

Regional Programme for Environmental and Health Research in Central America

Göran Bengtsson

**Department for
Research Cooperation**

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Sida Evaluation 04/22

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Executive Summary

During the period 1991–97, Sida/SAREC supported postgraduate training in environmental and health research at Universidad Nacional (UNA) in Costa Rica. The support was extended until 2003, with the ambition to include more universities and more countries in Central America (CA). As a major achievement of the 8 million SEK invested in the training programme until 2003 by Sida/SAREC, a research institute, Central American Institute for Studies on Toxic Substances (IRET), was established and equipped with scientific know-how inoculated by supervisors at the Karolinska Institute, the Institute for Working Life, Stockholm University, and the Agricultural University in Uppsala. The project output was two PhD's, who are in charge of the environment and health sections at IRET, some MSc's, a number of postgraduate training courses, on Master's level or higher, in ecotoxicology, environmental chemistry, and environmental and occupational health, and new insights into environmental and health problems caused by pesticides usage in Central America.

The grant approved for 2003 was for a so-called bridging phase towards a new programme for building capacity on environmental and health research in CA. One of the main issues for the bridging phase was the development of a ten-year regional programme for building a research capacity, in cooperation with 15 CA universities and 5 Swedish counterparts. Before making a decision on an expansion of the programme, Sida/SAREC decided to ask for an external evaluation of the activities in 1999–2002 and of the bridging phase in 2003.

This report contains an evaluation of the past project, a survey of the conditions to build research capacity at the national universities in CA, a discussion of the conditions in general that should be considered for a new regional programme, and suggested organisation and build up function of a new regional programme on environment and health issues.

The objectives and organisation of the proposal for the period 1999–2002 are reviewed and found to differ from those in proposals submitted to other national or international research councils in that less emphasis was given to the theoretical backbone of addressed problems, to a detailed resolution of the scientific methodology, and in that the conceptual ideas were short of focus.

The bridging phase proposal was omitted from evaluation because no activity report was at hand.

I compared the achievements, as they were presented in the activity report, with the plans in the proposal for 1999–2001 as one of the criteria of reviewing an extension of the activities. Many of the research studies were not published in international refereed journals, some were printed as local university reports, and some studies were still in the data collection process or in the process of evaluation. More of the studies may have been carried to scientific publication if the research plans had been more focused, theoretically based and justified, and associated with a more clear division of responsibility among participants. The regional courses were successful and a larger number than granted were arranged.

The potential for building a research capacity in CA depends on the present conditions for teaching and research, the state support achieved, and the strategies for development expressed by university authorities. I tried to collect some of that information by questionnaires and interviews at six CA universities and two Swedish counterparts.

The success or failure of a regional programme depends on the available resources, such as teachers, their age and academic training, the undergraduate curriculum, the university infrastructure, and the financial support. The incorporation of a regional dimension in a research-building programme is

probably the largest challenge. A regional programme may be designed such that the regional dimension amplifies the training impact and takes a regional programme faster to symmetry of research capacity.

Based on a) the results of the evaluation of the past bilateral programme, b) the analysis of the current circumstances for undergraduate and postgraduate training and research at the regional universities, and 3) the general conditions for building a research capacity in the region, I suggest a carefully controlled and stepwise build up of a regional programme. The message from the reviewed universities is in unison, unequivocal and with emphasis: we need this research training, and we want it. I suggest some cornerstones of a build up of a regional research-training programme and pay special attention to the Regionalisation, Management, Timing of programme activities and Tools for sustainability of a programme.

A regional CA programme needs a strong, encouraging, just, and efficient manager or management function. A manager must attend a training school including a mentor function, which SAREC must initiate, to become a manager. The regional programme is assumed to undergo three main phases of training activity: one in which bridges are built between the present qualifications of graduate students in CA and what is required of candidates for entrance to postgraduate training at a Swedish university. A second phase would be the professional training activities, and a third phase would be another bridging phase, to prepare the students for their future as researching teachers, competing for research grants and providing expert services to society, and also for a later future outside of university. The specific activities and the transition between them would need steering from a programme council and its manager.

To ensure sustainability of the investment into a programme, I suggest a number of activities under the headings Communication, Regular workshops, Activity carrots, Conditions and responsibilities, Cooperation with other programmes, and a Regional research council.

Table of Contents

1. Background for evaluation	5
2. Objectives	5
3. Methodology	6
4. Limitations	8
5. Basis for a regional research-training programme	9
5.1 Environmental and health problems in Central America (CA)	9
5.2 Past SAREC supported research	9
6. Evaluation of the environmental and health research programme in 1999–2001	10
6.1 Specific objectives	10
6.2 Organisation of proposal	13
6.2.1 Data compilation	13
6.2.2 Health	13
6.2.3 Environment	14
6.2.4 Organization of regional courses, Research training	14
6.2.5 General comments	14
6.3 Achievements	15
6.4 General Comments	17
7. Bridging phase	19
8. Resources and activity priorities at CA universities	19
8.1 Universidad Nacional Autónoma de Honduras (UNAH)	19
8.2 Universidad Nacional Autónoma de Nicaragua-UNAN-Leon	22
8.3 Universidad Nacional – UNA-Heredia	25
8.4 Universidad de El Salvador – UES – San Salvador	28
8.5 Universidad Nacional Autónoma de Nicaragua – UNAN-Managua	29
8.6 Universidad de San Carlos de Guatemala – USAC	31
8.7 Department of Systems Ecology, Stockholm University (SU)	32
8.8 National Institute of Public Health – NIPH	33
9. General comments	
– conditions for building a regional research capacity	36
9.1 Resources	36
9.1.1 Teachers – age distribution, degrees, capacities	36
9.1.2 Undergraduate training – efficiency, direction, sustainability	36
9.1.3 University infrastructure	37
9.1.4 Financial support	37
9.2 Interest in capacity building – teachers, decision-makers, users of knowledge	38
9.3 Cultural tradition and language	39
9.4 Need	39
9.5 Regional dimension	39

10. Recommendations	40
10.1 Regionalisation	41
10.2 Management	42
10.3 Timing of programme activities	42
10.3.1 Research school	43
10.3.2 English training	43
10.3.3 Courses	44
10.3.4 New equipment	44
10.3.5 Research based teaching	44
10.3.6 User-friendly projects	45
10.3.7 PhD training	45
10.3.8 Proposal training	46
10.4 Tools for sustainability of a programme	46
10.4.1 Communication	46
10.4.2 Regular workshops	47
10.4.3 Activity carrots	47
10.4.4 Conditions of responsibilities	47
10.4.5 Cooperation with other programmes	48
10.4.6 Regional research council	48
10.5 Concluding recommendations	48
11. References	49
12. Appendices	50

1. Background for evaluation

A decision by the Swedish government in 1989 was the formal starting point for an expansion of the bilateral aid to Costa Rica, by which its democratic development and role as peace maker in Central America (CA) was recognised. As a spin off of the decision, Sida/SAREC in 1991 gave support to a project on health effects of pesticides. Pesticides have been used in CA since the 1950's, and pesticides that are banned or restricted in industrialised countries are still among the most used in CA. The Sida/SAREC support included Programa Plaguicidas (PPUNA), a unit within Universidad Nacional (UNA), Heredia, the Institute for working life and the Institute of Environmental Medicine at the Karolinska Institute, Stockholm and was 0.5 million SEK per year in the period 1991–97. A postgraduate student was affiliated with the project from the beginning and defended her PhD thesis in 1997. The thesis used an epidemiological approach to describe health effects of pesticides and contained a documentation of chronic neurological impact of pesticides on workers in banana plantations.

The Department of Systems Ecology, Stockholm University, joined the project in 1993 and approved another UNA student as a PhD candidate. When the bilateral project came to an end in 1997, Sida/SAREC decided to continue to build up a research capacity on environment and health issues at UNA but expand the bilateral project into a three-year regional programme on research and research training, starting in 1999 and with a yearly budget on 1.1–1.3 million SEK. Sida/SAREC noticed that, although the research capacity at UNA, and more generally in Costa Rica, was reasonably good, some problems, such as the limited accuracy of the national cancer registry and the long-term environmental effects of pesticides, remained to be analysed by a scientific approach. The second UNA student defended her thesis on pesticide impact of banana production on aquatic ecosystems in 2000, and meanwhile, PPUNA had become a research institute, Central American Institute for Studies on Toxic Substances (IRET), within UNA. Some of the proposed programme activities were not carried out until 2001, and the programme was extended until 2002.

A new grant, 1.6 million SEK, was approved in 2003 for a so-called bridging phase towards a new programme for building capacity on environmental and health research in CA. The proposal asked for support of on-going activities, such as preparation of manuscripts from studies in the previous period, and new activities, such as planning of the regionalisation of the Master's programme in occupational health and a regional Master's programme in tropical ecotoxicology. One of the main issues for the bridging phase was the development of a ten-year regional programme for building a research capacity, in cooperation with 15 CA universities and 5 Swedish counterparts. Before making a decision on an expansion of the programme, Sida/SAREC decided to ask for an external evaluation of the activities in 1999–2002 and of the bridging phase in 2003.

2. Objectives

The main objective of the evaluation, according to the Terms Of Reference (Appendix 7), was to assess to what extent the objectives of the programme of 1999–2002 and of 2003 have been fulfilled. The main objective was combined with a number of specific objectives, viz. evaluate:

- the relevance and impact of the programme on the region and the individual country regarding poverty reduction, human rights, environmentally sustainable development, and gender equality;

- the interaction and exchange between the countries in the regions as well as with the Swedish counterparts;
- the quality of the achieved reports and publications (within his area of expertise), as well as the possibilities to finish up and preparing for further scientific reports;
- the possibilities for former students to continue and utilize their knowledge in further work and new positions;
- the ability of the programme to organize, manage and expand the programme;
- the cost-effectiveness of the programme and how much of the achievements could be attributed to Sida support. Present and future alternative funding sources shall also be discussed, as well as the financial management of funds with specific reference to the system of disbursements within the programme in a future perspective.

Finally, the evaluation shall advise Sida/SAREC if continued support to the programme is recommendable and if so, on what level of programme activity.

3. Methodology

The evaluation was focused on two sources of information. The first source was the documentation (project plans, activity reports) from the bilateral research and research training programme “Environmental and health research in Central America” in 1999–2001 and extended as a bridging phase in 2003. The second source was discussions in December 2003 with representatives for some selected CA universities and with two of their Swedish counterparts, and responses to questionnaires associated to the discussions. The first source was used to “...evaluate to what extent the objectives of the programme were fulfilled... and the quality of the achieved reports and publications...”, as specified in the assignment, and the second source to “...evaluate the interaction and exchange between the countries in the region...” and “...evaluate the ability of the programme to organize, manage and expand the programme.” My interpretation of the information collected and evaluated from the sources is expressed in a section on “General comments – conditions for building a regional research capacity” and in Recommendations.

The information from the first source was obtained from the proposals and activity reports listed in References. I was also reading the two PhD theses from the programme and the papers published in international refereed journals. Although the assignment may be interpreted such that individual publications were expected to be evaluated, I considered that to be beyond the point where an evaluation becomes more destructive than constructive. Whence, I acknowledged publication in an international refereed journal as the highest quality criteria of a research training process, regardless of the scientific quality of the publication. The bilateral programme support started ten years earlier but was not included in the assignment. Still, I used some limited data from that period in my evaluation of the activities after 1998. In December 2003 I had a short discussion in Heredia, Costa Rica, with the two PhD's that were responsible for the programme activities, Luisa Castillo and Catharina Wesseling, to get explanations and comments to my observations from reading the documentation. Two of the Swedish counterparts, the National Institute of Public Health in Stockholm and Department of System Ecology, Stockholm University, were also used as sources of information about the bilateral programme. I discussed the experiences of the supervision of environmental issues with Nils Kautsky and Michael

Tedengren in December 2003 and the experiences of health related issues with Christer Hogstedt in June 2004.

The information from the second source was obtained in three ways. The first way was by short visits to selected universities and faculties. The schedule for the visits is given in Appendix 8. The selection was primarily based on a list of e-mail contacts kindly provided by Luisa Castillo. The same list was, with minor modifications, used by her to come in contact with university representatives that might be interested in joining a regional programme. It turned out that a certain number of the e-mail addresses were wrong or could not be contacted for other reasons. I managed to come in contact with some of them by phone, but others did not respond on the phone. The e-mail list was completed with addresses to the rectors of the universities. Some of them responded very kindly to inquiries for a meeting, others not. Luisa Castillo finally came in contact with some additional representatives so that I could arrange my roundtrip, although in some cases I did not know in advance where I was going to stay, with whom I was going to meet, or at what time.

The visits were more or less informative. It turned out that in some cases, such as with USAC and UES, I met with only one of several groups or faculties oriented towards environment and health issues. In other cases, such as with UNAH, I met a large number of teachers, deans, and most, perhaps all, of the groups engaged in the issues. In some cases, such as with UNAH, the teaching and research facilities were demonstrated to me, but in others I did not even visit the university, such as with UES, since it was occupied by the students. I discussed the environment and health issues with the dean of chemistry and pharmacy at the same hotel as the rectors from Latin American universities had a meeting. I noticed that I was not offered to visit IRET, although that was the target of my evaluation.

A questionnaire about the conditions for building research capacity at the individual universities was sent out to 32 e-mail addresses (Appendix 9) prior to the visits. Only USAC and UNAH (four addresses) returned the questionnaire around the deadline. Later I received filled out questionnaires from UES and UNAN-Managua (an impressively detailed documentation). I edited most of the questionnaire responses, included them as Appendices, and used the information in them in my comments to the discussions with university representatives.

Those that were contacted and responded to the inquiries about discussions received one more questionnaire, specifying the general questions that I was going to address during the discussions (Appendix 10). All of the discussion participants (Appendix 11) seemed prepared for the questions. It became obvious, however, that no one outside of UNA knew anything about the plans for a regional capacity building programme, and some even thought that I was going to present the programme plans. The comments to and expectations on the programme plans were then given in a general context.

Additional contacts were made at a two-day workshop in Heredia in December 2003, when representatives for most of the state universities discussed plans for a regional programme. I was promised to get additional questionnaires filled out, some were turned in but others are still missing.

The results of the discussions at each university are summarised in this report in one-some few pages. The drafts of the summaries were sent to representatives for those that participated in the discussions, with inquiries to make corrections and additions. The two Swedish counterparts responded promptly, within a couple of days, with suggestions for improvements and comments. The only return mail from CA universities came from IRET, which added more detailed information that I placed as Appendix 5. I have made comments to the discussion results and to the answers in the questionnaires for each university, trying to emphasise the local conditions for building a research capacity with a SAREC programme.

4. Limitations

First, the evaluation is limited to the activities granted for 1999–2002. I have not received any activity report for the bridging phase grant in 2003 and decided to omit that programme period from the evaluation. This is obviously a violation of part of the main objective, but it seems redundant to pay attention to something for which there is no documentation. To compensate, I made an extensive discussion about the conditions for a regional programme and potential activities in a programme, none of which was mentioned as objectives for evaluation in the TOR. In my opinion, a discussion about the circumstances for a future regional programme would be a more valuable contribution to the evaluation process than a critical examination of what was not done during the last year.

Second, the survey of the conditions for building environment and health research capacity at the CA universities is not meant to be exhaustive but represents a sample of the population of conditions that I hope is reasonably representative. The number of interviews was limited by the list of contact persons I was provided, the responses to the questionnaires were erratic, the site visits were highly variable in information density, the written documentation offered at each university varied in quantity and quality, etc. Moreover, a thorough examination of the conditions for research building at a university requires active participation in the daily routines for a month or so, and that depth of analysis was not the purpose of the survey.

Third, the evaluation has been limited by the conditions under which other information than the one stored at Sida/SAREC could be achieved. All persons interviewed have been very kind and generous in discussion meetings, but many have been notoriously difficult to communicate with at e-mail distance and to get supplementary information. Many of us know, perhaps even enjoy and understand, this behaviour from past experience, but it is still fascinating that persons that are evaluated or considered for research grants are so reluctant to provide requested information.

Fourth, the evaluation of “the possibilities for former students to continue and utilize their knowledge in further work and new positions” was limited to the two students that received their PhD’s within the programme. I made some inquiries about the students that attended the distant learning programme on environmental and occupational health but they were either not known by the university contact persons or the same persons forgot to make the arrangements for interviews.

Fifth, I was unable to address the objective “the relevance and impact of the programme on the region and the individual country regarding poverty reduction, human rights, environmentally sustainable development, and gender equality”. I spent some hours thinking on it, preparing evaluation criteria, and reading some documents from other parts of the world about the phenomena. Then I realised how difficult it would be to find the reliable sources of information in CA. The impact of a research programme on e.g. poverty reduction in a country sounds like a long-term research project by itself and not amenable for analysis in a four year programme on building research capacity in Costa Rica and in CA.

5. Basis for a regional research-training programme

5.1 Environmental and health problems in Central America (CA)

Many surface waters in CA are highly polluted with domestic waste, urban and agricultural runoff, and industrial waste. Urban areas are rapidly expanding, causing air, water, and soil pollution, among other things, and rural areas are deforested and occupied for cultivation and grazing. Only small areas of natural resources are set aside and protected against exploitation. It has often been claimed that people in the region do not have the expertise, the resources, or the political courage to prioritise environmental and health management.

Groundwater was long recognized as a pristine resource in industrialized areas of the world since it is protected from pollution by thick layers of soil and rock. However, numerous cases demonstrate that pollutants move even to deep aquifers and once contaminated, they are almost impossible to clean up. Groundwater is the main source of potable and crop irrigation water in CA, and its importance is likely to increase in the next few decades as the quality of surface water continues to degrade. So far, relatively few groundwater contamination cases have been documented in CA, but unless protective actions are taken, many more are likely to be detected in the near future.

Environmental and health issues in CA are characterized by a lack of qualified personnel and a need for more training opportunities. The width of the problems requires multi-disciplinary collaboration among scientists, officials, policy makers, and local communities. It may sound like a dream, and may be so, but small steps can be taken to demonstrate the power of collaboration. Universities would be one appropriate source of collaboration, through multi-disciplinary undergraduate training programmes and research priorities.

5.2 Past SAREC supported research

The present plans for regional research cooperation are products of a bilateral programme between Sweden and Costa Rica, originating in 1989 and extended and expanded a number of times during the past 15 years. The birth of the programme coincided with an intense period of peacemaking efforts in CA supervised by Costa Rica. Civil wars were deteriorating El Salvador, Nicaragua, and Guatemala, and the US military infiltration continued to increase in Honduras. The bilateral programme was assumed to draw attention to the unusual political development and activity in Costa Rica and to strengthening the scientific expertise on health effects of pesticides. Environmental aspects on pesticide use were included in the programme in 1994. The programme was expanded in 1997 when Master's level courses were developed, intended for students from Guatemala, Honduras, El Salvador, Nicaragua, Costa Rica, and Panama. The same programme purpose and structure has been maintained throughout a couple of extensions until year 2003.

The original counterparts of the bilateral programme were the Pesticide programme of UniverSidad Nacional (UNA) in Heredia, CR, the National Institute for Working Life, the Institute of Environmental Medicine at the Karolinska Institute in Stockholm, and Department of Environmental Assessment, Swedish University of Agricultural Sciences (SLU) in Uppsala. The Department for Systems Ecology at Stockholm University joined the programme in 1994 as a counterpart for the environmental science training. The support was used to develop two areas of competence at UNA, one on the epidemiology of pesticides and another on the ecotoxicology, by postgraduate training of two students who defended their PhD theses in 1997 and 2000. The training programme was also helpful in upgrading the Pesti-

cide programme at UNA to a more permanent and formally acknowledged research institute at the university. The latter was mainly the combined result of the SAREC support of research training and a persistent and persuasive work by the two PhD candidates. They were also leading in organizing an international conference on pesticide use in developing countries in 1998.

A number of other organisations, such as the Pan American Health Organisation, the German Technical cooperation Agency, and the Canadian CIDA were also involved in the build-up of the research capacity at IRET. Environmental toxicology and health developed during this period as a strong multidisciplinary discipline at UNA, with research and training links to other CA universities, and has helped to recognize environmental pollution as a major issue in the development of the country. The impact factor of the training programme was also evident on the publication list for IRET. During the period 1991–98, there were five publications in international refereed journals, each of them with one of the PhD candidates as a co-author. The official duration of the PhD training was six years for each student. This is a remarkably good performance, given the circumstances, with a modest support (2.9 million SEK during 1991–97, i.e., 0.5 million per year), logistic and administrative problems associated with working at CA universities, and the challenges of adjusting the students to the Swedish training system.

6. Evaluation of the environmental and health research programme in 1999–2001

The bilateral programme came to an end in fiscal year 1997, but SAREC was prepared to support a continuation of postgraduate training in environmental and health sciences within a regional dimension. A new research proposal was prepared for the period 1999–2001 and approved by SAREC in late 1998, with essentially the same budget (3.6 MSEK) as requested. A so-called bridging phase proposal was prepared in late 2002 to give the programme participants an opportunity to further develop the regional links. The proposal was approved in early 2003.

