envisages a great deal of interaction in the setting up of projects from the point of view of engineering, economics and the environment upon which it is going to act; considering that these factors must be well explored and known, the authors propose that three matrixes be prepared for the identification and evaluation of environmental features:

1. The Environmental Baseline Evaluation.

    The horizontal lines outline the environmental elements of area upon which the project is going to act and the columns outlines.

    Three scales : of importance, of present conditions and of management for which the notes, as regards environmental characteristics range from 1 for the lower to 5 for the highest.

    In addition to identifying environmental characteristcs, this matrix may also be employed to classify these features according to a table of priorities, the results of which will reveal those characteristics requiring an analysis. Consequently, the characteristcs with notes 4 or 5 will be analysed on the following pages.



ENVIRONMENTAL BASELINE EVALUATION MATRIX

2. The Environmental Compatibility Matrix.

The lines represent top priority environmental characteristcs (as described above) while the columns represent proposed and induced activities. The following items area analysed in this matrix:

- the nature of the impact
  - positive intrusions (+)
  - negative intrusions (-)
- duration of the impact
  - short duration (S)
  - long duration (L)

- Notes for the values range from 1 for the lowest to 5 for the highest in which the activities generating the highest impact will be analysed under the next matrix.

Column 1 is obtained from column 2 (present condition) of the first matrix and should be compared against the others.

Columns!-2 -and-3 (structural and-non-structural alternative) concerns project alternatives involving engineering works for column 2 and not involving engineering works for column 3.

Column 4 (locational alternatives) considers different locations for the execution of each project alternative involving engineering works (structural alternatives):

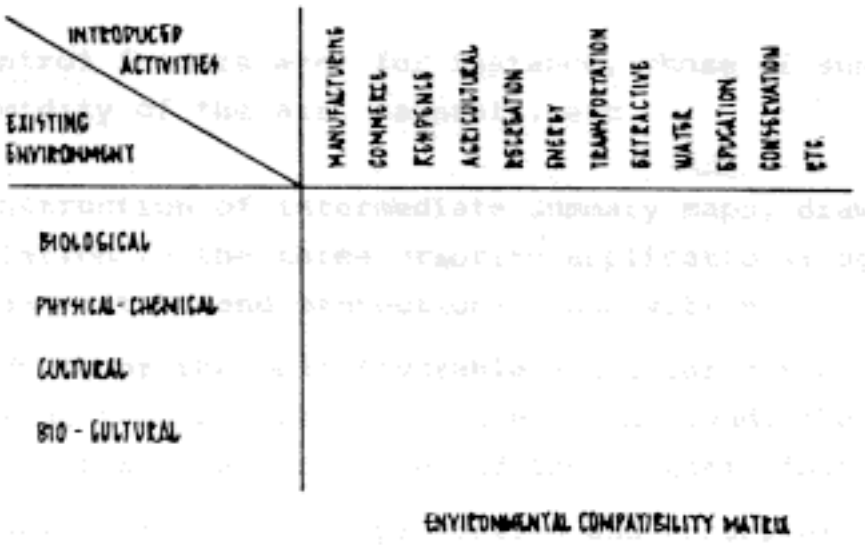
The last column (comments) consists of a space reserved for the comparison between the preceding columns.

The lines in this matrix represent decision criteria. In other words, it concerns the characteristics that were rated 4 and 5 under the environmental compatibility matrix. The lines also contain some additional criteria that have to be weighted for each project alternative such as incidence, access, unoertainty, etc.

Critical comments

In view of the flexibility, the scope and the applicability of the method, there are few objections that might be raised. It would appear reasonable to merely mention the degree of subjectivity as far as the ratings are concerned and also regarging the costs resulting fran the number of specialists that would work on it.

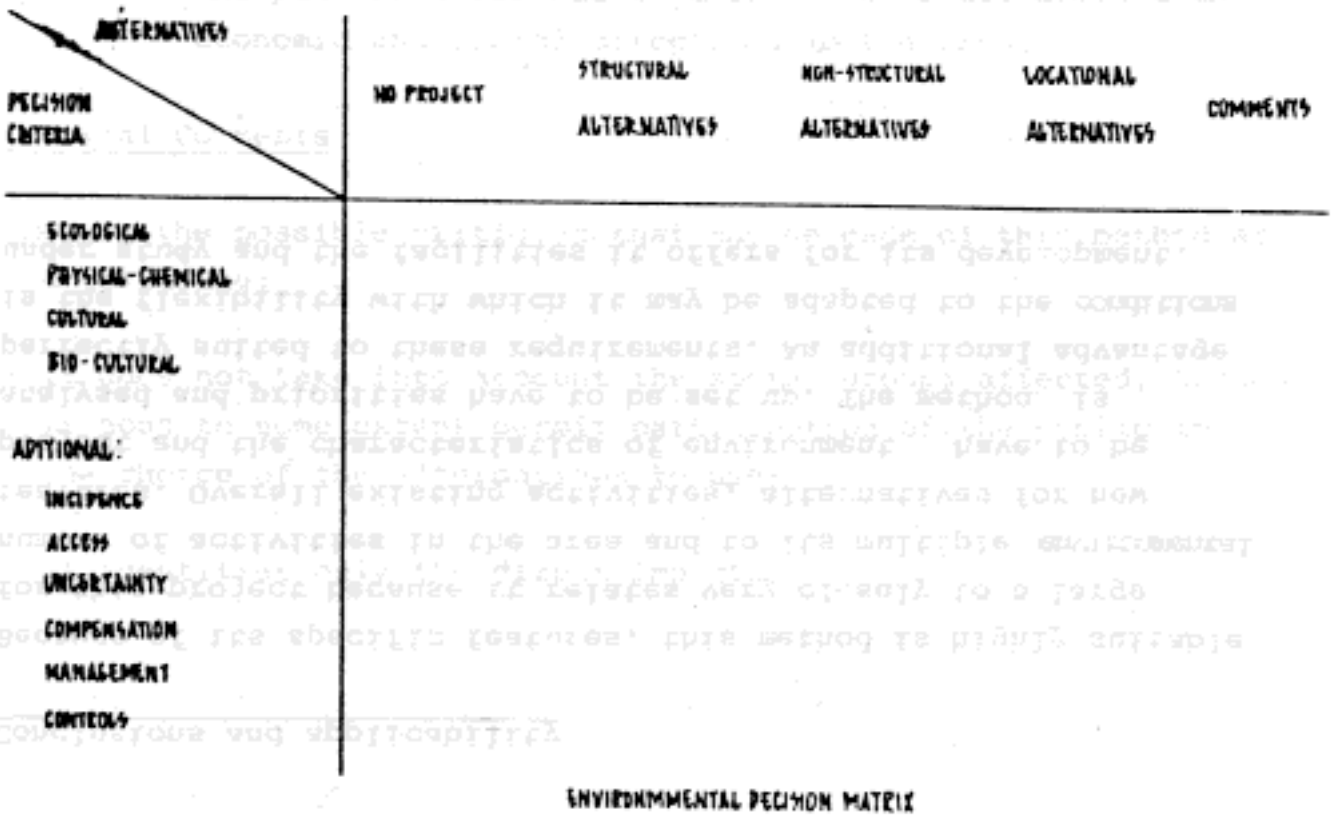
.



ENVIRONMENTAL COMPATIBILITY MATRIX

.

3. The Environmental Decision Matrix (see illustration below)



ENVIRONMENTAL DECISION MATRIX

Column 1 is obtained from column 2 (present condition) of the first matrix and should be compared against the others.

Columns!-2 -and-3 (structural and-non-structural alternative) concerns project alternatives involving engineering works for column 2 and not involving engineering works for column 3.

Column 9 (locational alternatives) considers different locations for the execution of each project alternative involving engineering works (structural alternatives):

The last column (comments) consists of a space reserved for the comparison between the preceding columns.

The lines in this matrix represent decision criteria. In other words, it concerns the characteristics that were rated 9 and 5 under the environmental compatibility matrix. The lines also contain some additional criteria that have to be weighted for each project alternative such as incidence, access, unoertainty, etc.

Critical comments

In view of the flexibility, the scope and the applicability of the method, there are few objections that might be raised. It would appear reasonable to merely mention the degree of subjectivity as far as the ratings are concerned and also regarging the costs resulting fran the number of specialists that would work on it.

Conclusions and applicability

Because of its specific features, this method is highly suitable for this project because it relates very closely to a large number of activities in the area to its multiple environmental features. Overall existing activities, alternatives for new project and the characteristics of environment have to be analysed and priorities have to set up. The method is perfectly suited to these requirements. An additional advantage is the flexibility with which it may be adapted to the conditions under study and the facilities it offers for its development.

Title:

Original: The planification Ecologique

Additional: Falque Method

Origin

Developed in France under the orientation of Max Falque, from the methodology of McHarg.

Bibliographical Index Card

Falque, A. & Galard, A & Tarbet, J. - "The Planification Ecologique". Les Moniteurs des T.P. 20 March 1975.

Objective and application

To land use planning, effecting an ecological inventory of the region, studying the compatibilities and incompatibilities between the environmental characteristics and the possible uses. All information recorded on maps and applied by overlaying them so as to determine the best use of the environment.

Description

Consists of four main stages:

Stage 1

- Inventory and mapping of the natural .characteristics: geology, geomorphology, hydrology, soil study, climate, vegetation, etc., to effect an analysis of the environmental dynamics in terms of landscape and economic values.

Stage 2

- Determination of a system of values of the factors for controlling the suitability of the milieu, for the various purposes envisaged, through ecological climatic control factors are, for instance, those of sunlight, humidity of the air, rainfall, etc.

Stage 3

- Construction of intermediate summary maps, drawn up in relation to the three priority applications: agriculture, urbanization and protection, conservation.
- Mapping of. the most favorable zones for agriculture, taking into account the slope of the land, the suitabi lity of soil and climate and the economic factors;
- Mapping of areas for protection and conservation; mapping of areas suitable for urbanization. These maps delineate the various zones, in line with the suitability for each kind of application.

