SANDIA REPORT
SAND98–2828
Unlimited Release
Printed January 1999

Managing Nicaraguan Water Resources

Definition and Relative Importance of Information Needs

Salvador Montenegro Guillén, Dennis Engi, and Katherine Vammen

Prepared by
Sandia National Laboratories
Albuquerque, New Mexico 87185 and Livermore, California 94550

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy under Contract DE-AC04-94AL85000.

Sandia National Laboratories

Issued by Sandia National Laboratories, operated for the United States Department of Energy by Sandia Corporation.

Available to DOE and DOE contractors from
Office of Scientific and Technical Information
P.O. Box 62
Oak Ridge, TN 37831

Prices available from (615) 576-8401, FTS 626-8401

Available to the public from
National Technical Information Service
U.S. Department of Commerce
5285 Port Royal Rd
Springfield, VA 22161

NTIS price codes
Printed copy: A07
Microfiche copy: A01

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

SAND98-2828
Unlimited Release
Printed January 1999

Managing Nicaraguan Water Resources

Definition and Relative Importance of Information Needs

Salvador Montenegro Guillén
Centro para la Investigación en Recursos Acuáticos de Nicaragua
Universidad Nacional Autonoma de Nicaragua
Telcor Villa Fontana Una Cuadra al Norte
Managua, Nicaragua

Dennis Engi
Strategic Initiatives
Sandia National Laboratories
P.O. Box 5800
Albuquerque, NM 87185-0160

Katherine Vammen
Centro para la Investigación en Recursos Acuáticos de Nicaragua
Universidad Nacional Autonoma de Nicaragua
Telcor Villa Fontana Una Cuadra al Norte
Managua, Nicaragua

ABSTRACT

This report provides an overview of the results of the Vital Issues process as implemented for the Nicaraguan Water Resources Management Initiative, a collaborative effort between the Nicaraguan Ministry of Environment and Natural Resources and Sandia National Laboratories. This initiative is being developed to assist in the development of an efficient and sustainable water resources management system for Nicaragua. The Vital Issues process was used to provide information for developing a project that will develop and implement an advanced information system for managing Nicaragua's water resources. Three Vital Issues panel meetings were convened to 1) develop a mission statement and evaluation criteria for identifying and ranking the issues vital to water resources management in Nicaragua; 2) define and rank the vital issues; and 3) identify a preliminary list of information needed to address the vital issues. The selection of panelists from the four basic institutional perspectives—government, industry, academe, and citizens' groups (through nongovernmental organizations

(NGOs))—ensured a high level of stakeholder representation on the panels. The already existing need for a water resource management information system has been magnified in the aftermath of Hurricane Mitch. This information system would be beneficial for an early warning system in emergencies, and the modeling and simulation capabilities of the system would allow for advanced planning. Additionally, the outreach program will provide education to help Nicaraguans improve their water hygiene practices.

ACKNOWLEDGEMENTS

We gratefully acknowledge the help and interest of the panelists who attended the panel meetings on November 14, 1997, February 10, 1997, and May 12–13, 1998:

- Ing. Miguel Cáceres, ADESUR
- Ing. Victor Campos, Centro Humboldt
- Ing. Arcadio Choza, MARENA
- Lic. Freddy Cruz, CECSA
- Dr. Arlene DeFranco, UCA
- Ing. Norwin Estrada, PARH–MARENA
- Ing. William Gámez, UNA
- Dr. Aída G. Infante, University of Mobile Latin American Campus
- Dr. Javier López, CAURA–MAS
- Dr. Jaime López, CIRA/UNAN
- Dr. Napoleón López, UNI
- Ing. David K. Milton, PARH
- Ing. Juan M. Muñoz, UNI
- Ing. Luis Palacios, INETER
- Ing. Roger Perez, MARENA
- Arq. Guillermo Perez, FORJEMOS
- Lic. Jairo Rodriguez, OPS–UNAN
- Lic. Marina Stadthagen, CONADES
- Arq. Danilo Saravia, FUNDENIC
- Dr. Guillermo Selva, Asamblea Nacional Comisión de los Recursos Hídricos
- Ing. Sergio Vado, Proconsult Ingenieros
- Dr. Melvin Wallace, Asoc. Juristas

Special thanks are also due to Dr. Jaime Incer Barquero of the Fundación Nacional para el Desarrollo Nicaragüense (FUNDENIC) for his insights and helpful advice, to Dr. Gustavo Roig for helping to conceive and initiate the project and for his invaluable contributions to the panel meetings, and to Ing. Roberto Stadthagen Vogl, Minister of the Ministry of the Environment and Natural Resources of Nicaragua, for his encouragement and support.

Intentionally Left Blank

CONTENTS

FIGURES

TABLE

Intentionally Left Blank

INTRODUCTION

The Nicaraguan Water Resources Management Initiative was established to develop an efficient and sustainable water resource management system for the country. The Vital Issues process[1] was the first step in implementing the Initiative (see Figure 1) and provided information that could be incorporated into a proposal for developing a state-of-the-art information system (IS). The impetus for this activity was an agreement between Mr. Roberto Stadthagen, the Minister of Ministerio del Ambiente y Recursos Naturales – MARENA (Ministry of Environment and Natural Resources), and Sandia National Laboratories to develop an IS to be used by decision makers in Nicaragua to help manage the country's water resources. The Vital Issues process was used to identify and prioritize issues considered vital to water resource management and to compile the information needed to address these issues.

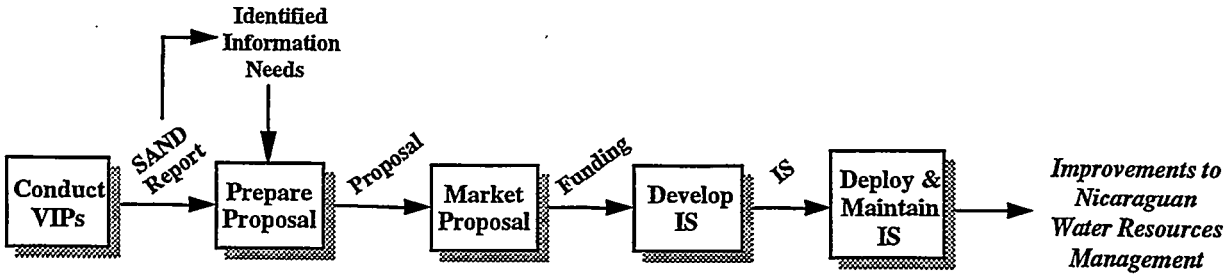

Figure 1. Five phases of the Nicaraguan Water Resources Management Initiative.

[1] The Vital Issues process involves multistage series of day-long workshops for identifying and prioritizing a portfolio of issues, programmatic areas, or responses to a specified problem and for identifying the information needed to properly address issues considered vital to managing critical infrastructure. It can also be used to develop portfolios of appropriate policy options and to allocate critical resources.

Three Vital Issues panel meetings were convened for the Nicaraguan Water Resources Management Initiative at the Hotel Barceló Montelimar in Nicaragua in November 1997 and February and May 1998 to discuss water resource management in Nicaragua. Each panel was charged with tasks leading to the identification of information needed to improve the management of Nicaragua's water resources. Panel meetings were facilitated by the Centro para la Investigación en Recursos Acuáticos de Nicaragua (Nicaraguan Aquatic Resources Research Center). This report summarizes the results of that process.[2]

[2] See Appendices A, B, and C for the final reports for the three panel meetings (translated from Spanish).

APPROACH

The Vital Issues process used in the Nicaraguan Water Resources Management Initiative involved three Vital Issues panel meetings. The three panels were convened to 1) develop a goal statement and evaluation criteria for identifying and ranking the vital issues for managing Nicaragua's water resources (Vital Issues Panel I); 2) define and rank the vital issues (Vital Issues Panel II); and 3) identify a preliminary list of information needed to address the vital issues in the proposed water resource management IS (Vital Issues Panel III).

To ensure a broad perspective on water resources, the panels comprised the following institutional perspectives:

- Ministries and government institutions
- Private sector
- Universities and academe
- Citizens' groups (through nongovernmental organizations (NGOs))

Three Vital Issues panel meetings were held to address Nicaragua's water resources management. The objectives of the first panel included establishing a mission statement articulating the purpose and characteristics of an information system for water resources management in Nicaragua. The panel was also tasked with defining and ranking the assessment criteria used to identify and rank the vital issues in the second panel. The panelists used three "metacriteria"—necessary, operational, and sufficient—to select and screen the assessment criteria. The second Vital Issues panel identified and ranked the vital issues.

The third panel reviewed the vital issues selected by the second panel and identified for each issue a preliminary list of information considered necessary for decision makers to successfully manage Nicaragua's water resources. The panelists were divided into four working groups, one for each issue. Each group was tasked with identifying information needed to address the specified issue. The panels further identified the information needs by category:

national, macro or regional, and micro levels. Within these categories, the panels addressed both specific and general topics.

The procedure used to rank the criteria and the vital issues in Vital Issues Panels I and II consisted of a three-step procedure known as "point-counterpoint-score" (see Figure 2). Each item (i.e., criterion or vital issue) was assigned a "champion" whose task was to present the item and "sell" it to the other panelists. Another panelist was assigned the task of providing counterpoint arguments to the champion's presentation in the form of constructive criticism. After the point and counterpoint arguments were presented, each item was scored against all items previously presented using pairwise comparisons. These comparisons were made using the following scale:

5 = much more important.
4 = more important.
3 = same (the two criteria are indistinguishable).
2 = less important.
1 = much less important.

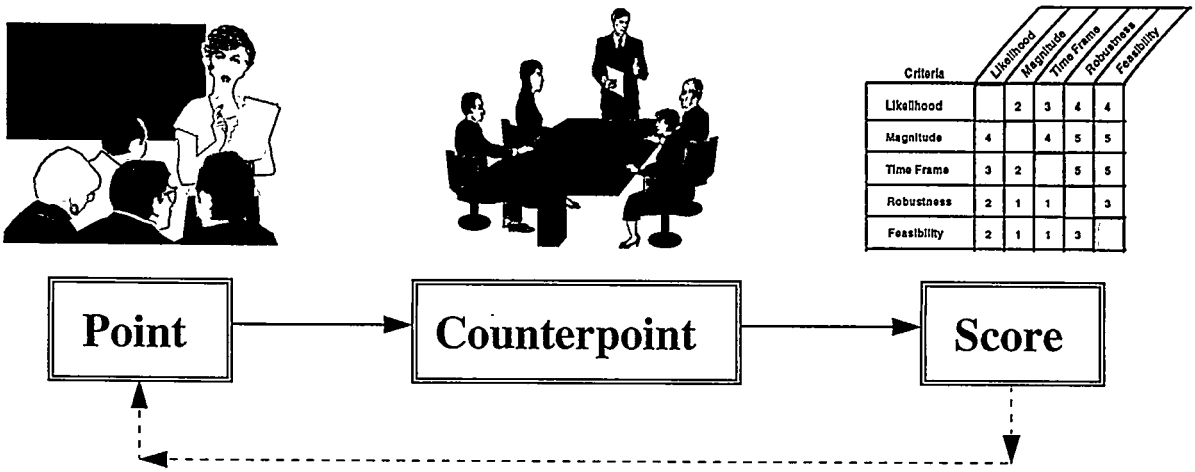

Figure 2. The three-step point-counterpoint-score procedure of the Vital Issues process.

The results of the criteria comparison in Panel I were used to calculate group-averaged relative weights of the ranked criteria.[3] The results of the comparison of the issues performed by the second panel were then used with the criteria weights to generate a group-averaged criteria-weighted relative ranking of all of the vital issues (means).[4] The extent of the panelists' disagreement with regard to the rankings (standard deviations) was also calculated.

[3] The relative weights of the criteria were calculated in the following manner: The scores for each row on each score sheet (one score sheet per panelist) were summed and then divided by the number of criteria minus 1 to obtain the relative value for each criterion for that score sheet. The resulting relative values were normalized, or divided by the sum of all the relative values, to obtain the relative weights for each criterion for each panelist. These individual panelist weights were then averaged over all panelists to obtain group-averaged relative weights for the ranked criteria.

[4] To calculate the rankings of the vital issues, the relative values were first calculated for all the vital issues on all the score sheets for each panelist. (The Vital Issues process uses separate score sheets for each criterion by which the items are compared.) As with the criteria, this was done by summing the scores for each row on each score sheet and dividing by the number of items minus 1. All the resulting relative values for a given criterion were then multiplied by their corresponding criteria weights. The resulting values provided a criteria-weighted ranking of the items for each panelist. These weighted values were then averaged for each vital issue across all the panelists to obtain a group-averaged criteria-weighted ranking for each vital issue.

Intentionally Left Blank

RESULTS

Vital Issues Panel I – Definition of Mission Statement and Evaluation Criteria

The first panel met at the Hotel Barceló Montelimar in Nicaragua on November 14, 1997, to begin the Vital Issues process. The panel was facilitated by the Centro para la Investigacion en Recursos Acuáticos de Nicaragua (Nicaraguan Aquatic Resources Research Center) from the Universidad Nacional Autonoma de Nicaragua (National Autonomous University of Nicaragua).

The panel developed the following mission statement:

> *Develop and apply a national system of information on water resources to promote its sustainable use. This system should serve as a base for decision making involved in the management of water resources of Nicaragua and also for the formulation of national policies. This system should also respond to all of the uses and users of water and stimulate a shared vision of the importance of water resources for the development of Nicaragua.*

The panelists then selected and defined the following seven criteria for assessing the relative importance of issues considered vital to the water resources management in Nicaragua:

- *Magnitude:* The measurement of the extent and scope of a vital issue's impact in environmental, economic, technical, and various other realms. All measures of *social impact* are excluded. *Social impact* was applied as a specific criterion to analyze the human aspects.
- *Likelihood:* The probability or frequency of the occurrence of an issue's impact.
- *Time frame:* The time that it takes for an impact to occur, the time it takes to respond to the impact, and the time it takes for the response to take effect.
- *Social impact:* The positive or negative impact of a relevant matter on a determined population.
- *Territoriality:* Importance of the occurrence in spatial territory, if it applies only to a specific place or could be applied to several.

- *Feasibility:* The possibility of solving an issue or whether studying an issue can make a difference in its solution.
- *Pertinence:* Asks whether the issue is relevant. All vital issues must be pertinent.

The first five criteria listed above, *magnitude, likelihood, time frame, social impact,* and *territoriality,* were identified as "evaluation" criteria because they were considered quantifiable and could be used to determine the relative importance of the vital issues. The remaining two criteria, *feasibility* and *pertinence,* were identified as "gatekeeper" criteria, that is, they could be used to determine whether or not an issue is vital in the first instance. It was decided that, in order for an issue to be considered vital to the management of Nicaragua's water resources, it must be both *feasible* and *pertinent.*

The five quantitative criteria, *magnitude, likelihood, time frame, social impact,* and *territoriality,* were scored in the context of their relative importance in assessing the issues using pairwise comparisons. Figure 3 shows the means and standard deviations of the scores (the square is the mean value, and the distance between the diamond and the triangle is two standard deviations in the scores). As shown in Figure 3, the ordinal ranking of the relative

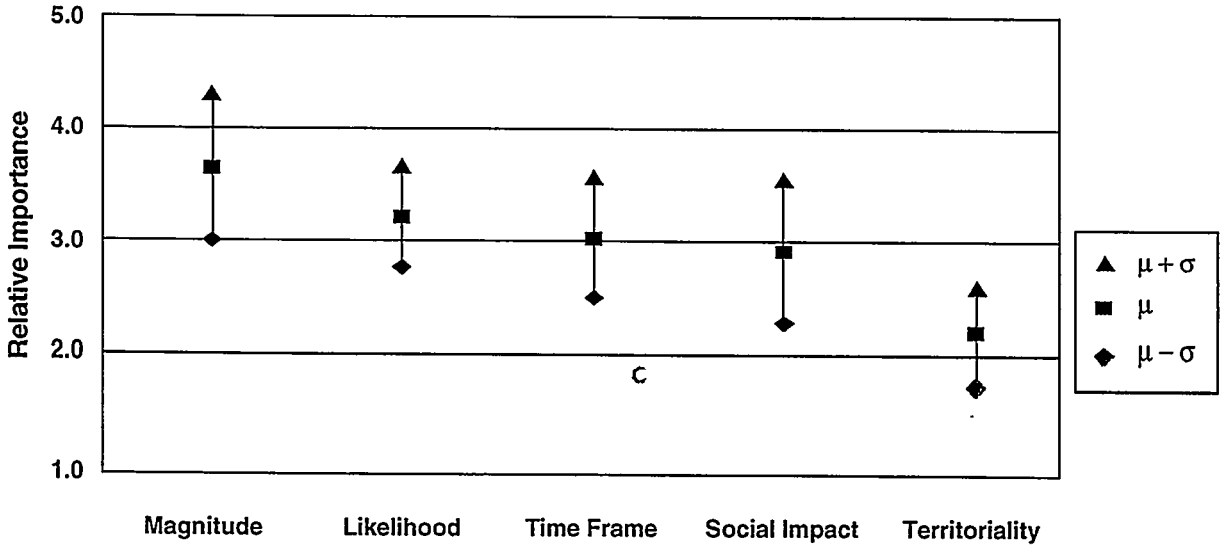

Figure 3. Nicaraguan Water Resources Initiative evaluation criteria scoring results.

importance of the criteria is *magnitude > likelihood > time frame ~ social impact > territoriality.* The standard deviation is an indication of the extent of the panelists' disagreement with regard to the rankings. The ordinal ranking with respect to the level of agreement in the relative importance of the criteria is *magnitude ~ social impact > time frame > likelihood ~ territoriality.*

Vital Issues Panel II – Definition and Ranking of the Vital Issues

The second Vital Issues panel for the Nicaraguan Water Resources Management Initiative met on February 10, 1998. The panelists identified the following four issues that they considered vital to Nicaragua's water resource management. The four issues were also screened using the metacriteria—*necessary, operational,* and *sufficient:*

1. Inadequate Control and Planning for the Management of Water Resources (Planning). Lack of vision, an institutional frame, a strategic plan, a portfolio of policies, and an implementation strategy all contribute to inadequate control and planning for Nicaragua's water resources management. Inadequate definition of the functions, responsibilities, and coordination between the institutions responsible for the management of water resources contribute to problems as well.