The proposal approved by SAREC in 1998 had six specific objectives and five different activities, which were supposedly addressing the objectives.

6.1 Specific objectives

- Promote health and environmental science research in Central America on consequences of pesticide use and create new knowledge in the fields.

This seems to be a broad and general objective, especially the latter part of it, but the first part is more serious and limited by a set of keywords:

Health and environmental science research – Central America – consequence – pesticide.

Health and environmental science research was clearly addressed, but separated, in two of the five activities. The suggested research activities had a strong applied flavour – “...evaluate...surveillance systems...”, “...compare the biodiversity of relevant fauna groups...”, “...toxicity testing systems is developed using native species...” – that should open for some mutual activities of health and environmental research. Multidisciplinary approaches are met with considerable difficulties in most countries and under most conditions, so it was of no surprise to find that a majority of the activities had either a health

or environmental appeal but not the two combined. However, some of the activities, such as the watershed approach and the banana plantation survey, could have been developed into joint efforts. I could not find any consideration of potential cooperation between health and environmental science researchers in SAREC's internal evaluation of the proposal prior to decision. One would think that efforts to promote research cooperation are helpful in the development of policies and management principles for pesticides in Central America, and that multidisciplinary promises to hold a niche within which research on environmental and health issues could establish its own internationally recognized strength. For instance, activities such as biomarker expression, parasitism-toxicity interaction, bioconcentration, and risk assessment share much of the same methodology and conceptual basis regardless of whether humans or other species are considered.

The Central American flavour of the proposal was limited. Most of the research activities were planned to use data, study areas, and facilities in Costa Rica but one activity, viz. the collection of data from surveillance systems, was suggested to include databases in Nicaragua and Guatemala. The work was obviously going to be made by personnel from Costa Rica, but "...suitable research groups..." in the other countries identified and encouraged to learn to use surveillance data by participating in the research training courses. Similarly, the watershed approach, which was intended for a Costa Rican river drainage basin, was suggested to be evaluated also "...in at least two other Central American countries." SAREC's evaluation prior to decision on support makes no comments about the invisibility of the upgrading of the research of the bilateral programme to a Central American affair. A clear definition of the ways in which the Central American extension of the bilateral programme would be achieved, in this case specifically with respect to research activities, may have helped to make the CA perspective transparent.

The keyword "consequences" implies that effects of pesticides are addressed. This was obviously true for some of the environmental science research activities, such as those on biodiversity, the ecological-economic evaluation, and the susceptibility-toxicity projects. However, the watershed activity had a number of exposure related projects, such as on the predictive exposure model development of something unknown and on bioavailability and bioaccumulation kinetics. And precisely what kind of data was to be considered in the surveillance systems for public health was impossible to extract from the proposal. But it seems to me that the keyword "consequences" makes the scope of the proposal too narrow. The final keyword, pesticides, was used in the project descriptions without exceptions.

- To initiate research in new areas: economic consequences of pesticide use, health risk management related to pesticides, and health and environmental impact of toxic substances other than pesticides.

The proposal was not very informative on the justifications for this objective, which implies a considerable expansion of the scope of the programme. It was not clear 1) what university and what person(s) in CA that had the capability to perform the suggested activities, 2) how the programme would manage the expansion, 3) how the research training would be organised, 4) what specific financial support that was allocated to the expansion, 5) what research problems were to be addressed. One would expect strong arguments for the expansion since the applying institute had just establish itself with two new PhDs. An obvious alternative would be efforts to consolidate the expertise of the institute within the areas in which the PhDs were trained.

I was unable to find any description in the proposal related to research on health risk management (what scientific problems, which approaches, what methodology, etc), or any specification of other groups of substances than pesticides (why they would be included, what new problems they would introduce, what scientific problems they would be used to address, etc). The plans to perform an ecological-economic evaluation of pesticide use were presented in a separate section of the proposal, but the

plans were so loose that it was impossible to understand what problems would be addressed and with what methodology. The proposed activities were described in two sentences: “Based on actual data from our earlier studies and literature reviews we will make an ecological-economic valuation of pesticide use in banana plantations. As a comparison we will make a parallel evaluation of an organic alternative where no pesticides are used.” The short description gives the impression that this expansion of the programme was intended to be geographically limited to Costa Rica, since the data would be extracted from work in banana plantations that were used to support cancer analyses among workers.

SAREC supported the expansion plans without any word of hesitation, but the plans were not justified within the context of building research capacity, the descriptions were loose, and the budget and the CA dimension were invisible.

- To initiate regional teaching courses and research training programs.

Two groups of training courses were suggested, one based on a distant learning methodology, and the other on laboratory and field exercises associated with the IRET facilities. The first group of courses were explained and motivated in great detail and with obvious enthusiasm. The methodology was developed by one of the Swedish counterparts (NIWL) and would, at least theoretically, be applicable to conditions of training students at a variety of CA universities. The latter group of courses were simply listed, but it appears that only two (aquatic ecotoxicology, occupational and environmental epidemiology) of the listed five courses were included in the budget. The budget for the courses was difficult to understand. The cost of the distant learning training of 15 students was estimated to a total of 300 000 SEK. The cost of the second group of courses was estimated to a total of 400.000 SEK for 3–4 students per year. It seems like this may simply have been a miscalculation, since between 14 and 25 students attended the courses. They were thus reasonably cheap, but the teaching costs (salaries to teachers from Sweden and Netherlands) were not specified in the budget.

This objective had a genuine CA perspective.

- To develop proper methodologies, applicable in other developing countries.

This objective was vaguely introduced (what is “proper methodologies”?) but I found some activities in the application in which the objective was mentioned:

- development of methodologies to collect data from various sources on the use of pesticides for different crops;
- implementation of a predictive, water-shed based exposure model for pesticides in drainage basins at the Costa Rican borders;
- development of toxicity test systems for native CA species;
- evaluation of methodology to compare community structure of relevant fauna groups exposed to pesticides.

The first of the cases was sufficiently explicit in presentation to be understood, but similar methodologies, used in other parts of the world, were not mentioned or discussed to demonstrate what steps were taken forward. The descriptions of the other three cases were too brief to be understood and evaluated.

- To maintain relations with international groups to support high quality research and training, and more specifically, to create a Central American network in the fields of the health and environmental impact of pesticide use.

I did not find any explicit implementation of this objective but lists of the cooperating institutions in CA and Sweden.

- To invest in the training of human resources at IRET.

As part of a more long-term mission to set up a Master's programme in health and environmental sciences, IRET asked for support to train two students in Stockholm to a philosophy of licentiate (PhL) level and one in Mexico to the MSc level. Supposedly, the students were to become teachers within the Master's programme. I was unable to locate this specific funding request in the budget, but SAREC's decision was to give it a "lower priority", whatever that meant. The argument for that decision, as well as the one to limit the number of supported participants from Costa Rica and Panama in regional activities to one third of the total number, is interesting. Those two countries have proven to have the most developed research capacity in the region, and SAREC's experience of worldwide regional programmes is that the most developed partners gain most profit from programme activities. With the development of a research capacity will also follow a capacity to use national or other international financial agencies as a major or complementary funding source for regional activities.

Another argument would be that continuous support of the build-up of specific IRET research capacity might not be the most efficient step towards a regionalisation of the programme.

6.2 Organisation of proposal

The proposal was organised in five components: Compilation of background information, Health, Environment, Organisation of regional courses, and Research training for IRET researchers. The Health and Environment components were subdivided in several activities. I make some brief and general comments about the organisation and content of the proposal in the following.

6.2.1 Data compilation

Data are obviously necessary for most research and have to be generated, collected, extracted, etc in different ways. Compilation and organisation of data in databases is not a research activity per se but sometimes part of a methodology. The data compilation in this case was justified with reference to the help in identifying priority pesticides, areas and populations with high risks, and to guide environmental and biological monitoring activities. The justification and connection to research activities was certainly loose (how will registration data guide environmental and biological monitoring activities?), and it would be better to describe data collection in detail as an activity associated with a specific research problem. This was indeed done in the Health component, as part of the surveillance based research, and it seems as if the Compilation of background information component should have been integrated as part of the research activities.

6.2.2 Health

The Health component had three activities: evaluation of surveillance systems on health effects of pesticides, regional training programme, and long-term health effects. The first activity overlapped in scope with the Data compilation component but had a more interesting challenge. Data collection in CA certainly has a number of limitations but one mostly overlooked is the improper and insufficient interpretation and communication to those who collected and provided the data. The ideas for regional training activity were well and convincingly presented but might have been more logical as an activity in the Organisation of regional courses component. The idea to use a cohort study of cancer among banana plantation workers in Costa Rica as a starting point for research on long-term health effects seems ingenious. As with most of the other activity descriptions, I lacked a clear definition of the objectives for the activity and explicit working hypotheses. Statements such as "The results will increase the knowledge of human toxicity of pesticides" are indicative of the lack of focus of a study. It is

far easier to accomplish a scientific work that has specific delimited hypotheses than one with a very general approach. I noticed that a very modest support, mainly for travelling and technical assistance, was requested for the research activities. It is not clear from the description which researchers and post-graduate students were to be engaged.

6.2.3 Environment

This component also had three activities; watershed approach, study on the biodiversity of wildlife and aquatic organisms in different agricultural management systems, and ecological-economic evaluation of pesticide use. The first two activities were subdivided into a number of projects, each of which was briefly introduced, mainly as working ideas. It seems attractive to consider pesticide effects on a watershed basis, especially when environmental and health effects are compared, but it is a demanding approach that may need cooperation by a number of disciplines. The proposal did not give any conceptual work plan on the watershed research, and it is unclear from the description what specifically would be achieved with the watershed modelling, what it meant, and how it was performed, except the general statement that it would “aim at identifying and reducing risks before detrimental effects on ecosystem functions and organisms from pesticide use arise.” The biodiversity activity was divided into two projects, one oriented towards evaluation of a methodology to use benthic macroinvertebrates to assess pesticide effects, and the other to compare biodiversity of amphibians, birds, and soil organisms. It seems as if the main purpose was to add experience of using taxonomy in biomonitoring to more students and staff members in CA rather than making a contribution to research on biodiversity or ecotoxicology. The use of species diversity or community structure as an endpoint in ecotoxicology has a great appeal for practical purposes but is associated with many problems of interpretation – specificity, resolution, sensitivity, accuracy, etc.

6.2.4 Organization of regional courses, Research training

These components were reviewed as part of the objectives.

6.2.5 General comments

I found three major differences in content between this proposal and those normally submitted to Swedish, European, or other international research councils:

- the role of scientific theory
The projects plans were described with virtually no background on the scientific status of the problem addressed, no hypotheses to challenge current trends or understanding in science, and without scientific justifications for the suggested projects. Most of the justifications were for site-specific conditions, that is, surveys on local-level exposure and impacts. It is obvious that research to be carried out in CA must have a local justification to support policy makers with knowledge to solve problems, but it is difficult to understand why the research must be cleared of references to current international research. As part of the research training, the Swedish partners of a programme should review proposal drafts as if they were intended for a Swedish research council, and SAREC should prepare instructions for proposal preparation to such a detailed level that external reviewers could use them as guidelines for their evaluation.
- the degree of scientific methodology and precision
The methodological resolution and wealth of details was mostly poor, such that the feasibility of a project was difficult to evaluate. Again, as part of research training, it is recommended that applications be carefully reviewed to bring the level of methodology to a point where pitfalls and challenges of data collection and model development are addressed. This is not the same as to ask for detailed method descriptions, which is redundant in a proposal.

- the extent of conceptual focus

A normal grant proposal benefits from a strong focus, to allow in-depth analyses. A programme, like the one supporting the research activities in CA, may have a broader but still cohesive scope because more people are involved to solve the problems. However, that does not mean that the focus must be lost and replaced by diversified appetizers. It is easy to understand the ambitions to attract SAREC with a broad programme that promises to develop a great number of skills and expertises, but somewhere on the road, the Swedish counterparts or SAREC's reviewers should have slowed down to limit the diversity of projects and encouraged a better focus. I realize that it is debatable whether a research-training proposal for CA should apply to the same quality criteria as an international research proposal since training is a process in which ambiguities are allowed and since the proposal must be harmonized with needs and priorities at the CA universities. But if the benefits of focus are diluted by brightness of diversity, one has to demonstrate that manpower resources are placed side by side with diversity.

6.3 Achievements

The proposal was granted in September 1998. An activity report, dated August 2001, was handed over to SAREC in October 2001. The cover page specifies the reported period to year 2000–2001, although support was granted for year 1999–2001, but no other report has been available. I have compared the achievements, as they are presented in the activity report, with the plans in the proposal as one of the criteria of reviewing an extension of the activities. One straightforward way of comparison is by promised and prepared reports, since research activities normally remain unauthorized until they are reported in international refereed journals. While preparing for the authorization, one may have the activities reviewed at international meetings. Research supported by SAREC should also be reported, in one or the other way, in local media in other formats than the international journals, preferably after international publication and with copyright holder permission. Other ways of comparison are by number of graduations, number of courses, impact on university, impact on society, competence of students and teachers, etc. Some of these, such as the impact of the research on the competence of the participants, are sophisticated parameters that were not possible to include in the evaluation.

Table 1 lists the promised reports and courses and compare them with those that were delivered.

The general impression is that more research products were promised than returned from the investment. Many of the studies were not taken to the stage where scientific analyses were made, some were printed as local university reports rather than in scientific publications, and some studies were still in the data collection process or in the process of evaluation when the activity report for the granted period was submitted. An outstanding exception was the research, chaired by Catharina Wesseling, on environmental health associated with surveillance systems from which a number of reports were delivered, in some cases even more qualified than promised. Wesseling is impressively productive in the scientific literature. I counted 18 papers in international journals since 2000, with her as one of several coauthors, of which 5 papers so far were from the last two years.

The collection of data on import and registration of pesticides in CA was said to be finished without major problems, whereas data on the use of pesticides in major crops were still collected. Collection of data from various sources for a common database is often refrained by limitations, e.g. because the data were not originally intended to be used in database comparisons or not collected such that they would fulfil conditions for use in modelling. Therefore, the delays of this activity were not surprising. It is more surprising and doubtful that pure data collection and compilation were supported by a SAREC grant. Pure data collection is not a research activity, and it seems to me that the organisation of databases on the use of pesticides in various crops would be more of concern for Sida than for SAREC.

Alternatively, data collections could be organised as part of a research objective, but that was not the case for the activity in CA.

The many shortcomings and errors of databases were evident from the reports on the efforts to analyse the cancer and mortality effects of pesticides on banana workers.

The refinement of the data analyses and the re-evaluation of previous observations is a nice example of a critical approach to data quality. The activity report is clearly explicit on the problems faced during the work on surveillance systems, especially in the cooperation with Plagsalud, and one would think that SAREC responded to these calls for concern by initiatives to promote the cooperation. That seems not to be the case.

The research activities on the watershed modelling, biodiversity, and ecological economy were obviously more premature than those on health and none of the activities ended up in an international refereed journal. Two MFS reports were the output of educational efforts. This was a nice example on concerted actions of Sida and SAREC supported activities and one could even imagine the advantages of associating specific MFS scholarships to a SAREC supported programme.

Although the distant research-training programme was not successful in delivering the anticipated reports, it was organised and supervised with great engagement and ingenuity. The meticulous description in the activity report of problems and challenges of the training programme is interesting and demonstrates many of the potential hang-ups of distant research training in CA. It seems as if this activity consumed much supervisor fuel. However, it must also have been rich in learning, and I suggest that the supervisors are asked to summarize their experience and suggestions for improvements of distant research training, as an extension of the summary in Int. J. Occup. Environ. Health in 2001.

Table 1.			
Programme component/activity	Proposed report/course subject	Delivered report/course subject	Comments
Compilation of background information	Database on pesticide registration	None	Said to be in process
	Database on pesticide use per crop	None	Said to be in process
	Regional scientific journals: various aspects of pesticide use	None	3 local university reports, 2 at UNA and 1 at UCA, El Salvador
	International journal: integrating database analyses	None	
Evaluation of surveillance systems	2 technical reports/country, 1 summarizing international report	1 draft manuscript for 2 of 3 countries, 1 in press paper (Int J Occup Environ Health)	
Promotion of surveillance based research	1-2 in regional journals	2 in international journals (Int J Occup Environ Health), 1 MSc thesis	
Cancer and mortality among banana plantation workers	2 scientific reports, 1 government report, 1 popular document for workers organisations	1 MSc thesis (Canadian)	Much data shown to be collected, some data analyses said to be in progress
Water-shed approach	"Scientific publications" promised. There were six projects described:		

	predictive exposure model	None	Database completed, 1 local (UNA) report on database
	analysis of groundwater samples	1 UNA report	
	bioaccumulation kinetics	2 MFS reports	
	sensitivity of native species	1 manuscript, 2 UNA reports	1 study partly supported PhD thesis at Univ Wisconsin
	evaluation of modelling scheme	None	1 workshop was scheduled for 2001. Not reported in proposal 2002
Biodiversity	"Scientific publications" promised. There were two projects described:		
	evaluation of benthic macroinvertebrates	None	
	comparison of community structure	None	
Ecological-economic evaluation	scientific publications	None	
Distant training programme	1 technical report, 5 "publications"	None	2 "study reports" in progress
Regional courses	1 in environmental epidemiology, 1 in aquatic ecotoxicology	1 in neurobehavioural effects of chemicals, 1 in environmental chemistry, 2 in aquatic ecotoxicology	

Four regional courses were given, partly on other topics than promised. The courses recruited teachers from Canada, Netherlands, Sweden, Venezuela, and Central America. The activity report from 2001 lists two courses that were given in 2001, on Neurobehavioural effects of chemicals and on Environmental chemistry. Difficulties to find a convenient date for all teachers to show up was the explanation offered for giving them at the last year of the period. The bridging phase application submitted in 2002 added another two courses, on Aquatic ecotoxicology, in year 2000 and 2002. The courses attracted 14–25 students each and the twice than promised delivery amount express the great capacity and devotion among IRET staff to accomplish regional research training courses.

6.4 General Comments

Two of the programme activities, the health research based on the surveillance systems and the regional courses, were equal to or even exceeding the promised production goals. This may have different explanations. A course is a course and needs an organiser, teachers, and students. It is a reasonably straightforward activity for an organiser who knows the subject, has contacts with teachers and can pay for teachers salaries and travelling. Courses are often a safe investment for an organisation like SAREC since academic teachers are cheap but professional and a larger group of customers (students) can be reached. It is not necessarily an efficient investment, unless the course participants engage themselves as tutors at their home universities. IRET is obviously capable to carry out postgraduate courses on health and ecotoxicological topics, combining practical exercises and theoretical elements with a mixture of their own staff and invited experts. I notice signs of inferior management (courses delayed and topics changed) and unrealistic goals (the proposed programme on five courses in three years on different subjects would be a challenge even for an experienced research group at an American or European

university), but it seems as if the present organisation at IRET successfully can accomplish one post-graduate training course per year.

The Swedish designers based the regional, distant learning programme on a modern, cost-saving teaching approach and positive experiences of its applications in African environments. Yet, there were a number of problems in using it for the health education and the programme largely failed to accomplish its objectives, in the sense that few of the projects were finished. The major obstacles, it seems, were the low quality of supervision (sporadic contacts between the student and supervisor in many cases), the absence of logistic and professional support at the home universities of the students, and the challenges of distant, advanced research training to the students. It is obvious from the activity report that the manager in Costa Rica, Catharina Wesseling, put a lot of energy into the programme, not the least in the workshops, which were attended by most of the students. Distant learning activities are normally a cheap investment into knowledge but require unlimited access to computers and Internet and dedicated and disciplined participation by the students into their projects. As long as this is more a dream than reality, one may have to adopt other strategies for the learning process. One may be to limit the number of universities in the programme and let each university participate with a minimum of 3–4 students, so that the students can stimulate each other by scheduled discussion meetings and help each other to improve the local supporting conditions. One may also consider paying a supervisor to stay repeatedly for, let's say, one week with each group of students. The training programme would call for a larger investment in that case but I doubt it will be less efficient when the finished study reports are evaluated.

The ecotoxicological research activities had a low payback of scientific reports. As a matter of fact, none of the activities resulted in an international refereed manuscript or paper, and a couple of the manuscripts in the thesis from 2000 are still not published. This is surprising given the monetary investment, ~320.000 SEK in 1999 and ~280.000 SEK in each of year 2000 and 2001 (Hardware and software for modelling and GIS, Field work, Laboratory equipment and maintenance, Minor equipment and reagents, Consultancy: computer programmer and GIS). This is far more than for the health research (50–60.000 SEK per year). One must then add the cost of the salary of those that were engaged in the research, including the Swedish supervisors, which were paid for a total of two months per year, which seems like nothing with respect to the content of the application.