Stage 4

- Production of a general summary map, grouping together the various usage maps into a single one. The maps produced in stage 3 are integrated, resulting in a mosaic of sectors which translates, rather than just a rigid, geometric zoning layout, a map of use suitability integrated into the complexity of the natural milieu. The planner still has to check this result against the economic and social directives to the area.

Critical Comments

Amongst the possible critiques that may be made of this method are the following:

- It does not take into account the social groups affected, though it does to some extent permit participation of the public in the choice of the alternatives to use;

- It identifies only the direct impacts;

- It requires a large number of maps, which might sometimes make it hard to apply on account of the high cost of this kind of material;

- It does not quantify the impacts, and the values are obtained in subjective manner.

Conclusions and applicability

This is a highly effective method, but one that is extremely detailed, so this renders it, by comparison with the methodologies of the overlay type, one of the more sophisticated approaches.

As to its applicability to this project, its use might be considered reasonable, especially in sub-portions where a higher degree of detailing is needed. But it is always worthwhile bearing in mind that its results should be subjected to subsequent analysis involving economic and social aspects.

Title: A Land Use Decision Methodology for Environmental Control

Source:

This methodology was devised in 1975 and is the result of surveys undertaken by the "Rocky Mountain Center on Environment - ROMCOE" under the sponsorship of Environmental Protection Agency.

Bibliographical and Index Card

Wichershan, K., Hansen, R.P. and Melcher, A.G.A. Land use decision methodology for environmental control. EPA - 600/5-75-008 - 1975, Washington D.C., 180 p.

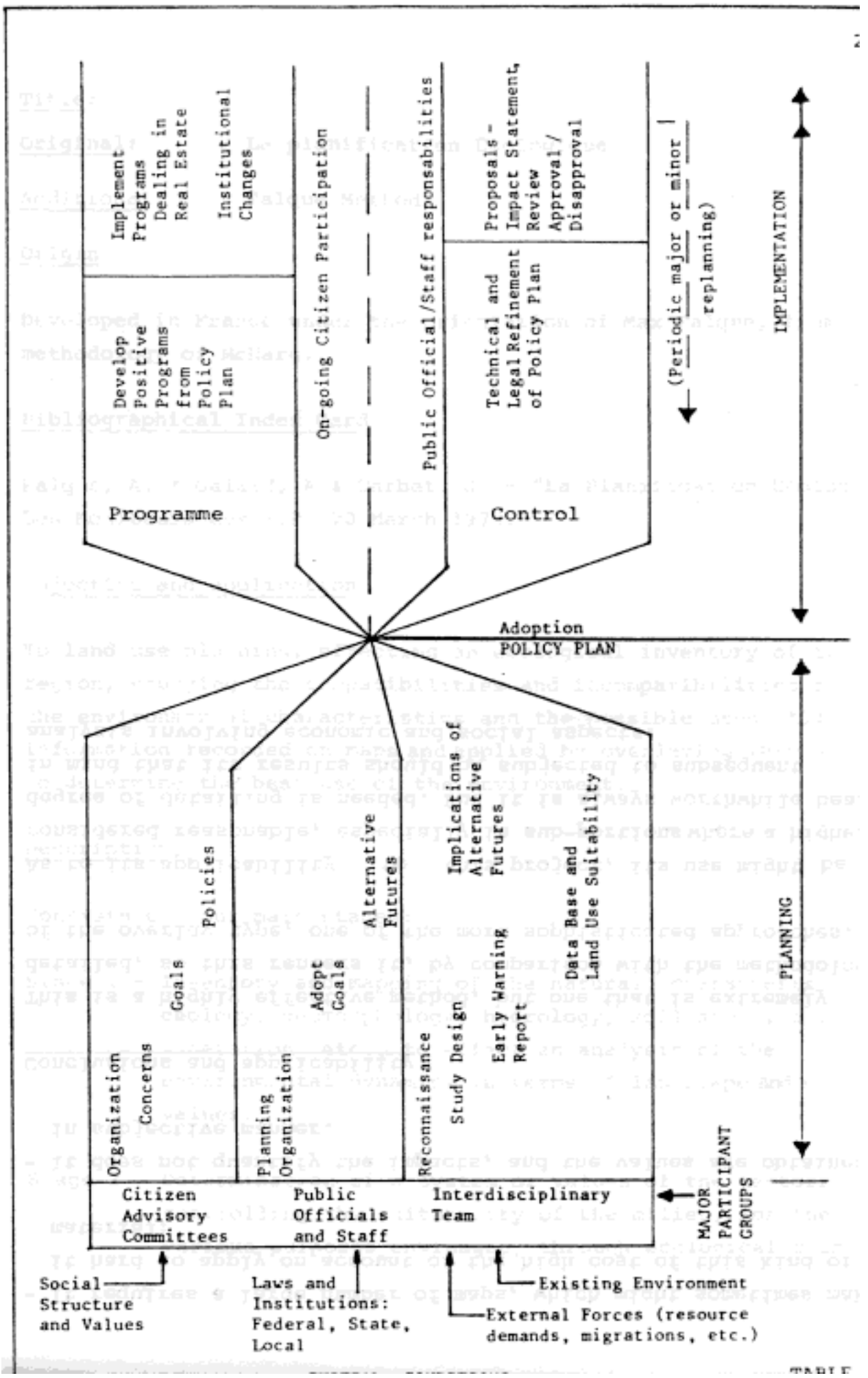
The objectives

The objective of this methodology is to develop an integrated planning system for land use to effectively incorporate the ecologic principles. The Methodology is called: Land Use Decision4faker-System - LUDMS:

Its objective is to overcome the drawbacks of irresponsible planning as far as environment is concerned. The system it proposes may be defined as a process enabling local government to set up planning policies and to adapt it to its specific requirements. It is a "universal" type of system. In other words: it is not based on any specific governmental or institutional structure and merely requires to be adapted to existing legislation and existing institutions.

Description

The basic structure of this system appears in succint form on table 1. It consists on the development of a planning policy representing the result of a certain planning effort that is transformed into legal laws and regulations.



The Plan requires the following steps to be accomplished:

1. In the event there is no planning staff, such a staff must be set up.

2. Citzens'Advisory Committees will be organized and actively and effectively participate throughout the execution of the plan.

3. An inter-disciplinary team will be appointed and will consist of specialists in the areas of Geophysics, Biology and Human Science.

4. Existing data will be reviewed by the planning and specialist teams.

5. A first meeting of the Citizens' Advisory Committee will take place.

6. The existing land use decision-making system will be analysed.

7. The citizens' commitee will endeavour to identify the interests of the community.

8. The inter-disciplinary team will be informed about the interests of the community.

9. The inter-disciplinary team will meet to field reconnaissance

10. The Citizens' Commitee will integrate activities with the inter-disciplinary team.,

11. A study design will bP developed by the project manager based on the findings of the citizens' committee and of the specialist team. The ,planning objectives will be included in the working plan.

12. The study design will be reviewed by the public, by the specialists and by the authorities involved.

13. The study design will be adopted. The area will be inventoried and the resources of the environment will be evaluated.

14. The community goals will be set up.

15. An "early wirnirg" report will be submitted by the interdisciplinary team.

16. The Community goals will be integrated and refined.

17. The community goals will be classified and put in order.

18. A report will be prepared concerning the inventory and analysis of environmental resources.

19. The community goals will be adopted for the purpose of the plan.

20. The policies required to achieve goals will be stated.

21. The policies will be reviewed by the citizens' committee.

22. The cmmunity will be informed about alternative plans devised by .the planning staff.

23. Environmental impact of the alternatives will be assessed.

24. Alternative plans will be reviewed.

25. Planning policies will be adopted.

The following chapter is a description of the process for the technical implementation and legal requirements for the acmrtwlishment of these planning policies describing the means and techniques devised to render the plan feasible for public authorities and the interested community. It includes map of environmental analysis, maps of environmental constraints to land use, zoning and monitoring plans. It also includes a plan for political implementation in which they analyse problems related to expropriation, the setting up of communitary facilities and recreation facilities, green belts, a reformulation of urban centres, setting up of new towns, etc.

They also include a list of regulations for the control of land use and a permit a system.

The four reports that are enclosed provide details on some of the phases. we have described and offer models of legislative codes.

Critical comments

The proposed system exhaustively encompasses all the steps required by the process of environmental planning. In addition to considerable investment it also requires political and legal effective support.

The participation of the community is a fundamental factor in this lengthy process. The technical team in charge of the plan will play a very important role in the undertaking.

The authors have examined several known methods for the assessment of environmental impact resulting from alternative plan but decided to make no recomendation.

Conclusions and applicability

The applicability of the LUDMS system to the regional conditions of this project would require better integration between the responsible authorities and decision-making teams. On the other hand, the detailed description of the different tasks it involves is a valuable contribution in making diagnoses and prognoses with regard to environment.

Title: The PADC Methods

Source:

This method. was developed by the research group of the University of Aberdeen
which entitled: Project Appraisal for Development Control (PADC)

Bibliography

Clark, B.D. (1976) Assessment of Major Industrial Applications: a manual. DDE Research Report N9 13, D.D.E., London.

Objectives and applications

The objective of this study is to apply techniques for the evaluation of potential impact on physical environment resulting from industrial development projects.

They encompass economic and social considerations in the areas where such programs are not compatible with the existing land use programs.

Furthermore, the method minimizes problems that are frequently encountered by specialists in analysing industrial projects, namely: the limited amount and insufficient detail of the data available for each project as well as the random manner in which such data are often supplied.

The study, undertaken by a group of researchers at the University of Aberdeen, gives several examples of such situations arising in Scotland particularly where the North Sea oil prospection projects are concerned.