2. Shortage of Human and Financial Resources (Resources). It was agreed that the shortage of human and financial resources is pertinent to managing water resources and that an information system may help solve or counteract these shortages.

3. Deficient Water Resources Management Because of Insufficient or Inaccurate Information (Information). It was agreed that the decision deficiencies caused by insufficient or inaccurate information are pertinent to managing water resources and that the quality of decisions about the management of water resources would be improved by an information system.

4. Inadequate Use and Pollution of Water Resources Caused by Insufficient Education in the Population (Education). It was agreed that an information system could

solve the lack of education problem and that citizens' education is pertinent to the matter of water resources management.

The four issues were then scored using pairwise comparisons in the context of the five evaluation criteria. The evaluation of the relative importance of vital issues scored by the panelists resulted in the following ordinal ranking.

Education ~ Information > Resources ~ Planning

Figure 4 shows the means and standard deviations of the scores (the square is the mean value, and the distance between the diamond and the triangle is two standard deviations in the scores). *Education* and *Information* were considered to have the same level of importance, and both were considered more important than *Resources* and *Planning. Resources* was considered more important than *Planning. Resources* had the least disagreement with respect to its relative importance. The level of agreement with respect to the four issues was nearly identical for the four vital issues.

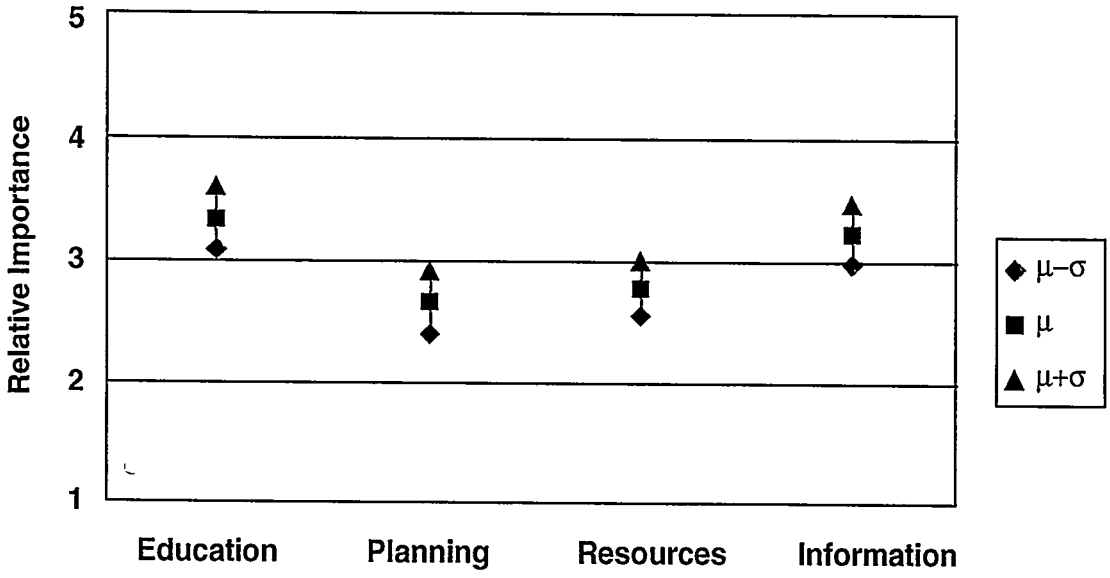

Figure 4. Composite relative importance of the vital issues.

Vital Issues Panel III – Defining the Information Needs for an IS

The third Vital Issues panel met at the Hotel Barceló Montelimar, Nicaragua, on May 12 and 13, 1998, and focused on its primary task, that of identifying information needs for each issue defined by the second Vital Issue panel. They adopted the list of specific information needs shown in Table 1.

Table 1. Vital Issues and the Corresponding Information Needs

Issue	Specific Information Needed
Inadequate planning and control for the management of water resources	*National Level* 1. Updating the institutional framework 2. Judiciary harmony 3. Identification of roles 4. Strengthening the community 5. Sustainability norms 6. Necessity or demand *Macro-Regional Level* 7. Inventory and diagnosis 8. Resource strategy 9. Quality and quantity 10. Current and potential uses, assessment of exploitation projects. 11. Management and recuperation on an exploratory level and semi-details including participatory processes *Micro Level (Basin, Micro basin, Municipality, Far-off Land, Community, Farm* 12. Inventory and diagnosis at a detailed level 13. Strategy 14. Quality and quantity 15. Current and potential uses in basic planning units 16. Socioeconomic planning 17. Decision making based on the water balance with participation of the society 18. All information related to the water basin

Table 1. Vital Issues and Corresponding Information Needs (cont.)

Issue	Information Needed
Lack of human and financial resources	1. Database that includes capacities and experience of the market supply of professionals that have the capacity to contribute to the production of information and improving the management of the resource water that should be located in the new Water Authority 2. Information to establish a relationship between the production of human resources and the labor market 3. Database about the technicians in the municipalities and universities related to the resource water and its management 4. Data about critical areas or basins that could be used as a model for the management of other basins, and could help stop the advancement of the agricultural frontier 5. Available information that could be incorporated in formal and informal education with emphasis on the care of the resource 6. Information regarding the use of water in the territory that could be used as a basis to guarantee financial resources for the recuperation and conservation of the resource
Deficient management of water resources caused by inaccurate or insufficient information	1. Climate conditions 2. Hydrogeologic characteristics 3. Hydrology 4. Socioeconomic conditions 5. Available volumes and demand 6. Actual and potential use of soils 7. Potential sources of contamination 8. Water quality 9. Feasibility of use 10. Physiography 11. Epidemiology 12. Planning 13. National and international agreements about water resources
Misuse and contamination of water resources caused by insufficient education of the population	1. Information that helps citizens visualize the deterioration of the water resource and its relationship to health, environment, economy, and social aspects 2. Indicators of efficiency related to the water resource (costs per patient, costs per cubic meter of drinking water) 3. Epidemiological studies related to water resources 4. Successful experiences of good use of the water resource, appropriate technology and citizen participation 5. Results of the research of contamination of water and its consequences 6. Laws, regulations, norms and results of related topics of the water resource 7. Programs of environmental education of the universities and schools

The following list of general information needs for establishing the IS was also identified:

1) Information macroindicators of the resource, such as:
   - Volume in quantity and classification of quality
   - Precipitation
   - Volume of flow
   - Temperatures
   - Evaporation and wind speeds
   - Infiltration
   - Relative humidity
   - Climatic, cyclical
   - Demand and availability
2) Implementation of an information system for monitoring and environmental audit of water data
   - Quantity and quality of the resource (What do we have?)
   - Water balance
   - Factors that interact with the resource
     - Pollutants
     - Users
     - Forest management

Intentionally Left Blank

COMMENTARY

Summary

Three Vital Issues panel meetings were convened in Nicaragua in 1997 and 1998 to discuss water resources management in Nicaragua. These meetings were a first step in developing an advanced state-of-the-art IS that could be used to manage the country's water resources. Each panel was charged with tasks leading to the identification of information needed to improve the management of Nicaragua's water resources. The first panel developed a mission statement and developed criteria for assessing the relative importance of issues vital to the management of water resources in Nicaragua. The second panel identified, defined, and ranked the vital issues. The third panel defined the information needed to address each of the vital issues.

Conclusions

The Vital Issues process provided valuable information that can be used to develop an IS that will help to manage Nicaragua's water resources. The process provided a format for both identifying and prioritizing vital issues and for identifying information needed to properly address those issues. The selection of panelists from the four basic institutional perspectives (government, industry, academe, and citizens' groups) ensured a broad spectrum of stakeholder involvement.

The already existing need for a water resource management information system has been magnified in the aftermath of Hurricane Mitch. This information system would be beneficial for an early warning system in emergencies, and the modeling and simulation capabilities of the system would allow for advanced planning. Additionally, the outreach program will provide education to help Nicaraguans improve their water hygiene practices.

Recommendations

It is recommended that an IS for managing Nicaragua's water resources be developed using the information obtained in the Vital Issues process as implemented for the Nicaraguan Water Resources Management Initiative and summarized in this report. It is also recommended that the panelists who represented the stakeholder communities by serving on the Vital Issues panels be included as team members during the development and implementation of the IS.

Appendix A – Nicaraguan Water Resources Management Initiative Vital Issues Panel I Report

Intentionally Left Blank

VITAL ISSUES PANEL I REPORT

DEVELOPMENT OF AN INFORMATION SYSTEM FOR THE MANAGEMENT OF THE WATER RESOURCES OF THE REPUBLIC OF NICARAGUA

(translated from Spanish)

November 14, 1997
Hotel Barceló Montelimar
Nicaragua

Intentionally Left Blank

EXECUTIVE SUMMARY

This report summarizes the results of the Vital Issues Panel I meeting for the Nicaraguan Water Resources Initiative, a collaborative effort between Sandia National Laboratories (SNL) and Nicaragua to structure a state-of-the-art information system for managing Nicaragua's water resources. The panel, first in a series of three, met on November 14, 1997, at the Hotel Barceló Montelimar in Nicaragua, to begin the Vital Issues process. The meeting objective was to conduct a discussion about how to develop an information system in order to improve water resources management in Nicaragua.

Participants included government representatives and individuals from academe, the private sector, and nongovernmental organizations (NGOs), all of which had in common a concern about water resources.

The impetus for the Vital Issues process, specifically regarding the water resources of Nicaragua, was an agreement between the Minister of Ministerio del Ambiente y Recursos Naturales – MARENA (Ministry of Environment and Natural Resources), Mr. Roberto Stadthagen, and SNL. The first panel was conducted by Sandia National Laboratories and facilitated by Centro para la Investigacion en Recursos Acuáticos de Nicaragua (Nicaraguan Aquatic Resources Research Center) from Universidad Nacional Autonoma de Nicaragua (National Autonomous University of Nicaragua).

The objectives of the first meeting were to establish a mission statement that would articulate the purpose and the specific characteristics of an information system necessary for the integrated management of water resources in Nicaragua and to define evaluation criteria to be used to assess the vital issues, which will be identified and evaluated in the second panel meeting.

The panel agreed on the urgency of developing an information system for the management of water resources since the existing data is scattered. They also agreed that the system should be decentralized, accessible to all shareholders, multi-sectorial and integrated.

It is essential to structure the data in order to use it in the decision making process, and to guarantee that the decisions will be the most sensible ones considering the country's real situation. It was emphasized that the system will support the development of a water culture in the country, which at the same time should stimulate water conservation. Based on these principles, the following mission statement was established:

Mission Statement:

> *To develop and apply a national system of information on water resources in order to promote its sustainable use. This system should serve as a base for decision making involved in the management of water resources of Nicaragua and also for the formulation of national policies. This system should also respond to all of the uses and users of water and stimulate a shared vision of the importance of water resources for the development of Nicaragua.*

Evaluation Criteria:

The panel also agreed on the following evaluation criteria for vital issues with their respective definitions:

- *Magnitude*: the measurement of the extent and scope of the impact of a vital issue in aspects of great importance such as environmental, economical, technical, etc. This panel preferred to exclude from this concept of *magnitude* all measures of *social impact* since it will be applied as a particular criterion to analyze the human related aspects.
- *Likelihood:* the probability or frequency of the occurrence of the impact of an issue.
- *Time frame:* the time that it takes for an impact to occur. The time it takes to respond to the impact and the time it takes for the response to take effect.
- *Social Impact:* a positive or negative incidence of a relevant matter on a determined population.

- *Territoriality:* importance of the occurrence in spatial territory, if it applies only to a specific place or could be applied to several.

Qualitative or "Gatekeeper" Criteria:

- *Feasibility:* the possibility of solving an issue or if the study of an issue could make the difference in its own resolution.
- *Pertinence:* relevance, all vital issues must be pertinent.

After the evaluation of the "relative importance" of the five criteria, the following ordinal results were calculated:

Magnitude> Likelihood ~ Time Frame ~ Social Impact > Territoriality

Intentionally Left Blank

INTRODUCTION

In June 1997, the Minister of Ministerio del Ambiente y Recursos Naturales – MARENA (Ministry of Environment and Natural Resources), Mr. Roberto Stadthagen, and Sandia National Laboratories agreed on developing an implementable information system focused on the problem of Nicaraguan water resources management. Sandia proposed to apply a strategic planning tool: *The Vital Issues process.* For that reason, CIRA – UNAN as a center for the investigation of water resources and part of the university community of Nicaragua, was invited to facilitate this process to build an information system that could be used by authorities or stakeholders responsible for the decisions of managing water resources.

This first of three Vital Issues panels was carried out with the participation of a panel of specialists who are responsible for taking decisions regarding the management of the water resources in Nicaragua.

The result of this first panel was the definition of the purpose of the initiative to develop an information system and the determination of the evaluation criteria that will serve to value the relative importance of vital issues that are fundamental for managing Nicaragua's water resources.

On the basis of the results from this first meeting, a second panel is to be held in February 1998 in which vital issues related to the integral management of water resources will be identified and evaluated according to the selected evaluation criteria.

The list of panelists and the meeting agenda appear in Attachments A and B to this report.

The Vital Issues Process

The Vital Issues process is a strategic tool, developed in Sandia Laboratories, that identifies a portfolio of programmatic activities aimed at satisfying high-level goals and objectives of people and institutions which have common, although possibly conflicting,

interests. It is a dialogue facilitated by experts sharing an interest in developing an activity and a common work sphere.

The panels are convened for one or two-day sessions and are designed to integrate a qualitative and quantitative information management approach.

The session begins with the qualitative phase in which the panel synthesizes the definition in light of the topic and related matters by producing a consensus about the given mission. The interaction is conducted with an interest in revealing traditional paradigms and preconceived definitions in order to promote generation of new approaches. This continues through the analytical phase in which quantitative methods will be applied based on the comparison of all possible pairs of elements to achieve a one to five ranking.

Panelists

The choice of panelists is made in order to provide a composition of participants that reflects the real needs of the information system: in the case of water resources, they are experts who represent institutions involved in the decision making process about this activity so essential to Nicaragua's development. In addition, in order to guarantee the achievement of a wide perspective of common interests regarding water resources, the meetings will be an intensive expert's exercise with panelists from the following sectors:

- Ministries and governmental institutions
- Private sector
- Universities and academe
- Citizens' groups (through Nongovernmental Organizations (NGOs))

Preparation

A letter of invitation provided the panelists with a summary of the process objective and a methodology explanation that offers examples of the purpose of the initiative and evaluation criteria to stimulate production of ideas upon this topic.

The Sandia representative, Dr. Dennis Engi, presented the Vital Issues process, and began describing Sandia's experience with over more than 70 Vital Issues panels in several world areas. It was emphasized that the process has been used as a strategic tool in areas with critical structure, which includes the chosen topic of water resources for Nicaragua.

The explanation of the Vital Issues process was illustrated in a brochure and distributed to all participants.

Dr. Engi emphasized that the panels constituting the "Vital Issues process" represent only one phase of the initiative for producing an information system that plans to improve Nicaragua's water resources management. The Vital Issues process will set up the context for developing the information system which is only possible in an expert's dialogue process that guarantees defining the real needs. The computer models cannot define the contents of reality, only experts from different institutions, who have the knowledge and make decisions which effect water resources, are able to define it.

After this, the expected results from the three panels applying the example of the Vital Issues process of Puerto Rico were presented.

It was emphasized that each panel will build on the results of the previous one and the final process result is to elaborate a proposal for developing the Information System which supports the decision making process concerning Nicaragua's water resources. This proposal will be presented to different financial organizations for its approval and financing.

Mr. Salvador Montenegro, Director of CIRA – UNAN, explained the reasons for choosing water resources as the first area in which it is necessary to build a supporting system for the decision making process. Water resources are the most important vital issue for the sustainability of Nicaragua's population. Due to this fact, the Minister of MARENA, Mr. Stadthagen, chose this critical infrastructure as the primordial approach in the process. Mr. Montenegro also emphasized that there are several initiatives for improving water resources management, the most important one being: "Action Plan for Water Resources Management."

He made it clear that the "Vital Issues process" is an aspect that complements the other initiatives making them more effective, that is, developing an information system to produce more sensible decisions.

DEVELOPMENT OF THE MISSION STATEMENT

Elements of the mission statement:

The purpose of the process should be expressed in a mission statement containing the reason for the construction of an information system and what do we expect it to do, the objective. Besides, it must include to whom it benefits.

After an extensive discussion it was agreed to unite the following two proposals in order to create the mission statement:

1. Develop an information system and a national responsibility based upon the sustainable use of the resource, water, in all its uses and for all its users, creating a water culture and a vision of its importance in the country's development and in the Nicaraguan society.
2. Develop a national information system for the integral and sustainable management of water resources taking into account the multiple needs of all levels of Nicaraguan society and that it simultaneously supports the decision making process and development of an organized national policy.