There were probably a number of reasons for the low payback of the investment, and I can suggest some that are logical interpretations of the contents of the application and activity report. 1) The overly ambitious plan to explore a larger number of very diverse research subjects. It would take a large and well-trained group of scientists to go to the depths with all subjects in three years. Research needs a focus, and Swedish supervisors should insist on guiding their new PhDs into a limited set of testable problems. The project on ecological-economic evaluation of pesticide use was obviously a far-fetched idea and a completely new area of research for the CA participants. It gives a premature impression, without any scientific details on objectives, hypotheses, or methodology. It would be safer to leave those ideas out of the programme and prepare for a separate application to international research institutes. 2) The absence of clear scientific objectives and hypotheses for the work, the absence of justification of the work through reviews of the international literature. One will be faced with numerous difficulties on the track, unless one has a strong scientific background in the problems to solve and unless one has developed clear-cut questions for the research problem. 3) The absence of a clear responsibility for each project. It seems as if a large number of persons were responsible but it would be better to have one coordinator and each participant responsible to solve a specific scientific problem or provide a specific support.

7. Bridging phase

A new programme application was submitted in November 2002, one year after the activity report for 1998–2001 was delivered. The application was limited to one year, a so called bridging phase between the former Central American programme and a new programme, intended to involve more CA universities, more international collaborators and to cover ten years. The general objective of the bridging phase was said to be “the establishment of a firm basis for a long-term collaborative program between Sweden, IRET-UNA and other Central American universities” on toxic substances, environment, occupational and public health. There were altogether eight specific objectives for this one-year project. At least 14 activities were suggested to be carried out, including the preparation of 15 scientific publications. The first activity was the coordination and planning of the proposal to build up research capacity in CA. It would be based on questionnaires on research interests and needs at the 16 state universities participating, inventories of the resources and needs, site visits by the applicants for discussions and drafting of a programme plan, and a final workshop with all participants.

I have not seen any written documentation from the 14 suggested activities or any evaluation of the achievements of the objectives, but I visited the final workshop in December 2003 in Costa Rica at which the 16 universities were represented. It was clear from the discussions that there is a long way to go to develop a joint conceptual basis for building research capacity in CA. Once that basis has been achieved, the design and management of the programme will be easier to agree upon.

8. Resources and activity priorities at CA universities

The potential for building a research capacity in CA depends on the present conditions for teaching and research, the state support achieved, and the strategies for development expressed by university authorities. The universities may have different subject profiles for undergraduate training in environment and health, they may be responsible for Master’s programmes, they may have a high proportion of Master’s degrees among teachers, they may have cells or satellites of active research. I tried to collect some of that information by questionnaires and interviews at selected universities. This chapter accounts for the edited responses to the interview questions and the information given to the questionnaires. The interview questions are shown in Appendix 6 whereas the questionnaire form is repeated for each university.

8.1 Universidad Nacional Autónoma de Honduras (UNAH)

Discussions with Dixiana Alvarado, representing the area of health in the Dirección Investigación Científica (DICU), a group of six teachers at the faculty of Microbiology (Gustavo Fontecha, Gina Laitano, Doris Quan, Ada Zelaya, Annabelle Ferrera, Lourdes Enriquez) and another group of eight teachers at the faculty of medicine (Nelson Montes, Decan, Lilia Meza Martinez, Vice Decan, Juan Mejía Merino, Winston Mejía Merino, Lina Carmenati, Maria de Courdes Amador, Edgar José Pineda Estrada, Emilia Aldumén). Details of information in Appendix 1.

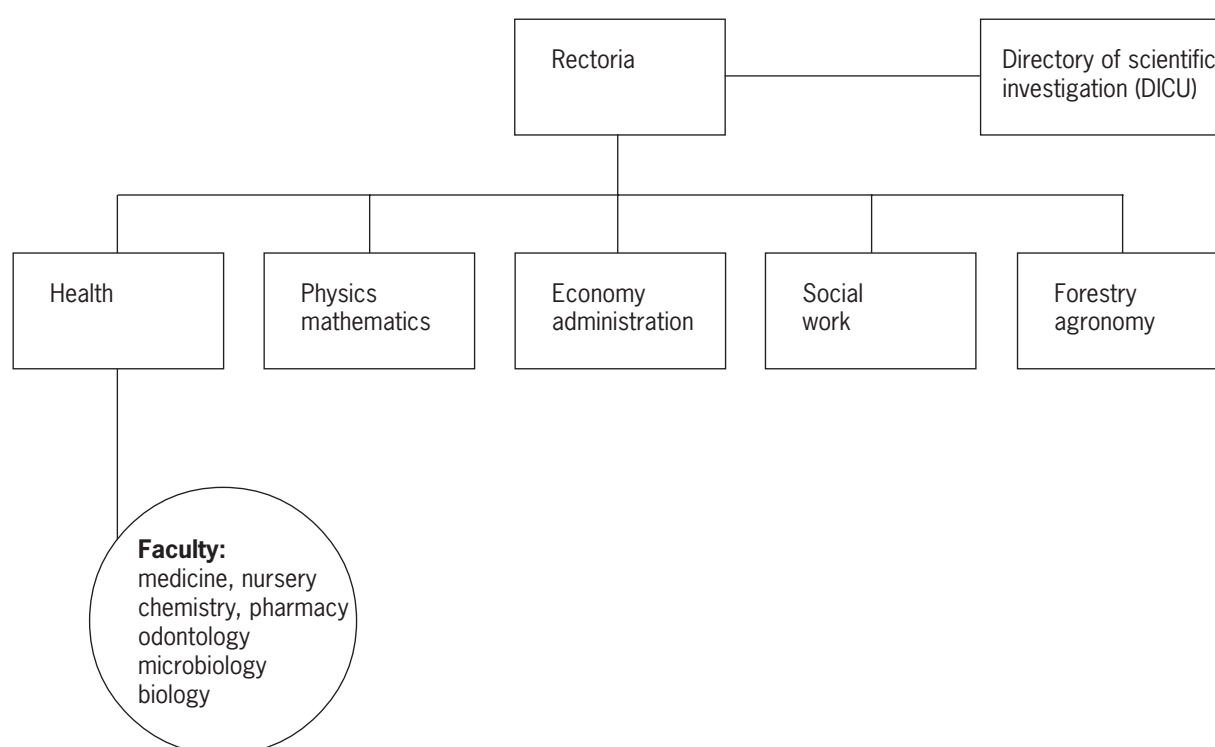
UNAH has about 35.000 undergraduate students in Tegucigalpa and is primarily organised in five subject areas (see figure on next page).

The subject area for health has about 10.000 students and a yearly intake of about 1700. Research activities at the university are supervised by DICU, engaging about 20 employees. DICU arranges the

yearly scientific week, during which the university teachers give lectures open to the public. About 80% of the activities during the scientific week arise in the health area.

Faculty of medicine

The faculty is responsible for training of medical doctors and nurses. The medical doctor programme is for 8 years, after which >50% of the students earn the degree, and the nurse programme is for 5 years. Both groups of students participate, unpaid, in the special extension work in public health, during which they practically assist employees at Ministry of health offices (local, regional, headquarter). Teachers also participate in the extension activities as supervisors, e.g. in vaccination. As a result of student participation, a health care procedure may be changed. Medical students go to health centres during the 3–4 year of studies to assist in nursing, vaccination, etc, and do their social service during the 8th year, e.g. by preparing a “research paper”. The nursing students often do the extension work to assist in social family programmes.



In general, a teacher spends 70% of the time in teaching, 20% in extension activities, and 10% in research. The major reason for the low research activity was said to be lack of funding. The public university receives 4% of the national budget, which causes deficits in most everything. Other reasons for the low research activity are lack of motivation and lack of a strategy and clear rules for research in the university council. UNAH has some minor internal funds for investigations, but DICU prepares applications to government departments, which approaches e.g. international organisations with requests for support. The size of a grant varies between \$500 and \$1000 (from Pan American Organisation for Health).

Faculty of Microbiology

The undergraduate training in microbiology lasts for 4 years and includes the extension programme, when the students practically assist at hospitals, etc. The problems with dengue have joined the teachers to focus on health aspects of microbiology, for instance by special courses in epidemiology, infec-

tious diseases, biosafety, and drug metabolism. Many of the teachers spend 90% of their work time on teaching, that is, 10–15 hours of teaching per week. The minimum level of teaching is 6–8 hours, and even a teacher with salary support from a grant teaches at least 10% of the time. About 60% of the teachers are engaged in research activities. The size of grants vary between \$2 000 and \$80 000, with 5% university overhead. However, grants are often managed by external agencies since the university management is slow and bureaucratic.

The department has built up competence in molecular biology, e.g. by a sandwich training programme with Nijmegen university, but hopes to build up competence on toxicology and environmental microbiology, e.g. on bioremediation.

The listed priorities for a new CA programme were: 1) courses for teachers, 2) Master's courses, 3) long term joint-CA research, including support to purchase analytical equipment, such as HPLC, GC, AAS, 4) PhD training.

Faculty of Chemistry and Pharmacy

The teaching programme in pharmaceutical chemistry includes a 4 months course in environmental chemistry and a 4 months course in toxicology. The programme lasts for 5 years, ending with a licentiate thesis, sometimes on an environmental issue, such as AcH activity in blood of humans exposed to pesticides. Only 12 of the 200 teachers have a Master's competence, but many others have working experience from other universities or have taken specialized courses, e.g. on HPLC, without getting the credit for it. Teachers have applied to attend Master's programmes but been rejected in the past (lack of replacement teacher?), so with the new UNAH strategy to promote postgraduate competence build up, there are hopes for more teachers engaged in Master's training.

Comments

The enthusiasm for the regional programme plans was overwhelming and the efficiency by which information about health and environment activities at UNAH was organised and provided to me was impressive. The coordination of the presentations was signed by Dixiana Alvarado as a representative for the directory of investigations, the special, common research office of UNAH. This seems to have a central role in fund raising and information to society, and its principal function as a professional office of reviewing the quality of proposals and raising external funds may be useful as a template for the whole region. The other interesting template candidate was the laboratory of molecular biology supervised by Annabelle Ferrera, a former sandwich type PhD student of Nijmegen university. The laboratory is unusually well equipped as a modern molecular biology unit, partly by donations from her former host university. Annabelle is successful in competing for grants from both European and American sources, she is scientifically productive, she is partly teaching, and she is co-supervisor for a new PhD candidate in the same kind of sandwich model with Nijmegen as herself originally. Without knowing any details, I consider this investment by a Dutch university as an efficient inoculum for the growth of molecular microbiology research at UNAH.

This laboratory was exceptional in the way that all other laboratories I visited at UNAH were poorly equipped or not at all. This poverty of equipment for experimental and analytical research and training within health and environment is shared with most of the other universities in the region. A regional support for the build up of a research capacity must also give an impetus to invest in new equipment, fit to assist in solving well-defined research problems within the programme.

A major problem for the build up of postgraduate training and research seems to be the lack of a clear university strategy that would, in practice, motivate and stimulate teachers to gain more scientific knowledge and relieve them from routine teaching. This problem is not unique to UNAH and not a responsibility of SAREC to solve but it must be recognised since it will affect SAREC initiatives to

build up the research. It seems as if the Central American Rector conferences would be a forum for discussions of common infrastructure changes to meet challenges in postgraduate activities. Likewise, new and efficient protocols for grant administration must be developed. Those presently at UNAH were thoroughly criticised.

The throughput of undergraduate students has certain limitations (>50% of medical students, <10% of biology students (Appendix)), but it was not clear to me whether the university would take a concerted action to try different methods to raise those numbers. Plans for improving the postgraduate training conditions were clearer, with Master's programmes planned for epidemiology, environmental sciences, and microbiology (Appendix). This is understandable, since less than 50% of the staff have a Master's degree or higher (Appendix). I also noticed that UNAH has a strong background, with different scientific approaches, in health sciences, with knowledge and interest in both faculty of medicine and faculty of microbiology.

8.2 Universidad Nacional Autonoma de Nicaragua-UNAN-Leon

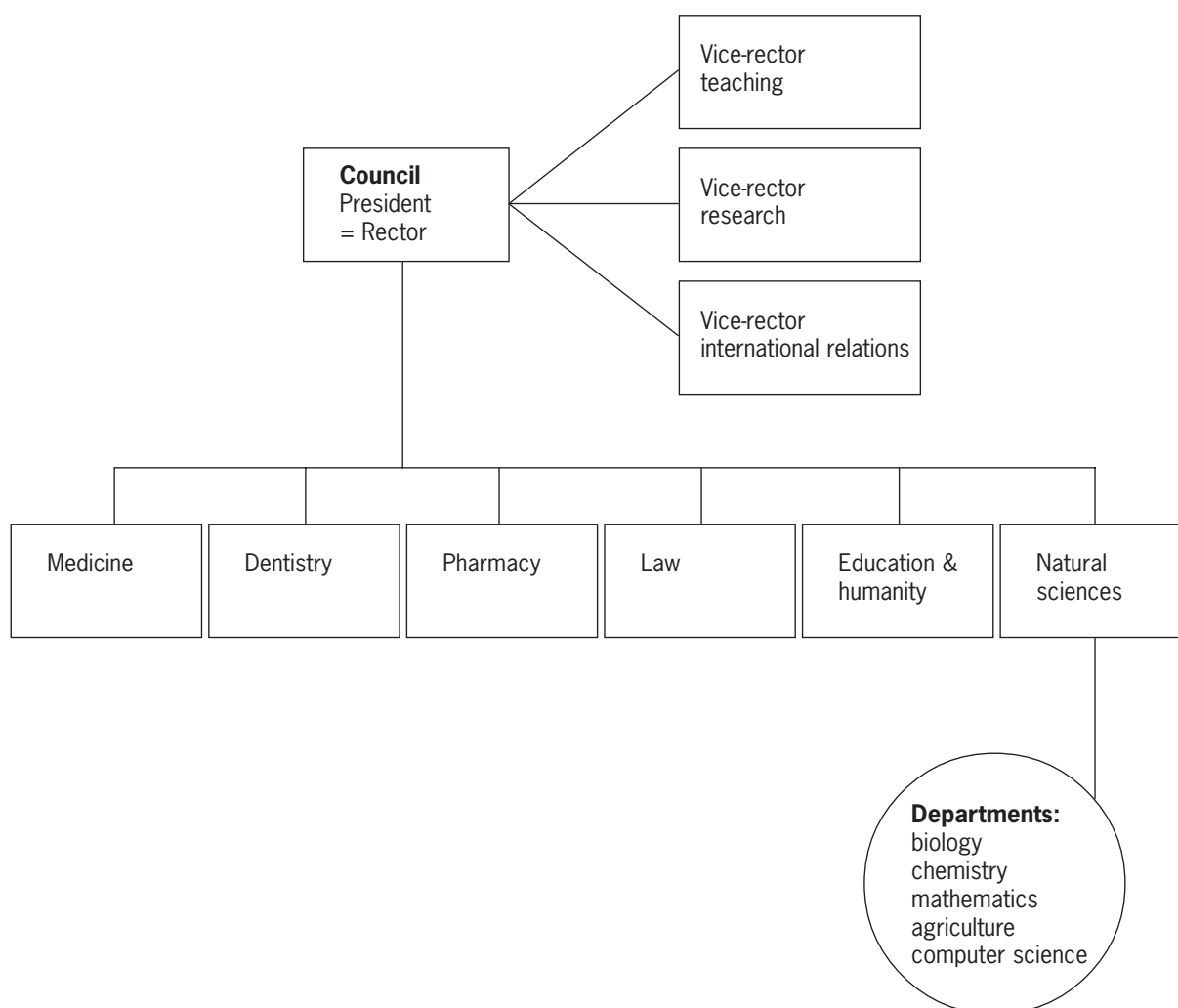
Discussion with Aurora Aragón and Teresa Rodríguez, Occupational and Environmental Health, Pedrorias Darilo, Natural Sciences, and Edmundo Torres, vice-rector.

The university has about 10 000 students and is organised into six faculties and managed by a rector and three vice rectors (figure on next page).

Medicine, dentistry, law, and computer science attract most of the students, but all of them study the same topics during the first year, when issues on environment and human development are addressed. Medical students return every now and then to environmental issues during their 6 years of training. As an example, students of occupational health have 80 hours of environmental teaching during the 5th year, corresponding to 10% of the teaching year, whereas students of environmental health have much emphasis on environment during their first year of studies. The students of biology (5 year programme) receive their environmental training during the 4th and 5th year, by 4 hours per week for 16 weeks. The importance of environmental issues is reflected in the change of focus in microbiology classes from health to environment. The students get some experience of their professional field by assisting at offices, solid waste treatment sites, etc.

1800 new students start each year at UNAN-Leon, 60 of which are in biology and 120 in medicine. 40–45% of the biology students graduate in 6–10 years and about 80% of the medical students graduate within 8 years. The difference in throughput may be attributed to the requirement for a diploma to work as a medical doctor and the good chances to earn money once the medical student graduates. The licentiate thesis at the end of the biology studies tends to prolong the training period.

The teaching on health issues has become problem based and organised in modules of optional courses. The modules are thematic, e.g., healthy life style, with a holistic approach and more than traditional student influence – for example, the students may suggest what they feel they need to learn rather than having to learn what the teacher decides.



The postgraduate training programme has a large number of two year Master's themes, some of which are in environmental and health sciences, such as Epidemiology, Public health, Occupational health, Natural resources management (sponsored by the sister university in Alcalá, Spain), and Management of protected areas (sponsored by NORAD). There is also one 8 weeks diploma (the first of three degrees of postgraduate specialisation for medical students) course on environmental toxicology (sponsored by the Pan American Health Organisation).

70% of the university expenses are for salaries for the 650 teachers, of which 80% are on full time. About 10% of the teachers have scholarships, mainly provided by international organisations such as Sida/SAREC. About 20% of the teachers are engaged in research, and 43 of them have a PhD. A new research incentive is represented by 12 scholarships, partly paid by UNAN-Leon and partly by Sida/SAREC, to research assistants, young postgraduate students that assist experienced researchers, with the intention to prepare the students for a combination of scientific and teaching career. The level of support for a research project varies between \$3 000 (UNAN-Leon funding – after internal committee peer review) and \$100 000.

The research activities started in 1980's with the support from Sida/SAREC and were given a major upgrading three years ago when a separate vice rector for research was appointed. Following the upgrading, the university is preparing to establish its first two research centres, one in environmental and occupational health and one in environmental studies. Teachers working within the centres will get less teaching, on average 12 hours per week, corresponding to 30% teaching, and a maximum of 16 hours

of teaching. Another, more than 20 years old, expression of research activities is the yearly oral and poster presentation of the student thesis work at the different faculties. UNAN-Leon has benefitted from a long period of bilateral cooperation with IRET at UNA-Heredia, by which UNAN-Leon has acquired a capacity to enroll itself in pesticide analyses. The support and cooperation is extended to other areas as well, such as postgraduate training exchanges and joint extension programmes.

The university has the ambition to improve its infrastructure such that it can support PhD programmes. The incentives to promote research resulting in international publications and contributions to scientific meetings are less teaching with maintained salary, and improved working conditions, e.g. reimbursement of travelling costs to international meetings. However, a PhD degree does not qualify for a raise in salary. By the different incentives to promote the scientific activities, the hope is to have roughly one third of the teachers work as effective PhDs. A major concern about the realisation of the plans is the limited references to science and technology in the development plan of the National Congress.

UNAN-Leon looks forward to develop projects in a symmetric cooperation with universities in the other CA countries. Joint research projects are prioritised as a way of learning, to get better teachers and Master's students. One is also looking forward to get accreditation by CSUCA for undergraduate courses so that students from other CA universities can become invited. A programme to build up research capacity in CA is suggested to be managed by one, fully dedicated, director assisted by a board of advisors that is responsible for policy and priority making, and by country specific directors.

Comments

UNAN-Leon is the only university in this report that has dedicated a vice-rector position to postgraduate training and research. This is a strong incentive, knowing that higher education in CA often suffers from numerous financial limitations and that the political power often is resistant to investment in more advanced university activities than basic graduation. In addition to the cost of salaries and maintenance of the special vice rector office, the university will have to take costly steps towards promoting postgraduate activities. The various incentives to promote the activities, such as the scholarships for young students and the establishment of research centres with teachers paid for less teaching, require a combination of internal funding and external grants. In the best of worlds, the centres may become fuels for the research capacity building and a channel for SAREC grants, but strong management is needed to ensure that teachers that do not qualify for the centres also are given encouragement.

With internal university resources for postgraduate activities so limited as in CA, concentration and focus of efforts are needed, and priorities on subjects and forms for reallocation of resources must have a reasonably long-term perspective. A combination of the internal focus on health and environment and a regional SAREC programme may be an effective test of the concept of prioritised research centres and give new insights for the future organisation of new research priorities and the strategy for the settlement of the internal support of the present centres. The vice rector's professional enthusiasm for development of efficient management systems is an important condition for that process.