Description

The method is basically divided into three phases:

1. Exchange of information between the individual responsible for the good quality of the project, and its authors, an essential condition for the good development of the project and its subsequent analysis;

2. To assess likely impacts by constructing of impact matrix (existing characteristics versus proposed characteristics) and submitting a report describing the project and outlining its possible impact and consequences-Impact Statement;

3. To decide upon its feasiblility and/or to offer suggestions to modify certain aspects of the problem submitted by the decision makers, bearing in mind that the impactsresulting from projects may be:

    - positive and/or negative
    - long and/or short
    - reversible and/or non-reversible
    - direct and/or indirect
    - local and/or general

Critical comments

The most frequent objections to this method are the following:

- it does not take any economic and social environmental impacts into consideration;
- it does not envisage local alternatives for the execution of the project;
- it does not take the significance of the impacts into consideration;
- it does not take the resilience of the site into account;
- it requires a considerable amount of data;
- it is not a low-cost method.

Conclusions and applicability

The method described herein is recommended mainly for the evaluation of environmental impact resulting from industrial activities.

Its main advantages lie in the flexibility offered by consultation among the different individuals who operate the project and its planners. Also, it is a useful system for the evaluation of environmental impacts and is well suited for use in official environmental control programs.

where this project is concerned, the method can be used for the analysis of types of industries existing in the case study area.

Titles

Original Title: Assessing Environmental Impacts of Multiple Use of Land Management

Other Titles: Welch and Lewis Methodology

Source

This Methodology was developed by H. William Welch and Gordon D. Lewis.

Bibliography and Index Card

Welch, H.W., Lewis,G.D., 1976.Assessing Environmental Impacts of Multiple Use of Land Management. Journal of Environmental Management (1976) 4, 197-209.

Objective and applicability

This methodology defines the relashionship betheen different environmental aspects when there is a land use change.It comprises a system for the identification of the subjects that have to be brought together in the evaluation process and lists the areas in which the degree of knowledge is insufficient.

Description

This methodology evaluates the potential impacts of different alternatives for land use by raking an analysis of the relationship between its different types, of the organisms controlling or having influence over this use and of the ecologic and h environmental systems comprised in it.

This relationship is explained by means of a diagram that illusttates the degree of its interference as regards the type of use that is being analysed. For instance, if we are evaluating the implementation of a touristland parcelling, the deforestation resulting from the parcelling will represent a first impact upon the vegetation. The destruction of vegetation will induce soil erosion which in turn becomes a secondary impact, and so on. The parcelling of land for recreational purposes will be undertaken by a commercial corporation who will exert first control of the operations. The corporation will have to abide by certain legal requirements that will be called secondary controls that, in turn, will require control by government agencies, or tertiary controls, etc.

This results in a tri-dimensional matrix encompassing land use, control agencies and ecologic and environmental factors in which the results of the impacts covered by the analysis are identified with a figure at the points where horizontal lines cross the vertical columns and represent an order of impact or control.

If we repeat this scheme for every possible type of land use we shall come across a number of important relationships of special circumstances that will have to be listed by order of priority and submitted for subsequent study.

Another matrix is used in quest of the solution. This matrix is also tri-dimensional and comprises different approaches, model-systems and methods as well as problems involving human relationships.The purpose, of this matrix is to define the method, model or system to be used in the solution of every impact and who are the specialists to call upon in the accomplishment of this task. For instance. in order to solve problems relating to the quality of water, a civil engineer might be appointed to devise a new method for sewage treatment according to criteria that were set up by a biologist according to assessing techniques developed by a chemist and approved under legislation drafted by an attorney.

Critical Comments

For each of the first actions only first order impacts may be taken into consideration.

There is no assurance that every important relationship will be taken into consideration.

The variables of time are not taken into consideration.

The intensity or the magnitude of impacts is not evaluated.

The participation of the community is not envisaged.

Conclusions and applicability

This methodology offers a number of alternatives and describes the way different elements react with each other. It also identifies the subjects that are essential to the evaluation process as well the areas lacking data and/or knowledge.

It-might be first applied in this project to assist in the identification of the type of specialists required for the development of the project.

Titles

Original:

A Comprehensive Methodology for Assessing Environmental Impact.

Other: The Sondheim Method.

Source:

This method was developed by Mark W. Sondheim, of the Department of Soil Science of the University of British Columbia in 1977. It has been used in the assessment of a substitution of a dam on Lake Shirley at the Algonquin Provincial Park, Ontario, Canada.

Bibliography

Sondheim, M.W., 1977, A Comprehensive Methodology for Assessing Environmental Impact. Journal of Environmental Management (1978) 6, 27-52.

Objectives and applications

A simultaneous evaluation of impacts in a large number of alternative projects and their classification according to available technical data, estimated according to the values of the different segments of population being affected.

This methodology was devised in view of the following objectives:

- Ease of handling a large number of alternative projects including projects based on different concepts and locations;
- The widest possible usage of a definition of what is "the environment";
- To offer a considerable flexibility in assessing different alternative projects with regard to different environmental aspects;
- To separate the subjective components of the project and-insure public participation;
- Reduction of time;
- Reduction of costs;
- Easy re-assessment in the event of changes;
- The capacity for using appropriate scales.

Description

Coordinating body

It is necessary to appoint a coordinating body to work with government agencies, private corporations or teaching centres. This group of coordinators will be in charge of managing the project and will perform the following duties:

1. To list all project alternatives and to codify them from 1 to m.
2. To make a list of environmental characteristics, either independent or quasi-independent that might be relevant for the project alternatives and to codify them from 1 to n.
3. To appoint an assessing group of specialists in a sufficient number to cover all environmental aspects as per item 2.
4. To appoint a study group of a y number of people representing government, industry, groups of public interest, community centres and other that might be affected by the program.

As far as the applicability to this project is concerned, if we take the integrated plan for the development of the entire area under consideration to be a"Project", and if we offer different alternatives to achieve this purpose, the mothod is quite satisfactory.

Titles

Other Title: Gilliland and Risser Methodology

Original Title

The Use of Systems Diagrams for Environmental Impact Assessment: Procedures and an Application

Source

This methodology was developed by Marta W. Gilliland and Payk G. Risser. It is illustrated by the essays undertaken at the Missile Sector at WhiliSands, under the administration of the Department of Army, in New Mexico.

Bibliographical and Index Card

Gilliland, M. W., Risser, P. G., 1977. The use of systems diagrams for environmental impact assessment: procedure and an application. Ecological Modelling, 3 (1977), 183 - 209.

Objectives and applicability

The purpose of this methodology is to illustrate the utility of systems diagrams and the use of energy as a measuring unit in assessing environmental impact.

Description

This methodology comprises five phases:

1. Construction of macroscale system diagram.

    The purpose of this phase is to collect and classify data, to define all the functions, to evaluate its relationship with human activities and provide a mechanism for comparing the impact of proposed actions among such actions and against the environmental.

    In building the diagram the same symbols as for energy circuits are used. They will represent the different actions of the system, namely: sun, rain, winds, animals, towns, industries, soil nutrients, sewage, surface and undergroud water with its polluants, etc.

    These elements generate or store energy and are linked by lines representing the courses of energy flows that act upon the system.

2. An evaluation of pathways and storages.

    Taking tire flow of energy in the time unit to be a unit, we deremine the energy flowing along each course and stored in each storage element.

3. Analysis of the data.

    Data obtained in the previous steps are analysed an the following is defined:

    - the variation in the flow of natural energy caused by the total of impacts generated by the project and by its alternatives;
    - what is the contribution of each individual impact to the overal:. result;
    - will it be possible to introduce technologies and/or controls to minimize great impacts.

4. Identification of impacts that require more detailed analysis.

    In the phase of construction and quantifying of the dragram (phases 1 and 2) the items that cannot be evaluated when represented an a larger scale are identified. In this case, it is necessary to enlarge the level of detail until it is possible to make an assessment.

5. Examination of impacts outside the bounds of the region.

    Boundaries are set upon the area to be covered by a project and its graphic representation. This means that there are inlets and outlets for these areas. These points are identified by the methodology that recommends that an assessment of these impacts is undertaken.

Critical Comments

- We cannot be certain that every course and important action is taken into consideration.

- It is difficult to establish the boundaries the system.

- It is difficult to quantify all the impacts as energy units.

- Impacts are not identified.

- The social groups affected thereby are not identified.

- Participation by the community is not envisaged.

- It requires a complicated system of data collection resulting in considerable waste of time and money.

- Its evolution in time is not covered.

- Aesthetic considerations are not taken into consideration.

Conclusions and applicability

The main advantage offered by this methodology is the possibility of quantifying total and individual impacts. This in turn permits comparisons between different types of impact, alternative variations and different strategies for environmental control.

As far as this project is concerned, it is precluded not only by the high cost of collecting data supplied through methods that are not yet widely known amongst us but also by the fact that it is restricted to the cases in which ecologic impact prevail.

Title: Integration of Environmental Considerations in the Comprehensive Planning and Management Process.

Origin: Report prepared by ABT Associates, Inc., under contract for the Office of Policy Development and Research, U.S.

Department of Housing and Urban Development.

Bibliographical Card Index

Department of Housing and Urban Development: Integration of environmental considerations in the comprehensive planning and management process. U.S., 1977.

Objective

The main objective of the document is to orient urban planning agencies and teams so as to make sure that policies, plans and programs take into account the environmental factors, besides orienting the evaluation of environmental impact of development plans, in compliance with the "Comprehensive Planning Assistance Program".

Description

The document starts by presenting comments and critiques to traditional planning, introducing concepts of environmental planning and listing its main concerns such as land use, water quality and resources, quality of the air, reduction and control of noise, control of flooding and other natural hazards, together with preservation of historic values and those of social equity.

Considers planning as a process defined in terms of important objectives and activities and not merely in those of isolated activities (water, sanitary sewerage systems, transportation,etc.) or individual levels of government (municipal, state, metropolitan, etc.).

The process ought to take into account environmental characteristics in the broad sense of the word, adding to the natural components of the milieu the social, human and cultural values.

The document is intended to be a guideline, dividing the process of planning into four major stage:

- planning studies;

- development and evaluation of alternative plans;

- implementation of the plan;

- management and monitoring of the plan.