The following Mission Statement was adopted:

Develop and apply a National Information System of water resources in order to promote its sustainable use. This system should serve as the basis for the decision making process involved in the Nicaraguan water resources management, and to formulate national policies. This system should respond to all water uses and all water users, and should stimulate a shared vision upon the importance of water resources for Nicaragua's development.

Discussion

The most important elements that contributed to the formulation of the proposed purpose of the initiative are:

1. *Necessity of the system: Does the system already exist in Nicaragua? Does it need to be created or just developed further?*

There was a consensus in the panel about the need for creating an information system. The management of a resource is only possible when knowledge about the resource exists. In Nicaragua, there exists some information in certain fields, but there are gaps where the resource is unknown and there are also problems concerning the reliability of the existing data.

There was a discussion if the information system already exists. It was clear to most of the panelists that there exists some information, but that it is not organized in a system. There exist some elements of the system but they are not organized in an implementable system. This fact impacts the organic and functional articulation and the establishment of all system relationships.

It was agreed that it is important that the legal frame exists in Nicaragua foresees the creation of the system:

In the Environmental Law there is a Chapter titled National System of Environmental Information, as follows:

Law No. 217. General Law of the Environment and Natural Resources

Section V. National System of Environmental Information

Article 31. The National System of Environmental Information is established under the responsibility of the Ministry of Environmental and Natural Resources. This system will be integrated by public and private institutions and organizations dedicated to generating technical and scientific information about the state of the Environment and Natural Resources.

Article 32. The information from the National System of Environmental Information will freely provide consulting access and will endeavor to periodically diffuse information, with the exception of restrictions by specific laws.

Article 33. Without prejudice of copyright laws, any person who performs an investigation or work about the environment and natural resources will submit an edition or copy of their investigation or study to the Ministry of the Environment and Natural Resources. In the

case of studies performed in the Autonomous Regions, a copy of it will be submitted to the respective Regional Autonomous Council.

The creation of a system of information is also foreseen in the Tentative Plan of the General Law about Water. It was also noted that a need existed to define what kind of information needs to be produced.

In summary, there exist legal previsions but it is necessary to work in the internal matrix, that is, instead of creating, we have to structure, organize and develop a system.

2. Why should this system exist? Whom does it benefit?

It is essential to have an integral management of water resources instead of the sectorialwise management, which currently exists. This is possible when the information is applied in an integral and multisectorial manner. Thus, the information must be multidisciplinary so it can respond to the expectations of different sectors, which is required by an integral management.

The system, in order to have an integral management, must be decentralized, accessible to all stakeholders and for all uses, and must be managed with all the stakeholders' participation.

It was mentioned the importance that all average citizens have access to the information generated by research projects to guarantee that this information can be applied for a positive change in the reality of water resources. The beneficiary should not only be the Government, but also the civil society. The system is created in the first place due to the public interest, to solve the problems of the society.

System Characterization

The following answers were raised to address the question, "What do we expect the information system to do?"

1. *Facilitate the decision making process:*

During the discussion that followed, it was emphasized that currently there exists information, but it is not used to make decisions. Thus, it is necessary to structure the information so it is suitable for use in making decisions, and to guarantee that the decisions will be more sensible regarding the real situation of the country.

It is known that some decisions are made and affect the resource negatively due to a lack of information or sometimes decisions are not taken due to a lack of order. Besides, a strategic frame to facilitate decision-making does not exist. For instance, an irrigation project using the subterranean water from Leon–Chinandega is risky due to the lack of information about the level and location of the pesticide pollution in this aquifer. It was stated that there is not an ordered process, things occur chaotically, there are initiatives implemented without knowing the water resources conditions, things are improvised or happen due to interests appearing spontaneously.

It was pointed out that there is a need to define the information system systematically so that it will not be subjected to political changes. It is clear that there is a need for supplying water no matter who might be in control of the government.

Another observation also emphasized that when decisions are to be made, it is not only a governmental responsibility but also one for which society as a whole is responsible.

2. *In order to support the creation of a national policy and a development strategy:*

It was acknowledged that there exist some information but due to a lack of order and national coverage it cannot be used as a basis for developing a national policy. It is necessary that every government maintain continuity in the use of the information but in the perspective of the actual political problems. Thus, having an information system is necessary for building development policies that respond to the country's needs.

It was noted that establishing priorities about informational needs are necessary regarding the demands of a policy and the country's development.

At the present time there is an information gap which causes project misplanning and negatively affects the country's development. There are hazardous projects that are approved due to a lack of information. The irrigation project in Chinandega was mentioned again as an example of this type of problem. Creating an adequate database is necessary to avoid these problems.

It was pointed out that the lack of information affects production and prevents its development. An information system would be used for planning investments responding to development needs.

At the present time, there are so many contradictions about the uses of water bodies due to a lack of coordination in the existing information. An information system would enable a planning process, for example it is necessary to have knowledge about the existing quantity of water in order to make a plan of usage or a plan to conserve the water.

Once this topic was discussed, it was emphasized that there are needs for a strategic policy, which means there is a need for institutionalizing development. If we could make decisions on a strategic basis, the information system could serve as a support in generating a plan and its implementation. In other words, the information system should be developed in close association with developing plans. Developing an information system for the country means working on the interpretation of our own reality to create a policy.

3. Support a water culture development and an understanding of its importance:

It was maintained that the system should support developing a water culture in the country, which at the same time, will stimulate the conservation of water. The established system should produce information that would facilitate a progressive advance in promoting a water culture in all levels of society; it should stimulate knowledge about water resources that facilitate formulating a usage plan, for instance, a plan for subterranean water conservation.

It was emphasized that the information system must not be seen as an instrument supporting the decision making process only, but also as one that foments a vision and a culture

that goes beyond the institutional environment. The decision making process is not only a task for the government, it should benefit the whole society.

Structuring the Information System

In a short discussion about some criteria regarding how to structure the information system, it was said that:

The information system requires an institutional coordination or a coordinating authority.

The Water Authority proposed by the Action Plan for Water Resources (PARH) would be oriented to the compilation of information in an adequate system that would allow for planning and management. It was noted that the institutional aspect is the main axis in an information system.

It is also important to have and structure the system at the municipal level. The system should be configured in such a manner that its use would not be limited to institutional spheres, but as stated by the law, which grants to the average citizen the right to know the information generated by research projects, to guarantee it will not be "shelved."

It was expressed that the information system should respond to the fact that water is an economic asset.

Additional Important Topics

The Action Plan for Water Resources Management (PARH) is in the process of preparing the "Tentative Plan for the General Law of Water," and proposing an institutionalization system for the national management of water resources a "Water Authority." PARH has included in its proposals the establishment of an information system. It was confirmed in the discussion that the information system proposed by the Vital Issues process must be compatible with the legal and institutional framework proposed by PARH. PARH also emphasized that the information system should have a decentralized integral management with the participation of all stakeholders and which constitutes a fundamental element of its

institutional plan. It is important that the system be configured by real demand and not by the supply, that in many cases is oriented and influenced by technology. This real demand must come from the information users, demarcating the system development or the information type. The panelists agreed that the initiative of the Vital Issues process is an additional support to PARH's concept in an aspect that needs to be developed in order to be more effective.

Intentionally Left Blank

CRITERIA SELECTION, DEFINITION, AND RANKING

Criteria Selection

After an intensive discussion and confrontation of every criteria with the metacriteria (necessary, operational, sufficient) it was agreed to use five evaluation criteria for the vital issues:

- *Magnitude*
- *Likelihood*
- *Time frame*
- *Social Impact*
- *Territoriality*

It was also established that there are two criteria which cannot be used for quantitative evaluation, "gatekeepers," that is, are applied to the yes or no classification. Thus, the vital issues should be pertinent and feasible, otherwise, they cannot exist as criterion.

- *Feasibility*
- *Pertinence*

In discussion, the functions of the evaluation criteria were clarified and confusion was eliminated with regard to the concept of vital issues. It was emphasized that the criterion will be applied in the second panel to determine the relative importance of the vital issues. Evaluation criteria are necessary to classify or to evaluate vital issues, not to specify them. This effort is not an attempt to specify a system design, but to organize it in a hierarchical order. The logical framework is to define the criteria and from them, determine which are the vital issues. These are the elements used as a rule in establishing the hierarchy.

During the criteria revision process of the original proposal, the criteria number was increased up to eight. *Cost* was eliminated by passing it through the metacriteria analysis since this element is included as a form to measure *magnitude* or the impact scope; the other two

criterion, *feasibility* and *pertinence,* were categorized as criteria that cannot be quantified but qualified, otherwise they are not vital issues.

There was a discussion as to whether *social impact* is itself a criterion or if it should be included in *magnitude* or in *feasibility.*

The **pro** arguments showed that in Nicaragua it is important that this criterion be measured as a special one; the human element should be particularized; it is important to highlight that many times *social impact* is stronger that *economical impact.*

The **con** arguments maintained the importance of not superposing criterion, it is a variation of *magnitude;* it is difficult to define *magnitude* without *social impact.*

The following two options were put up to a vote:

1. *Social Impact* is eliminated from the criteria list and *magnitude* is defined including *social impact.*
2. *Social Impact* is kept as a particular criterion and *magnitude* is carefully defined, making it clear that it does not include *social impact.*

Option 2 was agreed, thus *social impact* is taken as a particular evaluation criterion.

It was considered if *likelihood* and *robustness* were two independent criteria or if *robustness* could have been taken as a subset of *likelihood.* It was agreed to maintain both criteria independently, defying that *likelihood* is a time concept and *robustness* a space concept, that is, territory coverage. Besides, it was agreed to define the concept of robustness more specifically by changing it to *territoriality.*

It was agreed to consider *feasibility* and *pertinence* as criteria of qualitative category or "gatekeepers" or affirmative criterion.

Criteria Definition and Point-Counterpoint Discussion

Once the criteria were selected, the discussion was conducted using the point and counterpoint method.

The defender supports his criterion proving if it is necessary and operational and according to the subtopics, if it is specific, measurable, precise, relevant and opportune. Besides, it should be controlled if the criterion supports the purpose of the mission of the information system. The counter pointer should guarantee if the criteria really meet the metacriteria and offer a constructive critic.

It was also controlled if the criteria list was *sufficient.*

1. *Magnitude*

Working definition: the measurement of the quantity and quality of the extent and scope of an impact that can be caused by a vital issue.

Agreed definition: the measurement of the extent and scope of the impact of a vital issue in aspects of great importance such as environmental, economical, technical, etc. This panel preferred to exclude from this concept of *magnitude* all measures of *social impact* since it will be applied as a particular criterion to analyze the human related aspects.

Magnitude is essential because it measures the impact of each vital issue and it is the only criterion that shows a dimension of its own effect. It quantifies a wide range of aspects such as social, environment, economics, technical, etc.

However, it is precisely due to this characteristic of being a wide-open criterion and very general that confers limitations that need to be specified in the evaluation. The discussion about *social impact* shows this weakness and expresses a need for being more specific when specifying a particular aspect. It is very difficult to capture the multitude of specifications that are necessary for evaluating vital issues.

2. *Likelihood*

Working definition: the frequency in which an event can occur.

Agreed definition: the probability or frequency of the occurrence of the impact of an issue.

Likelihood is also a wide range criterion; it can be applied to different problems of society such as climate, politics, social aspects, etc. It is a scientifically indisputable tool and because of this has a transcendental relevance. It is essential because *magnitude* cannot be measured if *likelihood* is unknown, all criterion are subordinated to *likelihood.* It is an importer or indicator of the recurrence degree in which a vital issue might appear. We do not approach a problem that might occur once every thousand years in the same way as we approach one that occurs every six months.

However, *likelihood* is still limited in precision. This criterion is more difficult to specify than *magnitude.* Mentioning the type of decisions about water resources we have to make subjective estimates of probability of any aspect that might change easily. For example, it is more difficult to show the probability of a climate change, while the possible impact is easier to analyze.

3. *Time Frame*

Working definition: estimated time for an impact to occur.

Agreed definition: the time that it takes for an impact to occur. The time it takes to respond to the impact and the time it takes for the response to take effect.

The time factor is very important regarding environmental impact. For example, the violation of water resources can cause its destruction if it is allowed to continue over time. Temporality is also essential for all planning since deadlines and results to be accomplished have to be presented. The time factor is necessary to evaluate any important issue. In the aspect of being operational, temporality is more specific, measurable, precise, relevant and opportune than other criteria.

4. *Social Impact*

Agreed Definition: positive or negative incidence that affects a determined population.

The question was raised, *"Why is it necessary to differentiate social impact from magnitude?"*

Natural resources, among which water resources are very important, are dependent on the most important natural resource, which is the population, the human beings that use them. Nature does not exist to be contemplated but for the social utilization of the human beings that live in it. For this reason it is necessary that this criteria should be measured separately from other variables such as economic impacts, etc.

It is interesting to recall the polemics that took place in our countries when some supranational entities such as the International Monetary Fund and the World Bank obliged us to adopt the national adjustment plan. These institutions denied inclusion in a differentiated way of the *social impact* that these adjustment measures would have on our population. However, last year the International Monetary Fund and the World Bank began to talk about social adjustments, to differentiate economical adjustments and diverse policies from social results. Using this concept which is fashionable nowadays and that has been widely debated in Latin America, it is also very important to use it here when we talk about the impact of a vital issue; it should be measured first by the effects on the population, by the social aspect.

It was also said however, that *social impact* is a *magnitude* component. If it were separated regardless of its importance, conditions would be set for separating another type of impact.

It was sustained that for a country like Nicaragua, that has been under a difficult poverty situation that increases daily, as it has been shown by all indicators, it is very important to have a separate criterion that measures the impact of the resource, water, on development and on poverty.

5. *Territoriality*

Working definition: importance of the presence or occurrence in the territory.

Agreed definition: importance of the occurrence in spatial territory, if it applies only to a specific place or could be applied to several.

This criterion should be included to define the importance or the critical point of an issue regarding spatial magnitude of this occurrence; spatial extension in a problematic situation. *Territoriality* does not regard any aspect already included in the remaining five criteria. It is operational because it can be represented as one indicator. It is important in evaluating a fact in its spatial coverage. For instance, when certain territories are considered that tend to be more prone to disasters caused by water resources. When we talk of water resources, we always refer to a spatial area, basin or sub basin.

6. ***Feasibility***

Feasibility was defined as the possibility of solving an issue or if the study of an issue can make the difference in its solution. This is a nonquantifiable criterion.

7. ***Pertinence***

Pertinence was defined as relevance. All vital issues must be pertinent. This is a nonquantifiable criterion.

Ranking of the Evaluation Criteria

In order to determine the relative importance of the Vital Issues to be identified by the next Panel, this Panel was asked to quantify the relative importance of the assessment criteria. This task was accomplished by making pairwise comparisons of the assessment criteria. These comparisons were accommodated using the following scale:

5 means that one criterion is much more important than another.

4 means that one criterion is more important than another.

3 means that the importance of the two criteria are indistinguishable.

2 means that one criterion is less important than another.

1 means that one criterion is much less important than another.

RESULTS

The results of the pairwise comparisons of the criteria are illustrated in Figure A-1. Relative importance is illustrated in the figure by the vertical location of the square. The numerical value associated with this vertical location is the relative importance of the criterion compared to the hypothetical average criterion in this population of criteria using the scale described above. The 'hypothetical average criterion' has, by definition, a relative value of 3.0. So, for example, the *time frame* criterion (which is slightly over 3 in relative value) is very close to the hypothetical average criterion. In contrast, *magnitude* is significantly higher and *Territoriality* is significantly lower than the hypothetical average criterion. From the figure it can be seen that the ordinal results for the relative importance of the evaluation criteria are as follows:

Magnitude > Likelihood ~ Time frame ~ Social Impact > Territoriality

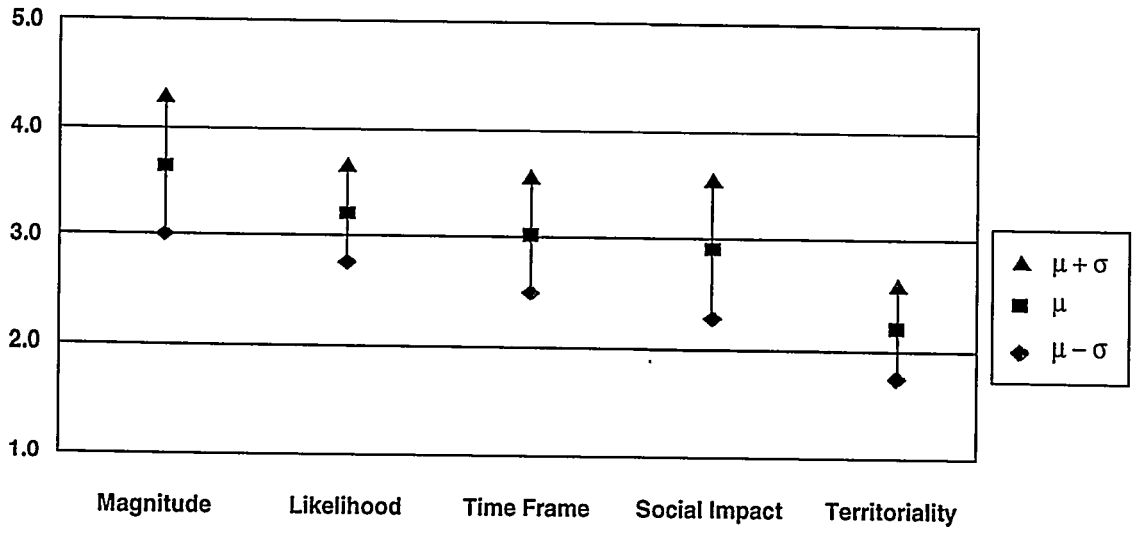

Figure A-1. Nicaraguan Water Resources Initiative evaluation criteria scoring results.