The Master's programme is impressive, especially in health sciences, and it is understandable that the university would prioritise joint research projects within a regional programme rather than Master's courses. The university has more than 20 years of experience of support from SAREC, with a strong profile in health sciences, which will facilitate its participation in a regional programme. Environmental issues may become equally strong by the focus of microbiology on environmental applications and by the new research centre, such that the failure to carry out the biodiversity study during the previous programme period may be considered as a rare accident at work.

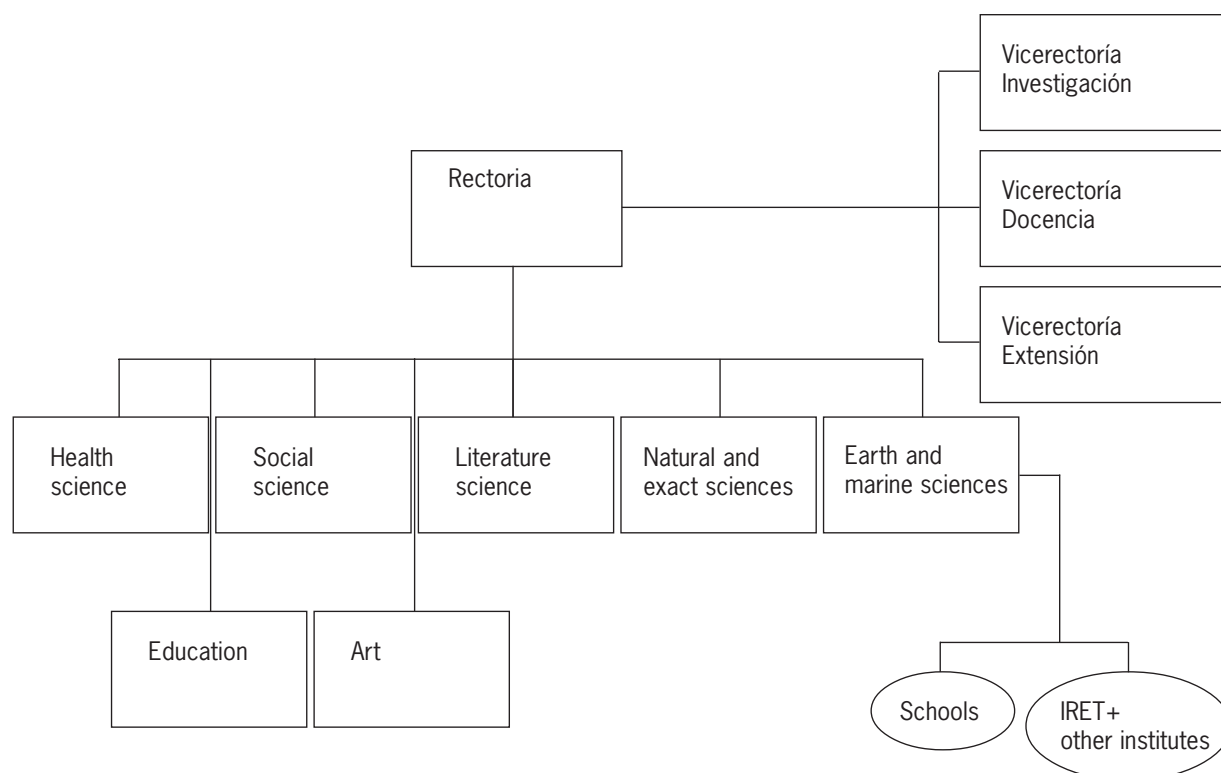
No appendix information is available. I have not seen the research facilities and equipment at UNAN-Leon.

8.3 Universidad Nacional – UNA-Heredia

Discussion with Sonia Marta Mora, Rectora UNA, and, separately, Luisa Eugenia Castillo, coordinator of Environmental Section of IRET, and Catharina Wesseling, Head of Health Section of IRET. Details of information in Appendix 5.

UNA has established itself as a knowledge base in the Costa Rican society, and the university as an institution is frequently asked to provide or evaluate information for decision makers in the society. People have also recognized UNA in general through e.g., workshops within the frame of local development programmes. They are extension activities by which the university have an impact on regional development in Costa Rica, e.g., by regional training programmes. To gain the reputation as a useful and reliable institution in society is a long-term process, according to the Rector, that also requires a history of representative democracy. Research was long an honoured word with little practical implications. Starting a few years ago, it has also received practical attention, and in the near future, the government may support different groups with funding to order research and with scholarships for university training.

UNA was a pioneer among CA universities to bring attention to environmental issues, and environment is one of the key words in the strategic plan of the university. Environmental management has been implicated at the campus at various organisational levels, e.g. actions to save electricity. Environmental health has become a new discipline, and the creation of IRET-UNA in 1998 may be considered as a milestone in the move towards environmental and environmental health oriented research at UNA. It was decided to give environmental research an independence from the teaching schools because an institute seems to have a better reputation for international cooperation than a school. The head of IRET-UNA reports to the dean of Earth and Marine Science Faculty with the same power as a head of the teaching schools:



UNA has obtained accreditation by CSUCA (Confederation of Central American Universities) as an education institute so that students from other CA countries can participate in graduate degree programmes. Improvements of graduate training programmes are currently under evaluation. For instance, all programmes will have a gender and environment perspective. Staff members spend between 25 and 100% on teaching but can make their own priorities between teaching and research. The university has a small source of funding of assisting teachers that can replace teachers that take more research responsibility. A high proportion of the teachers will retire in the next few years, and the university has taken the initiative to hire those that are interested to continue teaching. Another initiative is to raise funds to hire visiting teachers.

External funds are charged with an overhead for common internal academic development, such as Internet and infrastructure, but support for major investments has to come from the government. UNA is successful in such fund raising, and new buildings for \$3 billions are presently under construction on campus. This investment is considered very important since the condition of the physical facilities is a major limitation for both research and teaching.

IRET-UNA (Central American Institute for Studies on Toxic Substances) was created in 1998 as an extension of the former Pesticide Program of UNA. Two laboratory sub-units, on pesticide residues analyses and on ecotoxicological studies, support the research, teaching, and extension activities of IRET in CA. The institute has been supported by Sida/SAREC from 1990 until 2003. The support was initially concentrated on health training and building a capacity for chemical analyses but included ecotoxicology in 1994. The institute has about 30 staff members engaged in various networks and services in Costa Rica and Central America and has attracted support from a number of international organisations, such as the Pan American Health Organisation (PAHO), the European Union, and the Canadian International Development Agency (CIDA). The staff members have 25% of teaching, corresponding to 10 hours per week including preparation. Most of the teaching is made by supervision of student theses but also in courses of a Master's programme in occupational health and in some courses organised by other units within UNA. The institute has some internal UNA funding, including salary for senior researchers, house rent, and other minor operational expenses.

It is hoped that the suggested regional programme will help to elucidate environmental and health problems in the region and to give suggestions for their solutions. Wesseling and Castillo have experienced how the past 20 years of environmental work in CR has convinced people and authorities to listen to and take advice on environmental and health issues and how government agencies and regional societies even ask for support. A regional programme will hopefully help to catalyse this process in the other CA countries. IRET is in a position to be engaged in the programme with staff members that are co-supervisors in a sandwich model of student training, by teaching in Master's courses, as supervisors of Master's and doctoral theses, by participation in joint research, and by coordination. Support for PhD training has a higher priority in health sciences because Master's programmes on health are available at other universities in the region. The institute is prepared to develop a Master's programme in ecotoxicology, since that subject is not available in the region, and a Master's programme in occupational and environmental health, with a focus on research training. A director is suggested to be responsible for the management of the regional programme and to report to two coordination groups. One would have official representatives for the universities and be responsible for e.g. the selection of student candidates and for harmonisation of the counter-granting by the universities. The other would be an expert group, responsible for selecting supervisors and research topics. Webb communication would be considered as an important glue of management, and the coordination groups and participants would meet at annual workshops, at which e.g. theses arising from programme activities may be presented.

Comments

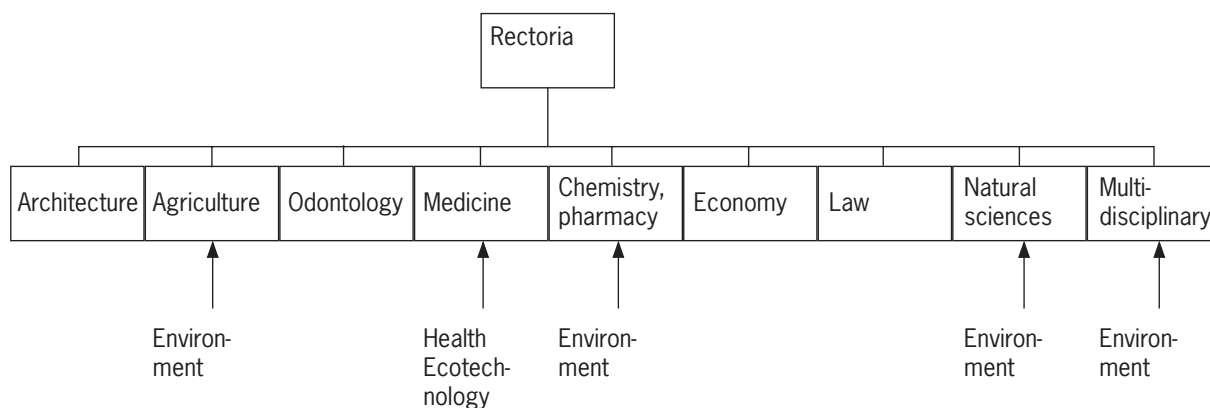
UNA seems to have a results-oriented rector, who has recognised the benefits for the university and society of supporting environmental and health sciences. UNA is exceptional among the visited CA universities in having a positive communication with the political leadership and in being recognised as a knowledge basis in the society. I was also given the impression that UNA has a more generous financial support from the government than the other visited universities in the region, with a higher flexibility in the teachers' allocation of time for research and teaching than noticed in other countries. In the build up of environment and health competence, IRET has been provided with at least three full time faculty positions, with very favourable research conditions. Yet, the funding of specific research projects at IRET is almost entirely dependent on external sources, as are most of the staff members. The research institute has thus been trapped by a large number of short-term external commissions to maintain the facilities such that they also can be used in research projects. Regardless of that, IRET has a very strong position in environmental and health sciences in CA, and the two leading stars, Wesseling and Castillo, have an enthusiasm and competence for research training that is very important to use in a regional programme. I have only a vague knowledge about the activities at IRET, since I was not offered to visit the institute or to meet any other staff members than those mentioned. I have some concern about the knowledge and recruitment basis for health science at IRET since UNA has no undergraduate training in medicine and since IRET is an institute within Earth and marine sciences. I understood that the teaching responsibility of the IRET staff members was equivalent to the lower limit at UNA but included a large load of supervision. This raises the question about the connection between postgraduate training programmes at IRET and teachers in undergraduate environmental and health training and the methods for transmitting research knowledge from IRET to the teaching schools.

Most likely, those that were engaged in the build up of IRET consider the past SAREC support as a necessary building stone for the organisation, with a special responsibility for building the competence to a PhD level. The case must have lessons to learn, such as on the influence of the characteristics of the participating students on the progress of a programme, but the support seems to have come to a point of harvest and refinement. The advancements made by IRET during the past five years is well illustrated in Appendix 5. The institute has established an impressive number of international collaborations and other main sources of funding than SAREC, and several of its staff members are active in publishing in international journals. Compared with many other organisations mentioned in this report, IRET-UNA has come much further in building a research capacity. To promote symmetry of research capacity for the region, a regional programme should allocate more of the support into these other organisations. However, that does not mean that the support should be taken away from IRET, but the support should take other forms than in the past. IRET needs to consolidate and further develop its research capacity, e.g. with more staff members in PhD training, but as long as none of the CA universities has a PhD training programme, IRET is dependent on supervision from sources outside of the region. The future PhD training may use other universities, e.g. in Mexico, from the long list of collaboration, and the institute should be given support from a regional programme to find other external sources for upgrading the analytical equipment. This out-phasing of IRET as the primary target of research building support by SAREC is another challenge for a regional programme and for SAREC and must be made with fingertip sensitivity to ensure sustainability of the established research capacity. A regional programme may want to be specifically concerned about three issues at UNA: 1) promote post doc activities by the two PhD's, including research at IRET, at other CA universities, and supervision in regional courses and Master's programmes; 2) promote sustainability of IRET by advices on external fund raising and quality assurance of scientific production; 3) promote postgraduate training of teachers outside of IRET involved in undergraduate training in environmental and health sciences at UNA.

8.4 Universidad de El Salvador – UES – San Salvador

*Discussion with Salvador Castillo Arévalo, Decan faculty of Chemistry and Pharmacy, and Sandra Peraza.
Details of information in Appendix 2.*

The university has about 32 000 students and admits about 9000 yearly after entrance tests. More than 50% of them pass to a degree. UES is organized into a number of faculties:



Environmental issues appear, as indicated, in teaching in several faculties, whereas health teaching is limited to the faculty of medicine. This has also responsibility for training students on ecotechnology. The last year of the 5 year training in chemistry and pharmacy and the 8 years training in medicine is devoted to work (practice) in society, often associated with environmental issues, e.g. regulation of the use of chemicals. The topics for the work are often suggested by government agencies.

UES receives only 1.3% of the national budget. The limited support is reflecting the political tension between the government and the university, which is considered more of a guerrilla source and student factory than a knowledge base. The present solution to the conflict, which stems from the civil war, is that the university is left without political support but produces graduate students. The university has taken the mission to try to demonstrate its knowledge base, e.g. by inviting government representatives to university activities, suggesting improvements of environmental health technology, and participating in committees on toxic products regulation.

Five of the 80 teachers in chemistry and pharmacy are Master's and three of them are PhD's. Teacher's salary occupies 90% of the subsidy from the government, and only \$600 is left to spend on research for the whole university. The practical rule to distribute this source of funding is to give each faculty \$10 as a starting capital. Some research can be done without major investments in e.g. equipment, but the teachers must get inspired to engage themselves in research. One initiative taken at UES is the strategy to limit teaching to 70%, corresponding to 25 hours per week, preparation time excluded. Teachers are also asked to supervise groups of students on various theses work, by up to 15 hours per week.

The faculty of chemistry and pharmacy has a small unit that makes chemical analyses for external customers, e.g. the sugar industry, and is accredited to make water analyses. The major limitation for the work is lack of equipment, such as HPLC, GC, IR, and AAS. For instance, requests on pesticide analyses are sent to IRET in Costa Rica. The university had much equipment before the civil war, but it was removed by the militaries.

UES is responsible for one Master's in public health and another two years Master's in environmental science, including ecotoxicology, supported by Madrid University.

A strategy for the establishment of a regional programme is suggested to have three steps: 1) define areas of research, e.g. toxicology, associated with certain needs in society, 2) prepare for Master's and PhD training, 3) let each Master and PhD develop a core unit of research and acquire equipment. The highest demand at the faculty is for training of teachers for Master and for shorter courses for teachers to help solve immediate problems. Contracts should be made between the university and a Master's student for payback by teaching for 10 years. The programme should be managed by a professional council, including the CSUCA secretary, and by a rotating coordinator position.

Comment

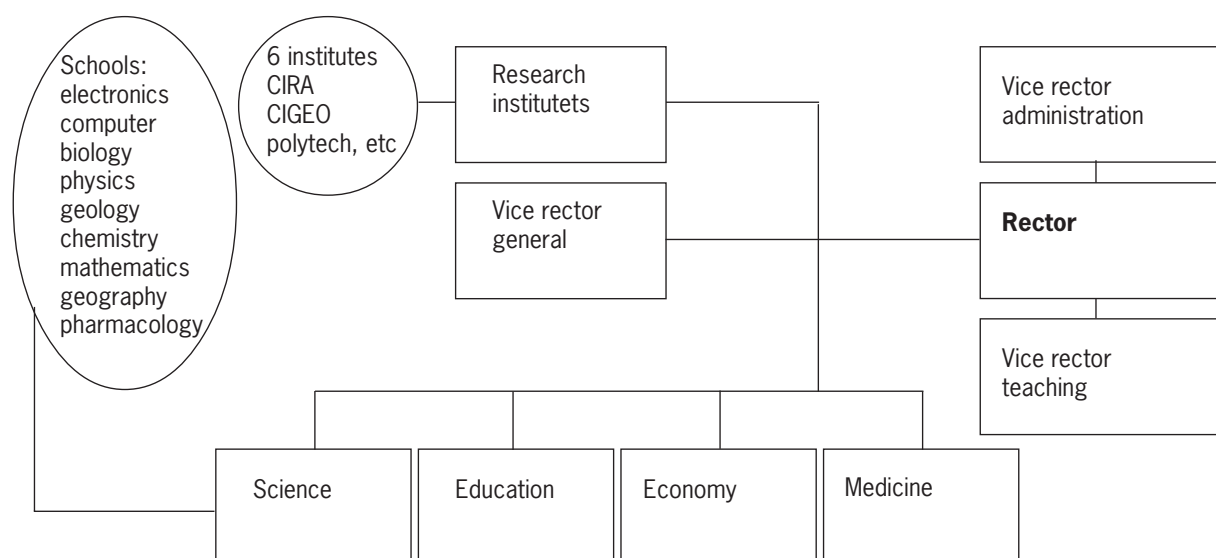
UES represents the classical dilemma of SA universities, with a very limited government subsidy, meant to support the production of graduate students and only sufficient to pay teachers' salaries as long as they teach 25 hours per week, excluding preparation time. Environmental issues seem to appear in several undergraduate training programmes, without coordination, but what special initiatives that are taken to promote postgraduate training and research are unknown to me. The faculty of multidisciplinary sciences and the Master's programme in environmental sciences called my attention, but no information was available to me.

The conditions for the visit to UES were unusual. I was given two e-mail addresses in advance, one of which did not respond. The other was the Rector, who organised my stay at a meeting with rectors from Latin American universities but who did not have time for a discussion. The students occupied the university at the time for my visit to San Salvador, so I had a discussion with the dean of chemistry and pharmacy at the hotel but no visits to the university. After meeting some UES representatives at the programme meeting in Heredia, I was provided with the information in the appendix.

8.5 Universidad Nacional Autónoma de Nicaragua – UNAN-Managua

Discussion with Katherine Vammen, vice-director of CIRA, Salvador Montenegro, director of CIRA, Gustavo Sequeira, director of research, Julio Traña, director of postgraduate programmes. Details of information in Appendix 3.

The university has about 15000 students at the Managua campus and is based on a mixture of faculties and research institutes:



The research institutes are affiliated with the university, starting in 1982, directly under the Rector, partly because they were moved into university from outside, e.g. from a ministry, and partly to express an emphasis on research. There is no vice rector for research and postgraduate training, for historical reasons (teaching university) but a revision was said to be underway.

The faculty of medicine has about 1500 students and admits 200 yearly. 75% of them graduate within 6 years and another 15–20% within another 2 years. About 25% of the students have scholarships, and it has been noticed that the most successful students are found among those that study full time.

The faculty has a strategic plan, suggesting ways to improve the infrastructure and efficiency of teaching, and participates in the university wide auto evaluation process. That is intended to recognise weak points in the infrastructure, to address needs in society, and to improve relationships with government ministries. Some teachers are shared with the pharmacology school in the science faculty. This faculty has about 5000 students and admits about 400 yearly for the 5 years school programmes.

A full time teacher at UNAN-Managua is lecturing 12–16 hours per week (excluding preparation time), corresponding to 75% teaching. The university spends 80% of its income from the government on teacher's salaries and 10% on infrastructure services. The reasons for this heavy emphasis on teaching are both historical (UNAN-Managua was originally like a teaching college) and political (the government and the National Congress have little interest in research but consider universities as student factories). The university will try to take steps towards its recognition as a knowledge base by emphasizing research that is valuable for society, e.g., in agriculture, environment, and eco-agricultural technology. There are efforts to work with city mayors to help to improve water conditions in the major lakes, and to use the extension programmes of the university to give advice to miners and cooperatives.

Two initiatives to promote research activities were mentioned: 1) national student research, which is a one week research on one problem per student group, and 2) teachers research programme, in which teachers may propose projects to their faculties for granting. A typical internal grant is \$200. The largest external grants are \$160 000 per year from Belgium and \$500 000 per year from Sida/SAREC. The university takes no overhead fee but pays for sanitation, water supply, physical facilities in general, and technical (journals etc.) information.

The research institutes sell services to external customers to acquire some research funding for them. Typically, 10% of their staff members are engaged in research activities and the others in various external commissions.

Each faculty and research institute has recently adopted a research plan, which specifies the capacity for research, the possibilities, the needs to be addressed in society, and how the quality and efficiency of research activities will be improved. UNAN-Managua has currently 90 students in PhD training, 30 of which are abroad, and the ambition is to educate a critical mass of teachers at the PhD level. However, there are no specific initiatives to support young teachers in research, albeit 60% of the university teachers will look for retirement in the next few years.