Each stage is covered by an individual chapter in which the respective activities and main concerns are examined from the point of view of environmental planning and suggestions are made as to known methods and techniques, for their better application. Thus, for instance, the chapter on "Planning studies" comprises the activities of formulation of objectives, collection and interpretation of data, identification and analysis of problems and surveying of priorities, for each main concern involved.

The item on "Land use and environmental planning" in the same chapter is divided up into studies of land suitability, planning of coastal areas, disposal of solid wastes, development of energy resources.land use and conservation of energy, urban planning.

Critical Comments

This document, rather than being an EIA methodology, contains an exhaustive guideline for environmental planning. It calls for the participation of a multi -disciplinary team and would require substantial funding. The duration of the studies seems appropriate to planning processes and would depend on the conditions prevailing in the area under study.

The proposal for evaluation of the environmental impact of plans is fairly general, being more connected with the legal requirements of the country. No specific methods for this evaluation are suggested.

Applicability

The guideline suggested for the process of environmental planning could be studied with a view to orienting, subject to appropriate adaptation, work on proposals for environmental management of a project. 'The procedures will be analyzed in greater detail in the stage entitled "lnalysis of EIA Methodology of development plans".

Title:

Methods of Environmental Impact Assessment for Use in Project Appraisal and Phisical Planning.

Origin: The document was drawn up as an activity of the Department of Town and Country Planning of the University of Manchester, in the United Kinadom, as an overall appraisal of the methods for evaluating environmental impact, applicable to the analysis of plans for urban and regional development.

Bibliographical Index Card

Lee, N., and Wood, C. "Methods of Environmental Impact Assessment for use in project appraisal and physical planning.Occasional paper N9. 7. 1980. University of Manchester, 78 pp.

Objective

Rather than presenting a new methodology of evaluation of environmental impact, the document deals with a review of the available methods applicable to major development projects and plans, indicating to what point the application of those methods

results inproper evaluation of the environmental impacts of such projects and plans.

In document, EIA methods are defined in two different manners: as an all-encompassing technique of approach (methodology) through which environmental impacts are evaluated; and a specific technique of evaluation used as a part of the technique of such approach.

Description

The document establishes criteria for appraisal of methods, bearing in mind the best result from the four most important tasks of preparing an evaluation of environmental impact. Identification of impacts, measurement of the variables generating impacts, interpretation of environmental data, and disclosure of results-The authors propose two different systems of classification of the EIA methods, one for projects and the other for development plans, indicating in each one of them, the various stages of the work and the respective tasks together with examples of the most appropriate methods. Tables 1 and 2 represent these systems.

The document also contains twelve appendices, a detailed examination of the methods mentioned, and includes for each ones of them a description, questions regarding use and suggestions for implementation and application.

Critical Comments

The documents suoeeds in attaining its objectives since the tasks proposed seem to cover all activities required for the evaluation of the environmental impact of projects and plans. As regards community participation, the methodology permits it to be integrated merely as one of the methods proposed for the achievement of certain tasks, but the effectiveness of integration of community interest into the process of planning is open to doubt.

Aplicability

The system of classification for methods of EIA offers a sound guideline for preparing development projects and plans. It is flexible enough to be integrated into any planning system in force.

As regards evaluation of impacts, the methods suggested are readily adaptable to restrictions on time and costs.

TABLE 1. A CLASSIFICATION SYSTEM FOR EIA METHODS FOR PROJECTS

TASKS	METHODS (examples only)
STAGE A. DESCRIPTION OF PROPOSED DEVELOPMENT	
1) Identify aspects of project for which information is to be sought distinguishing, where necessary, between different stages in the proposed development (e.g. construction and operating phases) and between different levels of screening.	Checklists, consultations with developer.
2) Determine resources to be used in construction and initial operating phase, wastes to be created, physical form of the development.	Data sheets, engineering drawings, etc. prepared by developer. Mass balance analysis. Accident and uncertainty analysis (this continues through a number of assessment stages).
3) Forecast future resource use, waste generation, etc. over the expected life of the development.	The same methods as in 2 apply, but methods of production and technological forecasting are also relevant.
STAGE B. DESCRIPTION OF EXISTING AND PROJECTED ENVIRONMENTAL CONDITIONS	
1) Identify aspects of existing and projected environmental conditions for which information is to be sought.	Checklists, consultations with environmental agencies. Alternatively, may be linked with A.1 through the use of matrices or through more elaborate representations of relationships such as networks.
2) Collate existing environmental data and identify gaps in information.	Consultation with environmental agencies and voluntary organizations. Use of data bank and retrieval systems.
3) Obtain additional environmental data to meet remaining deficiencies.	Review of existing monitoring systems. Special surveys using a variety of techniques (aerial photography, field sampling, etc.).
4) Predict future environmental conditions without the proposed development).	Variety of available methods, ranging from simple forms of extrapolation to complex modelling studies. Consultation with environmental agencies.
5) Summary and presentation of environmental data.	Mapping, overlay methods, summary sheets.
STAGE C. ASSESSMENT OF PROBABLE IMPACT OF DEVELOPMENT	
1) Assess magnitude of impact (in present and future conditions) on:	
(i) air, water and land;	diffusion and resource utilisation models, physical intrusion assessment;
(ii) receptors within the environment.	ecological modelling, damage functions.
2) Assess importance of impact by:	
(i) investigating response of affected parties;	social surveys, agency consultation and public participation;
(ii) aggregating individual environmental impacts.	scaling and weighting systems, overlay methods, use of panel of experts.
STAGE D. COMPLIANCE WITH OTHER ENVIRONMENTAL PLANS, POLICIES AND CONTROLS	
Assess likely compliance of development with existing and proposed controls.	Agency consultation, checking of extant plans.
STAGE E. REVIEW OF ALTERNATIVES TO THE PROPOSED DEVELOPMENT	
1) Identify alternatives to be considered.	Checklist (of types of alternatives to be reviewed), consultation and survey methods.
2) Describe project alternatives and assess their impacts.	Same methods as in A, C, D above, combined with screening methods.
STAGE F. PREPARATION OF NON-TECHNICAL SUMMARY OF THE ASSESSMENT	
— significant features of assessment and [illegible]	Communication methods.

TABLE 2. A CLASSIFICATION SYSTEM FOR EIA METHODS FOR PHYSICAL PLANS

TASKS	METHODS (examples only)
STAGE A. INITIAL IDENTIFICATION OF GOALS AND REFINEMENT OF OBJECTIVES	
1) Identify aspects of the environment to be studied, for which goals and objectives might be formulated.	Checklists.
2) Determine 'first round' environmental goals and objectives.	Environmental agency consultation to determine existing and planned environmental quality standards and targets; public consultation on basis of preliminary statement of planning issues.
STAGE B. SURVEY, PREDICTION AND ANALYSIS OF ENVIRONMENTAL CONDITIONS	
1) Identify aspects of existing environmental conditions for which information is to be sought.	Checklists (see A.1).
2) Collate existing environmental data and identify gaps in information.	Consultation with specialist agencies, use of existing maps and aerial photographs, use of data collation and retrieval systems.
3) Obtain additional environmental data to meet remaining deficiencies. Identify gaps that cannot be satisfactorily filled.	Review and revision of existing monitoring systems, special surveys using a variety of techniques (aerial photography, field sampling, etc.)
4) Predict main social and economic changes over the planning period (assuming no new plan implementation).	Population and economic forecasting techniques applied to the planning area.
5) Predict physical resource use and waste generation levels associated with forecast economic/social changes.	Checklists and matrices for identification use. Resource and waste coefficient analyses.
6) Predict magnitude of impact on environmental quality.	Environmental agency consultation, screening procedures, resource depletion, diffusion and damage analysis, landscape assessment techniques.
7) Analyse future environmental conditions: compliance with 'first round' environmental goals and objectives; review of goals and objectives.	Agency and public consultation on basis of survey report; mapping and overlay methods.
STAGE C. GENERATION AND EVALUATION OF ALTERNATIVE DRAFT PLANS	
1) Develop alternative plans and determine environmental evaluation criteria.	Intuitive techniques. Delphi forecasting consultation. Trade-off, cost-benefit, goals achievement matrix analyses. Lists of standards.
2) Describe the relevant features of each plan and assess physical changes, changes in resource use and in waste generation associated with its implementation.	Checklists; resource and waste coefficient analyses; accident and uncertainty analysis.
3) Predict magnitude of environmental impact associated with plan implementation on: air, water and land (including mineral resources), living receptors within the environment.	Checklists, consultation, screening procedures, resource depletion, diffusion and damage analysis. landscape assessment techniques.
4) Assess importance of impacts: determine compliance with environmental quality standards; investigate response of affected parties; aggregate individual environmental impacts.	Lists of standards, social surveys, public participation. Scaling and weighting systems, overlay methods.
STAGE D. PLAN DECISION, IMPLEMENTATION, MONITORING	
1) Select plan for implementation.	Application of evaluation criteria; agency consultation and public participation; plan modification in light of these.
2) Monitor environmental impact arising from plan implementation; review implementation process and plan in light of this.	Environmental monitoring systems.

Title:

Guidelines for the Environmental and Social-Economic Planning Alto Rio das Contas (Brumado Region)

Source

This document was developed by the Planning Centre of Bahia -CEPLAB in the State of Bahia, Brazil. It is a result of work undertaken by the authors proposing a plan to be applied in the Brumado region.

Bibliographical and Index Card

Uribe, A. Ogata, M.G. Proposed Project - Guidelines for the Environmental and Social-economic classification of Alto Rio das Contas (brumado Region) - CEPLAB, 1980.

Objectives

To offer guidelines for the classification of land use and to adapt local resources in the light of the possibilities and shortcomings existing in the social, economic and environmental conditions.

Description

This project makes a profound analysis of the Alto Rio das Contas region in order to obtain sufficient information to induce the government to embark upon a plan for the development of that region.