These results illustrate that in the judgment of this Panel, the *magnitude* of the impact of the Vital Issue is the most important criteria in determining its relative importance. Next (and equal) in importance are the *likelihood* and the *time frame* for the occurrence of the vital issue.

Finally, *social impact* and *territoriality* were judged to be of least (but equal) importance in determining the relative importance of the Vital Issues. It should be emphasized that one of the metacriteria used to screen these assessment criteria was *necessary.* This metacriterion ensured that each assessment criterion was *necessary* because without it some important (indeed, essential) aspect would go unrecognized. Consequently, although *social impact* and *territoriality* were judged to be of least relative importance as assessment criteria; they are, nonetheless, essential to the assessment of the vital issues.

Another important result illustrated by the figure is the level of agreement between the panelists regarding the relative importance of the evaluation criteria. The level of agreement is illustrated in the figure by the distance between the triangle and the diamond. This distance is two standard deviations in the scores provided by the panelists. There is no intent to use this data to conduct any rigorous statistical tests on these results. However, the graphic results illustrated in the figure provide a sense for the level of agreement. The ordinal result for the Relative Level of Agreement is as follows:

Territoriality ~ Likelihood > Time Frame > Social Impact ~ Magnitude

The interpretation is that there is the greatest agreement among panelists in the placement of *territoriality* and *probability.* There is less agreement about the placement of *time frame.* Finally, the least agreement is in the placement of *social impact* and *magnitude.*

ATTACHMENT A

Vital Issues Panel I Panelists
November 14, 1997, Nicaragua

Government Sector

Ingeniero Luis S. Palacios R.
Instituto Nicaragüense de Estudios Territoriales (INETER)
Nicaraguan Institute for Territorial Studies
Tel. 2492756
Fax. 2491890

Ingeniero Arcadio Choza
Ministerio del Ambiente y Recursos Naturales (MARENA)
Ministry of Environment and Natural Resources
Tel. 2632870
Fax. 2632620
Ambiente@marena2.sdnnic.org.ni

Ingeniero Norwin Estrada
Plan de Acción para el Manejo de los Recursos Hídricos (PARH)
Plan of Action for the Management of Water Resources
Tel. 2632871
Fax. 2632615

Academic Sector

Doctora Aída González de Infante
University of Mobile Latin American Campus
Tel. 088-20961
musica@ibw.com.ni

Doctor Jaime Incer Barquero
Fundación Nacional para el Desarrollo Nicaragüense (FUNDENIC)
National Foundation for Nicaraguan Development
Tel. 2781223, 2650500(267)
jincer@tigre.uam.edu.ni

Private Sector

Ingeniero Freddy Cruz
Consultora Empresarial Centro Americano S.A. (CECSA)
Consulting Contractors of Central America S.A.
Tel. 2281206
Fax. 2281213
cecsa@nicarao.org.ni

Ingeniero Javier López Medina
Ingeniería Caura
Engineers Caura
Tel. 2672850
Fax. 2672850
caura@nic.glom.com

Ingeniero Sergio Vado A.
Proconsult Ingenieros
Proconsult Engineers
Tel. 2651412
Fax. 2650254

Nongovernmental Organizations Sector

Ingeniero Nelson Medina
Centro de Investigación de la Realidad de América Latina (CIRA)
Center for the Investigation of Latin American Reality
Tel. 2682318
Fax. 2682914
cira@tmx.com.ni

Ingeniero Miguel Cáceres
Asociación del Desarrollo Sostenible Urbano y Rural (ADESUR)
Association of Rural and Urban Sustainable Development
Tel. 2799046

ATTACHMENT B – AGENDA FOR VITAL ISSUES PANEL I

AGENDA DEL PANEL SOBRE ASUNTOS VITALES

14 de Noviembre de 1997. Hotel Barceló Montelimar, Nicaragua

Hora	Tema	Expositor
8:00-8:30	Bienvenida e introducción	SMG
9:00-9:45	Vistazo general y descripción del proceso de panel	Dennis Engi
9:45-10:45	Deliberación del Propósito de la misión	Todos (Facilitado por Engi)
10:45-11:00	Receso	
11:00-12:00	Decisión sobre Propósitos de la Misión	Todos (Facilitado por Engi)
12:00-13:00	Almuerzo trabajo	
13:00-14:15	Discusión sobre criterios de Evaluación del Programa	Todos (Facilitado por Engi)
14:15-14:30	Explicación del Proceso de categorización de criterios	Dennis Engi
14:30-14:45	Receso	
14:45-16:00	Categorización de criterios	Todos (Facilitado por Engi)
16:00-16:30	Semblanza de resultados	Todos
16:30-17:00	Impresiones del proceso	Todos (Facilitado por Engi)
17:00	Resumen y clausura	SMG

Intentionally Left Blank

Appendix B – Nicaraguan Water Resources Management Initiative
Vital Issues Panel II Report

Intentionally Left Blank

VITAL ISSUES PANEL II REPORT

DEVELOPMENT OF AN INFORMATION SYSTEM FOR THE MANAGEMENT OF THE WATER RESOURCES OF THE REPUBLIC OF NICARAGUA

(translated from Spanish)

February 10, 1998
Hotel Barceló Montelimar
Nicaragua

Intentionally Left Blank

EXECUTIVE SUMMARY

This report summarizes the results of the Vital Issues Panel II meeting for the Nicaraguan Water Resources Initiative, a collaborative effort between Sandia National Laboratories (SNL) and Nicaragua to structure a state-of-the-art information system for managing Nicaragua's water resources. The panel, second in a series of three, met on February 10, 1998, at the Hotel Barceló Montelimar in Nicaragua. A panel of experts met to establish the basis for developing an information system for the management of Nicaragua's water resources. In order to guarantee that the system would correspond with the needs of the decision making process in the Nicaraguan reality, the panel counted on the participation of experts who represented different sectors involved in the decision making process of the management of water resources. This initiative applies a strategic planning tool called the Vital Issues process, developed by Sandia National Laboratories; the panels were facilitated in Nicaragua by the Nicaraguan Aquatic Research Center of the National Autonomous University of Nicaragua (CIRA-UNAN).

The objective of this panel was to define the vital issues or the critical problems of water resources in Nicaragua. Knowing these critical problems, it is then possible to define the needs of the information system in the coming third panel. Their identification is essential because they offer a basis so that the information system can respond to the national needs, which is a must for the sustainable management of water resources. In addition, the relative importance of the vital issues was assessed using seven evaluation criterions (*magnitude, likelihood, time frame, social impact, territoriality, feasibility* and *pertinence*) defined in the first panel.

Vital Issues or Critical Problems of Water Resources in Nicaragua

All four vital issues refer to two levels: national and local.

1. **Inadequate Control and Planning for the Management of Water Resources.**
   - Lack of vision, an institutional frame, a strategic plan, a portfolio of policies, and an implementation strategy for Nicaragua's water resources management.
   - Inadequate definition of the functions, responsibilities and coordination between the institutions responsible for the management of water resources.
2. **Shortage of Human and Financial Resources.**
3. **Deficient Water Resources Management as a Result of Insufficient or Inaccurate Information.**

   Examples:
   - Irrigation Project of Leon-Chinandega
   - Contamination of Rio San Juan
   - Lake of Managua
4. **Inadequate Use and Pollution of Water Resources Caused by Insufficient Education in the Population.**

The evaluation of the relative importance of vital issues scored by the panelists resulted in the following ordinal ranking:

Education ~ Information > Resources ~ Planning

INTRODUCTION

The second panel of the Vital Issues process focused on developing an information system to support the management of water resources in Nicaragua was convened on February 10, 1998, at the Hotel Barceló Montelimar. This initiative uses a strategic planning tool, which was designed by Sandia National Laboratories and was facilitated by CIRA - UNAN as a research center for Nicaraguan water resources. The objective of this second panel was to define the vital issues or critical problems of water resources to which the information system should respond. The endeavor would be to design the system with the necessary information to facilitate the decision making process taking into consideration the issues that are vital for improving the quality of life in Nicaragua. The dialogues were organized with the participation of experts who have been involved in different initiatives involving water resources in Nicaragua.

The list of panelists and the meeting agenda appear in Attachments A and B to this report.

The Vital Issues Process

This process is constituted by a series of three panels; each panel builds on the results of the previous one. The first panel established the mission statement, which emphasized the need for developing an information system as a basis for the decision making process and which would also serve as a basis for elaborating national ware resources policies. (See Nicaraguan Water Resources Initiative Vital Issues Panel I Report, November, 14, 1997.)

Also seven criteria were determined to evaluate the importance of the vital issues identified in this second panel. It is necessary to define these vital issues or critical problems of water resources in Nicaragua and relate them with the respective needs of information that will constitute the information system. These needs of information will be analyzed on the third panel to guarantee that the system will respond adequately to the reality of water resources in Nicaragua.

Panelists

In order to structure a system. It is important to count on the participation of experts who represent different sectors involved in the decision making process concerning the management of water resources. In order to guarantee the definition of the needs of information which would constitute the base of the information system the participants were invited from the following institutional sectors whose work involves water resources:

- Ministries and Institutions of the Government
- Private Sector
- Universities and Academe
- Citizens' groups (represented by Nongovernmental Organizations (NGOs)).

A special invitation was made to the General Director of the National Council of Sustainable Development whose role in planning is essential for the management of the country's water resources.

Preparation of the Panelists

Considering that the second panel builds on the results of the first panel, the preparation of the panelists was guaranteed by turning in the Report of the Vital Issues process of the first panel to each panelist. In addition, to stimulate reflection about possible Vital Issues of water resources suggestions were included in the invitation letter.

Dr. Dennis Engi from Sandia National Laboratories emphasized to all panelists the importance of understanding the entire process of developing the information system. He explained that the vital issues process is the first stage of a chronology to be developed in a process of several steps.

The information needs associated with the critical problems of water resources constitute the base that generates a proposal for the development of an information system for the management of water resources.

Dr. Engi mentioned that generally, the main investigators of the proposal are selected from the panelists. The third phase involves the promotion of the proposal seeking its financing normally from international financial organizations. The last phase implies the construction of the system and its adequate implementation.

Report

It is important to verify that the reports of the panels have an essential function since they serve as an information base upon which the proposal is elaborated. Thus, it is vital to emphasize that the report authors are the panelists, which means they participated in its elaboration. The report written by the rapporteur is submitted to the panelists for their suggestions of changes and critics.

Plan of Action for the Management of Water Resources (PARH)

Mr. David Milton, main technical consultant of PARH, spoke about PARH's experience in evaluating the water resources of Nicaragua. In the quantitative evaluation of planning units, which were practically the hydrographic basins of Nicaragua, they were able to identify the areas where the resource is tensioned, that is, the exploitation percentage is very high and urgent management actions are needed. Mr. Milton emphasized that the "Plan of Action" did not achieve a qualitative evaluation of water resources since there does not exist an organized system of information in the country.

Intentionally Left Blank

REVIEW OF PANEL I RESULTS

There was a discussion about the definition and assessment of the relative importance of the evaluation criterion, *territoriality.* Instead of the reported definition "importance of the occurrence in a spatial territory" it was proposed to modify it to *"importance of the territory in the occurrence of a hydric phenomenon."* It was sustained that it is important to assess the territory and its capacity to have water resources. There are diverse types of territories with several types of water resources. Thus, in a certain way, *territory* defines the importance of management, conservation or the heritage of water resources because where the resource is located is where possibly the users who benefit from it are. It was stated: "I see *territory* as the basic geographic unit because the most important thing in any management process of a water resource is solely the occurrence of the resource in the territory. *Territoriality* should be evaluated as the most important among the evaluation criterion."

Dr. Dennis Engi responded that all of the selected criteria are important but some of them could be more or less important than the others. The interpretation of the definition of *territoriality* is more important. As an explanation it was offered the following hypothetical situation applying the criteria in the assessment of vital issues:

Let us suppose we have two vital issues that are equally important regarding: *magnitude, likelihood, time frame, social impact,* but the first issue occurs only in a specific territory, that is a geographic area in Nicaragua and the second vital issue occurs broadly in several geographic regions. If Issue 1 is limited to a specific zone and Issue 2 is to a broader zone, then Issue 2 is more important.

PARH's consultant (Mr. David Milton) presented the example of how their project chose focal zones. After the evaluation at national level, it was explained that these zones were chosen for having common problems that could be broadly represented in all territories in Nicaragua.

It was also thought that thinking on the function of the information system, the two main stakeholders are the users and the territory. The issue they wanted to emphasized on was the role of territory as general substratum and not as a criterion. To this, it was recommended to consider the new concept of *territoriality* in the context of determining vital issues.

It was recalled the implementation of the criteria as standards against which we are relating situations. For instance in the geographical matter, it that is broader in its geographic occurrence is more important. It was recommended as a preparation for selecting the vital issues that it is important to consider the arguments in favor framed in the context of the seven criteria. The criteria are for judging or assessing the importance of an issue. It has to be located in time and space and has to be assessed by its size.

VITAL ISSUES OR CRITICAL PROBLEMS OF THE WATER RESOURCES OF NICARAGUA

All vital issues refer to both levels, national and local.

1. **Inadequate Control and Planning for the Management of Water Resources.**
   - The lack of vision of an institutional framework, a strategic plan, a portfolio of policies, and an implementation strategy for the management of Nicaraguan water resources.
   - Inadequate definition of the functions, responsibilities and coordination between the institutions responsible for managing water resources.
2. **Shortage of Human and Financial Resources.**
3. **Deficient Management of Water Resources as a Result of Insufficient or Inaccurate Information.**

   Examples:
   - Irrigation project in Leon - Chinandega
   - Pollution in Rio San Juan
   - Lake of Managua
4. **Inadequate Use and Pollution of Water Resources Caused by Insufficient Education in the Population.**

Discussion

There were several contributions about the importance and necessity to define the vital issues in order to design the information system.

- The information system must respond to the national needs of all sectors and for all possibilities of implementation. In order to do this, we have to define the crucial elements we wish to emphasize, that is, the critical problems of water resources which have to be urgently taken care of.
- Applying these critical problems, we can then determine the requirements of the information system which are needed to respond to these problems and in order to have a sustainable management of water resources.

- An opinion center should be created which would allow us to decide the use of the resource. According to this use, we will design an information system for monitoring the course of this water resource. Information does not have an objective in itself. We still do not have this shared-vision. And this is the task here. If we apply this shared vision of the critical problems, we can more easily grasp the needs of the information system.
- There do exist some institutions that have an information system; MINSA (Ministry of Health) has an information system that collects all the epidemiological data from the SILAIS (Regional Health Authorities), etc. However, the problems still occur. The vital issues should serve to guide us in designing an information system that is able to solve the problems in a fast and efficient way. The surveillance of water quality is stated in paper but has not been put into practice, and the population is affected by this lack of surveillance of water quality. That is why defining basic problems, essential factors in the deterioration of the resources or the vital issues, is of great importance in the elaboration of a system that will organize the information based on these problems.

In order to have a wide range spectrum of suggestions that could facilitate the determination of the vital issues or critical problems of Nicaragua's water resources, the panel elaborated a list of "NOs," which hinder the adequate management of water resources.

List of "NOs"

There is no:

- Protection of the resources.
- Adequate citizen participation.
- Enough education in the population.
- Sustainability indicators.
- Information about use and potential demand upon the resource.
- Information about pollution.

- Balance in the territory of the resource consumption and worsening.
- Education for the users.
- Research and development.
- Technical and financial instruments.
- Adequate information about the resource water, for example, there are no inventory lists, diagnoses, analysis, nor research for the management of the resource.
- Studies to determine the adequate use of the water in different water bodies.
- An institutional and legal frame that prevents, rewards or penalizes those who violate the law.
- Strategy, a plan for the management of the water resource that allows an integral management toward sustainable development (the development of the use, exploitation and protection of the resource should correspond with the economic development plan of the country).
- Inter-institutional coordination.
- A responsible institution to manage the information.
- Control of the exploitation of the resource.
- An organization that assigns the use of the resource in a controlled manner.
- Investment, economic instruments.
- A controlled process of data production and the surveillance of the resource (monitoring).
- Adequate indicators to sustain human health.

These "Nos" come from the fact that we do not have enough information to advance in an educational strategy, in a strategy for the collection of data or an integrated management, etc. Due to the absence of information, we are restricted in transmitting the message, organizing the territory, advising the population and managing the resource. The problem with all these NOs is that they impede us in postulating anything. As long as this information has not been

produced, we can't know where we are at this moment and with what we can count on to start the whole process.

Comments of PARH

The representative of Plan of Action for Water Resources, Mr. David Milton, informed about some of the important steps that PARH had taken to add some input to this process. The Tentative Plan of the General Law of Water is basically ready to be presented to the Assembly this year. But this law is not so different in other countries. The problem is not the law itself but "changing the legal frame in a way in which we can have an integrated system in the management of water resources is a painful process. Changes must be made. Institutional changes must be made. An investment in collecting data must be made. This is why it is difficult, because we are dealing with many institutions that have to do with water resources and each one of them has its own role. The new law contemplates the creation of a sole institution for managing water resources."