UNAN-Managua has six Master's courses in environment and health: Public health (one given by faculty of medicine, one by the polytechnic institute), Natural disasters (CIGEO), Management and environment (faculty of science), Epidemiology and Sexual reproductive health (faculty of medicine). In addition, there are diploma courses in Toxicology, Vector borne diseases, Diabetes, and Physiotherapy for medical students. The postgraduate programme is financed by grants from international organisations and the Ministry of health. In addition, the university rewards the students with scholarships.

The university would like to prioritise scholarships to young students for working with scientists and PhD training within a regional programme.

Comments

Two very different organisations, a research institute for environment and a teaching school faculty for medicine, represent postgraduate activities in environmental and health sciences. The research institute makes a marginal contribution to undergraduate training but a major contribution to services in society and postgraduate training, whereas the medical faculty makes a major contribution to undergraduate training and a smaller but increasing investment into postgraduate training and society services. The partial autonomy of CIRA, and the other research institutes, may have helped to focus its activities towards the exterior of the university, but it seems obvious that the link towards undergraduate training has been weak. Although their area of interest are partly different, CIRA and IRET share many of the same characteristics as research institutes – their staff can count a number of Master's and PhD's, in training or with degrees, they are deeply involved in commission services and postgraduate courses, and they are well equipped for chemical and biological analyses. The detailed information in the appendix about the capacity of CIRA is also indicative of maturation of an organisation with international recognition. The faculty of medicine is a more traditional student teaching organisation, with heavy teaching loads for the teachers, but notable steps are now taken towards postgraduate training in health sciences, with Master's courses and two teachers enrolled in PhD training on environmental health, sponsored by SAREC. At this time, it would be valuable for the faculty to make priorities among potential areas of research interest, to ensure that the overlap with other health oriented research in Nicaragua and in CA is kept at a minimum.

More important, the postgraduate activities may benefit from a reorganisation of the university structure, with more emphasis on research and postgraduate training (a vice-rector for research, a research secretariat, a research council, etc), by integrating research institutes, such as CIRA and CIGEO, in undergraduate training and teachers of the science faculty in postgraduate training. This may help to update the teaching schools on research knowledge and promote a reformation of science courses with respect to new aspects of environmental sciences. It would also promise to make the process of acquisition of external research grants more focussed and efficient.

8.6 Universidad de San Carlos de Guatemala – USAC

Discussion with Bessie Olivia, Francisco Perez, and Oscar Cobar, School of Chemistry, Faculty of Science, Chemistry, and Pharmacology. Details of information in Appendix 4.

Environmental issues are addressed in education within the faculty of Science, Chemistry and Pharmacology in three of the 5 years long careers, chemistry (25 students earn a licentiate degree yearly), microbiology (20–25 licentiates/year), and biology (50 licentiates/year). The first year of undergraduate training introduces the same overview of natural sciences for all of the faculty students. The chemistry students take analytical chemistry courses, with a focus on environmental chemistry, throughout the career. The last year allows for a specialisation, e.g. in environmental chemistry, in which the students may take samples, make analyses and evaluate them to describe pollution exposure in a river. English courses are compulsory for the chemistry students. The university has no plans to establish a separate faculty or school of environmental sciences, but the faculty of Science, Chemistry and Pharmacology has a special Group of Environmental Research, for which Francisco Perez is the coordinator.

The teachers have three main grant sources, the academic sector, the government sector, and the private (ONG) sector. The university has some limited funds, for which the Institute of Research has the management responsibility within the faculty. Guatemala has a national research council, which supports environmental research at the universities. A typical size of an ONG grant is \$25 000.

The faculty authorities encourage its teachers to participate in training programmes to improve their capabilities as teachers and supervisors of undergraduate theses. The faculty pays temporarily the replacing teachers during periods of training in a Master's or PhD programme. It is intended to establish a Master's programme on Environmental Analytical Chemistry. Master's and PhD training activities are highly ranked in the proposed regional programme, but the support for acquisition of modern instrumentation for environmental analytical chemistry is even more important. The available equipment is old and partly donated by private companies, but the faculty does not have the capability to analyse e.g. trace metals and pesticides. The faculty has staff members with Master's degree in environmental chemistry and training at IAEA and universities in Europe and South America, but they have not access to instruments to develop research and teaching projects.

Comments

USAC, and notably the School of Chemistry, which was the only unit of environmental and health sciences represented at my visit, has a number of characteristics that makes it both a strong argument for a regional programme on research training and a strong candidate for support by a programme: little acknowledgement from the national congress but a number of channels of communication to society (e.g., the university radio-TV station, see appendix), low examination efficiency in undergraduate training (40% after 6–8 years, see appendix), no present Master's course but ideas for one on environmental chemistry, candidates prepared for PhD training, staff with professional training in analytical chemistry but outdated equipment, some grant support for research but no scientific publications, and a great interest in research training. Just like the faculty of chemistry and pharmacology at UES, the one at USAC has a small unit of analytical chemistry services, whose external commissions help to maintain some of the equipment for environmental surveys and monitoring. I was not given the impression of a well-developed cooperation between chemists, geologists, toxicologists, ecologists, epidemiologists, etc on environmental issues in undergraduate training or in postgraduate activities. A regional programme may also help to develop a university network of interactions between the disciplines, e.g., by explicitly require a demonstration of local cooperation before the USAC group is admitted. It is even possible that the development of cooperation may initiate discussions to establish a more permanent training programme and organisation on environmental and health sciences.

8.7 Department of Systems Ecology, Stockholm University (SU)

Discussion with Nils Kautsky and Michael Tedengren.

The department was engaged as a Swedish counterpart from 1993 and responsible for supervision of one PhD candidate, Luisa Castillo, who started in 1994 and defended her thesis in 2000, only six years after setting out on the PhD programme. The objective of the engagement was to bring some ecological relevance and context into the bilateral programme and to release a candidate within ecotoxicology from routine work and teaching at UNA. There were a couple of reasons for the limitation of the supervision of Master's and PhD students: first, the grant given by Sida/SAREC was limited to cover expenses for at most one candidate, and second, there were no other qualified candidates at UNA at that time. A Master student, Margareth Pinnock, was trained and received an international M.Sc. at SU in 2003. In addition, two Costa Rican undergraduate students received research training in Sweden during 2003.

The department had no past experience of cooperation with the Karolinska Institute or the National Institute of Public Health, so the extension of the bilateral programme from health to environment aspects brought expertise from the different disciplines together. However, the cooperation was limited to joint meetings to discuss scientific and administrative issues when the PhD candidates were in Sweden and the co-organisation of an International pesticide conference in Costa Rica. Another coun-

terpart was the Department of Environmental Assessment at the Swedish University of Agricultural Sciences, which contributed with teachers to the courses in environmental chemistry and ecotoxicology and with certain advanced chemical analyses.

The SU supervisors are proud of what they have achieved with a small grant and of the good evaluation they received by students at the field courses in CR. Their supervision was initially challenged by a large number of administrative and scientific problems. The central administration at UNA was inefficient and even counter productive in management of the grant and in organising the logistics of the programme work, for instance by failing to make a vehicle available for field trips. The scientific problems have also been associated with the conditions at UNA and with a lack of tradition of understanding the essence of scientific work. The CR students were often occupied by administrative and laboratory responsibilities at UNA and IRET even when they were in Sweden, because the institute had to take many short lived and small consultant commissions for its survival. As a result, the students became overworked and lost scientific focus.

Another experience of the past was the ambitious programme plans and promises of achievements in the proposals to Sida/SAREC. Some shortcomings in achievements were due to problems to find someone with appropriate competence for the work at UNA, or an inability to organise the work at IRET. The institute underwent a number of reorganisations during the past period and should be better prepared to engage itself in postgraduate training in the future. SU also knows better today than before who is capable to do specific work at UNA, although it is obvious that staff members are still very busy in too many projects. The high ambitions are also evident in the plans for the two years Master's training in tropical ecotoxicology. Courses will occupy the first year and thesis work the second, in which each student will have one SU supervisor and one from IRET.

The SU staff members acknowledge the capacity for research training in CA but emphasize that good spoken and written English is required of candidates for entrance to a future programme. One would also like to focus the future research training on integration of environment and health aspects, on defining common assessment and measurement endpoints (biomarkers) for environment and health research, on groundwater associated research, on impacts at the watershed level, and on the cost-benefit analysis of crop pesticides.

8.8 National Institute of Public Health – NIPH

Discussion with Christer Hogstedt, Director of Research department

NIPH was established in 1992 as a state agency under the Swedish Ministry of Health and Social Affairs. It is a national centre of excellence for the development and dissemination of methods and strategies in the field of public health. Hogstedt, who 1981–2001 served as professor of occupational health and epidemiology at the National Institute for Working Life, was engaged in the SAREC supported build-up of occupation health research at UNAN-Leon since 1986 and in occupational and environment research at UNA since 1990, mostly as a tutor and mentor, a professional bridge between the science of environmental and occupational health and students trying to apply it to problems in Costa Rica and CA. As one of the results, Catharina Wesseling defended her PhD thesis in 1997, six years after she was admitted to the PhD programme at the Karolinska Institute. This exceptionally short time to a PhD degree was due to a combination of several favourable personal characteristics, such as good knowledge of English, good knowledge of the discipline, many work hours per week, and talent. Another evidence for a successful, but rare, case of research achievement in a SAREC programme was the high rate of publication in international peer reviewed journals, by papers that were mainly prepared by Wesseling.

The strong emphasis on evaluation and implementation of surveillance system in the programme was possible as Costa Rica had a reasonably well-developed system for registration. The plans to extend the system to Nicaragua and Guatemala and make the registries useful for e.g. evaluation of regional differences, met with difficulties because the support of the project Plagsalud, which was responsible for the establishment of the surveillance system, by DANIDA was discontinued when Denmark went blue-coloured.

The problems facing the distant learning courses were different, and several reasons for the low graduation rate, such as conflicts with other work responsibilities, deficient communication with the tutors, and difficulties to access Internet, are given in the programme activity report of 2001. In addition to those explanations, it was mentioned that the original success of the course concept was associated with the design for 1-year development courses in Africa and Asia. Obviously, they became much more challenging and arduous when they were transferred into 2-year postgraduate research training courses.

The fairly sketchy description of scientific objectives, approaches, and methodology in the last years grant proposals to SAREC was said to reflect a programme application approach for research and research training rather than a traditional project proposal. The method of working would be the same, e.g., the first step of surveillance analysis to establish a baseline of data with evaluation of data quality and validity, as if the proposal had been submitted as a project description to a Swedish research council. A programme proposal may allow for more sketchy, tentative, and even ad-hoc flavoured descriptions as long as the programme is based on a history of reliable publications, graduations, and other fulfilments of given promises, that is, the applicants inspire confidence. If required, more detailed specifications of study populations, methodology etc could be delivered in annual reports, but normally a programme would be evaluated at the end of the programme.

The thin thread of scientific interactions developed between health and environment activities, mainly limited to management and coordination discussions, was one of the disappointments of the past programme periods. There were several difficulties in merging the disciplines towards multidisciplinary. One was the concern for a case of the common minimising-of health aspects seen in organisations supporting and carrying out environmental science research. The closest examples are the limited interest for health aspects in the Swedish Environment Protection Agency and the Foundation for Strategic Environmental Research in Sweden (MISTRA). This would be of special concern at UNA, which has no faculty of medicine and thus no traditional backup by health science expertise. Another reason was the difficulty of building multidisciplinary on PhD training, in which the candidate is expected to go into depth in the specific and often discipline limited thesis topic. Another disappointment was the difficulties to achieve a regional reach out with the surveillance system and the distant learning course, for reasons given above.

The consolidation and internationalisation of IRET and the initiation in 2003 of the Sida Health supported, regional, long-term SALTRA (SALud y TRAbajo) programme on occupational health development and capacity building in cooperation with UNAN-Leon is successful spin off from the SAREC programme. IRET was growing during the years of SAREC support, by accumulating academic energy and with new permanent positions offered by UNA. IRET has achieved a level of international recognition and has often visitors from abroad, for longer or shorter periods.

NIPH is prepared to contribute to a regional SAREC programme by assisting IRET to become self supported, by providing expertise to the programme and by listening to and commenting rather than dictating ideas and approaches, and by under-pinning the integration of health and environmental sciences, for instance by a focus on a watershed area. NIPH would also like to help to promote more so called Indepth research approaches, such as that made in cooperation between UNAN-Leon and Umeå university (the Swedish counterpart and PI Carina Källestål is now employed at the Research

Dep, NIPH, in Stockholm). Those area based field laboratories create the scientific and demographic capacity for epidemiological studies of occupational as well as environmental, acute as well as chronic, health effects. This would be a realistic aim of a programme since several of the universities, e.g., UES and UNAH, have well established health departments. Building a capacity like this would also benefit from a closer cooperation between Sida/Health and Sida/SAREC.

Comments on Swedish counterparts

The two Swedish counterparts are acknowledged organisations within their fields of expertise, and the supervisors, tutors, and mentors of the past bilateral programme have gained considerable experience of postgraduate training for building research capacity in Costa Rica and the region. In general, they were successful in bringing the supervised students to their final examinations, degrees, or publications, notwithstanding a broadly outlined and somewhat straggling research programme. In addition to the professional expertise, their enthusiasm for the task of training CA students must have been an important condition of the result.

The costs of their activities in 1999–2003 are not readily visible. One of the difficulties for understanding the basis of the calculations is the diversity of activities calling for supervision, teaching, mentorship, etc. The amount requested for two months salary, including social benefits, seems very low, especially compared with the travelling costs. Two months of salary would not even pay for the six scheduled yearly trips if each of them were 1–2 weeks long, giving the impression that the bilateral programme hardly can have paid for all working hours by the Swedish counterparts, especially during the bridging phase in 2003, when no salary costs were specified, except for a modelling expert.

I understood that NIPH paid the salary for Christer Hogstedt as an indirect support of the SAREC programme, but I doubt that a Swedish university would explicitly demonstrate the same generosity.

I disagree with the opinion that a SAREC programme may be approved based on other scientific qualifications and demands for resolution and precision than a normal project proposal to a Swedish research council. My arguments are two. First, the preparation of an application is a part of the research training process, and it should be the responsibility of the Swedish supervisors to guide the students through the preparation work and critically review the different steps. This process will prepare the students for a professional life in competition for limited research resources. Second, a scientifically rigorous application will help to focus the work to feasible goals and to clarify hypotheses and pitfalls in methodology and infrastructure before experiments and fieldwork take off. The probabilities of failures may be lowered and the efficiency of the training process increased if normal proposal preparation instructions are adopted. SAREC may have to be prepared to support a separate period of proposal preparation, with clear instructions on expected achievements.

A regional programme will be a much greater challenge for the two counterparts than the past bilateral programme was. They will have to take a major responsibility in supporting the management function, and once the programme accepts a number of Master's and PhD's students, more supervisors with different expertise will have to be engaged. I have some concern about the supervision on health aspects, since Christer Hogstedt, who is a unique resource for building research capacity on occupational and environmental health in CA, is approaching official retirement. His successor(s) should be introduced from the beginning of a first programme period, at the same time as the official academic host of health training is identified. In general, I suggest that the Swedish counterparts prepare a special strategy for their role and participation in a regional programme, to address the goals and challenges.

9. General comments

– conditions for building a regional research capacity

Success or failure of efforts to build up a research capacity in CA depends on a number of local and regional conditions, covered in the following sections.

9.1 Resources

9.1.1 Teachers – age distribution, degrees, capacities

Short-term programme activities, such as regional courses and workshop, would be relevant for all categories of teachers, regardless of age and formal academic degrees, in supporting efforts to improve undergraduate teaching. And teachers are, in general, the main resource of all universities in the region. How much of this resource that is prepared to accept and use injections of knowledge from a programme is an open question, but I remain positive and assume that nearly 100% of the teachers in environment and health would be willing to upgrade themselves when conditions permit. Long-term programme investments, such as Master's and PhD's training, must be guided by specific selection criteria, such as age, degree, and capacity. The small sample of age distribution presented in the Appendix, with the age of 40 given as a cut-off limit, indicates a large variation, with anything from 10 to 100% of the teachers below 40. The percentage of PhD's is low, which is supposedly a strong case to invest in building up a research capacity, but the percentage of Master's may vary from 0 to 40%. There are certainly reasons for the large variability, and it is important to analyse and evaluate those reasons to make priorities for support on Master's and PhD's levels such that equal opportunities for capacity building are given for all participating universities.

9.1.2 Undergraduate training – efficiency, direction, sustainability

Development of research and undergraduate training usually go hand in hand – with little progress in research, the content and structure of undergraduate training tends to become preserved, with changes made in undergraduate training (new teaching areas, new combinations, new ways of teaching) often comes a breakthrough for new directions of research. My impression from the discussions and from previous experience is that changes of undergraduate training at the state universities are very slow, with few exceptions. I did not hear any of the universities giving up on teaching zoology, botany, microbiology, chemistry, geology, limnology, etc and replacing them with courses in environmental sciences, biotechnology, ecology, and so on. However, the creation of a special faculty of multidisciplinary at UES is interesting but I know nothing about the details. I have serious doubts that people in CA need students with a profession in zoology to solve problems in society or to find new, less drug and pesticide consuming production methods. I am afraid it will take long before this preservation ban is released and a thematic revolution made at the universities. The traditional division of teaching sciences, echoes of the European pattern of subject organisation, will prolong the turnover time of students in a regional programme since they are not prepared to use, e.g. modern theories in ecology, environmental microbiology, etc. The training in health may have proceeded further as some of the universities have introduced separate courses on environmental and occupational health, supposedly also addressing exposure to toxic compounds. Students of health may thus be better prepared for postgraduate training. Most of all, I would like to see environmental sciences and environmental and occupational health to merge into a new faculty at the CA universities. That faculty would certainly make a strong connection to needs in society and perhaps be useful to demonstrate the universities as a knowledge basis, but I have little hope for that change, especially as I know of very few examples in developed European countries, where conditions for merging environment and health have been to hand for long.

9.1.3 University infrastructure

The organisation for supporting postgraduate training varies largely from one university to another. Some have separate management institutes for research (USAC, UNAH), some have created specific research institutes separate from the teaching units (UNA, UNAN-Managua), and UNAN-Leon has created special research centres as part of a teaching unit. All of the arrangements are evidence of an expression of importance of postgraduate activities, and the diversity of arrangements reflects local historical conditions and present, locally compromised strategies to integrate research into a teaching university. I will not attempt to justify one or the other approach to organise postgraduate activities at the universities, since that is beyond my competence, but I have the feeling that the decision to create a post as vice-rector for research at UNAN-Leon, in parallel with a vice rector for teaching, is a very strong move towards upgrading postgraduate activities.

In addition to the structure for management of postgraduate activities, facilities, equipment, and the critical brain mass are important components of the infrastructure. They are important components during the course of a regional programme, since the infrastructure has to support the participants in the programme, and they are important after the programme is finished but the build up continues. All of the autonomous universities seem to have the capability to renovate and add new facilities, and the rectors at e.g., UNA and UNAN-Managua are keen on raising facility funds from their governments and national congresses. The Internet facility seems to be extended every year, with major support from e.g., Sida, but the build up of a modern library service for research is far slower. I also have some concern about the fee that the universities will have to pay for access to electronic databases on literature. Those costs are taken off rapidly and may exclude poor universities from the scientific literature, unless e.g. UNESCO finds ways of support.

The availability of modern equipment for environmental and health science research is, with notable exceptions such as in microbiology at UNAH and in CIRA at UNAN-Managua, poor. Equipment is expensive to purchase and to maintain, and a regional programme may want to make a contribution such that each of the participating universities is supported with some basic equipment for their postgraduate activities within the programme and that each university may be added more specialised equipment as they organise their future plans on research specialisation. It is obvious that a regional programme can help to focus the universities on different specialisations to avoid repetition and to stimulate cooperation. With a specialisation on slightly different research problems follows options to lessen competition between the universities but to share unique equipment. A regional programme must ensure that equipment on a purchase list is accompanied by a corresponding list of research and training activities for which it will be used.

A regional programme can promote the build up of a critical brain mass by concentrating rather than diluting its resources and by interacting with the university leaders to coordinate activities. Supporting one university and one faculty with resources for more than one Master's or PhD student at a time would create a small group that might help to organise scientific discussions, to solve infrastructure problems more efficiently, and to make the support from the programme more visible at the university. A group of students would also be stronger than a single individual in negotiating with the university leaders to improve the conditions for postgraduate activities, such as reducing the teaching hours, especially after the programme support has ceased.