According to the authors, this methodology is based on the theory of Ecosystems, inspired on the work of Bertrand, Tricart and Sotchava. It is analysed in five sections:

1st. evaluation, description and analysis of environmental and social economic dynamic of the area sestina the basia assessment of such dynamics as well as its impact upon the environment bearing in mind its potential and its drawbacks. With this purpose in mind, "homogenous areas" are defined from the point of view of nature and social and economic conditions.

2nd. To define and select geosystems for the area under study. In this phase the authors declare that geosystems correspond to rather homogenous areas both from the point of view of nature and from.the point of view of social and economic conditions. This screening consists of a classification of pre-defined geosystems in which environment conservancy problems are encountered, that offer good potential for production and others where pressing social and economic problems are easily identified.

Geosystems that have been selected will be represented on a 1:100.000 scale, or more if necessary.

3rd. Potential use of the areas that are to be studied in detail. This phase comprises a more profound study of the geosystmrs, based on specialized bibliography, the interpretation of conventional type aerial photography, the preparation of subject charts, a listing of human/environment relations and farm labour. Special questionnaires will be used to assess what are the problems and expectations of the involved community and upon completion of that phase charts showing potential use for every geosystem will be subidtted, recommending the areas best suited to become natural biologic or ecologic reserves under appropriate legislation.

4th. Guidelines for environment and social-economic classifications required for the introduction of appropriate legislation.
At this point it is intended to embark upon an analysis of natural potential and to propose a system for the classification of use of soil and natural resources.

5th. Information and Education
The purpose of this phase that will be developed simultaneously with the proceding phases, is to devise a system for collecting, storing and processing of information concerning natural and social-economic environment.

Critical comments

The main objection to this method derives from the fact that it has never been experienced in practice and is merely a proposal.

To apply it would mean a very restricted contribution to well known EIA methodologies. It might be said that this is more of a project for the macro-division of regions into areas that includes some of the principles of methodologies of superimposition of map (overlays) rather than the development of a methodology.

There is no mention of assesing the environmental impacts resulting from the proposed actions.

Conclusions and applicability

Based on the above, this method might be efficient if applied in an area offering few complexities. Otherwise the cost of a profound study for the identification and selection of geosystems likely to attract political attention will make this undertaking quite unfeasible.

As far as this project is concerned it would appear there is litle to add except that the project might be expanded once the propoced plan is effectively adopted.

Section II

First approach to environmental impact assessment methodologies application

Brief information about the case study area

1- General Description

The project document signed by FEEMA and UNEP proposes the application of appropriate EIA methodology to the case study area defined as the industrial corridor between Rio de Janeiro and Sao Paulo, along the Paraiba do Sul river valley and the touristic and industrial corridor. along the sea coast, as can be seen in the map enclosed. .

This area reaches to the East the densely populated Rio de Janeiro City, to the North the Paraiba river basin boundaries, to the South the Atlantic Ocean and to the West Sao Paulo State border. It comprises nearly 7000 square kilometers, about 16% of the State area. It includes seventeen Municipalities: Angra dos Reis, Parati, Mangaratiba, Itaguai,and Rio de Janeiro along the sea, crossed by the federal road that links Rio de Janeiro to the port of Santos in Sao Paulo State; Nova Iguaqu, Paracambi, Pirai,.VOlta Redonda, Barra Mansa and Resende, crossed by the federal road that links .Rio de Janeiro City to Sao Paulo City; Vassouras, Barra do Pirai, Mendes, Paulo de Frontin, Rio Claro and Miguel Pereira. These municipalities are part of three different administrative regions, the Metropolitan Rio de Janeiro Region,the South Coast Region and the Industrial Region, of Paraiba River Medium Course. Its population is nearly 1.900.000 inhabitants, 19% of the estimated total of the State in 1980 and the economic activities are diverse.

Its geophysical features encompass three river basins: Paraiba do Sul medium course river basin, between two dams, Funil and Santa Cecilia.; the Sepetiba bay contributing basin and the IlhaGrande bay contributing basin.The first two of them are connected by a water diversion from Paraiba river to Guandú river, for energy generation and, as a by product, for water suply to Rio de Janeiro metropolitan area.

2 - Special Features

The social and economic development of the area is determined by its geographic location, near the two most important cities of the country.

- West of Metropolitan Region

This sub-area includes the districts of Santa Cruz and Campo Grande of the Rio de Janeiro Municipality, Japeri and Queimados of

Nova Iguaqu Municipality and Itaguai, Mangaratiba.and Paracambi. Its population is around 758 of the area inhabitants, with a rapid demographic increase due, to the industrial growth observed in Santa Cruz, Campo Grande an Itaguai which atracted a large number of workers from other regions.
There are five industrial districts in this sub-area, under the responsability.of the State Secretary of Industry and Commerce in different occupation stages; two ports for ore export, with large coal storage areas, one under construction in Sepetiba bay and the other in opperation in Mangaratiba; a large industry of hearvy nuclear reactors and about 30 other industries.

A steel plant has been planned near Itaguai City to produce 8 million tons per year in its first phase.

Besides, part of this sub-area is engaged in agriculture activities such as, bananas, tomatoes and orange plantations.

It correspondes to the Sepetiba bay contributing basin, limited by the Serra do Mar mountain range, which closes a large sedimentary plain crossed by artifiyial drainage channels. Its main river, Guandu, receives about 160m^3/s of water derived from Paraiba river, with great importance for suplying water to about 10 million inhabitants and local industries.

The principal environmental problems are industrial water pollution which have impact on Sepetiba bay water quality, industrial air polution,and indiscriminate land use and development.

- South Coast

This sub area is made up of two municipalities Angra dos Reis and Paraty, which comprize the Ilha Grande Bay ocntributing basin; it possesses a mountanous topography with the ridges of the Serra do Mar range reaching up the seashore. It has two distinct formations, the Serra do Mar mountain range, with its high ridges, and small flood plains surrounded by hills and mountains. There are many small and rocky islands which take the form of hills emerging from the sea.

Until the construction of the Rio - Santos Motorway, the difficulty of access to the-region enabled the conservation of the historical sites of Paraty and Mambucaba, as well as most of the original tropical forest. With the greater accessibility brought by the Rio-Santos road, the region underwent rapid development, with intense real state speculation. There was a significant change in the pattern of land use, which before was mainly for agriculture and fishing, turning to tourism activities and industrial plants. These comprize a nuclear power plant, a large shipyard (Verolme) and an oil terminal and pipeline.

Among the environmental problems brought about by the recent changes in land usage there are:

- landslides along the road and the deposition of sediments on river river beds and beaches due to geomorphological changes caused by the construction of the motorway and by the use of hillside slopes for land parcelling;

- risk of oil pollution in oil terminal where traffic is about twelve oil tankers for month;

- terrnic water pollution since the first nuclear power plant will take up 40m^3 /s of see water for the generator refrigeration which will be returned to the bay with a 7°C temperature increase; also, this effluents will contain chloride'although in that exact quality is yet-unknown.

Due to the real estate boon in the area, the price of land went up considerably. As a result, the local population was forced to occupy the hillsides and sloped land, generally less sought for by construction. This led to the formation of sub-housing areas in the periphery of the cities. The consequence of this process was the cutting of vegetation, causing damage to springwaters and erosion of hillside with deposition of sediments in riverbeds and seashores. Also, there has been an invasion by population and real estate interprises of mangrove eoossystems-. deteriorating them,and causing their extinction. This - together with the opening of canals and their constant dredging will imply in the acceleration of the sedimentation process of the Ilha Grande Bay and in the eventual dissapearance of its biota.

- Paraiba do Sul river basin

This is the most important of. the described sub-areas. It is responsible for around 15% of Gross State Product and is crossed by Paraiba do Sul river, the main source of Rio de Janeiro water supply.

It includes ten municipatities and is considered the second important State industrial area.

Its physical aspects were determined by the erosive action of. Paraiba do Sul river and affluents. The geologic structure originated deep valleys on the mountain slopes and small hills as a transition to the alluvial plains.

Its population, nearly 450 000 is mostly urban (778) and the demographic increase is related to the industrial growth observed since the construction of a steel plant in 1945.

Other economic activities, such as agriculture, cattle raising and tourism, are well developed although less important than industry. A suitable location, near Sao Paulo, Rio de Janeiro and Minas Gerais consuming markets, with good transport facilities, efficien water and electric power supply and large plain areas, provided industrial growth and the resulting urban development.

The critical environmental problems are mostly due to the industria and urban pollution. Basides thirty major industries, including some chemical and three steel plants, a major uranium enrichment plants is under construction near Resende, to produce fissible material for atomic energy instalations, undowbtely with high polluting potencial.

Paraiba do Sul river flow.and its selfdepuration conditions have been sufficient to absorb the serwage due to the population growth and support the next twenty years predicted growth.

Information abbut the occurence of toxical pollutants.shows that there is no immediate risk although some accidents have been

observed in the last years.

3 - Conclusion -

The different and complex environmental aspects and problems of each described sub-area show that-the study area is completely in accordance with the main project purpose: to promote environmentally sound development of a region with accelerated urban, industrial and touristic growth whose damage potencial may be large but not yet realized.

1. The Leopold Matrix

To compose the matrix, it is necessary to compile the whole of the environmental conditioning factors in the area, the ways of using the environment and the social, economic and cultural conditions of the population. The aspects are arranged and inter-related with the columns covering the following activities: urban, industrial, rural, touristic, etc. (see ill II.1). The methodology scheme is described in details in Part I of this report.

For the purposes of this exercise, it was selected the entire case study area, inasmuch as the methodology had to be handled in an area presenting sufficient diversity of problems to permit the best possible application.

The environmental characteristics were defined from the oricinal Leopold Matrix, and adapted to the conditions prevailing in the area. The activities considered were those contained in the proposals for zoning of the governing plans of the municipalities beloging to the area, as drawn up by the Planning Board of the State Government, containing proposals and descriptions of the municipalities.