In summary, there exists certain inertia in the institutions to changes. The consequences of institutional changes are unknown.

DISCUSSION ABOUT THE QUALITY OF THE VITAL ISSUES

Changes to the Strawman Vital Issues and Other Considerations

It was mentioned that it is important to manage the natural resource, water, at its corresponding locations. The local government can manage the resource and use the information on site.

In the second vital issue "Shortage of Financial Resources" it was recommended to add human resources to the financial resources.

It is necessary to deal with the four vital issues at the national and local level. This should be treated as a preamble to the four vital issues.

It was proposed to take into consideration as a vital issue, the transnational critical problems as it is exemplified in the cases of pollution in San Juan River and the violation of borderline water limits for fishing. It was agreed that this problem is dealt with in Vital Issue 1, which refers to Planning.

Considering these inter-border problems, it is therefore necessary to complement the element *planning* with *control.* Planning is not enough if it is not controlled.

Point-Counterpoint Methodology for the Vital Issues Process

According to the working method of this workshop and considering the agenda, it is necessary to present in the defense of a vital issue the following points: First, it is necessary to describe and define the nature of the problem. Second, it is needed to define "why is it necessary or important to take into consideration this point." Third, the defender should consider if the vital issue is operational, that is, if the following panel can offer information needs useful in solving the critical problems. Furthermore, it is necessary to answer the question: How the information system can help in responding to this problem? It is not necessary at this point to name the information needs or design the system, but justify why it is believed that an

information system can support in the solution of the problem. Finally, each vital issue should be considered in relation with the seven criteria.

The pro defense process should be seen as a promotion of the vital issue representing it as the most important problem. The arguments must be based on the seven criteria.

The counterpoint process is for criticizing the arguments of the pro defense; it can be constructive or destructive. It should also include the four points previously described. It should also control if the vital issue has been discussed considering all the seven criteria of evaluation.

Vital Issue 4. – Inadequate Use of Water Resources and Pollution Caused by Insufficient Education in the Population

Pro Defense:

This problem has its origins in structural causes. The development models and adopted styles, which have been produced by economic policies in the past, have caused the insertion of Nicaragua in the agro-exportation field, for example, the cotton "boom" which transformed the economic and human geography of this country. This caused some severe consequences for example, the opening of the agricultural frontier, the extinction of large quantities of forest areas and all this accompanied by a process of a new style, of new ways of territory and resource use and therefore, the introduction of inadequate practices to very fragile ecosystems. This resulted in a reversal process in the education of the new actors in these new circumstances of the territory. It is a serious problem that endangers the sustainability of the national economy itself.

This problem must be tackled because it is needed to guarantee the survival of Nicaragua and its population and it is needed to look for options in the future. And above all, we must approach this problem which will give us the possibility of searching for a new model to face the needs of development which allow us to negotiate our comparative advantage which is totally based on natural resources. The problem of education, therefore, becomes cause and effect.

How can we influence in solving this problem or how can an information system help. It will give us data and elements to make decisions in this direction; on the one hand to face the derived problems we have been dragging as a result of an inadequate use of resources and education in how to use them and on the other hand, to take advantage of the robustness and the opportunity that still remains in this country.

The problem of lack of information in terms of water resources usage is really a problem of great magnitude since it affects the country as a whole as well as its inhabitants and could endanger the current production system.

The frequency of occurrence of this impact is in all the national territory.

As far as the *time frame,* this problem became more severe since the 50s, with the opening or the impulse toward the colonization fronts, the bad management of the water resources and their basins and the waste culture.

The *social impact* is serious; there is a direct relationship, an increase in the degradation of the environment means an increase in poverty. And water, being one of the main natural resources, all sectors of the economy are affected. The livestock sector does not have water resources for the cattle, agriculture is more fragile, and poverty increases.

Regarding *territoriality,* and considering that 93% to 96% of the water that this country receives as rain, drains to the Atlantic, and the enormous level of deforestation, the problem becomes one on the national level. Regarding *feasibility,* it is important to know at which stage the problem can be faced and know how to prioritize which part of the process is going to be tackled first. The pro defense believes that it is at the local level of production where this problem should be tackled first. If this country does not solve its water problems and their misuse, all we can expect is a completely unfeasible country.

Counterpoint:

The speaker supported the pro defense arguments.

Comments:

- Education, understood as formal instruction, is not necessarily correlated to degradation of natural resources. There are countries having a higher education level from a formal perspective, but are dominated by a consumption culture and are the ones that hit harder on the water resources problematic. There are tribes that have a more natural life culture but have an almost complete illiteracy level and do not degrade the environment. Thus, there is not necessarily a direct correlation between education versus resources implementation but it is a cultural problem. Education is a part of culture, which is a more global vision. Not necessarily the most "educated" people are who degrade less.
- But we are referring to the education in the use of the resource, not education in general.
- When we talk about a lack of education it means something more; it means lack of knowledge. Lack of understanding that exists in the process and which has disastrous consequences. There is an absence of knowledge of how things work, but in addition to the users' lack of knowledge it refers to the lack of this understanding at a higher level, if the ones who decide really understand the problem in terms of time, space and responsibility. The sustainable vision to see things in a long term period, it seems that we lack this vision of a forward perspective and we only want to act concerning the immediacy of the problem or at the convenience of the one who makes the decision to push it according to his/her own interests. We are referring to the lack of willingness to make things happen. They think it is important but it is for the future. This must be solved one day. There is not a will for acting. There is a lack of interest in changing the reality now. So, when we talk about education, we have to evaluate how much is a supine ignorance to the problem, a lack of knowledge, a lack of vision or a lack of will.
- Parallel to creating viable policies, the population must be educated.

Testing of the Qualitative Criteria

It was agreed that an information system could solve the lack of education problem and that citizens' education is pertinent to the matter of water resources management.

Vital Issue 1. Inadequate Planning and Control for the Management of Water Resources.

Pro Defense:

Nicaragua is a country that historically has tried to develop a great number of projects with the idea of solving the problems of water resources. It has not been possible to organize the majority of these projects since there does not exist the capacity to know if these projects are complementary, excluding or if they are feasible. These are projects that are sustained precisely in the use of water in order to be developed. An example is in Valle de Sebaco where there exists a contradiction between choosing the irrigation plan or the energetic plan. There is a large amount of projects upon which the country does not have the capacity to make a decision because either the knowledge is not adequate or available, nor exist the conditions and data needed to put them into practice. We cannot continue thinking that we can develop ourselves especially sustaining ourselves in the use of the resource without having the fundaments of planning of the use and development of this resource. It is necessary to create conditions of adequate knowledge so we can truly establish a strategic plan of development or a policy that would allow us to carry out a sustainable development and an economic development adjusted to the *feasibility* of the problem.

Why could an information system help us in solving this problem? There does exist an information system but these are information systems aimed to respond to a determined problem, that achieve the role for which they were created, for instance: the system of epidemic surveillance of MINSA, system of environmental information of MARENA, systems of hydrological network based on hydroelectric criteria. However, there is not an information

system that enables the planning of water usage. The problem is that the information does not have a response capacity to achieve the usage planning level.

If we are talking about managing a resource, to the future perspectives of having access to concessions of water use, for example, we will be unable to grant those concessions, we will be unable to establish the management of a resource that we do not know.

In terms of *magnitude*, there is a broader magnitude when we talk about the country's planing, of the resource availability.

The frequency of occurrence is almost systematic since the development plans, those of running water as well as irrigation and industrial are problems that are always on the agenda.

Time frame: we are talking of a 20 or 25 years old problem that has been dragged and until now that we have dealt with seriously.

The social incidence is unquestionable. Economic development has obviously an essential influence in the socioeconomic development of the country.

Territoriality, spatially plays an important role because in Nicaragua we can speak of a resource distribution in the territory in a way that allows the introduction of the identification of specific uses. For instance, the case of the Atlantic coast, where we know that there exists a great quantity of superficial water available but where we have not been able to visualize development strategic plans. The Pacific zone where we talk of underground aquifers having great sustainability and availability but that are not managed on a usage plan basis.

The *feasibility,* the capacity of solving this issue, depends on whether the system responds or not.

Pertinence, we cannot say that this problem is linked to a system of information or a problem related to the country's water resources. The aspect of counting on the information in order to have an adequate vision, to have the adequate institutional framework and the policies is fundamental so that the information system can really orient this capacity to respond to the planning needs.

Counterpoint:

The vision of planing has several flaws in this country. First, there does not exist an integral planing that allows seeing the water resource in a coherent manner; you can only find sectorial plans on the exploitation for very specific means, for irrigation, for electricity, etc. Thus, there is not an integrating and coherent vision of planing as a national process. Sometimes planing is made not knowing if the organization according to its mandate could be in contradiction with other mandates in the State itself. Sometimes the planning is not clear regarding the objective it wants to achieve, the expected goals or results, and the benefits; many times the benefit is only seen from the perspective of an economic profitability; the existence of the social benefit is implied but no one says here and how much it is going to assume and to whom it is aimed. The information system not only should provide information of the momentary situation or the perspective of what might happen, extrapolating these figures to future options, but the information system should be a system of permanent control or permanent diagnostic so it can analyze if the planing is defective. For example, to analyze if in this territory this new factor is convenient or not. The benefit expected here could detriment another alternative that might be more important for the economic development of certain people. The use of this resource in this territory should be used to favor this activity and not another one. It is not only important to produce basic information but also evaluate the projection to see how far these goals can really be fulfilled. Which variant could be introduced into the process that could be used to rectify this form of planing periodically or to reform the present policy.

Another thing is that we always believe that the great planner is the State and we are all expecting that the State will plan and present us a suggestion that we will accept or reject accordingly to our conveniences. It is important in this planning process to integrate the interested sectors that live in the territory and that use the resource water so we can truly

respond to the people's expectations; that is if we really want to cooperate in the management process and the conservation in benefit of the water resources.

Summarizing, first, planning must be integrated by all the possible options assessing in each territory the most feasible and beneficial ones. Second, there must exist a participation of the affected, the users, in the process. And third, the information process should not be limited only in providing information for planning but also for the follow-up of the process. Because it might be possible that in the course of five or more years this river could dry up or become polluted and obviously the planning must adapt to these developments to these circumstances that occur, and that might have not been foreseen. Of course if the planning was good you should have foreseen this.

Comments:

- Deficiency in planning is associated to two elements: a lack of long term vision from the people who make decisions at certain levels associated with a lack of political willingness to plan. Thus, even though it is spoken about, it is not seriously carried out. Then the problem is that we cannot define in an organized and planned manner the route of our own future. So we will always be following the role assigned by the invisible hand of Adam Smith.
- In this country there existed a Ministry of Planning during Somoza's administration. Planning was demanded, however planning was not controlled, it just remained in paper. We should think about a planning that would lead to a second phase of controlling what was planned and to see if the adaptations are correct; if what was planned was really carried out.

Testing of Qualitative Criteria

It was agreed that planning is pertinent to the issue of the management of water resources. It was intervened that it is pertinent if it responds to certain conditions, for example if it is adequate to the territorial characteristics. It was concluded that it is feasible that the information system could support the planning process.

Vital Issue 2. Shortage of Human and Financial Resources

Pro Defense:

This is one of the greatest deficiencies the country has especially at local levels. The shortage of financial resources inhibits the possibility of measures that might favor national development. Limitations for shortages of both resources constitute one of the most severe limitations that the country has in its different territorial expressions in order to provide a better exploitation to this resource, water and consolidate national development. It is necessary to incorporate this issue because without information about human and financial resources any planning or management remains only wishes.

An information system should contribute in the sphere of these two resources. In the first place it would be good if the information system reveals the needs of human and financial resources that could give this information, which are the human and financial resources the country needs and particularly for the issue of water resources.

In the second place, the information system could help as far as it provides information about the evolution of these financial and human resources. How they have accumulated, how they are generating, how are the universities and other education centers in matters of qualification of these resources and the availability of financial resources. It is important that information can be collected in matters of financial resources, given the great shortage the country has, and organized in an information system. For example in relation to the different existing programs where sometimes financial resources exist but since they are isolated among themselves, this availability cannot be capitalized neither in human or financial resources.

In terms of *magnitude*, its impact is national.

In terms of *likelihood*, this is an almost daily occurrence.

Regarding the *time frame*, this is already a great shortage and its solution is on a long-term basis.

In terms of *social impact,* the shortage of human and financial resources affects wide sectors of the population because some measures, policies, planning cannot be implemented and they might benefit the whole population.

In terms of *territoriality,* this occurs at levels of every locality; it is a national problem that expresses its insufficiencies at the territorial or local level.

Concerning *feasibility* aspects, both resources do influence in the possibility of solving any vital issue.

It is also extremely relevant to work and respond on terms of both resources.

Counterpoint

The financial resources invested in different projects sometimes produce isolated information in the different institutions that do not produce the expected impact in the country due to the fact that everyone is acting out his part in a punctual way. As soon as some authority establishes the necessary coordination related to the evaluation of the quality of these projects and their importance in the country, it will be more feasible that foreign cooperation or financial resources can be considered important for the planing on a national level. It is necessary to add that the impact that foreign cooperation is causing with these projects or the impact of the information they are generating does not have the required quality due to the fact that it is produced in this isolated manner.

Comments:

- In the economic assessments in this country there exist a total limitation to measure or assess the environmental benefits. For example, a rural community loses economically in attending to health problem of the population since the population drinks water from a river which is polluted. What might be the social cost or economic benefit if the same population had its system of wells in less polluted conditions? The cost of building wells seems very expensive. And these are always the economic arguments. But the health costs and well-being are much more important and economically more beneficial on a mid or long term

basis than continuing with the traditional methods. In all information systems, costs must be assessed, intangible costs which means taking into account the subtleties of nature to provide some service to the users that are not costs that can be measured in terms of pipes, machinery, electricity, etc.

- Local dimension - It is at local levels where the shortage of human and financial resources, which inhibits any planning, has more resonance.

  It is important to mention the assessment of natural resources, in its incorporation in national accounts as well as a factor within the production, that economists call externalities. The environmental costs, who guarantees them - the producers, the state, the government?

- The externalities of costs especially in gas emissions are developing into a big industry, which is called the commerce of emissions. The commerce of annual money for emissions has been estimated in US$50, 000 billion.

  It has to be emphasized that this kind of financial instrument exists and offers a possibility to re-invest these funds in any environmental aspect. In the context of the information system, when elaborating a strategic planning, these economic instruments can be taken into account.

Testing of Qualitative Criteria

It was agreed that the shortage of human and financial resources is pertinent to the management of water resources and that an information system might help in solving or counteracting the shortage of human and financial resources.

Vital Issue 3. Deficiencies of Decisions as a Result of Insufficient or Inaccurate Information

Pro Defense:

Information is the issue in this panel. The problem of information is at three levels: 1) Data input or a database, 2) Phase of processing or analysis of information, that is the framework of the information system, and 3) Output of the informative frame.

The problem of information has to be assessed in all levels. For example, it is possible to have a good information system but it might be possible that the database in the input is not of good quality and thus, the results would give wrong information. The decisions made on the basis of this information will therefore be wrong also. But it might also occur that the data are good at the beginning but the system is badly designed in a way that the information is wrong again; decisions made from this information would generate further problems. The third case is that the first two phases are functional but the presentation to the users is not functional, that is, it is not accessible to the users and thus the decisions turn out to be wrong also. Another current problem is that decisions have been made with insufficient or inaccurate information. Specific cases: Environmental impact assessment, which requires a database, is being made using insufficient or incorrect data. Thus, the recommended measures are not effective enough to avoid the environmental impact generated by several projects in the country.

In the evaluation of the *magnitude* of the information for the system, it is obvious that this reaches the maximum value since it is intrinsic for the system of information.

Territoriality will depend on the decisions based on information that affect a determined territory.

In *time frame,* it also begins to cause effects at the moment of wrong decisions. The probability that wrong decisions are made when there is insufficient or inaccurate information is very high.

The *social impact*, which can occur due to decisions on the execution of projects that have been sustained in a decision based on errors in a database, could be enormous. Many examples have been mentioned here for example the evaluation of good water quality which eventually proves to be of bad quality.

Counterpoint:

The main issue is to have an information *system.* The system is as good as the quality of information that feeds it. We have to develop a sub-system not a system because the system

must be integrated by all the different elements we have been talking about, the process of control, execution, planning, monitoring, etc. What we have been calling a system has to be a component of the system. What are the functions that this information sub-system must have? Fieldwork, where inspections and monitoring are carried out, which produce data, values, volumes, quality, substance contents, etc., of the water bodies, aquifers, basins. And carry out investigations that produce information. This is the essential role of the system. Here is where the essential role of the sub-system must end. In order that it be an organization that is concentrated in producing data and information, it must be have two components, data and information production. This subsystem must be part of a broader system which spreads this information, stimulates the citizen participation (NGOs), civil society and official channels, organizations of the state or government that are the direct co-users of this information in order to produce the mentioned planning; so they have the capacity to produce the official strategy with this information. There exists a necessity for an adequate institution that leads the execution of the information system. This information should serve as a feedback for the whole integral system. Thus, it is my opinion we should lead to the proposal of a sub-system that has to be part of a holistic effort fully integrated, in which different institutions take part and have this niche of interaction.

If a system of information solely exists for itself, we will not be able to accomplish this mission that we have taken on.

Comments:

- The information system should be oriented to a purpose; the horizon we want to reach is planning. Planning cannot be a derivation from information but needs the information as feedback.
- The hazard of the quality of information.