9.1.4 Financial support

The CA universities are in general very poor, and, as said by several representatives, deficits are facing most activities. Most of the universities use 80% or more of their income for teacher's salary, and the most obvious contribution to postgraduate activities by a university would be the salary support. As with most other characteristics at the CA universities, there is a large range of solutions, with the

most far-reaching extremes at the research institutes, such as IRET at UNA and CIRA at UNAN-Managua, where teaching for leading staff members is limited to e.g. supervision of student thesis work at different degree levels and teaching at Master's courses. Those conditions are not necessarily the best since the teacher's knowledge from research is not exposed to undergraduate students, and the teachers have fewer possibilities to stimulate the brightest students to continue with Master's training. A regional programme will have to ensure that the participating students are released from most of their teaching when they attend the programme, and that the contract for pay-back to the university explicitly specifies an upper limit of undergraduate teaching, let us say 25% including preparation time, and that the home university continues to pay the full salary.

External funding will continue to be the only real source of research funding, except for the salaries of teachers. Thus, it will be important that a regional programme actively is training the students in the preparation of grant applications and in reporting the research activities. It will be even more important to upgrade the capability once the programme is ended, and the universities should be encouraged to organise a permanent post as grant application mentor for CA.

9.2 Interest in capacity building – teachers, decision-makers, users of knowledge

The plans to create a regional programme to build research capacity was met with great enthusiasm by all with whom I had discussions, although most of them did not know anything about the plans at the time I visited them. This interest is not surprising, given the conditions under which postgraduate activities exist in CA. The enthusiasm is a necessary condition for a programme, but one would wish that the bridging phase grant had been used more efficiently, by workshops and discussion forum on Internet, to expose and evaluate individual expectations on the objectives and content of a programme. It is obvious that there will be as many expectations as interested participants, but a programme must focus to be successful. The discussion has barely started with the first workshop held in Heredia in December 2003, and will have to continue for the next year, with open discussions on priorities and the necessary focus of the programme, so that the enthusiasm is maintained even when compromises are made.

The university leadership has generally been alert and positive in responding to the plans and to my visit. Some, like the rector of UNA, have been generously interested and devoted much time for discussions, which may be indicative for a university which has been successful in building research capacity from external funds and which has been recognised by society as a knowledge basis, by virtue of its competence and the readiness by decision makers to use it. What interest decision makers and people in general have in a regional programme is unknown to me, but I am convinced that a programme addressing environmental and health problems in society and a programme that is organised to communicate with society will be met by more sympathy than antipathy.

The national and local society in which the university is an, autonomous, player reminds itself in everyday university life, and the society's struggling for peace, freedom and justice in the settings of poverty raises the question about the purpose of building research capacity at the universities. The more professional knowledge base at a research supported university compared with a teaching college can be used to transmit better knowledge and problem solving capacity to next generation of working citizens and to help in solving current problems in society. The CA universities have already the links to both functions, as is obvious from the data on teaching programmes, expert support, and society service projects (see e.g. appendices), although the functions can be improved. Several of the universities have problems to be recognised as knowledge basis by the political elite and probably also by people in general and they would hardly be more recognised only by building a research capacity to communicate with international refereed science journals. A regional programme may want to support a capacity building to the extent that the university teachers become more professional in solving envi-

ronmental and health problems in society and support short-term research projects designed to solve a specific problem in society, with a scientific approach and new methodological tools. By building a capacity to use research in both of the functions mentioned, the universities may become more respected by undergraduate students as well as by knowledge users outside of the university.

9.3 Cultural tradition and language

The distance in scientific approaches and relations to philosophy of science between a European and American university teacher and one in CA may be huge. Whereas much effort of e.g. a Swedish scientist goes into testing potential explanations to an observation, the mere description or classifications of observations is the direction research often takes in CA. Unless practically prepared for the different approaches, a student from CA easily gets lost in a training programme in Sweden and the first years of acclimatisation are slow in progress. This calls for special activities as a preparation prior to the postgraduate training. This also holds for the English language, which is worldwide accepted as the present language of science. English, spoken as well as written, is often poor among students in CA and one of the most common and evident obstacles of postgraduate training. It calls for yet another preparatory activity, whether intense, individual course or what. CA students that are very well in English should be asked for advice.

9.4 Need

It was obvious from the discussions with university representatives in CA and from the returned questionnaires (appendix) that all share a need for support to build up a research capacity in environmental and health sciences. The common argument was the lack of financial and human resources to do scientific research in the way it is defined in Sweden and in the international scientific community. The point of departure for the support varies from one university to the other. Some of the university units described here have research-active PhD's, or PhD students in training programmes, whereas others have a low proportion of Master's and PhD's in the staff and marginal research activities. Even with a PhD in the staff there may not be any incentives to be scientifically active because the PhD becomes isolated in the interest for science and scientific discussions. It follows that the prioritised needs are different from one unit to the other, a difference that a programme council will have to address and resolve. With different needs also follows that a programme should be reasonably diverse with respect to the levels of activities, such as Master's courses and cooperative research projects, offered. It was also clear from the discussions and questionnaires that the universities need the support to demonstrate the usefulness of research to support the build up of the society.

9.5 Regional dimension

The incorporation of a regional dimension in a research-building programme is probably the largest challenge of all. It is already difficult to design and accomplish a bilateral programme with one university and several participating units because of different language traditions, different territorial ambitions, management officials with little research experience, etc. The regional dimension includes the consideration of the different levels of advancement in environmental and health training at the different universities, the adjustment of a support to the specific conditions of each university (teacher's interest, problems to be solved, plans to develop undergraduate training, etc), and prioritisation of support such that initial duplication of build up of the same competence and equipment in all of the countries is avoided.

A regional programme may help to build up a regional competence, such that the universities together form a basis for research and training within environment and health sciences. None of the universities can count on having all expertise and all possible equipment within the disciplines, at least not in the beginning of a programme, but have to define their specific competence and priorities in open discussions in a programme council. The regional dimension also means that those that have the highest competence and largest resources should be sources of training and research support in a regional programme. It may be necessary to have both a university political advisory board for the programme, and a scientific management council, to solve some of the regional dimension challenges.

Unless SAREC would have unlimited resources for supporting research training, the regional dimension will divide the resources among the universities so that each of the universities may be less granted than if the university was granted in a bilateral programme. That is especially true for the training to PhD, whereas other activities in a training programme, such as regional courses, would be open to the same category and number of students regardless of whether they were supported on a bilateral or regional basis. With the same level of funding, a bilateral programme would introduce a certain level of research capacity to an individual university at a higher rate than a regional programme. However, it does not follow that the time it takes to build a certain research capacity in the region is the same when bilateral programmes are copied as when regional programmes are copied. A regional programme may be designed such that the regional dimension amplifies the training impact and takes a regional programme faster to symmetry of research capacity. For instance, a regional programme may promote the learning in regional courses of solving local environmental and health problem by a scientific approach and cooperation between students from different universities, or it may promote cooperation in the same field area among students from different universities working on their MSc theses. The same students may become the inoculums by which the knowledge is spread at local universities.

10. Recommendations

No one would deny that environmental and health conditions in CA need to be improved. Everyone may have different opinion about the strategy and priorities of the process to achieve the better conditions. Some would argue that public school reforms or extended provincial medical care or investments into agro-technology or better roads or more freedom would be the starting point for improvements. Research training would most probably not be considered as the most needed activity in the process of improving health and environmental conditions, especially if the training is only for the benefit of the university (becomes more prestigious) or groups of teachers (more international recognition). But if the universities and teachers are prepared to address regionally important health and environmental challenges in a research training programme, they may be able to demonstrate to decision makers and the public in general that professional competence and scientific approaches to environmental and health issues are necessary conditions for the improvement. They are certainly not sufficient conditions but need to be used hand in hand with many other activities, such as campaigns to increase the public consciousness, extensions of health centres, and investments into sustainability of e.g., aquaculture and agriculture. One would wish that Sida/SAREC could demonstrate the power of concerted actions by linking their activities in CA more tightly together.

The message from the universities responding to the programme plans is in unison, unequivocal and with emphasis: we need this research training, and we want it. Subsidy is indeed easy to accept as long as the service in return is marginal, but it was clear from the discussions with university representatives

that they are prepared to do something in return to the programme. The precise arrangements for the service in return should be specified in the contracts. While the need for and interest in a research training programme is easy to accept and acknowledge, the programme organisation, management, and return from the investment is likely to cause concern. Rather than listing all conditions of concern, I prefer to suggest some cornerstones of a build up of a regional research-training programme. I pay special attention to the *Regionalisation, Management, Timing of programme activities and Tools for sustainability of a programme*.

10.1 Regionalisation

How will a programme become regional? A clear definition of the regional dimension is crucial for the fate of the programme. I would like to contribute to the discussion with some few keywords:

Open to everyone

Everyone here means all autonomous, national universities in the region, at least those that are interested and are prepared to participate on the terms of other agreements.

Same opportunities to everyone

This is easy to say but how will it be possible to ensure that all participating universities have the same influence? Will influence be rated based on the size of the university (cf political influence in EU), or will influence be rated country wise such that each country will occupy the same number of opportunities? This needs to be thoroughly and openly discussed and decided before proceeding with any other programme plans.

Regional problems

A programme should identify environmental and health problems that are common for the region, problems and challenges that everyone can agree (compromises) are important to address and build up a professional capacity to solve. A programme must then focus upon those problems, define research questions, identify one common field area (watershed?), and work with those questions in concert.

Cooperation

Cooperation must not be limited to programme meetings but expressed in research and training projects. For examples, a student can have effective supervisors from more than one university, regional teacher's team prepare and realise regional courses, students from different universities participate in the same fieldwork, students in the health and environment disciplines design multidisciplinary projects.

Management

The management activity is important for the regional dimension, and the region must be represented in the management, in one or the other way. Unless it is possible to find a truly regional manager, one that represents the region rather than a country or a university and who is genuinely devoted to working for the region, a programme may be managed by a group of managers, with one, yearly rotating, main manager supported by vice managers representing the region.

Service in return

A regional programme must activate the participating universities to support the regional dimension, e.g. by contributing to regional and common projects with resources in proportion to the university income.

10.2 Management

A regional CA programme needs a strong, encouraging, just, and efficient manager or management function. Sure, people have been crying for the moon before, but I have seen so many examples on progress of research programmes depending on the management function that I don't hesitate to emphasize the criteria. It is easy to underestimate the challenges of coordinating and managing a programme for the whole of the region, but those who have experienced the difficulties of communicating between students, project groups in CA, and Swedish supervisors in bilateral programmes may fear for the consequences of a regional programme. The strategy for a management function must therefore be very carefully developed. A first step in selecting a management function may be a workshop, organised to pay full attention to the organisation of a programme. It may be necessary to meet for more than one workshop, to ensure that the selection process is thorough and that everyone is comfortable with compromises that have to be made. I have a very strong recommendation against a management that comes from UNA and IRET, for two main reasons: 1) Costa Rica, and UNA, is a leading academic profile in CA, and IRET has a very strong reputation as an academic institution in the region as well as international. In virtue of its competence and experience, UNA/IRET will have a major influence on many of the scientific activities within a programme. A manager from another part of the region can hopefully absorb that, such that the lead in postgraduate training that Costa Rica has in the region can be inoculated and transmitted to the benefit of the region. A management function that comes from Costa Rica would run a higher risk of consolidating the unevenness of competence and experience of research since it would give the impression of a bilateral programme extended to the region.

2) The investments that SAREC, UNA, the Swedish universities and their supervisors, and Luisa Castillo and Catherine Wesseling made into their PhD training was not meant to be primarily for research administration. Their remarkable enthusiasm for environmental and health issues and academic training must now be canalised by SAREC support into postdoc activity, in which they are engaged as regional course teachers and supervisors for postgraduate students at other CA universities and where they engage themselves in cooperative research, sharing their expertise and experience.

A manager must attend a training programme to become a manager. I suggest two activities for this training programme. The first activity is a combination of theoretical and practical course on the secrets of respected and efficient management, that SAREC must initiate and require all their programme coordinators to attend. The second activity should be management supervision. During the first year of the research-training programme, the CA manager must have an experienced Swedish research manager as supervisor. The supervisor must be acting on site for long periods to help to solve problems of management that are facing a manager of a training programme in CA.

The programme manager must also have a secretary with specified, written instructions, including the daily communication with participants and arrangements of the logistics for meetings.

10.3 Timing of programme activities

One can imagine that a programme will undergo three main phases of training activity: one in which bridges are built between the present qualifications of graduate students in CA and what is expected of candidates for entrance to postgraduate training at a Swedish university. A second phase would be the professional training activities, and a third phase would be another bridging phase, to prepare the students for their future as researching teachers, competing for research grants and providing expert services to society, and also for a later future outside of university. The specific activities and the transition between them would need steering from a programme council and its manager. The suggested activities and their timing are illustrated in the following table.

Time phase	Training activity	Steering
Early	Research school	Management training
	English training	Programme council
Middle	Regional courses	Management supervision
	Master's courses	Programme priorities
	Master's theses	Coordination Masters
	Evaluation new equipment	Coordinate new equipment
	Research based teaching	Reform undergraduate courses
	User-friendly projects	Board of society users
Late	PhD training	Activity evaluation
	Proposal training	Mentor proposals

10.3.1 Research school

A research school summarizes professional activities that aim at preparing graduate students for post-graduate training. Professional means activities that are mainly about the capability to acquire disciplinary competence, those that prepare the students for understanding and using scientific methodology. This knowledge and way of thinking must be adopted and accepted by the students, regardless of their background or cultural and political inclinations. Activities that prepare the students for living and studying in Sweden are different in the sense that they provide information to facilitate survival in a foreign environment without requiring obedience. Among activities are training in philosophy of science, planning and realizing research projects, scientific writing, and current problems in health and environmental sciences and how they are addressed. Swedish teachers would have to be hired, at least initially, but I expect that there will also be qualified CA teachers among those that have received PhD degrees or are far ahead in their present PhD training in other programmes. Research school activities should be offered at all of the participating universities and open to all (English speaking) teachers. All activities of a research school must be compulsory for students that plan to candidate for the programme. I expect that a first programme year will concentrate on the research school to prepare candidates for selection and to give attention to the programme at the universities. Preparation of programme students in a research school is absolutely necessary to reduce the initial lag time of post-graduate training at a Swedish university and to increase the efficiency of PhD training.

10.3.2 English training

Poor knowledge of spoken and written English among students in CA is a generally known and certified fact. Supervisors are very concerned about it, and although they still accept graduate students with casual knowledge of English, they become more reluctant since the progress of postgraduate training depends closely on knowledge of English. The present scientific language in the world is English, so anyone wanting to communicate on science needs to know the rules of interpretation and composing in English. Past SAREC programmes have tried various methods to help graduate CA students to acquire some basic English, and perhaps the experience from them can be used to identify the most cost-effective teaching method. I have some predilection for individual and intense courses in which the student stays with a native English speaking family and take lessons daily. I have no confidence in the TOEFL test but it seems to be one of the few official measures of familiarity with the English language. Good English must be compulsory for participants in a programme, and a programme council should define the criteria for the acceptable level of English.

10.3.3 Courses

Courses are requested by several of the universities, and several of them already arrange courses within e.g., Master's programmes. A regional programme council should carefully survey the present Master's programmes and regional courses to find out whether and how complementary efforts can be made from the programme to add more research training aspects to them. There may be reasons to coordinate the Master's level training in the region and to organise themes of courses. The former bilateral programme in Costa Rica successfully introduced a number of regional courses that may be extended to a regional programme and coordinated with regional courses arranged by other bilateral programmes. The Master's and regional courses should, if possible, be given in CA, if necessary with Swedish and other foreign teachers in the start up phase. The CIDA sponsored Master's courses in water resource management is a good example on how CA teachers gradually take the full responsibility for the teaching. PhD candidates should be given the opportunity to supervise Master's theses.

10.3.4 New equipment

Some of the research training will be database analysis oriented, e.g. surveillance, and the other may be more oriented towards acquisition of data by measurements. The conditions for acquisition of chemical, physical, and biological data are, with notable exceptions, poor, not to say very poor, and this direction of research training must be built up with basic analytical equipment as well. It would not be very wise to design the build up such that all universities momentarily install the same equipment, but equipment decisions must be preceded by discussions in the programme and its council about priorities and specialisations in analytical capabilities among the universities and working groups. I have no doubts in the rationale of using a regional programme to build up a capacity for chemical, biological, and physical analyses, but the build up must be guided by a strategy in which the requirements for equipment arise from specified, cooperative research projects and training courses, among which a programme council makes selection decisions. The build up of equipment may be organised such that SAREC specifies a yearly amount of equipment support to a programme. In the process of defining cooperative research projects, the programme council identifies working groups that are qualified to prepare proposals for some of the main equipment needed in the research projects. The council must consider a regional symmetry in the selection process and ensure that the receiving university has the physical facilities and personnel to operate and maintain the equipment. A contract must be written between the council and the university receiving the equipment, specifying the conditions for use, e.g., supporting the regional programme, the fee users have to pay for the analyses, and the rules for using the equipment for external commissions.

10.3.5 Research based teaching

All undergraduate university teaching is supposed to be linked to research. A regional programme can contribute to that goal in at least two ways. One would be to organise courses on new approaches for teaching environmental and health aspects in undergraduate courses. The courses can be combinations of theoretical introductions and practical field and laboratory exercises. A second contribution would be at the council and manager level, who can take initiatives to stimulate faculties and schools to reform their course structure so that environmental and health sciences are offered as powerful and society applied teaching programmes. A regional programme may even initiate working groups from the programme and teaching courses, with the purpose of suggesting specific steps of development of e.g. environmental teaching at a university. The promotion of research-based teaching is an important investment in building a research capacity since better undergraduate courses in the disciplines will improve the competence of graduated students that can be recruited to research training. This is also an argument for linking the Master and PhD students of a regional programme to intermittent, time-limited undergraduate teaching at their universities.

10.3.6 User-friendly projects

A regional programme may want to develop a methodology by which a renewed and improved research capacity can be used to solve environmental and health problems at the local community level. This may be considered as an extension and solidification of links that already exist between the universities and local community or new links, in which university expertise on environmental and health aspects work together, across the national borders, to solve a problem that, so far, was not approached by a university. The problem definitions may be developed in cooperation between users of the knowledge and the university teachers, and the research plans for solutions reviewed by the panel of supervisors. I imagine that teachers that have passed the research school and one or two postgraduate courses, e.g. arranged by a programme, may give a professional input to problem solving, and that the experience the teachers get from these project, especially when different expertise cooperate, is a rational and cheap investment into building research capacity. When the local user is a private, profit-making organisation, rules for co-funding of the research should be developed. The reports from a user-friendly project can be used as part of a more formal academic training, e.g., MSc and PhD, but can be published locally, after scientific reviewing by a PhD within or outside a regional programme.

10.3.7 PhD training

The most advanced investment of a regional programme would be the PhD training. It is a long-term commitment and the most expensive potential activity. The processes of selection, performance, and return are equally important and need much support and ingenuity to be successful. It is difficult to find better and more qualified final functions than a PhD as a basis to build research capacity at a university, so even if the investment is expensive and may fail, it is necessary. The costs can be reduced in cases where present PhD's in the region can be engaged as co-supervisors and in that way contribute to an earlier independence of the capacity building. Yet, the next 10–20 years will probably see a major input of Swedish supervisors in the capacity building, but the PhD's will hopefully gradually take over as supervisors so that the support for capacity building will take other forms.

The selection process refers to candidates as well as research problem. Potential candidates can be selected from their performance in the Research School, English course, Regional courses, and Master's thesis. Those that are suggested and selected must have a long-term commitment with their home university, and the university must present a plan by which they demonstrate how the PhD will be given authority and challenges to develop teaching and a research profile at the return. The evaluation of potential candidates by the Swedish supervisors is important. A contract must be drawn up between the student and the programme and home university, in which all benefits for and claims on the student are expressed to ensure that all students are treated equal and that reasonable solutions are given to foreseen problems. The terms of visa applications for the study periods in Sweden must be rationalised by SAREC authorities, so that the present, more than primitive, conditions are replaced by efficient ones, in which the application is submitted and permitted once for the whole PhD period.

Another variable to consider for the selection process is the distribution of candidates among the universities. Regional symmetry is, again, a keyword, and a programme council should also try to select at least two candidates from the same university. Two candidates can cooperate and give more power to negotiations with their home university upon return, so that the training programme will have more impact on the capacity building at the university than a single, lonely PhD. The Swedish supervisors will have a main responsibility to promote social and scientific cooperation between candidates from the different universities, at least during the study periods in Sweden, but the programme council must take the responsibility to promote cooperation between the students in CA, e.g. by joint, multidisciplinary field work, by workshops at which the students discuss their achievements, and by granting the students to work at each other's university.

The research problems for the PhD candidates should be scrutinized and evaluated with the same sensitivity and professionalism as the candidates. The selection may use a number of qualifiers, e.g., the societal (environmental, health) relevance of a problem, the specific competence and area of research interest, present or foreseen, of the group from which the candidate is recruited, and possibilities to integrate health and environmental aspects, and the council should make efforts to coordinate the work by each student to one geographic area. That approach would help to glue the programme together – all participants would feel that they share at least one interest in the programme, namely the progress of research in the geographic core area, and programme meetings would always have a reasonable probability to find unifying discussion subjects from the work in that area. The supervisors should engage themselves to ensure a high scientific quality and detail resolution of the study plans and projects descriptions.