1.1 The Scenario

To a scale of 1:100.000, the following areas corresponding to the matrix activities were mapped, namely: Urban (residential, commercial, service activities and urban expansion); Agricultural; Cattle raising; Institutional (military areas, parks and so on); Industrial (industrial zone, industrial districts and isolated industrial activities) (see figure II.2). This information that was used is contained in the proposals for municipal zoning of the physical-territorial and Governing plans drawn up by the SECPLAN - Board of Planning of the State Government, and FUNDREM-Foundation for Development of the Metropolitan Region of the State Government.

We also mapped highways BR-101, BR-116 and BR-393, the "Steel Railroad", the Terminals, the Paraiba do Sul river and the Lajes and Funil dams.

The municipalities of Engenheiro Paulo de Frontin, Piendes and Rio Claro do not have any zoning proposals, and the direct impacts are not taken into account.

1.2 Working Method

The team was divided into five groups per area of technical concern identified from the environmental characteristics of the area under study, and they set up as follows:

1. Earth and environmental processes;

2. Quality of the water and air;

3. Biological resources and ecological relationships;

4. Social sectors and uses of the environment; and

5. Cultural and esthetic aspect.

After identification of possible impacts each group set up its own criteria for calculating the magnitude of interference of activities proposed for the area. Later on the team was regrouped so as to establish the relative degree of importance.

1.3 Magnitude

The criteria for determining the magnitude of the impact of each item in the group of activities were set in order dependent on the level of danger of parameters that define environmental characteristcs.

These parameters vary a scale whose minimum limit is 0 (zero) and the maximum is 10 (ten), Each group of environmental characteristics is as follows:

<u>Mineral Resources</u>

As regards evaluation of the impact undergone by the mineral resources in function of their use, a maximum note was given to the situation in view of the fact that any kind of working implies their extinction. In cases of removal of sand, a rating of 5 was given, inasmuch as this is a resources that can be recuperated.

<u>Soil</u>

In relation to urban activities, industrial areas, touristic and institutional zones (military areas and Rural University) we took into account merely the water-proofing and comparing of the soils, merely on account of the level of occupation anticipated, presupposing that this is an area that is to be built up.

Hence for an area of 40% ocupation we ascribed a value of 4.

As regards the infra-structure, we considered that the highways compact, waterproof, breakdown the structure of strata, and produce disaggregation, so that they rate 6. The railroads interfere in similar "fashion, but do not cause waterproofing so they get a rating., of 5. The oil-pipelines cause disaggregation and compacting to..a lesser degree, and may or may not cause waterproofing, so they get a rating of 4. Transmission lines merely cause disaggregation so they rate 3. In rural areas, it was considered that animal husbandry causes disaggregation and compacting, so it gets a rating of 7 for the first aspect and 3 for the latter.

Agriculture disaggregation and improverishes, so gets a rating in relation to the latter effect of 7. The impact caused by economic reforestation was the same as that from agriculture.

The ideal thing for evaluation of the impacts would be to detect stages of disaggregation.

Geomorfology (Relief)

In this item, a check quite close to reality would be obtainable by observations on the spot of each activity in relation to the level of interference with the geoform and the range of slope into which the respective location fitted.

But as regars interference by urban nuclei, industrial areas, touristic locations, military installations, institutional development (Universidade Rural), the infra-structure and the terminals, the respective locations were considered in relation to the slope of the ground by checking maps to a scale of 1:50.000. We also took into account, based on the prior knowledge of the group, the destruction of kind of configuration. Hence the rating were ascribed in order dependent on the level of slope and destruction of shape.

In relation to the use of mineral resources, we took into consideration the various activities of ore extraction, quarrying and,formation of dams, and assigned them a rating inasmuch as they tend t0 completely extinguish the geoform. More effective valorization of findings imply identification in the field of the relative stage of each one of these activities.

Surface and Groud-Water (Recharge)

Surface and underground waters.

These are impacted by urban area, industrial and institutional areas (buil-up zones), through waterproofing of the soil, removal of vegetal cover, rectification of canals, strancrulation of natural grainage. Due to the unavailability of data, we took into account merely the waterproofing of the soil through figures on rate of occupation.

As regards tourism areas, we considered merely those located in the hilly areas and on the BR-101 highway up to the skirts of the mountains, ascribing them a rating of because they interfere with infiltration into areas close to springs.

Regarding the infra-structure, we took into account the strangulation of natural drainage and possible silting up of river valleys.

Quality of Water and Air

The criteria for determining the magnitude of the impact of the activities in urban areas, rural areas, industries and terminals were set in order dependent on the level of danger of the parameters defining the,quality of the water in a body of water. Values were defined for each parameters, on a scale whose minimum limit is 0 (zero) and the maximum the sum total of the values of the parameters, taking into account the fact values above 10 (ten) would be considered as being the maximum magnitude on a scale of 1 (one) to 10 (ten) on the matrix. The parametery considered were: radioactivity, toxic elements or compounds, agricultural defensives, heavy metals, other inorganic elements or compounds, organic burden (measured as OD deficit), sanitary aspects. physical and chemical parameters and other organic compounds.

Each group of parameters brings together a number of factors that would appear to be the pollutant agents. When any one of them occurs, over and above the permissible water quality values (1) the degree of magnitude is given by the values ascribable to the parameters. To reach these values, we checked for each activity foreseen the quality and quantify of the wastes produced.

We subsequently calculated the burden imposed by these wastes in the respective receiving bodies and compared them with the legal standards.

As regards quality of air, we took the same procedure that had been adopted for water quality being considered as parameters;

- heavy metals;
- carbon monoxide;
- sulphur oxides;
- nitrogen oxides;
- ozone;
- particles in suspension, and
- sedimentable particles.

Climate

As regards the criteria adopted for establishing the magnitude of the impact of activities on the climate, were considered as parameters: rainfall, relative humidity, temperature and light (radiation).

(1) We took the standard quality of water for public supply since this represents about a mean value of water quality standards. INITED STATES, ENVIRONMENTAL PROTECTION AGENCY. Public water supplies. In "Water quality criteria; a report by the

commitee on "Water quality criteria", Washington, DC, 1972, s.II, p 48,92,il (Ecological Research Service, R3 73,033).

Floods

To ascribe a scale of values to this situation, we considered the rate of occupation of the soil, anasmuch as this implies waterproofing, due to lack of more complete information.

Erosion

For urban nuclei, industrial areas, institutional zones and terminals, allowance was made merely for the factor of slope of the land, anasmuch os other necessary data were not available, such as the slope in the actual point of localization, the extent to which the vegetal cover had been removed, the type of soil, the surface run-off, etc.

In rural areas, as regards agriculture, we took into account merely the effect of disaggregation, inasmuch as no data are available on each agricultural area separately, along with the conditioning factors.

The rating ascribed to the items os mineral resources were given with regard to the process itself, without taking into account the surrounding factors, and maximum rating was given, except where dams were concerned, whose rating was 1.

Compacting of Soil

In those activities liable to cause compacting, we took as criterion the rate of occupation anticipated, except where animal husbandry is concerned.

Nut having the required data, we considered for the urban nuclei, industrial areas, touristic areas, infra-structure and terminals, the tollowing criteria.

Location on sloping ground or otherwise, extent of occupation and angle of slope.

Regarding use of minerals, we took a maximum value for barriers, since the objective of the action is gradual extinction of them. Instability sets in right from moment the activity is commenced. In cases of extraction of minerals and quarrying in general terms, the instability increases gradually, on account of the strong resistance of these materials, so in these cases a minimum rating for magnitude was given.

Biological Conditions (Flora/Fauna)

We include here the flora and the fauna and in the former case the vegetal cover was deemed to be of importance. We took into account two aspects in the criterion adopted: the quality, in terms of the vegetal types, and then the quantity, in terms of devastated areas.

The scale of values attributed to the vegetal types was a maximum to forests, reefs and mangrove' ecossystems, with value 10 (ten), decreasing for Scrub, Brush, farmed land until grassy meadows, with value 2 (two).

For the devastated areas the scale varied according its perceptual leval with values from 2 (for 0-24% of devastation) until 10 (for 100%).

The notes on the vegetation types were added to the respective levels of devastation and the arithmetic mean of those values was calculated so as give the degree of magnitude for each impact.

As regards the fauna the procedure was similar and the criteria of quality were given to the parameters and its values: introduced fauna (with a minimum value like 2), primary consumers, all together (those of the natural fauna), until all (with a maximum value 10).

The criteria and values for quantity contained the following parameters and values: oscillation of frequency in variation of minor significance (2), substituition in the ecological nich (4), migration or migratory barrier (6), reduction in population (8) and extinction of population (10).

Ecological Processes (relationships)

In this sector we considered the following relationships: eutrophication, vector and alimentary chains.

In the case of eutrophication, we took a scale of 1 to 10, in accordance with the level of interference of the activities. For each one of them we defined factors more or less favorable to the appearance of eutrophication:

Activities	Values	Parameters
Dam	8	-decanting of sediment; -reduction of turbidity in water -reduction os speed of water
Urban Nuclei	5-7	-bodies of water of minor flow -river running through flatland -rectifield canal -quantity of domestis waste
Industry	3-4	-quality and quantity of effluents
Agriculture	2	-use of fertilizers

In the case of agriculture, an activity that interferes directly in the alimentary chain, but is not expressive nor contains innovations foreseen for the area, a medin impact was ascribed.

Animal husbandry, being an activity which is expressive in relation to the scenario, receives a rating for meduim to high impact.

As regards the Industry and Terminals activities, we adopted, the same criteria as those for water quality, mentioned previously, and arrived at the following rations:

Notes on Water Pollution	Notes on Alimentary Chain
1 - 2	1
3 - 4	3
5 - 6	5
7 - 8	7
9 - 10	9

In the case of the Atomic Plant we ascribed a value of 9, because this activity interferes with the alimentary chain at a level of primary producers due to the thermal pollution.

A value of 7 was ascribed to touristic activities, and to the infra-structure on account of the existence of swamps near to highway BR-101.

Social Sectors

We include here the following sectors: Health, Education, Housing, Feeding, Safety, Employment, Populational Dynamics, Recreation and Leisure.