  The decision-making process requires a certain level of quality of information. But first it is necessary to identify the problem in Nicaragua of the nonexistence of information. And

regarding quality, it is needed to have criteria for quality in order not to exaggerate a level of quality, which is not necessary.

- The information system must have quickly accessible information and this must be opportune. The public must have access to the information, and for this the language used in spreading it must be understandable.
- It is a good important to relate the issue of information to education, that is, the way to spread the information.
- The system must be an open system. It must be a dynamic system which is in constant interaction.

Testing of the Quality Criteria

It was agreed that the decision deficiencies caused by insufficient or inaccurate information are pertinent to managing water resources and that we can improve the quality of decisions about the management of water resources with an information system.

Sufficiency

Have all the main macro problems been tackled?

Proposal:

The issue of institutional and legal framework has to be dealt with as an independent vital issue, autonomous. It cannot be a part of planning because it is a problem in itself. We would then have to start eliminating all the points.

Opinions:

If we start dividing vital issues we would have to continue desegregating all of the vital issues.

It was agreed to leave institutional and legal framework in the *Planning* context but it was stressed that special importance must always be given to these two aspects.

Proposal:

There are vital issues that are very much alike and could possibly be simplified. Vital Issue 2, *Shortage of human and financial resources,* and Vital Issue 4, *Inadequate use of water resources and pollution caused by insufficient education in the population,* are closely interrelated.

Approach to the Information System

In the discussion about the Vital Issues there was much reflection and discussion regarding the approach to the information system. It is considered important to present these thoughts that would benefit the understanding about the relation between vital issues and their information needs. Besides, it is necessary to document the reflection about some aspects in structuring a possible system. These are treated as comments, not in an organized manner.

- An information system has to have a system for collecting data, for storage, for processing the data, and disseminating the information. There is a big difference between data and information. One can have much data and still not have information. There is a whole process in turning data into information. The system should serve as a support, as a tool in the management of water resources. There is risk in having too much useless data. Thus, it is important to think about vital issues that will project the necessary information so we will not build a monster.
- How do you design a information system to manage the resource water in order to make decisions. It has to do with a problem of:
    - Information production. *Input.*
    - Follow up. (Monitoring). *Output.*
- It is a scale issue. At the base of the ladder we have the necessity to get to know the resource. The development of this system of information in the broadest context of the word, is information as investigation as observing the resource. That is the base of the instrument

that would allow advancing to the second step, which is to the National Commission of Water Resources, in order to create a strategy. However this is not the end, because this strategy might stay in a book if it is not taken into the considerations by the third level, in this case, the National Council of Sustainable Development, which, even though it is beginning, has to tackle this problem. So the process begins originally with collecting data, where is the resource? How is the resource characterized in order to have the needed elements to build a strategy of use, conservation and management of water resources. Once this strategy is planned it is taken to the consideration of a national council so it can be adopted as a national policy. Here we are finding the way to establish the right instruments so the decision-making process can begin.

- We are striving for decisions that might improve the use of water resources and make possible their exploitation. However, in absence of an adequate information system, the failure risk is great. Decisions that do not count with information are high-risk decisions. What we are trying to set up is a way to exploit and protect water resources with information that allows this. The keyword is *adequate.* Our epidemiological information system is not adequate. It is a system that does not work because obviously from the results, that information does not give feedback to the decisions. If this tool, the information system does not constitute part of a system that allows an adequate control, or if the objectives for which we are organizing ourselves are not defined, we will hardly achieve our objectives.
- The information system should have the capacity to make planning of the water resources possible.
- It is a methodological problem. There are three basic steps: recognize, systematize and complete so a planning can be made and it is possible to define strategies to manage water resources and make decisions on both levels, central and territorial.

RESULTS OF RANKING THE VITAL ISSUES

The "ordinal" results for the composite values of the vital issues are as follows:

Education ~ Information > Financial ~ Planning

The quantitative results of the scoring exercise are shown in Figures B-1 through B-6. The first five figures illustrate the relative importance of the vital issues for each of the five criteria as assessed by the panelists. The final figure (Figure B-6) illustrates the composite value of the four vital issues defined by Panel II. The relative importance of the five criteria, as assessed by Panel I, was used to determine the composite value of the four vital issues.

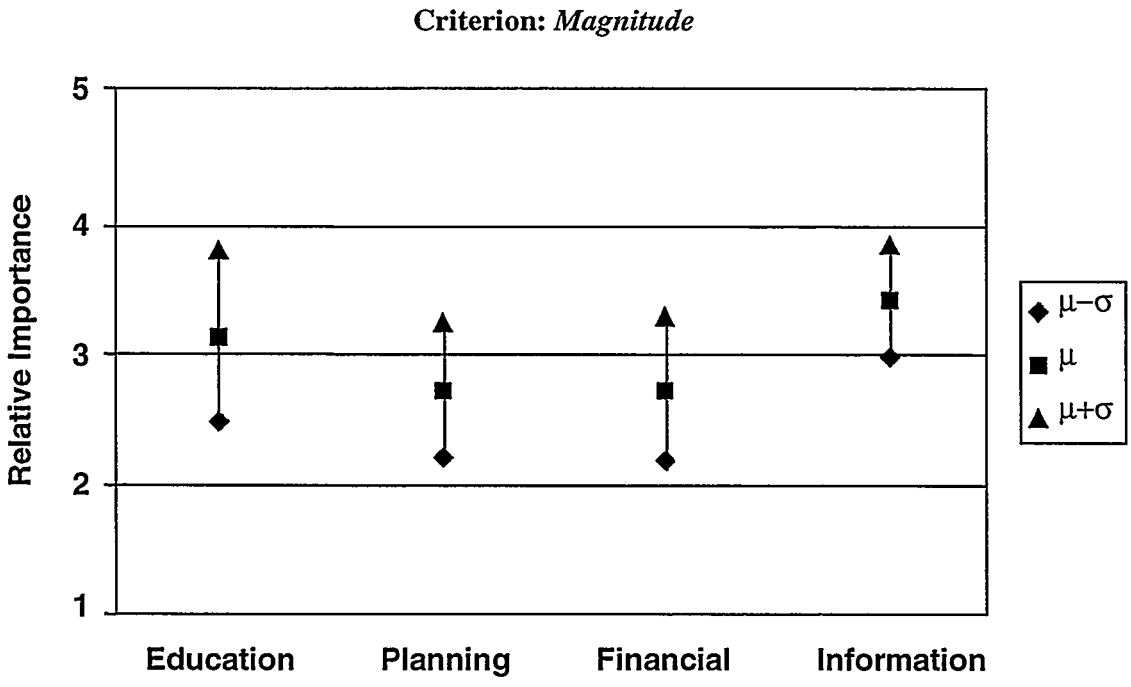

Figure B-1. Relative importance of the vital issues for the *magnitude* criterion.

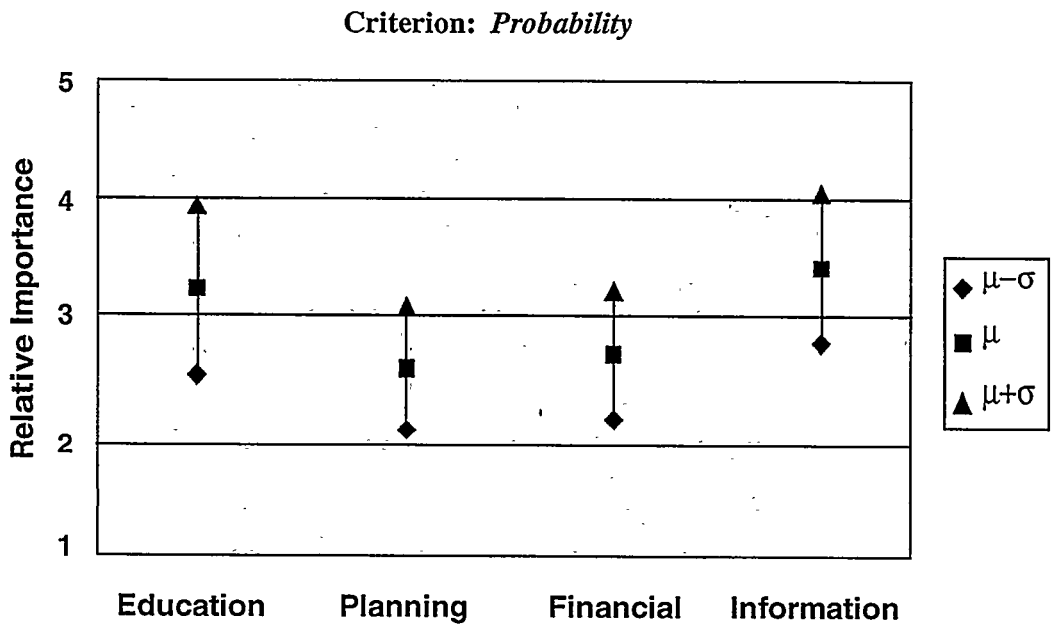

Figure B-2. Relative Importance of the Vital Issues for the *probability* criterion.

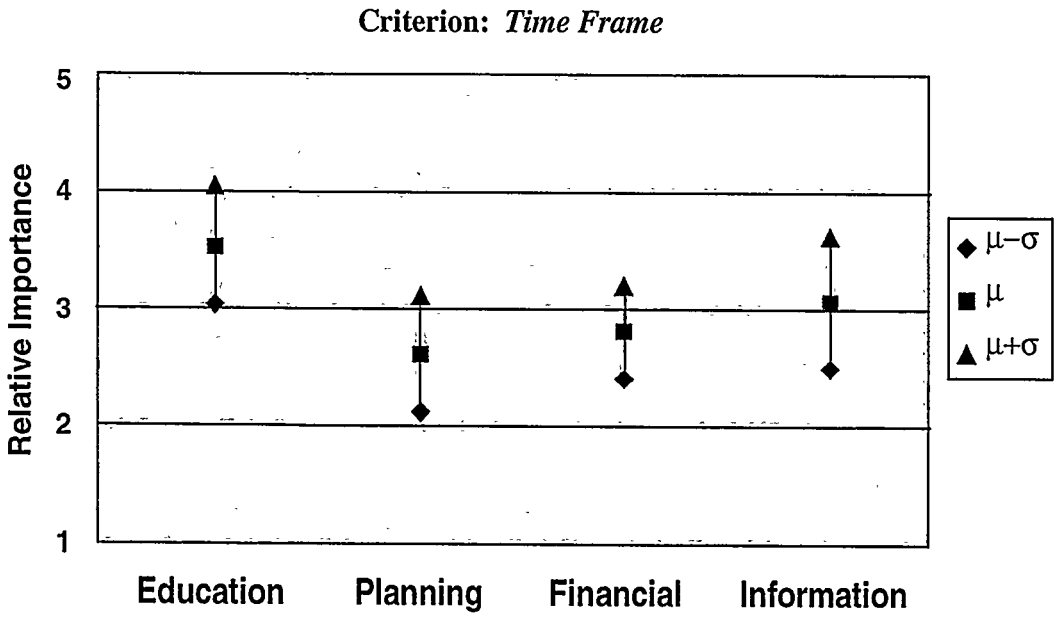

Figure B-3. Relative Importance of the Vital Issues for the *time frame* criterion.

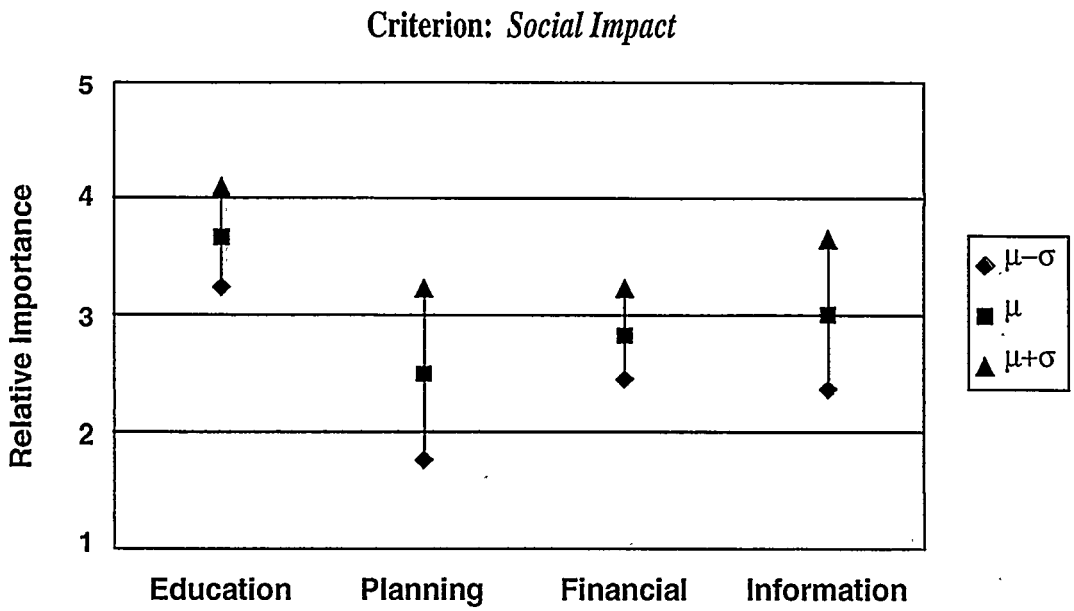

Figure B-4. Relative importance of the vital issues for the *social impact* criterion.

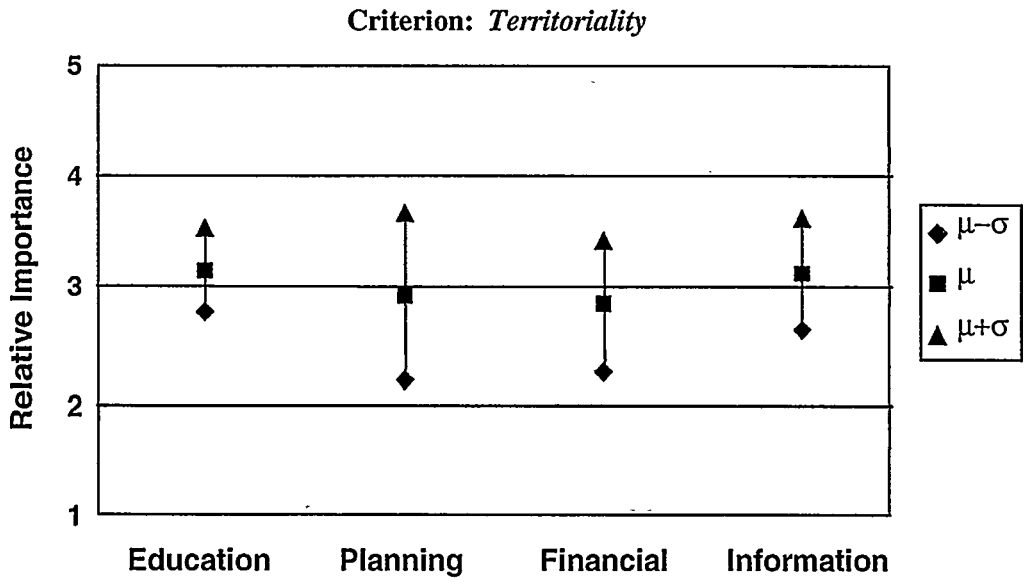

Figure B-5. Relative importance of the vital issues for the *territoriality* criterion.

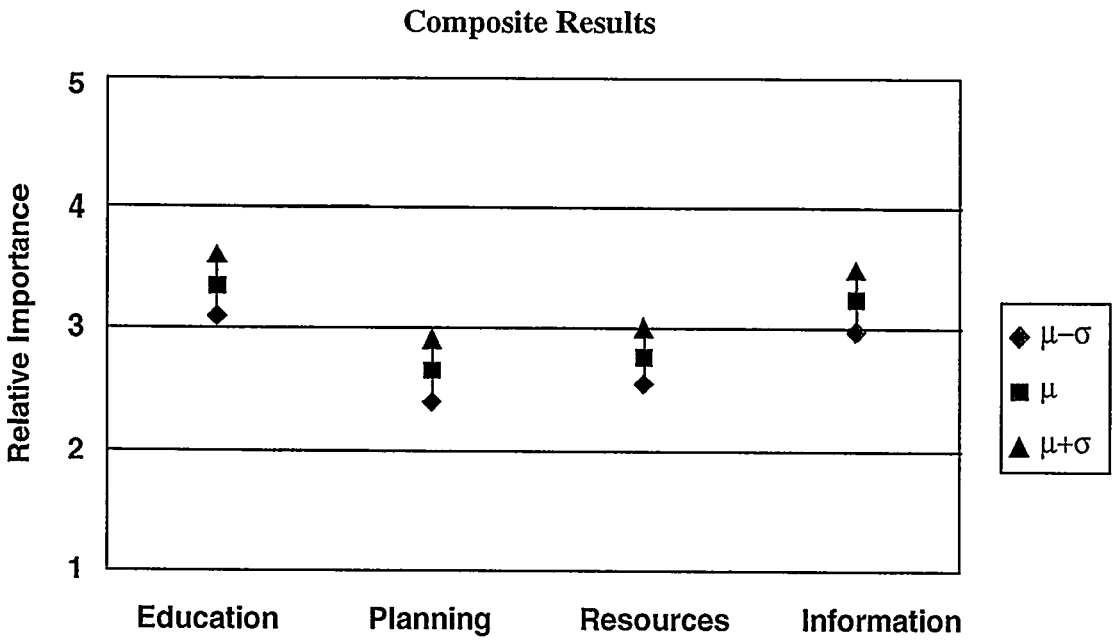

Figure B-6. Composite relative importance of the vital issues.