The popular sandwich model has its vindicators and critics, and this report is not meant to compare and evaluate advantages and disadvantages. As long as other approaches are not demonstrably superior, the sandwich model can be used with flexibility. There are obviously social and economic consequences of the stay in Sweden for candidates with families and certain privileges from their home university that should be carefully addressed. One of the major challenges of the sandwich model is the work condition for candidates at their home universities. There are numerous holdbacks for the work, reducing the efficiency of the scientific process and delaying the studies. In exceptional cases, the efficiency of the PhD training with respect to the individual and the capacity building may be higher if the candidate stays less than 50% of the time at the Swedish university.

10.3.8 Proposal training

In the best of worlds, a new PhD will establish a core of research, research training, and inspiration source for teachers. A necessary condition for the establishment is a successful application for external grants. A PhD candidate must learn to identify potential sources of grants (an extensive list of granting agencies for CA can be found at <http://www.netropica.org>) and practice on preparation of proposals. This can be accomplished via a training course for a whole group of PhD candidates and by individual practices. The programme should have a couple of Swedish proposal mentors that assist and advice the individual PhD's in their first efforts to submit applications. Although individuals may successfully apply for research grants, there are good reasons to abandon the individual approach. First, the probability of being successful increases with the number of active proposal participants, as long as they represent independent and complementary scientific expertise, joining for a common goal. Second, the probability of sustainability of the research increases with the number of project participants.

Successful research needs a critical mass and that can be achieved by cooperation between a PhD graduated from a regional programme and colleagues within the same scientific discipline or a different discipline. Third, a regional dimension can be maintained in a cooperative project between different universities that use its others resources.

10.4 Tools for sustainability of a programme

10.4.1 Communication

All written documentation (project proposals, course programmes, contracts between participants and programme council, activity reports, etc) must be in English, simply because this language is presently the international language of science. In communicating with society, undergraduate courses, etc., translation to Spanish should be made. Oral presentations and discussions of project plans, results, etc, must be in English, as a necessary exercise in the foreign language. Other discussions, e.g. at council meetings, may be in Spanish.

SAREC must be approached with a strategy plan for a regional programme. A first plan should present the conceptual structure and function of a programme, a timetable, and a well-motivated budget idea. If the plan is approved by SAREC, partly, in revised form, or entirely, a more detailed operational plan for the first years of build up should be submitted to SAREC.

I have a strong feeling that there is a need for much more discussions of a potential programme among potential participants in the region. I realise that the number of schools, departments, teachers, etc that may be interested in influencing a programme plan is far larger than represented in this evaluation. They must first be identified at the different universities and encouraged to make their voices heard. This can be done stepwise. For instance, each university may be asked to elect a university coordinator for programme planning. All coordinators get the same, written instruction for their function, including the task of preparing a report (in English), reflecting the views and opinions of the teachers that were interested in making their voices heard. After the deadline for report submitting is passed, one or more workshops are organised to prepare drafts for a strategic plan. The workshop can invite all identified teachers or only the local coordinators and the Swedish counterparts. Regardless of the procedure, the local coordinators are instructed to organise local meetings to discuss and comment the drafts for a strategic plan. The grant approved by SAREC in 2003 for the bridging phase of the bilateral Costa Rica programme may still suffice to cover the expenses.

10.4.2 Regular workshops

In addition to information exchange on a web home page, a regional programme should have regularly scheduled workshops. Programme participants must attend the workshop to report and discuss their achievements and plans, but the workshops should be organised such that a different university is the host each time. The local organisers may compose a workshop programme, in which local teachers, who are not engaged in the programme, are given the opportunity to present and discuss their recent scientific achievements. This open-to-local-university-community approach of workshops may be a way for the programme to be recognised in the region.

10.4.3 Activity carrots

Strict rules for performance evaluations must be applied within the programme and I prefer the carrot variety. That means that each time a programme council approves an activity, a contract must be drawn up in which achievements and a time schedule are specified. In case the applicant(s) fails to achieve the results on time, without good reasons, the activity is supported until it is finished. Applicants that manage to achieve the results on time may be offered to apply for more activities. As an example, a group of organisers of a Master's training programme may be asked to repeat the programme once more or organise one more activity if the promise to pass 75% of the participants through the courses during the first of the two years was fulfilled. If less than 75% passed the examinations, the group would still be supported a second year, with extra attention paid to raise the turnover. Likewise, a university faculty may be asked to introduce one more PhD student in a training programme if their first candidate finished the Philosophy of Licentiate degree (halfway to PhD) on schedule. If the first candidate was delayed, the support may be extended until the PhD degree is achieved but the faculty will not have the option for another candidate. Hopefully, this carrot approach will encourage the local faculty to actively support their participants in the programme.

10.4.4 Conditions of responsibilities

Contracts must be drawn up between 1) participants and the programme council, 2) participants and their home university, 3) participants and the Swedish counterpart, 4) the programme council and the home universities of the participants, to define the conditions of the activities. All participants in e.g. MSc and PhD training must be entitled to the same rights and duties, for instance on insurance, scholarship, pay-back teaching after the training is over, which must be explicitly expressed in the contracts.

With a sandwich model of training, the participants need agreements with their home faculties for conditions on leave and replacement, for working conditions while at their home university, etc. The Swedish university law for PhD training should normally cover the formal agreements between participants and the Swedish counterpart. The programme council may want to make agreements about the local support of participants with the host universities, to promote work conditions in general for participants during the stay at their home university.

10.4.5 Cooperation with other programmes

SAREC already supports bilateral research training programmes on health and environment in Nicaragua, the Canadian CIRA supports a network on water resource management between Costa Rica, Nicaragua, and Guatemala, and there are probably several other programmes, each with a number of postgraduate training activities. It is advisable that a regional programme cooperates with other programmes in the region, especially on courses and fieldwork. Presently, there seems to be very little exchange of information between the programmes, for reasons that are not obvious to me.

10.4.6 Regional research council

Universities that already receive SAREC support, e.g. in Costa Rica and Nicaragua, become dependent on this support also after the programme goals have been achieved. One of the main reasons is the limited number of research grant sources available in CA. This raises the question about a regional research council for environment and health sciences. It is indeed beyond the responsibility of SAREC support but the sustainability of the SAREC investment into building a research capacity seems to be heavily dependent on the research funding conditions after the build up period is over. The process of creating a regional research council will probably be tedious and trying, but SAREC may want to encourage Sida to start discussions and negotiations with national education ministries and potential funding sources (US, EU, etc), with the goal to create a regional research council in environmental and health sciences.

10.5 Concluding recommendations

The impact of research on environment and health in CA on the international scientific society is very low. That is evident from the low number of publications in international databases, such as Web of Science, and the low number of citations of authors with a home address at the public CA universities. The responses to the questionnaires in this evaluation have the same clear message. Since all of the interviewed representatives for the universities justify an interest in building a research capacity, one of the two most important conditions for a SAREC support seem to be fulfilled.

The second important condition is that of feasibility. This condition has many dimensions or bottoms, some of which I have already discussed at different lengths in the evaluation. SAREC will have to take a risk of failure here, but my experience from similar situations in the past suggests that the risk will be reasonably low if strict control is applied to the management and equal opportunity of coordination and if a programme is gradually developed, conceptually as well as practically. I have already given suggestions for timing of certain events in developing the programme, but let me repeat some of the initial events, itemized:

- Application of a strategy plan for a programme, including the management structure, a timetable, and a tentative budget. Hopefully, the bridging phase grant is available for the initiation of local university discussions and regional workshops, as I have suggested.
- A strategy plan should pay special attention to the regional dimension and identify activities that promise to be more efficiently supported on a regional level than on a bilateral. The strategy plan

must specify the objectives of a programme (what are the priorities and why?) and the expected impact of a programme on environment and health activities at each of the participating universities. The strategy plan must also contain a declaration of the counter support by the universities.

- SAREC makes an intentional decision on a regional programme. If a strategy plan is accepted after revision, SAREC should give a frame decision on a programme, including a statement about a total possible granting for a first build up period.
- Programme manager(s) and council members are appointed and start the detailed planning of a programme. The overall plan must contain the management plan, with detailed instructions, the functions of one or more programme council, the procedures for communications within the programme, agreements between the programme and the university officials, and the programme activities for the first period.
- SAREC evaluates the detailed proposal and, after revision, allocates the budget for the first period. A regional unit, such as an international aid bank, or CSUCA, or a consultant company for which the programme pays a part time salary, should supervise the management of the funds. Individual universities are not an alternative, partly because they are known to be inefficient in research grant management, and partly because it would be destructive and inefficient for the programme to have all participating universities reporting to the programme management. Following the decision, SAREC officials start specific discussions with e.g. Sida representatives to prepare for cooperation in CA on e.g. local field activities and for the establishment of a regional research council. SAREC should also develop a scheme for the evaluation of a regional programme so that the payback of a regional and a bilateral programme, preferably in the same region, support can be compared.

11. References

Environmental and health research in Central America. Proposal for research and research training activities. Central American Institute for the Studies on Toxic Substances (IRET). January 1999–December 2001. DNR 1998–3598. References therein.

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Sida. Stöd till programmet “Toxic substances in Central America: health, environment, and development.” Beslut 2003-02-20. DNR 2002–4141.

12. Appendices

Appendix 1. Questionnaire responses from UNAH.

University as a knowledge base	Medicine &Nursery	Biology	Microbiology
What activities have been accomplished during the past 5 years to transfer knowledge on environmental and health issues from the university to society?	Teachers have helped to develop manuals for health regulations at Ministry of health. Teachers suggest improvements of norms, but normative rules are rarely followed. Teachers have also given advice for coordination of work at ministries of environment and health.	Participation in various workshops and seminars promoted by the government and civil organisations. Popular science presentations during the "scientific weeks" of UNAH	At least 76 research projects were developed in the last 5 years related mainly with human health, epidemiology and development of technology. The majority of them have been a basis to the transfer of knowledge to the society.
What inquires have been received on information on environmental and health issues from local and national government authorities during the past 5 years?	Prevention of accidents; Infections and transmission of sexual diseases; Uterus cancer; Models for healthcare; Logistics for health care	Evaluation of the extent of water pollution and its control	Some technologies have been transferred and training has been given to professionals of the discipline.
What improvements of national legislation and regulation of environmental and health issues have been realized during the past 5 years by initiatives and knowledge support from the university?	University teachers have been involved in promotion and prevention work related to national legislation and regulation of environmental and health issues, e.g. Members of a national technical committee dealing with regulation of toxic substances.	Participation in the National Technical Water Committee to develop quality norms for tap water, sewage discharge and the use of water resources. Presently, advice is given to the realisation of the norms for tap water.	
What is the strategy/plans for knowledge transfer on environmental and health issues from university to society for the forecoming 5 years?	The plans are revised and suggested to include e.g., The role of projects on health promotion and Socialisation of research results. Another project is to create a National Centre for Research in Toxicology, with support from the government and other national and international sources.	No strategy/plan but participation in the Water Committee continues.	

Undergraduate training

What are the subjects of teaching and their proportions at the undergraduate level? (it would be fine with a page showing the structure of the teaching program, e.g., in a flow chart, which may be complemented with proportions, i.e., number of study weeks and typical number of attending students)	The undergraduate training programme is presently under revision.	botany, zoology, ecology, water resources, management of resources.	See figure
What environmental and health science topics are covered in classes? (here it would be preferable to have a recent schedule (in Spanish) from teaching environmental and health science at various levels)	The postgraduate training in nursery has 3 special topics: Family health, Integration of infant and youth health care	pollution (water, air, soil, biota) effects on health and environment, pollution control laws and legal norms related to environment and health.	
What are the total number of students attending undergraduate training, and the numbers studying environmental and health oriented subjects during the last 5 years?	10 students participate in the special training on Integration of infant and youth health care	about 250 in the career of biology	graduates: 150 in 5 years
What are the percentages of students enrolled in undergraduate education that passed the various examination degrees (bachelors, masters, etc) during the last 5 years?		5-10%	
What are the plans for the next few years for teaching on environmental and health issues (e.g., for changing recruitment, structure of teaching programme)?	For the forthcoming year a special training of operations nurses is planned. For the future the concepts of environmental and ecological health will be considered.	Development of Master's programme in Environmental sciences, with emphasis on environmental assessment and control.	
Master's training			
What Master's programmes are given, what is the financial source, how many students are enrolled and how many received the degree the last 5 years?		Public health in faculty of medicine, risk management in faculty of engineering.	No master program is offered in our academic unit.
What international Master's programmes are given in environmental and health sciences (programme located at your university but with students from other universities and with a major contribution from foreign teachers)?		None	

What Master's programmes abroad did your students of environmental and health sciences attend the last 5 years, how many of your students went abroad to obtain a Master's degree in environmental and health sciences? Known destinations of Master's students in environmental and health sciences (Government services, management, hospitals, high school teacher, consultant, etc)? Titles of last 5 years of Master thesis within environmental and health sciences?	Master's programme in occupational health started in 2002 supervised by a Cuban university.	None	
What are the plans for the next few years for programmes on environmental and health sciences?	Master's programme in epidemiology planned for forthcoming year.	Development of Master's programme in Environmental sciences	One suggested in microbiology. Hopes for Master's in biotechnology, hematology, clinical microbiology.
PhD training How many of the staff members of environmental and health sciences were enrolled in a PhD training programme during the last 5 years? What organisation was the host of the programme and who paid for the training? How many percent of their full time were staff members engaged in PhD training programmes? How were they replaced in faculty while they attended the PhD programme? Known destinations of PhD's in environmental and health sciences (Government services, management, hospitals, high school teacher, consultant, etc)? If the PhD's stayed at the university - what tasks were they offered? What are the plans (needs, dreams) for the next few years for PhD training programmes in environmental and health sciences?		None	We have a PhD student in a sandwich type programme with the University of Nijmegen (Netherlands).

Research

What research projects have been carried out in environmental and health sciences during the last 5 years?	Research priorities are defined by the unit for Scientific investigations at UNAH and projects realised within the departments	Several studies on water quality	
What research funding has been raised in environmental and health sciences in the last 5 years and what are the sources of those funds?		Support from governmental agencies, GEF	
What proportions, on average, of the research funds have been used to cover expenses for salary, consumables, equipment, and administration?		None	
For faculty staff members that received research funding - how much of their total work time (approximate range in %) were allocated to research activities?		For GEF support about 40%	
What research projects in environmental and health sciences include collaboration with a) other faculties within the university, b) other national universities, c) other CA universities, d) other international universities?		None	
What activities were accomplished at the university during the last 5 years to stimulate staff members interest in research and development?	Scientific journals and an acknowledgement of research active persons are offered.	The stimuli are very few. There is no institutional strategy to stimulate staff members.	
What are the plans for the next few years for research in environmental and health sciences? What areas of the research field do you want to develop, how may fund raising improve, how about collaboration and organisation of infra-structure?	Prioritize the area of environmental health and reinforcement of one of the present activities	Plans to prepare project proposals on chemical pollution and metals for external funding	Several research projects are developed at the moment related to the areas of health and environment. The duration of these projects varies. Some of them are long term. The areas that would interest us to develop would be those related to ground water microbiology, biotechnology, toxicology, and others. The grants would be beneficial in the development of research, since one of our main limitations is in the equipment and reagents Our academic Unit has a long record of collaboration with foreign organizations and universities, in such a way that we are open to the

possibility of participating in any regional or international program of development. Our university collaborates with counterpart of the infrastructure and salary of the researches.

Staff members

How many staff members are there in environmental and health sciences? What (approx.) percentage of them are below 40 and above 60 years old?	35 staff members; 15% younger than 40, 9% younger than 60, 5% older than 60.	38; 8 in research and 30 teachers. 10% are below 40, 5% above 60.	All the personnel of the Microbiology Department (28 teachers) are involved in the area of health sciences.
How many of those staff members have a final degree as a) bachelor, b) licentiate, c) master, d) PhD?	Magister: 6; "Especialistas": 6; Licentiates: 23.	Research: 1 licentiate, 5 masters, 2 PhD; teaching: 25 licentiate, 5 masters	Licentiates: 11 Master: 13 PhD: 4
What scientific papers were published during the last 5 years by faculty staff members in environmental and health sciences? (this refers to official journals in CA or other international journals, in Spanish or English)	On average 4 publications per year in Spanish	None	The list of research works is found in Appendix 1.1. At the moment we do not have the list of which of these research works have been published.
What Master's theses were supervised by staff members of environmental and health sciences during the last 5 years?		None	
What specific activities are planned for the next few years to stimulate the academic development of staff members in environmental and health sciences?	The current teaching reform at UNAH encourages teachers to earn higher degrees, e.g. Master's and PhD, since they then will become better teachers.	Participation in training workshops.	UNAH has presented a new strategy for competence build-up by education for higher academic degrees, but no special incentives are given.

Proposed research capacity building programme

What major effects do you expect the proposed long term research capacity building programme will have on environmental and health sciences activities at your university?	Hope that the programme will give equal opportunity to all participating universities to support research training. The faculties would especially like to establish competence in toxicology.	Stimulate research on chemical pollution and metals.
What are the most important benefits for your university of the regional approach of the programme?		
What improvements would you suggest be made to the current proposal to better satisfy the needs at your		

university - another focus,
other activities, another
organisation, etc?
What are the major
limitations at your university
for a successful participation
in the programme?

Lack of financial resources,
personal with specific
competence, and
institutional support

Financial administration, lack
of equipment and resources.

Recuento de proyectos de investigación del Departamento de Microbiología, UNAH 1999–2003

Dr. Gustavo Adolfo Fontecha S.

Comité de investigación y extensión 2003

Sección	Proyecto		Invest.	Institución Cooperante
Virología	Etiología viral en infecciones respiratorias agudas	Viral etiology in acute respiratory infections	Ivette de Rivera	
Virología	Resultados preliminares sobre seroprevalencia de Hantavirus en la comunidad de Marcovia, Choluteca 1998-1999	Preliminary results on seroprevalence of Hantavirus in the community of Marcovia, Choluteca 1998-1999	Ivette de Rivera, Gustavo Fontecha, Vilma Espinoza	New Mexico State University
Virología	Alta frecuencia de infección con el virus linfotrópico humano en grupos de riesgo en Tegucigalpa	High frequency of infection with the human linfotropic virus in risk groups in Tegucigalpa.	Ivette de Rivera	Secretaria de Salud Pública
Virología	Evaluación de dos pruebas de Laboratorio para el diagnóstico de rotavirus	Two tests laboratory evaluation for the diagnosis of rotavirus.	Ivette de Rivera	Abbott Laboratories
Virología	Resultados preliminares sobre la estandarización de la prueba molecular PCR para la diferenciación de HTLV-I y HTLV-II	Preliminary results on the estandarización of the molecular test PCR for the differentiation of HTLV-I and HTLV-II	Ivette de Rivera	Cruz Roja Hondureña, Abbott Laboratories
Virología	Validación de un PCR anidado para la detección y diferenciación de HTLV-I y HTLV-II	Validation of a PCR nested for the detection and differentiation of HTLV-I and HTLV-II	Ivette de Rivera	Cruz Roja Hondureña, Abbott Laboratories
Virología	Detección sensible y específica del ADN del VIH-I en muestras de sangre en papel filtro por medio de PCR para el diagnóstico en infantes	Specific and sensitive detection of the DNA of the VIH-I in blood samples in filter paper through PCR for the diagnosis in infants	Ivette de Rivera	UNICEF, PAHO, Ministerio de Salud Pública, NWMT
Virología	Prevalencia de anticuerpos contra Hantavirus en áreas rurales de la región central de Honduras	Prevalence of antibodies against Hantavirus in rural areas of the central region of Honduras	Ivette de Rivera V. Espinoza	NMSU, PAHO
Virología	Asociación entre serología y PCR en el	Association among serology and PCR in the	Ivette de Rivera	