We selected indicators for each social sector, that would, reflect the social development and the, conditions of life, weighted according to a scale of values going from 1 to 10.
The indicators, selected were: general and infantiy mortality, morbidity, birth rate situation (natality) and provision, of health service, for health; level of education, and equipment, for purposes of education, for education; housing conditions, available services, sanitation, garbage collection services etc., density of population, financing facilities available and, facilities (public squares, parks and the like), for housing; general level of nutrition, acquisition of food products, feeding habits, supply of foodstuffs in the location studied and supply facilities, for nutrition; existence of localities unsuitable for human settlements, facilities and policing, for security; supply of jobs, under-employment, income, employment (by age and sex) and supply of manpower, for employment; population growth, structure of population (sex, age, etc), internal and external migrations, spatial distribution of population and recreation and leisure, for population.

We established a degree of intensity. for each activity.foreseen, which could be applied to both the social sectors and the uses of-the environment (next "item). With this in mind, three different factors were taken into account:

1. Type of action-urban-nucleus, industry, etc.

2. Situation in being -'Diagnosis of the governing plans and-specificity of the point of interference.

3. Extent to which the-action is all-encompassing.

It use established a list with continuous values for each find of action (columns) according. their intensities varing from 0 (zero) to 10 (ten)

Among the vectors, we considered the most important of the activities were those of urban area on account of their generating larger quantities-of-organic garbage.

The value ascribed as an order of magnitude was a function of the ratio of the number *i*nhabitants to volume os garbage generated by the area.

We adopted the classification of urban area of the IBGE -Brazilian Institute of Geography and Statistics; according to the number of inhabitants, as follows:

Classes	Values
over 100,000	9
from 50,000 to 100,000 inhabitants	8
from 20,000 to 50,000 inhabitants	7
from 5,000 to 20,000 inhabitants	6
less than 5,000 inhabitants	5

In practice we took the estimated urban population for 1980, for calculation of -the magnitude.

In the Port activity. we took the size and:proxirity of the center dispersing vectors. Hence the values ascribed were 4 and 3. .

The agricultural activity, suppying wastes from foodstuffs, is a focus for proliferation of-vectors, and we ascribed a value of 2 for magnitude.

As regards alimentary chains, in view of the impossibility, of adopting amore rigid parameter, we adopted-classes whose subjective order of magnitude was according to the levels of impacts varing from a minor, with value 1 (one), to a high with value 9 (nine).

Uses of Environment (Land Use).

The mechanism adopted wars the same used to calculate the magnitude of the impacts. in the social sectors.

Thus indicators were established for use of the environment existing in the region under study and, after they had been duly set in order, weightings were ascribed to them.

Here, the indicators selected were: population density, quantity of waste (sewage and garbage), water consumption, marginal occupations, infra-structure, facilities and services in urban area, density of constrution, allotment of land urban expansion and value of the land, for urban areas; water consumption, increased release of wastes, infra structure, value of land and labor, income, for industrial areas; shift in useof land, valorization and dividing up of land and reduction in rural labor, for agricultural and animal husbandry areas; springs, destruction of natural vegetal cover, occupation of banks of rivers and canals, slopes exceeding 450 and 300, swamps and beaches, heads, tongues of land, bare coastline, for preservation areas; pollution, destruction of scenic beauty, detraction from typical features of the countryside and dividing up of land, urban expansion, for areas of tourist activity; predatory, occupation and extraction of native flora and fauna, for institutional areas: demolishing of social and cultural structure, valorization of land and homes of the fishermen, marginalization of activity and reduction in number of fish, for handicraft type fishery occupations; valorization of land, redefining of uses, dividing up of land, establishment of areas, for preservation and urban expansion, for subsistence agriculture.

After establishing the intensity of each kind of action and also defining factors for the social sectors, in accordance with the following criteria:

Urban nuclei -

Occupation existing in urban nuclei and related to proposals, in terms of expansion of the area, calculation of minimum average building lot proposed and rates of mean maximum occupation, population density, degree of urbanization in relation to the region, functions of the (present) urban nuclei.

Industries -Generation of direct and indirect jobs, level of technology (production process and output of wastes), kind of industry, water consumption, power consumption, quality of water and air.

Areas of tourism -Valorization of the land, destruction of the countryside, dividing up of the land, infra-structure, floating population, increase in local cost of living, increase in occupied area, physical environmental conditions.

The correspondency of the scales used was in relation the notes of magnitude (1 to 10).

Cultural and Esthetic Aspects

This topic covers the following items: archeological and prehistoric sites, historic monuments, handicraft-type fishing activities, folklore, scenic spots, possibility of taking the waters for health, parks.

Values from 1 to 10 were established to the following parameters: Tor archeological and prehistoric sites: scientific exploration, conservation, depredation and total destruction;

In practice the magnitude was calculated according to the arithimetic mean of the value ascribed to the parameters.

for historic monuments:
preserve as historic site, recuperate, abandon, depredate, detract from inherent characteristics and demolish;

for handicraft-type fishing:
increased fishing (development of activity) reduction of catch and expulsion of fishermen;

for folklore:
foster and detract from inherent characteristics, cultural impact, and extinction;

for landscape:
recovery, constructions unsuitable to the environment, cutting down of forest cover, demolishing of vegetation and slopes and formation of points of erosion;

for possibility of bathing:
privatization, of the beach, detraction from characterists, cutting down of forest cover, buildings near beach and rendering beach unsuitable for bathing; and

for parks:
delineation, disappropriation, supervision, conservation, collective facilities for avoiding depredation, camping

activities without any infra-structure; private homes and

hotels, invasion of land; cutting down of forest cover and

dividing up park into,, allotments.

Importance

A weighting procedure was defined for the environmental characteristics on a scale going from 1 to 10, after the establishment of a order factors appearing on the matrix.

Then each degree of magnitude was multiplied by the weight of the corresponding environmental characteristic.

Environmental characteristics		Values
Social sectors		10
Uses of the environment		9
	water	8
	Processes	7
Physico-Chemical Characteristics	Land	6
	Atmosphere	6
Ecological relationships		6
	Fauna	5
	Flora	5
Cultural and Esthetic factors		4

1.5 Computations

A general analysis of results is provided by the last row and column computation.

Each value corresponds to sum of the importances given in the build through matrix and is related with the rows (environmental characteristics) at the right side and with the columns (activities) at the down side.

Analysing the computation row, it is possible to observe that the urban area of, greater impact on environmental characteristcs is ITAGUAI with the importance value summaring 1979. Analysing the computation column, surface, summaring 2416, is the most impacted environmental characteristcs.

1.6 Critique on the results of applying the Leopold Matrix

The purpose of the application was to train the team through a methodological exercise in the case study of the project.

The prior knowledge of the team was taken as basis, inasmuch as the short time available and the lack of up-to-date information and data did not permit any other alternative.

Although the working group was composed of a multi-disciplinary team, we noted a shortage of professionals in certain areas such as those concerning institutional and social aspects.

The magnitude values in most cases included the relative importance. For the calculation of the latter we did not relate the impacts of greater magnitude but established the environmental characteristcs through weighting, without taking into account the specific interference of each particular action and the environmental dynamics of the various components. The establishment of the weightings entailed equal values assigned to different impacts and over-valorized the final results in terms of relative importance.

The results of the matrix were checked at the time of the analysis effected, through the average impacts of the lines and columns. Hence we observed: for the interference of the actions there was a certain coherence in results, whereas as regards the environmental characteristcs incoherence was seen in relation to the weighting system established using prior knowledge for the analysis of the respective results.

2. The N. W. Sondheim method

Essays in which this method was used led to the selection of a specific project activity among those existing in the region, in view of the peculiar features of this method.

The higway between Rio de Janeiro and Santos, called the BR-101 highway was built early in the 70's. It follows the coastline and in the early stages of the project, no environmental impact studies were undertaken. The construction of the highway merely followed the usual engineering procedures. It destroyed several sand beaches and severely affected the landscape during the construction phase. The environmental impacts still can be observed, to the point where landslides occur and the pavement caves in while. small valleys are periodically flooded and some beaches are silted up.

Considering that the present project intends to hold workshops to discuss specific subjects the tourism activities industry and development plans, this working group decided to adopt the Sondheim method for the assessment of the environmental impact caused by the above named highway.

The methodology comprises alternative projects. This difficulty was overcome by the working group by drawing a new course for the highway that is considered as an alternative to the project that has been executed. This course will bear the title of "hypothetic BR-101" in the development of this report.

This new course bypasses all the flat areas and whenever feasible, respects local topography. It avoids disturbing hillsides and winds round mangrove ecosystems.(i11.II.3).

All the members of the project. staff worked, according to the method, as: coordinating body members of Rathing panel and weighting.

The coordinating body, in addition to defining project alternatives also defined environmental parameters to be taken into consideration when assessing environmental impact and the social segments to be represented in the weighting panel:

- Definition of Environmental Parameters:

a) Physical Aspects..

Relief Shape
Shape
Hydrology
Processes (Erosion - Flooding - Landslides)

b) Biologic Conditions

Flora
Fauna

c)Social and Economic Aspects

Health (Infant mortality -Health care units)
Education (Number of schools - number of enrolled students)
Housing, (services),
Employed manpower (in, every sector)

d) Cultural Aspects and Aesthetic Aspects

Folklore
Artisan fishing
Archeologic sites
Landscape
Parks
Sea-bathing

e) Political Aspects

Local political contraints

f) Urban Expansion

Population density
Degree-of Townscaping
Urban area
Population

g) Expansion.of Tourism

Equipments for tourism
Fluctuating population

h) Industrial Expansion

Number of industries
Employed,manpower
Production value (at constant prices)

i) Rural Areas

Modification in land use
Fluctuations in rural population
Agricultural and Cattle production

- Definition of social segments

a) Primary sector (fishermen - farmers - cattle breeders)
b) Local associations (urban population - businessmen - trades-people)
c) Townhalls (Municipality Government)
d) FEEMA
e) Historic Patrimony Department
f) EMBRATUR"(Biazilian Tourism Office)
g) Vacationers
h) Real estate agents

2.1 Rating Panel

The working group was divided into sub-groups according to the environmental aspects that were defined and according to the corresponding professional qualifications.