ATTACHMENT A

Vital Issues Panel II Panelists
February 10, 1998, Nicaragua

Government Sector

Ingeniero Luis S. Palacios R.
Instituto Nicaragüense de Estudios Territoriales (INETER)
Nicaraguan Institute for Territorial Studies
Tel. 2492756
Fax. 2491890

Ingeniero Arcadio Choza
Ministerio del Ambiente y Recursos Naturales (MARENA)
Ministry of Environment and Natural Resources
Tel. 2632870
Fax. 2632620
ambiente@marena2.sdnnic.org.ni

Ingeniero David Milton
Plan de Acción para el Manejo de los Recursos Hídricos (PARH)
Plan of Action for the Management of Water Resources
Tel. 2632871
Fax. 2632615
Parh@ibw.com.ni

Licenciada Marina Stadthagen
Consejo Nacional de Desarrollo Sostenible (CONADES)
National Council of Sustainable Development
Tel. 2661701
Fax. 2667409

Academic Sector

Doctor Jaime López
Centro para la Investigación en Recursos Acuáticos de Nicaragua (CIRA/UNAN)
Nicaraguan Aquatic Resources Research Center
Tel. 2678211; 2786981; 2786982
Fax. 2678169

Doctor Jaime Incer Barquero
Fundación Nacional para el Desarrollo Nicaragüense (FUNDENIC)
National Foundation for Nicaraguan Development
Tel. 2781223
jincer@tigre.uam.edu.ni

Licenciado Jairo Rodriguez
National Autonomous University of Nicaragua, Leon (UNAN-Leon)
Panamerican Organisation of Health (OPS)
Tel. 0311 3114 0 0 4970
Fax. 0311 5057
unanleon@uni.com.ni

Private Sector

Licenciado Freddy Cruz
Consultora Empresarial Centro Americano S.A. (CECSA)
Consulting Contractors of Central America S.A.
Tel. 2281206
Fax. 2281213
cecsa@nicarao.org.ni

Doctor Napoleon López
Consultor Privado, Universidad Nacional de Ingenería (UNI)
Private Consultant, National University of Engineering
Tel. 088 32889
napo@ibw.com.ni

Nongovernmental Organizations Sector

Doctor Melvin Wallace
Centro de Investigación de la Realidad de América Latina (CIRA)
Center for the Investigation of Latin American Reality
Tel. 2663846
Fax. 2682314
cira@tmx.com.ni

Arq. Danilo Saravia
Fundación Nacional para el Desarrollo Nicaragüense (FUNDENIC)
National Foundation for Nicaraguan Development
Tel. 2781545
dsaravia@sdnnic.org.ni

ATTACHMENT B – AGENDA FOR VITAL ISSUES PANEL II

AGENDA DEL II. PANEL SOBRE ASUNTOS VITALES

10 de Febrero de 1998. Hotel Barceló Montelimar, Nicaragua

Hora	Tema	Expositor
8:00–8:30	Bienvenida e introducción	Salvador Montenegro
9:00–9:15	Vistazo general del proceso	Dennis Engi
9:15–9:45	Deliberación del Propósito de la Misión y Criterios de Evaluación	Dennis Engi
9:45–10:00	Receso	
10:00–12:00	Identificación de los Asuntos Vitales del Manejo de los Recursos Hídricos	Todos (Facilitado por Engi)
12:00–13:00	Almuerzo	
13:00–14:00	Identificación de los Asuntos Vitales del Manejo de los Recursos Hídricos	Todos (Facilitado por Engi)
14:00–14:15	Explicación del Proceso de Categorización de los Asuntos Vitales y Asignación de los Defensores	Dennis Engi
14:15–14:30	Preparación de Posiciones de Defensa Defensores	
14:30–14:45	Receso	
14:45–16:45	Categorización de los Asuntos Vitales	Todos (Facilitado por Engi)
16:45–17:00	Resumen y clausura	Salvador Montenegro
17:00	Coctel de cierre	

Intentionally Left Blank

Appendix C – Nicaraguan Water Resources Management Initiative Vital Issues Panel III Report

Intentionally Left Blank

VITAL ISSUES PANEL III REPORT

DEVELOPMENT OF AN INFORMATION SYSTEM FOR THE MANAGEMENT OF THE WATER RESOURCES OF THE REPUBLIC OF NICARAGUA

(translated from Spanish)

May 12 – 13, 1998
Hotel Barceló Montelimar
Nicaragua

Intentionally Left Blank

EXECUTIVE SUMMARY

This report summarizes the results of the Vital Issues Panel III meeting for the Nicaraguan Water Resources Initiative, a collaborative effort between Sandia National Laboratories (SNL) and Nicaragua to structure a state-of-the-art information system for managing Nicaragua's water resources. The panel, third in a series of three, met on May 12–13, 1998, at the Hotel Barceló Montelimar in Nicaragua. In order to guarantee that the system would correspond with the needs of the decision making process in the Nicaraguan reality, the panel counted on the participation of experts who represented different sectors involved in the decision making process of the management of water resources. This initiative applies a strategic planning tool called the Vital Issues process, designed by Sandia National Laboratories; the panels in Nicaragua were facilitated by the Nicaraguan Aquatic Research Center of the National Autonomous University of Nicaragua (CIRA-UNAN).

The objective of this panel was to define what are the specific needs of information that correspond to each of the four vital issues of the water resources of Nicaragua, identified in the second panel. How can this information aid in making decisions in planning, human and financial resources, management and education?

Information needs for each of the Vital Issues or Critical Problems of the Water Resources of Nicaragua

Issue	Specific Information Needed
Inadequate planning and control for the management of water resources	*National Level* 1. Updating the institutional framework 2. Judiciary harmony 3. Identification of roles 4. Strengthening the community 5. Sustainability norms 6. Necessity or demand *Macro-Regional Level* 7. Inventory and diagnosis 8. Resource strategy 9. Quality and quantity 10. Current and potential uses, assessment of exploitation projects. 11. Management and recuperation on an exploratory level and semi details including participatory processes *Micro Level (Basin, Micro basin, Municipality, Far-off Land, Community, Farm* 12. Inventory and diagnosis at a detailed level 13. Strategy 14. Quality and quantity 15. Current and potential uses in basic planning units 16. Socioeconomic planning 17. Decision-making based on the water balance with participation of the society 18. All information related to the water basin
Lack of human and financial resources	1. Database that includes capacities and experience of the market supply of professionals that have the capacity to contribute to the production of information and improving the management of the resource water that should be located in the new Water Authority 2. Information to establish a relationship between the production of human resources and the labor market 3. Database about the technicians in the municipalities and universities related to the resource water and its management 4. Data about critical areas or basins that could be used as a model for the management of other basins, and could help stop the advancement of the agricultural frontier 5. Available information that could be incorporated in formal and informal education with emphasis on the care of the resource 6. Information regarding the use of water in the territory that could be used as a basis to guarantee financial resources for the recuperation and conservation of the resource

Information needs for each of the Vital Issues or Critical Problems of the Water Resources of Nicaragua (cont.)

Issue	Specific Information Needed
Deficient management of water resources caused by inaccurate or insufficient information	1. Climate conditions 2. Hydrogeologic characteristics 3. Hydrology 4. Socioeconomic 5. Available volumes and demand 6. Actual and potential use of soils 7. Potential sources of contamination 8. Water quality 9. Feasibility of use 10. Physiography 11. Epidemiology 12. Planning 13. National and international agreements about water resources
Misuse and contamination of water resources caused by insufficient education of the population	1. Information, which helps visualize the deterioration of the water resource and its relationship to health, environment, economy and social aspects 2. Indicators of efficiency related to the water resource (costs per patient, costs per cubic meter of drinking water) 3. Epidemiological studies related to water resources 4. Successful experiences of good use of the water resource, appropriate technology and citizen participation 5. Results of the research of contamination of water and its consequences 6. Laws, regulations, norms and results of related topics of the water resource 7. Programs of environmental education of the universities and schools

The working group for Issue 1 also identified a list of general information needs for establishing the information system, as follows:

- Information macroindicators of the resource, such as:

  1) Volume in quantity and classification of quality

  2) Precipitation

  3) Volume of flow

  4) Temperatures

5) Evaporation and wind speeds

6) Infiltration

7) Relative humidity

8) Climatic, cyclical

9) Demand and availability

- Implementation of an information system for monitoring and environmental audit of water data

1) Quantity and quality of the resource (What do we have?)

2) Water balance

3) Factors that interact with the resource

   - Pollutants
   - Users
   - Forest management

INTRODUCTION

The objective of the procedure applied in the third Panel is to constitute an information system, and for that reason this phase of the Vital Issues process was dedicated to defining *what are the information needs* and in what form they should be used. How can this system help to make decisions about planning, human resources, financial resources, management and education? Since in the second panel it was possible to identify the problems by defining four vital issues, now it was time to identify the information needs for each one of them.

The list of panelists appears in Attachment A to this report.

Intentionally Left Blank

METHODOLOGY

The panelists were divided into four working groups and each one was assigned the duty of identifying the needs for information for one of the Vital Issues.

Intentionally Left Blank

RESULTS OF THE WORK GROUPS

DEFINITION OF THE INFORMATION NEEDS

Group 1 – Vital Issue 1. Inadequate Planning and Control for the Management of Water Resources

The procedure consisted of defining the "Management Territorial Levels" and the needs for information of each level. Three territorial levels were defined: National, Macro-regional, Micro-level. Furthermore, the type of information required was identified, considering the first as having a specific character and the second with a general character.

The information needs for this vital issues were defined at each of these levels.

Specific Information

National or decision-making level:

- Update Institutional Framework – It is necessary to have an entity responsible for managing the whole legal system so it can help in the regulation processes.
- Judiciary harmony – Even though there are different laws, they are not enforced or are not applied.
- Identifying roles – Identify the roles of institutions that apply rules, norms, or regulations.
- Strengthening the Community – Strengthening laws in the community.
- Sustainability Norms – Norms should be systematized and be sustainable.
- Necessity or Demand

Note of the Narrator:

My impression is that the factors defined as specific information at the national level in reality are preconditions for the functioning of an information system which may facilitate the management of water resources. These factors are changes or institutional reforms necessary to establish a working information system. It is important to point this out because all the groups discussed these institutional preconditions, which shows the great concern existing to reform

the institutional and legal framework that are necessary for the good management of water resources.

Macro Level, Regional:

- Inventory and diagnosis.
- Resource strategy.
- Quantity and quality of the resource.
- Current and potential uses.
- Assessment of exploitation projects.
- Management and recuperation on an exploratory level and semi-details including participatory processes.

Micro Level:

It might be a county, a basin or a municipality.

- Inventory and diagnosis at a detailed level.
- Strategy.
- Quantity and quality
- Current and potential uses in basic planning units.
- Decision-making based on the water balance with the participation of the society.

General Information

Recommendation: It is of great importance that all institutions having information, are present in the meetings, for instance INETER.

It is necessary to respond to the following questions in order to establish an information system: where is the resource located? What is the condition of the resource? What do we have and in what amounts?

- Information Macro-Indicators of Resource
  1. Volume in quantities and classification of quality. Without this information we cannot make decisions on the use of the resource.

2. Precipitation. It is important to know the amount of precipitation in the territory or the basin or recharge zone in order to be able to estimate how much water exists.
3. Volume of flow. How much water is departing from the basin?
4. Temperatures.
5. Evaporation and wind speeds.
6. Infiltration.
7. Relative humidity.

- Implementation of an Information System for Monitoring and Auditing of Water Resources - The implementation of an information system for monitoring and auditing of water resources must include:

1. Quantity and quality of the resource. (What do we have?)
2. Water Balance.
3. Factors that interact with the resource.
   - Contaminants.
   - Users.
   - Forest Management.

Discussion

Speaker 1:

It is necessary to organize an information system that supports the need for national management of the water resources which truly coordinates the efforts, promotes the projects and confers responsibilities of control of all activities, which are being developed in the territory that are related to the sustainability of the water resources.

All these needs of knowledge, planning, management, legislation, education and development of projects should focus on a primordial effort, which is the creation of a National Authority of Water Resources which should be the ultimate authority in promoting this concept of sustainability of the resource. This National Authority should be represented by the principal

government officials, local authorities in whose territories problems of destruction of the resources can be clearly observed, the productive sector and the nongovernmental organizations; that is all sectors of the Nicaraguan society should participate in order to form a national shared effort. It is necessary to find the way to direct the enthusiasm of the civil society and the commitments of the Government in order to find one solution. It has to be an organization with sufficient credibility and support so its efforts can be given priority or evaluated in the country.

There can be no planning, monitoring nor promotion if there does not exist an Authority or an institution having a central strategy which promotes this matter in all spheres.

Speaker 2:

He made a retrospective revision of the development of a Water Authority beginning with the existence of the Water Resources Commission, moreover, he explained the objective of the Plan of Action for Water Resources (PARH) which might help solve the problem of the institutionalization of this Authority. At the present time it is anticipated the creation of the ultimate Water Authority within the new Ministry of Foment and Commerce. Regarding this aspect, it was expressed the difficulty that such an authority subordinated to a Ministry might have, in responding to the activities of this ministry and thus creating the possible situation in which the authority would not be able to act using its full faculties needed to solve the specific problems of the resource.

Speaker 3:

The bill that regulates the formation of this ministry is still a draft. He also expressed his opinion that the Water Authority should not be included in the structures of this Ministry, MIFIC. He also said that this is the right time to make a proposal containing information of where and how this water authority can be created. The inclusion of the Water Authority within the MIFIC occurred before the water crisis in Chontales, Boaco, Matagalpa, Madriz and Nueva Segovia, where the scarcity of water reached the urban areas. The fact that water is the mother of all

resources, is a strong argument, which supports the idea that the Water Authority should not be included in the MIFIC as if water was any commercial resource. A possible suggestion was that the Authority could depend directly on the Presidency.

Speaker 4:

It is true that the objective of this panel is to determine the needs of information that such a system requires. However, if there exists no entity that uses that information to make decisions, the system would be of little use. Thus, it is necessary to link this initiative of developing an information system to the conception, creation and development of a pertinent Authority that will use it, administer it and, of course, that will enforce this system to fulfill its functions.

Further comments were related to the problems of the institutional framework of the National Water Authority.

Note of the Narrator: It is important to mention that this discussion impressed efforts to promote a Water Authority. These efforts still prevail and have great importance for the future management of water resources and the future use of the information system.

It was further discussed, if the identification of the needs of information proposed by Group I are sufficient to deal with this vital issue.

Suggestions to be included in the list of necessities.

- The demand of use and water availability.
- What is the use of water and its economy measured in m^3 of water per dollar and who administers it? The information system is associated with the socioeconomic planning of the region. Who are going to be its users?
- At the macro level, the aspect of space and time should be included: as well as cyclic information of the region or the influences of climate in general.
- It is important the information at the level of basin management.

Clarification of the Difference Between Vital Issues 1 and 3

The first vital issue consists in understanding the strategy to manage the resources. What are the plans, and the strategies involving the legislative and political part? The third Vital Issue refers to the condition that when you then have information, it is necessary to know how you can improve the management of the water resource. The first is about planning and the third one is more technical.

Speaker:

The concept that the value of water depends on the cost incurred in transporting it is erroneous and thus, it is essential to consider water as a resource, which also involves its reproductive process. There should exist a factor, which considers that Nature can no longer be a water supplier without protection. Provisions should be included in order to change the soil use and to educate our peasants so they will no longer continue deforesting. Furthermore, this factor should reflect the components necessary to return this resource to Nature in order to assure its quality and quantity benefits.

Conclusions

The information needs for the Vital Issue 1, *Inadequate planning and control for the management of water resources* are listed Table C-1.

Table C-1. Specific Information Needs for Vital Issue 1, *Inadequate Planning and Control for the Management of Water Resources*

Issue	Specific Information Needed
Inadequate planning and control for the management of water resources	*National Level* 1. Updating the institutional framework 7. Judiciary harmony 8. Identification of roles 9. Strengthening the community 10. Sustainability norms 11. Necessity or demand *Macro-Regional Level* 12. Inventory and diagnosis 13. Resource strategy 14. Quality and quantity 15. Current and potential uses, assessment of exploitation projects. 16. Management and recuperation on an exploratory level and semi details including participatory processes *Micro Level (Basin, Micro basin, Municipality, Far-off Land, Community, Farm)* 17. Inventory and diagnosis at a detailed level 18. Strategy 19. Quality and quantity 20. Current and potential uses in basic planning units 21. Socioeconomic planning 22. Decision-making based on the water balance with participation of the society 23. All information related to the water basin

The panel identified general information needs for establishing the information system, as follows:

- Information macroindicators of the resource, such as:

  1. Volume in quantity and classification of quality
  2. Precipitation
  3. Volume of flow
  4. Temperatures
  5. Evaporation and wind speeds
  6. Infiltration

7. Relative humidity
8. Climatic, Cyclical
9. Demand and availability

- Implementation of an information system for monitoring and environmental audit of water data

1. Quantity and quality of the resource (What do we have?)
2. Water balance
3. Factors that interact with the resource
    - Pollutants
    - Users
    - Forest management

Group 2 – Vital Issue 2. Lack of Human and Financial Resources

Human Resources

In Nicaragua there exist many human resources related to research and the promotion of the resource, water. We are not only talking of the fact that there exist hydrobiologists, hydrologists, hydrogeologists, or sanitary engineers, but also if these professionals have the capacity to inform about the importance of the resource from the perspective of promoting efforts, legislation, education for the population, proposing regulations and cost assessments. This means the involvement of more sectors and actors. There are professionals that even though they have technical skills, they cannot dedicate time to work with water resources problems since they cannot find a proper sphere in which to develop their capacities. The universities are always producing human resources in the fields of education, training and development. How can these efforts be inserted into the structures where the resource is really being managed?

Training, integration, and the mobilization of these human resources means finding the financial mechanisms, which make it possible to situate them in these positions of influence and

action. Obviously, within these human resources there are planners who can quantify the value of the resource in order to lure financial sources by the quantification of the resource. There is integrity between the importance of human resources and the importance of the facilities for financing these processes or information. The loss of these resources is caused by the absence of a conducting force in the process capable of evaluating the capacities and experience of these people.

These people cannot count on a job position or a line of work in a specific ministry nor can they find clear options in the private sector unless there exist groups of consultants whose knowledge is needed for a specific time or for a specific project. The only way to be able to assess these human resources is stimulating the creation of a National Water Authority which will really allow to expand the spectrum of activities where it is possible to promote what is failing to be able to handle the problem of water management. Thus, it is necessary to establish the National Water Authority to respond to these aspects.

In respect to the needs of information, it is essential to know what resources Nicaragua can count on because it is the only way we could know or quantify these human resources and in that way realize if there are resources or levels missing.

We're talking of classifying technicians, engineers, promoters, educators, journalists, and producers. The country possesses human resources but the market is so disperse that it is necessary to conduct a study in order to know how to apply this information in the process. This process not only involves evaluating the actual supply of professionals but also what the government can create through its Ministries, which includes legal needs existing in the territories from the municipality level to farms where training and technology must arrive sometime if we really believe that water can be well managed and administered on all levels up to the family.

There exists a divorce between the public and private universities and the demands of the enterprises that employ these human resources; as a result, the people graduated from

university cannot be situated in the field for which they are specialized. Universities should also prepare conditions so that the human resources that have to do with water management can find an employment option for living and where they can perform their profession. It is necessary to establish a relationship between the production of human resources and the labor market to avoid this dispersion. Water management involves a wide variety of options, and also different types of management.

Resources tend to rotate around projects or institutions that in a certain way are in the attractive zone. In the case of water resources, they are linked as a centralized unit in the capital city mainly.

There is a complete neglect for the capacity of reinforcing human resources, that is, in responsibility of the municipalities in managing water resources in their own territory. The municipalities are the place where projects should be defined since it is here where the water problems are projected in the sense of water basins. The municipalities lack professional technical support to formulate proposals and implement projects that have to do with the benefits of the inhabitants who directly need the resource, water. This problem is becoming critical since there are populations disappearing, where the problem of water supply is a vital issue and their inhabitants have to come to Managua to solve their problem. An example is Matagalpa, which has been without water for 4 weeks. There are no levels of responsibilities at the municipal level that are capable of organizing management options. There does not exist one aspect of the rural problematic that does not have to do with the resource, water.

Observing the scarcity of water that Nicaragua has experienced, it is necessary to deal with this situation from the perspective of the more critical areas. For instance the south basin of Lago Xolotlán that feeds the aquifer of all the wells of Managua; the Ticuantepe basin, from which Managua is extracting water; the Mayales basin, etc. It is necessary to give priority accordingly to the first water need, which is supplying the population.

Another important problem is the lack of perception of the majority of the population who does not have access to the knowledge that demonstrates the value of water. This ignorance makes the people believe that Nicaragua is a country blessed by providence and it does not matter how much they bum the forests or pollute the rivers, they will always be able to count on these goods. This concept that Nature can subsidize development is a problem of the nation, which does not promote the responsibility for the care of the resource. For this reason it is essentially important that the Ministry of Education promotes values concerning the environment. It is necessary to stimulate the approval of the concept of good management of water resources in order to assume responsibility for them. Positively, it must be commented that the population is more conscious than 10 years ago.

The private sector in Nicaragua still does not understand the realities of environmental deterioration. They have not caught the message and thus it is necessary to communicate with them so they can assume their responsibility. They control processes or elaborate products using water as an important input.

Financial Resources

They can be generated internally. For instance, the same water consumption can contribute to the management of the same basin. Or it is possible to create funds at the municipality level for the benefit of the population.

Moreover it is necessary to direct international financing to repay Nature part of the costs due to its use and to create local capacities so the inhabitants sense a responsibility toward Nature.

Many of these problems are due to the lack of a National Water Authority.

Discussion

Speaker 1:

Insufficient human resources: Our universities have formed too little professionals with a field of specialization in water resources. The information system should be more oriented to influence and develop the capacities for looking after the resource.

Financial Resources: It is necessary to change the policy towards the use of the resource that stimulates its recuperation as a resource.

Speaker 2:

The information plan should include an evaluation of the situation of the professional supply containing the following information:

- Which experts exist who are working with the water subject?
- How many are there?
- What are the specialists offered in the universities and evaluate if these specialties correspond to the needs of the information system.

Summarizing, one of the points for the needs of information requires a diagnostic of the situation of the professional and technical supply in subjects related to water.

Speaker 3:

It is important to incorporate into the formal education at the secondary and university level the aspect of water conservation which should include not only topics specific to water, but also of soil conservation, reforestation, resources management, etc. The resource water cannot take care of itself but only through the adequate use and management of other resources.

Speaker 4:

The lack of a legal branch responsible for these water matters is in the root of our incapability in having the human resources also.

Speaker 5:

The information system should include the updated demand of human resources in all the territory so we could have an inventory list of professionals.

Narrator's Note:

In the elaboration of this report it was noticed that some of the information needs formulated by the group corresponded more to objectives for creating the information system. Thus, the needs were reformulated taking into consideration all the elements in the discussion.

Conclusions

The information needs for Vital Issue 2, *Lack of Human and Financial Resources,* are listed below.

1. Database which includes capacities and experience of the market supply of professionals that have the capacity to contribute to the production of information and improving the management of the resource water which should be located in the new Water Authority.
2. Information to establish a relationship between the production of human resources and the labor market.
3. Database about the technicians in the municipalities and universities related to the resource water and its management.
4. Data about critical areas or basins that could be used as a model for the management of other basins, and could help stop the advancement of the agricultural frontier.
5. Available information that could be incorporated in formal and informal education with emphasis on the care of the resource.
6. Information regarding the use of water in the territory that could be used as a basis to guarantee financial resources for the recuperation and conservation of the resource.

Group 3 – Vital Issue 3. Deficient Management of Water Resources as a Result of Inaccurate or Insufficient Information

Attempt to identify the requirements of information and assess if these requirements exist in the country, if they partially exist and if they are reliable. Later, determine the most important advantages that might be obtained once the information system is functioning properly with the required information.

As far as management is considered the same information is needed for good planning. Thus, many elements are already contemplated in the necessities of Vital Issue 1.

We established some information requirements that are fundamental so that the information system can work in a proper manner and can manage or administer the information system.

Proposed information needs:

1. Climate conditions.
2. Hydrogeological characteristics. Aquifer characteristics, such as transmissibility, exploitation capacities, etc.
3. Hydrology. Surface runoff, characteristics of the caudal of surface water, etc.
4. Socioeconomic. How many people live in the area and under what conditions they live. This will help to define the requirements the population makes upon the resource which depends a lot on the economic activity, economic characteristics.
5. Available volumes, demand.
6. Actual and potential use of soils.
7. Potential sources of contamination. Inventory of industries, agricultural activities and human settlements.
8. Water quality.
9. Feasibility of use. Availability does not always mean possible use.
10. Physiography. Topographic characteristics.

11. Epidemiology. Illnesses associated with the use of water in order to make decisions over future uses.

12. Planning. Existing planning.

Evaluation of Existing Information

The majority of this type of information is incomplete which makes it necessary to make interpolations in order to form prognostics. For this reason this type of information is not adequate for making decisions.

The advantages which would offer the system of information if it were functioning properly with the required information are as follows:

- It would help in making more certain decisions over the adequate use of water and therefore it would be possible to improve substantially the sanitary conditions of the population.
- Environmental studies would have a better possibility to make projections and diagnostics, which would help in taking more adequate environmental measures if the information is more precise, adequate and better systemized. For this reason it would be possible to evade negative impacts.
- It would allow optimizing the use of the resource.
- It would reduce the deficit in the trading balance.
- It would allow us to have available energy at less cost, which is a fundamental element to stimulate the industrial development and therefore the national development.
- As an educative tool.
- As a scientific reinforcement of the academic centers.

Discussion

- It is very important to include the time aspect for the climatic information.

It is also important to consider the advantages of the possibilities that offer designing appropriate models for the management of the water resources. It is possible to use models

with a memory for example of the last five years. For example the behavior of a reservoir considering all past levels.

Another advantage would be to have regulations and norms for the appropriate planning in the territory.

- A characterization of the basins of Nicaragua was elaborated with 15 different elements to categorize the value of the basins: surface area, flow data, tributaries, caudal, geographic area, connecting aquifers, population of the territory, potential of the water, potential use, additional resources (forest, tourism, soil, fauna), threats of contamination, special border characteristics, etc. The evaluation was included in a study called "The Characterization of the Operating Basins of Nicaragua." It is important to up date this type of evaluation in order to lay down priorities in planning and management of the basins. It is important to define priority areas for sustainable development.

  The next contributions were principally about the need to set priorities in the information, financial problems, the use of modeling, software for modeling and for organizing the information.

- In order to form a plan for the organization of a water basin, social-economic and physical information is needed. There are two types of information, one for planning and the other to control the results of monitoring (the level of potability and the level of possible use).
- The actual information is very dispersed and also the production of information is often repeated because it is not accessible, also it is sometime treated as a "national secret." The Central Bank is organizing a database in the National Library.
- The process of designing and developing an information system of the national water resources cannot be limited to only gathering knowledge and monitoring or the production of data but also should consider other important aspects such as availability, accessibility and have a special character that makes it accessible to everyone.

- There does not exist a center to collect and store the results of all the studies that are carried out by international or national organizations. It is necessary to create such a center to store results of this type of research, agreements, treaties and projects that deal with water resources.
- It should be recommended to include national and international agreements about water resources.
- He made the suggestion that CIRA/UNAN could help to organize a transinstitutional cooperation to set up such a system of information that includes all the necessities of information for the four vital issues elaborated in this panel.

Conclusions

The information needs for Vital Issue 3, *Deficient Management of Water Resources as a Result of Inaccurate or Insufficient Information,* are listed below.

1. Climate Conditions
2. Hydrogeological Characteristics
3. Hydrology
4. Socioeconomic
5. Available Volumes and Demand
6. Actual and Potential Use of Soils
7. Potential Sources of Contamination
8. Water Quality
9. Feasibility of Use
10. Physiography
11. Epidemiology
12. Planning
13. National and International Agreements about Water Resources

Group 4 – Vital Issue 4. Misuse and Contamination of Water Resources due to Insufficient Education of the Population

In this discussion, education should always be understood as the formation of citizens and not only as a formal concept.

The Objective of the Information System

It should allow the educative system, formal and informal, to have access to relevant information which can be used to educate citizens in the rational and efficient use of water resources, evade contamination of water, create values of conservation and communicate the relationship: water-health-environment among others.

Characteristics of the Information System

1. Public. Nonrestrictive access for all users.
2. Flexible. Coordinate sectors, groups of interest and levels of formation.
3. Efficacious. The system should be organized with the brevity specific to the case.
4. Participative. Groups and institutions can contribute information voluntarily.
5. Agile. Receive and give information in a rapid way.
6. Efficient (Resources-Cost). Use and maintain the existing information.
7. Collaborative. Be supported by all existed data of all institutions.
8. Systematic. Collects relevant information to regional phenomena which affects the water resource at a local level and vice versa.
9. Maintainable.
10. Secure.

Which kind of data and information should contribute to the information system?

1. Information, which helps visualize the deterioration of the water resource and its relationship to health, environment, economy and social aspects.
2. Indicators of efficiency related to the water resource (costs per patient, costs per cubic meter of drinking water).

3. Epidemiological studies related to water resources.
4. Successful experiences of good use of the water resource appropriate technology and citizen participation.
5. Results of the research of contamination of water and its consequences.
6. Laws, regulations, norms and results of related topics of the water resource.

Values and Opinions That Should be Promoted

1. Water is a natural resource:
   - Vulnerable.
   - Finite (scarce).
   - Valuable.
   - Essential for life.
2. Water is a social good, that has a value of use and an intrinsic value related to its quality, quantity, distribution, vulnerability and capacity to protect among others.
3. The cycle of water can be affected by human activity.
4. Some processes can contaminate water in a serious and irreversible way.
5. Water is life... when it is clean.
6. Water is death... when it is polluted. (contaminated.... use indicators)
7. There exists a concept of intergenerational justice relative to water.

The information system should provide:

1. Information to educate the people.
2. Annual bulletins about water resources.
3. Popular publications.
4. Information in the form of graphics, pictures, maps, etc. about the situation of the water resources.
5. Popular versions of laws and experiences of their application.

6. Alerts over transitory phenomena, which affect the resource, water and restrictions of use.
7. Tendencies, prognostics of phenomena, which affect the quality and quantity of water resources and its application on the local, regional level.

To whom is the information system directed and who are its users?

1. Formal system of education.
2. Health system.
3. Municipalities.
4. NGOs.
5. Journalists.
6. Religious sector.
7. Politics.
8. Private Sector.
9. Community.

Discussion

- The structuralization of a potential institution to organize the system should involve transinstitutional coordination.
- The universities should form values and in this case environmental values.
- Education was evaluated as the most important of all the four of vital issues. Environmental education is a transversal concept which covers all areas.
- The information system should include programs of environmental education of the universities and schools.

Conclusions

The information needs for Vital Issue 4, *Misuse and Contamination of Water Resources due to Insufficient Education of the Population,* are listed below:

1. Information, which helps visualize the deterioration of the water resource and its relationship to health, environment, economy and social aspects.
2. Indicators of efficiency related to the water resource (costs per patient, costs per cubic meter of drinking water).
3. Epidemiological studies related to water resources.
4. Successful experiences of good use of the water resource appropriate technology and citizen participation.
5. Results of the research of contamination of water and its consequences.
6. Laws, regulations, norms and results of related topics of the water resource.
7. Programs of environmental education of the universities and schools.

ATTACHMENT A

Vital Issues III Panelists
May 12 – 13, 1998

Government Sector

Licenciada Marina Stadthagen
Consejo Nacional de Desarrollo Sostenible (CONADES)
National Council of Sustainable Development
Tel. 2661701
Fax. 2667409

Ingeniero Roger Perez Elizondo
Ministerio del Ambiente y Recursos Naturales (MARENA)
Ministry of Environment and Natural Resources
Tel. 2632870
Fax. 2632620
ambiente@marena2.sdnnic.org.ni

Doctor Guillermo Selva
Asamblea Nacional Comisión de los Recursos Hídricos
National Parliament –Commission of Water Resources
Tel. 2282099
comision@asamblea.gob.ni

Academic Sector

Doctora Arlena de Franco
Universidad Centroamericana
Central American University
Tel. 2673638
Agropec@ns.uca.edu.ni

Ingeniero William Gámez M.
Universidad Nacional Agraria
National Agrarian University
Tel. 2669661

Ingeniero Juan Manuel Muñoz
Universidad Nacional de Ingenería
National Technical University
Programa de Investigación y Docencia en Medio Ambiente
Program for the Investigation and Education in Environmental Studies
Tel. 2781462
pidma@tmx.com.ni

Private Sector

Licenciado Freddy Cruz
Consultora Empresarial Centro Americano S.A. (CECSA)
Consulting Contractors of Central America S.A.
Tel. 2281213
Fax. 2281213
cecsa@nicarao.org.ni

Doctor Napoleon López
Consultor Privado, Universidad Nacional de Ingeniería (UNI)
Private Consultant, National University of Engineering
Tel. 088 32889
napo@ibw.com.ni

Ingeniero Javier López Medina
Ingeniería Caura
Engineers Caura
Tel. 2672850
Fax. 2672850
caura@nic.glom.com

Nongovernmental Governmental Organizations Sector

Doctor Jaime Incer Barquero
Fundación Nacional para el Desarrollo Nicaragüense (FUNDENIC)
National Foundation for Nicaraguan Development
Tel. 2781223
jincer@tigre.uam.edu.ni

Architecto Guillermo Perez
FORJEMOS
Tel. 2440830

Licenciado Victor Campos
Centro Humboldt
Center Humboldt
Tel. 2492903
humboldt@ibw.com.ni

DISTRIBUTION:

20 Salvador Montenegro Guillén
Telcor Villa Fontana Una Cuadra al Norte
Centro para la Investigación en Recursos Acuáticos de Nicaragua
Universidad Nacional Autonoma de Nicaragua
Managua, Nicaragua

1 Tech Reps, Inc.
Attn: Nancy Hetrick
5000 Marble Ave., NE
Albuquerque, NM 87110

1	MS-1049	Dan Hartley, 4000
1	MS-0185	David Goldheim, 4300
1	MS-1380	Dave Larson, 4301
1	MS-0449	Reynold Tamashiro, 6237
1	MS-0451	Ron Trellue, 6238
1	MS-0449	Ricardo Sarfaty, 6237
1	MS-0451	Sheila Nelson, 6238
1	MS-0103	Dennis Engi, 4303
20	MS-0159	Rita Simon, 4103
1	MS-9018	Central Technical Files, 8940-2
2	MS-0899	Technical Library, 4916
1	MS-0619	Review & Approval Desk, 15102 for DOE/OSTI