These groups embarked upon a study of the technical criteria to assign values to the impacts of each alternative:

<u>Physical Aspects</u>

Values were assigned to "landslides and lack of stability of filled-in areas". The starting point was the measure in kilometers according to sections of the highway, the hypothetic and the"effective one, where embankments and earthwork exist. Weighting-was assigned according to the type of problem; instability of embankments was assigned the. value of 6 and earthwork 4. The final value was obtained by multiplying the values for the affected section by these values.

Alternative Projects	Embankment (Km)	Eartwork (Km)
Existing Highway	102,0	102,0
Hypothetic Highway	50,0	11,0

Biologic Aspects

The impact upon the biologic aspects, both for the existing highway and for the hypothetic one was assessed according to the sum of qualitative and quantitative factors. For the flora, quantification was obtained based on the percentage of the affected area related to the values assigned according to an increasing order.

(Affected area % of the total)	Value
0 - 25	1
25 - 50	2
50 - 75	3
75 - 100	4
100	5

Quality was assessed based on the type of vegetation that was affected by road construction associated to weightings based on the respective ecologic importance.

Types of Vegetation	Weightings
Grassland	1
Cultivated fields	1
Coastal Vegetation (land and beach)	1
Brushwood	2
Woods	2
Swamps	3
Mangrove ecosystems	3
Forests	3

The same method was used in evaluating fauna starting with the percentage of affected species against respective weighting.

Affected Species (% of the total)	Value
0 - 25	1
25 - 50	2
50 - 75	3
75 - 100	4
100	5

Qualitative evaluation considered typology to which weightings were attributed, based on the known biologic relationship between fauna and flora.

Type of Fauna	Weighting
Species that are unimportant to man	
Species specific in the food chain	1
Species important in the food chain	2
Species important to man	2
Specific in the food chain	3

Cultural and Aesthetic Aspects

The criteria adoped were the same as those used for Leopold's Matrix.

As far as pre-historic and archeologic sites are concerned, featuring historic monuments, folklore, landscaping and parks, no difference was detected as regards the impact caused by alternative projects.

However, as regards artisan fishing and sea bathing, the size of the beaches was taken into consideration and, in-the case of the hypothetic BR-101, the course of the highway was removed from these sites to insure better conditions for fishing, agriculture and recreation.

The values therefore represent`a lesser impact resulting from the hypothetic BR-101.

Urban Expansion

The parameters adopted to define the expansion of urban nuclei likely to be affected, were thefollowing: total population, urban population, degree of urbanization, urban area and population density.

To quantify the urban area we only used data from 1970 and 1980.

There was an increase of 2,5 times the values for 1970. We took this figure to quantify the.impact of the two alternatives upon urban expansion.

The remaining data were considered as not sufficient for our purpose as they merely represent estimates and do not take into account interference caused by the highway.

We concluded that there is no difference: in urban expansion as far as the two alternatives are concerned and the two were assigned the same value.

Tourism Expansion

The parameters we used consisted of tourism equipment and roaming population.

In considering equipment, we discovered that in 1980 there were 45 hotels in the area under study. Due to lack of data on the conditions before the construction of the highway, we only took into consideration the hotels that then existed in the urban nuclei, of which there was a total of 22.

For 1980 we estimated fixed and roaming population bearing in mind the size of the areas suitable for tourist activities. We next calculated the mean percentage of the roaming population for the area and compared it with the residents of each urban nucleus and came to a mean percentage of-608 that was taken to be base value for tourist expansion.

As regards the hypothetic highway we concluded that an increase in roaming population-was likely to occur due to the greater availability of land between the highway and the coast.

Social and Economic Aspects

In the evaluation of this item we intended to consider a few parameters to qualify the quality of life, namely: health, education, housing, food, and others that would help us define what are the social and economic conditions of the population. However, because the data on hand were outdated, we decided to work upon a hypothesis based on known factors.

We attempted to make a qualitative evaluation of the impacts of the alternative projects upon these indexes, considering the following factors:

- availability of personnel of higher qualifications;
- endowement of the population with better equipped centres;
- increase of land value;
- real-estate speculation;
- ownership and usage of land

Starting from this point we concluded that interference is equal in the two alternatives.

Political Aspects

In assessing the present item we based ourselves on the degree of interference upon the area of municipal power. The criteria that were adopted were the capacity of the population to revindicate and the political strenghtening of the municipality.

In this respect we concluded that the existing BR-101 did not alter any of the above criteria and consensus among the team revealed that the hypotetic BR-101. would show the same results because of the same factors.

Industrial Expansion

In the analysis of industrial expansion resulting from project alternatives we employed data concerning the number of industrial plants that were erected before and after the construction of the existing BR-101.

The results proved that there was no difference and the two projects were assigned the same value for this item with the only exception of the Furnas thermo-nuclear plant, the construction of which is linked to the construction of the BR-101 highway in spite of the fact that the actual site was selected in the light of other considerations.

Rural Expansion

Existing data concerning agricultural production were the paramaters used in this analysis. We found out that there was some decrease in agricultural production when comparing preand post construction of the highway. However, this fact is not directly related to the construction of the highway because of the facilities it offered for transporting the products. In comparing the two projects, we found out that the hypothetic highway might contribute to reduce the amount of land, available for agriculture and consequently improved conditions for tourism would have been detrimental to the primary sector. The hypothetic BR-101 was assigned ,a higher impact value under the present heading.

Costs

The costs of the alternatives were compared to assess costs. In the calculation of costs, we considered the lenght, width and number of bridges. In comparing the. hypothetic the BR-101 to the existing one we found that it is 100 km longer and has 116 bridges. Regardles of these factors, however, the cost of the hypothetic, highway would be higher.

Based on the above mentioned criteria, we arrived at the matrix of values on the technical panel and these values were

standardizes (see chart: II. I).

Because we had only project alternatives, the standardization of the values for each environmental variable resulted in the values of -1,0 and + 1 showing a greater impact, equal impacts and smaller impact, respectively (see chart II1).

Weighting Panel

By using the Delphi technique, our group looked into every social sector, every institution and corporation that is one way or another involved in the area. Starting from this point, a matrix was built up by assigning these sectors to its columns and assigning the same parameters of the technical assessment, to the horizontal lines.

Consequently, the involved sectors weighted on the environmental parameters considering the importance of the respective interests.

Because it is impossible to have the cooperation of these groups in an exercise in methodology, the groups were represented by the team and the values for each of the corresponding environmental aspects resulted in the mean average of the values assigned by the members of the group (see chart II.2).

2.3 The results: Final Matrix

This matrix establishes a comparison between projec alternatives. It was obtained by multiplying the matrixes of standard evaluation and of weighting. If we want to find out what is the best project alternative, we must add up each line corresponding to each project and to find out which of the two is higher and therefore the better one.

For the two project alternatives the group proposed, the hypothetical BR-101 seems to offer a better option considering the conditions of the environmental (see chart II.3).

CHART II.1

APLICATION OF THE METHOD OF SONDHEIM

RATING PANEL

PROJECT ALTERNATIVES	ENVIRONMENTAL ASPECTS										
	PHISIOGRAPHIC ASPECTS	BIOLOGICAL CONDITIONS	SOCIAL AND ECONOMICAL ASPECTS	CULTURAL AND AESTHETIC ASPECTS	URBAN INCREASEMENT	POLITICAL ASPECTS	TURISTIC INCREASEMENT	INDUSTRIAL DEVELOPMENT	RURAL AREA	COSY	
ALTERNATIVE 1	812	20	5	29	2,5	1	60	0			VALUES
ALTERNATIVE 2	656	5	5	0	2,5	1	120	0			RATING PANEL
ALTERNATIVE 1	-1	-1	0	-1	0	0	-1	0	+1	+1	STANDARTIZED VALEUS
ALTERNATIVE 2	+1	+1	0	+1	0	0	+1	0	-1	-1	

CHART II.2

APLICATION OF THE METHOD OF SONDHEIM

WEIGHTING PANEL

ENVIRONMENTAL ASPECTS \ AFECTED PARTIES	FISHERMEN AND RURAL INHABITANTS	URBAN POPULATION	MUNICIPAL GOVERNMENT	TEEMA	IPHAN - INSTITUTE OF NATIONAL HISTORIC AND ARTIST SITES	EMBRATUR - BRAZILIAN ORGANIZATION FOR TOURISM	SUMMER VACATIONISTS	REAL STATE AGENCIES
PHISIOGRAPHIC ASPECTS	4	3	3	5	3	4	5	3
BIOLOGICAL CONDITIONS	5	2	3	5	1	3	5	2
SOCIAL AND ECONOMICAL ASPECTS	4	5	5	4	2	3	3	1
CULTURAL AND AESTHETIC ASPECTS.	2	4	3	3	5	4	5	3
URBAN INCREASEMENT	3	4	4	3	2	2	1	4
POLITICAL ASPECTS	1	4	5	4	2	3	1	3
TURISTIC INCREASEMENT	2	5	4	4	4	5	3	5
INDUSTRIAL DEVELOPMENT	1	3	4	4	1	1	1	2
RURAL AREA	4	3	3	2	1	1	3	2
COST	1	3	1	1	1	5	1	1

CHART II.3

APLICATION DE THE METHOD DE SONDHEIM

FINAL MATRIX

AFECTED PARTIES / PROJECT ALTERNATIVES	FISHERMEN AND RURAL INHABITANTS	URBAN POPULATION	MUNICIPAL GOVERNMENT	FEEMA	IPHAN - INSTITUTE OF NATIONAL HISTORIC AND ARTIST SITES	EMBRATUR - BRAZILIAN ORGANIZATION FOR TOURISM	SUMMER VACATIONIST	REAL STATE AGENCIES
ALTERNATIVE 1	-8	-8	-9	-14	-11	-10	-14	-11
ALTERNATIVE 2	+8	+8	+9	+14	+11	+10	+14	+11