	diagnóstico de la infección por VIH en neonatos	diagnosis of the infection by VIH in neonates		
Virología	Caracterización biológica y química de un extracto de plantas con actividad antiviral contra virus Herpes Simplex y su mecanismo de acción	Chemical and biological characterization of plants extract with antiviral activity against virus Herpes Simplex and its mechanism of action	Claudia Lara, Carmen Galo	
Virología	Producción de antígeno de dengue a partir de cultivos celulares	Production of dengue antigen from cell culture	Ivette de Rivera	
Virología	Prevalencia de infección por VIH-1 en mujeres postparto y tasa de transmisión vertical en el Hospital Escuela de Honduras	Prevalence of infection by VIH-1 in postpartum women and vertical spreading rate at the School Hospital of Honduras.	Ivette de Rivera	
Virología	Prevalencia de infección por HTLV en diferentes grupos de población de Tegucigalpa, Honduras	Prevalence of infection by HTLV in different groups of population of Tegucigalpa, Honduras	Ivette de Rivera, Ekaterina Bonilla	
Virología	Determinación de subtipos de VIH-1 circulantes en Honduras	VIH-1 subtypes determination in Honduras	Ivette de Rivera	
Virología	Comparación de dos pruebas serológicas para el diagnóstico de dengue	Two serology tests comparison dengue diagnosis.	Ivette de Rivera	
Virología	Prevalencia infecciones por <i>Chlamydia trachomatis</i> en la población femenina del Hospital Escuela en Tegucigalpa	Infections prevalence by <i>Chlamydia trachomatis</i> in the female population at The School Hospital in Tegucigalpa	Ivette de Rivera	Abbott Laboratories
Inmunología	Estudio de comunidades microbianas del suelo	Study of the soil microbial communities	Jorge Carrasco	Programa de certificación de semillas, secretaria de Recursos Naturales
Inmunología	Desarrollo y estandarización del PCR-IS1533 para detectar y diferenciar serovares de <i>Leptospira interrogans</i>	Development and standardization of the PCR-IS1533 to detect and differentiate serovares of <i>Leptospira interrogans</i>	J. Carrasco	Instituto Hondureño de Investigaciones Veterinarias
Inmunología	Desarrollo y estandarización del <i>nested/multiplex</i> -PCR para diagnóstico de malaria	Development and standardization of the <i>nested/multiplex</i> -PCR for malaria diagnosis	J. Carrasco	PAHO, Ministerio de Salud Pública
Inmunología	Desarrollo y estandarización de captura de antígeno y anticuerpos mediante ELISA	Development and standardization of capture of antigen and antibodies by means	J. Carrasco	Programa ampliado de inmunizaciones, Secretaria de

	para el diagnostico de tosferina	of ELISA for the I diagnose of tosferina		Salud Publica
Inmunología/ Bacteriología	Implementaron y estandarización de una prueba de ELISA para el diagnostico de <i>Leptospira</i>	Implementation and standardization of a ELISA test for the diagnose of <i>Leptospira</i>	J. Carrasco, Lelany Pineda	INDRE-Mexico, Instituto Hondureño de Investigaciones Veterinarias
Inmunología	Implementación y estandarización del <i>nested</i> PCR para diagnosticar mancha blanca en el camarón	Implementation and standardization of a <i>nested</i> PCR for the diagnose stains white disease in the shrimp	J. Carrasco	Camaronera Santa Inés
Inmunología	Estudio de comunidades microbianas del suelo. II. Suelos contaminados con químicos experimentalmente	Study of soil microbial communities. II. Contaminated soil with chemists !!!experimentally?	J. Carrasco	Programa de certificación de semillas, secretaria de Recursos Naturales
Inmunología	Estudio de comunidades microbianas del suelo. III Suelos cultivados con plantas transgénicas	Study of soil microbial communities. III. Soil cultivated with transgenic plants.	J. Carrasco	Programa de certificación de semillas, secretaria de Recursos Naturales
Inmunología	Desarrollo y evaluación de un marcador genético RAPD-PCR para diferenciar poblaciones e individuos de <i>Triatoma dimidiata</i>	Development and evaluation of a genetic marker RAPD-PCR to differentiate individuals and populations of <i>Triatoma dimidiata</i>	J. Carrasco	Netropica
Inmunología	Comparación genotípica (RAPD-PCR) de <i>Triatoma dimidiata</i> proveniente de Honduras y Guatemala	Genotypic comparison (RAPD-PCR) of <i>Triatoma dimidiata</i> from Honduras and Guatemala	J. Carrasco	Netropica
Inmunología	Evaluación molecular e interacción biológica entre <i>Dendroctonus frontalis</i> y <i>Pinus</i> sp.	Molecular evaluation and biological interaction among <i>Dendroctonus frontalis</i> and <i>Pinus</i> sp	J. Carrasco	COHDEFOR
Inmunología	<i>Leptospira</i> sp. aislado de muestras de agua e identificados como <i>Leptospira interrogans</i> mediante PCR-IS 1533	<i>Leptospira</i> sp. Water sample isolation and identifying as <i>Leptospira interrogans</i> by means of PCR-IS 1533	J. Carrasco	Instituto Hondureño de Investigaciones Veterinarias
Inmunología	Estudio de comunidades bacterianas del suelo: IV, suelos cultivados con soya transgénica (tolerantes a herbicidas) y soya no transgénica	Study of soil bacteria communities: IV, soil cultivated with transgenic soya (tolerant to herbicides) and with no transgenic soya.	J. Carrasco	Programa de certificación de semillas, secretaria de Recursos Naturales
Inmunología	Arqueogenética y la historia de la población maya en Mesoamérica.	Archeogenetic and the Mayan population history in Mesoamerica.	J. Carrasco	

Inmunología	Producción de proteínas excretoras/secretoras de <i>Taenia solium</i>	Excretory and secretor proteins production in <i>Taenia solium</i>	J. Carrasco, Maritza Canales	
Inmunología	Desarrollo y estandarización de múltiplex PCR para detectar ADN de <i>Plasmodium vivax</i> y <i>P. falciparum</i>	Development and standardizations of multiplex PCR to detect <i>Plasmodium vivax</i> and <i>P. falciparum</i> DNA.	J. Carrasco	PAHO, Ministerio de Salud Pública
Inmunología	Implementación de la captura rápida de antígeno mediante OptiMAL test	Implementation of the quick capture (recovery maybe) of antigen by means of OptiMAL test	J. Carrasco	PAHO, Ministerio de Salud Pública
Inmunología	Identificación genotípica de <i>Escherichia coli</i> mediante PCR del gen ARNr 16S en aislados de porcinos recién nacidos	Genotypic identification of <i>Escherichia coli</i> by means of PCR of the gene ARNr 16S in recently born pork.	J. Carrasco	IHIV
Inmunología	Detección y caracterización de <i>Xylella fastidiosa</i> en café de Honduras	Detection and characterization of <i>Xylella fastidiosa</i> in Honduras coffee	G. Fontecha, Lourdes Enríquez	IHCAFE
Inmunología	Limitada diversidad genética en aislamientos de <i>Plasmodium falciparum</i> de Honduras	It limited genetic diversity in isolations of <i>Plasmodium falciparum</i> of Honduras	Irma Enamorado J. Figueroa	
Bacteriología	Diagnostico de leptospirosis en humanos	Leptospirosis diagnose in humans	Reina Rivera	INDRE-Mexico
Bacteriología	Investigación de <i>Listeria monocytogenes</i> en quesos de tipo artesanal	<i>Listeria monocytogenes</i> research in craft type cheeses.	Sandra Hernández	
Bacteriología	Comparación de fragmentos moleculares de cepas de <i>Mycobacterium tuberculosis</i> aislados en Honduras y Guatemala	Comparison of molecular fragments from <i>Mycobacterium tuberculosis</i> strain collected from Honduras and Guatemala	L. Pineda	
Bacteriología	Seroprevalencia de anticuerpos contra <i>Leptospira interrogans</i> en poblaciones con actividades ocupacionales de alto riesgo	Seroprevalence of antibodies against <i>Leptospira interrogans</i> in high risk activities populations.	L. Pineda, R. Rivera, R. Rivera	
Bacteriología	Detección y aislamiento de <i>Leptospira</i> sp. a partir de roedores selváticos	Detection and isolation of <i>Leptospira</i> sp. from forest rodents	R. Rivera	
Bacteriología	Eficacia del hipoclorito de sodio 1% como desinfectante en cavidades en pacientes que reciben tratamiento de operatoria dental	Efficacy of sodium hypochlorite (1%) as disinfectant in patient's cavities that receive dental operation treatment.	L. Enríquez	Facultad de Odontología, UNAH
Bacteriología	Prevalencia de anticuerpos contra	Prevalence of antibodies against <i>Leptospira</i>	R. Rivera,	

	<i>Leptospira interrogans</i> en trabajadores de alcantarillados de la ciudad de Tegucigalpa	<i>interrogans</i> in sewer workers from Tegucigalpa city.	R. Rivera, L. Pineda	
Bacteriología	Evaluación de la calidad sanitaria e inocuidad de los quesos artesanales distribuidos en los mercados capitalinos	Sanitary and quality evaluation of the craft cheeses distributed in the city markets.	S. Hernández	
Bacteriología	Reducción de nitratos, un método alternativo de prueba de susceptibilidad a drogas de <i>Mycobacterium tuberculosis</i> . Resultados preliminares	Nitrate reduction. An alternate method for testing drugs susceptibility of <i>Mycobacterium tuberculosis</i> . Preliminary results	L. Pineda	
Biología Molecular	Seroprevalencia de Citomegalovirus en diferentes grupos poblacionales de Tegucigalpa	Seroprevalence of Citomegalovirus in different populations groups from Tegucigalpa	Annabelle Ferrera, Miriam Arias	Netropica
Biología Molecular	Incremento de riesgo de neoplasia cervical en mujeres infectadas con HPV en Honduras por la quema de leña en la cocina	Cervical neoplasia risk increment in HPV infected women in Honduras by using wood as fuel in the kitchen.	A. Ferrera	Comunidad Europea
Biología Molecular	Diagnóstico del virus de la mancha blanca en camarones utilizando la reacción en cadena de la polimerasa	White spot virus diagnostic in shrimps using the polymerase chain reaction.	A. Ferrera	Camaronera El Faro
Biología Molecular/ Bacteriología	Detección molecular y bacteriológica de <i>Escherichia coli</i> O157:H7 en carnes de res en Tegucigalpa	Bacteriological and molecular detection of <i>Escherichia coli</i> O157:H7 in cow meat in Tegucigalpa.	A. Ferrera, L. Enríquez	Laboratorio Internacional
Biología Molecular	Prevalencia de infecciones cervicovaginales por <i>Chlamydia trachomatis</i> y el virus del papiloma humano en población estudiantil y mujeres embarazadas	Cervical-vaginal infections prevalence by <i>Chlamydia trachomatis</i> and the human papiloma virus in student population and pregnant women.	A. Ferrera	Universidad de Nijmegen, Holanda, Abbott laboratories
Biología Molecular	Implementación de un modelo para la obtención de un control positivo de virus cabeza amarilla en camarones	Implementation of a model to obtaining a positive control of yellow head virus in shrimps	A. Ferrera	Universidad de Baja California
Biología Molecular/ Bacteriología	Detección de <i>Vibrio cholerae</i> serotipo O1 toxigénico en aguas residuales de zonas hospitalarias en Tegucigalpa	<i>Vibrio cholerae</i> serotype O1 detection in sewer water from hospital areas in Tegucigalpa.	A. Ferrera L. Enríquez	

Biología Molecular	Virus Herpes Simplex y enterovirus como agentes causales de encefalitis aguda en pacientes del Hospital Escuela-Materno Infantil	<i>Herpes simplex</i> and enterovirus as responsible for acute encephalitis in patients from the Materno-Infantil School Hospital.	A. Ferrera	PAHO
Biología Molecular/ Bacteriología	Detección de <i>Escherichia coli</i> O157:H7 en muestras ambientales usando técnicas moleculares e inmunocromatográficas	Detection of <i>Escherichia coli</i> O157:H7 in environmental samples by using molecular and immunochromatograph techniques	A. Ferrera L. Enríquez	Laboratorio Internacional
Biología Molecular	Detección del virus del papiloma humano y <i>Chlamydia trachomatis</i> en mujeres embarazadas de Tegucigalpa utilizando métodos moleculares y serológicos	Human papiloma and <i>Chlamydia trachomatis</i> detection in pregnant women from Tegucigalpa by molecular and serologic methods	A. Ferrera	Universidad de Nijmegen
Biología Molecular	Genotipos circulantes de Citomegalovirus en diferentes grupos poblacionales de Honduras y Costa Rica	Circulates genotypes of Citomegalovirus in different populations groups from Honduras and Costa Rica.	A. Ferrera	Netropica
Biología Molecular	Predisposición genética y alto riesgo de carcinoma de células escamosas del cérvix en mujeres hondureñas	High risk and genetic predisposition of cervix scaly cells carcinoma in Honduran women.	A. Ferrera	WOTRO (Hollanda)
Biología Molecular	Caracterización de cepas de rotavirus en Honduras y Nicaragua	Rotavirus strain characterization in Honduras and Nicaragua	A. Ferrera, D. Quan	Netropica
Biología Molecular	Infecciones por <i>Chlamydia trachomatis</i> y virus del papiloma humano genital en estudiantes universitarias de Tegucigalpa	<i>Chlamydia trachomatis</i> and genital human papiloma virus infections in students from university of Tegucigalpa.	A. Ferrera	Universidad de Nijmegen, Abbott labs.
Biología Molecular	Caracterización de helechos mediante RAPD en una plantación de Honduras	Fern characterization by means of RAPD in a Honduras plantation.	A. Ferrera, G. Fontecha	EXVECAM
Biología Molecular	Implementación y estandarización de un multiplex-PCR para la detección de los 4 serotipos del virus del dengue	Standardization and implementation of a multiplex-PCR for the detection of the 4 dengue virus serotypes.	A. Ferrera	Universidad de California
Biología Molecular, Parasitología	Rotavirus epidemiología in Honduras	Rotavirus epidemiology in Honduras	D. Quan, A. Ferrera	Smith Kline
Parasitología	Prevalencia de geohelmintos en escolares de diferentes regiones de Honduras	Geohelmintos prevalence in students from different regions of Honduras	D. Quan, M. Canales	PAHO

Parasitología	Comparación de dos métodos coprológicos para el diagnóstico de teniasis	Comparison of two coprology methods for teniasis diagnosis.	M. Canales	Universidad de Brock, Canadá
Parasitología	Parásitos intestinales en niños de 1 a 15 años de un barrio marginal de la capital	Intestinal parasites in children from 1 to 15 years old from marginal neighborhood	M. Canales	
Parasitología	Artrópodos carroñeros y su aplicación en medicina legal	Scavenger arthropods and its application in forensic medicine.	A. Ciliezar	
Parasitología	Morfología de estadios inmaduros de Diptera Cyclorrapha.	Immature stadiums morphology of Diptera Cyclorrapha.	A. Ciliezar	
Parasitología	Parásitos intestinales en manipuladores de alimentos que laboran en las cafeterías de la UNAH	Intestinal parasites in food manipulators that works at The University cafeteria.	M. Canales	
Parasitología	Evaluación del impacto de la intervención terapéutica para geohelminths en escolares de una población de la zona norte de Honduras	Impact evaluation of the therapeutic procedure for geohelminths in students from a locality in northern Honduras.	D. Quan	
Parasitología	Evaluación externa de la calidad en Parasitología	External quality control evaluation in Parasitology.	D. Quan	CMQCH
Parasitología	Impacto de la educación en salud para el control de <i>Taenia solium</i>	Health education impact for <i>Taenia solium</i> control.	M. Canales	Brock University
Parasitología	Parásitos intestinales en la aldea de Jalaca	Intestinal parasites in the Jalaca village.	M. Canales	Brock University
Bioquímica	Evaluación externa de la calidad en la sección de Química Clínica de los Laboratorios Clínicos del país	External quality control evaluation in the Chemical Clinic section of the Clinical Laboratories of the country.	Ada Zelaya	
Bioquímica	Estandarización de sueros para evaluación externa de la calidad en el Laboratorio Clínico	Serum standardization for external quality control evaluation at the Clinical Laboratory	A. Zelaya	
Bioquímica	Condicionantes de la calidad del laboratorio clínico	Determining of the quality of the clinical laboratory	A. Zelaya	
Bioquímica	Evaluación externa de la calidad en Química clínica y hematología	External quality control evaluation in Chemical and hematology clinic	A. Zelaya, Gina Laitano	

Appendix 2

Response from UES

Las respuestas están organizadas en bloques, según los títulos:

1. interrelación Universidad de El Salvador (UES) y sociedad
2. estudiantes de pregrado
3. entrenamientos de maestrías (MSc)
4. entrenamiento de doctorado (Ph.D)
5. Investigaciones
6. miembros del staff
7. programa propuesto para construir la capacidad en investigación

Tengo pendientes para el lunes enviarle los títulos de las tesis de maestría en desarrolladas por los estudiantes de la maestría en Medio ambiente y recursos naturales, así como los tópicos que desarrollan las especialidades relacionadas con medioambiente y salud.

Desarrollo del cuestionario

A manera de introducción va la siguiente información.

La Universidad de El Salvador cuenta con 12 facultades, a saber:

1. Ciencias y Humanidades (2 escuelas – artes y ciencias sociales, y 6 departamentos: letras, idiomas, educación, psicología, periodismo y filosofía)
2. Ciencias Naturales y Matemática (4 escuelas: química, biología, física y matemática)
3. Ciencias Sociales y Jurisprudencia
4. Ciencias Económicas
5. Medicina
6. Química y Farmacia
7. Ciencias Agrícolas
8. Odontología
9. Ingeniería y Arquitectura
10. Multidisciplinaria de Oriente
11. Multidisciplinaria de Occidente
12. Multidisciplinaria Paracentral

Un dato de interés es la existencia del Ministerio de Medio Ambiente y Recursos Naturales (MARN) de reciente creación. En el sitio www.marn.gob.sv hay información acerca de los documentos e informes emitidos por el Ministerio relativos al estado de algunos recursos naturales del país.

Además existen en el país diversas ONGs relacionadas con Medio Ambiente y Salud, así como instituciones estatales. La UES interacciona con ellas a través de Convenios de Colaboración, además de la participación de los docentes del área en diferentes comisiones estatales relacionadas con el tema de medio ambiente y salud.

La UES desarrolla junto con el MARN diferentes proyectos de investigación, por ejemplo:

“Vigilancia volcánica” – estudio de los procesos de desgasificación difusa de algunos volcanes y conlleva la vigilancia en modo continuo de 5 puntos de la cadena volcánica de El Salvador.

En el marco de colaboración UES-MARN se ha gestado un proyecto para el establecimiento en la UES de un Centro de Investigaciones en Ciencias del Mar. La escuela de Biología centra esta actividad.

La UES tiene además en materia de investigación interrelación con otros organismos estatales como CENDEPESCA – investigaciones relacionadas con los recursos marino-costeros, las cuales se desarrollan con amplia participación de docentes y estudiantes de la Universidad.

Las proyecciones de la UES van encaminadas a la formación de recursos humanos de alto nivel en el área de medio ambiente y es además una de las 7 áreas estratégicas de desarrollo de la Investigación científica y tecnológica de la UES con componentes a corto, mediano y largo plazo.

Estudiantes de pregrado

La UES tiene alrededor de 40 000 estudiantes y 1 300 profesores, y en sus 12 facultades sirve un total de 79 carreras.

La Fac. de Medicina tiene la Licenciatura en Ecotecnología y en los últimos 5 años ha graduado aproximadamente 120 estudiantes en esa especialidad.

En las Facultades de CC Naturales y Matemática, Química y Farmacia, Ciencias Agronómicas e Ingeniería se sirven asignaturas relacionadas con medio ambiente, por ejemplo Química del Medio ambiente. añadir luego otras carreras en las que se obtienen conocimientos relacionados con medio ambiente.

En los últimos 5 años solo 6 estudiantes de pregrado han continuado sus estudios y obtenido su maestría en medio ambiente.

Entrenamientos de Maestría

En la UES existen actualmente 19 Maestrías. Las facultades de Ciencias Naturales y Matemática, Medicina y Ciencias Agrícolas tienen especialidades relacionadas con las ciencias del ambiente y salud:

1. La Fac. de CC Naturales y Mat. tiene un Diplomado en Gestión de Riesgos y una maestría en Medio Ambiente y Recursos Naturales, la maestría tiene menciones en
 - a. Manejo sostenible de los Recursos Naturales
 - b. Gestión de Medio Ambiente
 - c. Manejo sustentable de los recursos marino-costeros

Esta maestría fue aprobada por el Consejo Superior Universitario (CSU) en el año 2001

2. La Fac. de CC Agrícolas tiene la maestría en Agronomía Tropical Sostenible, con menciones en
 - a. Agricultura Sostenible
 - b. Protección Vegetal

La Maestría fue aprobada por el CSU en el año 1999

3. La Fac. de Medicina tiene la Licenciatura en Ecotecnología y la Maestría en Salud, esta última con menciones en
 - a. Salud Pública
 - b. Servicios Integrales en Salud Sexual y Reproductiva

La Maestría de la Escuela de Biología surgió en 1998, organizada por el Dr. Joan Franch, con apoyo de la Universidad Autónoma de Barcelona (UAB): Esta primera Maestría duró 4 años, se impartieron dos módulos de asignaturas por año. La Maestría ha contado y cuenta con la participación de profesores de diversas instituciones: UAB, U. Autónoma de Puebla, U. Nacional Autónoma de México, U. Autónoma de Nicaragua, GTZ, y organismos nacionales como PRISMA. La Maestría ha graduado ya la primera generación de estudiantes: 34, los cuales se encuentran trabajando en ONGs, Ministerio de Educación, Ministerio de Salud Pública, Ministerio de Obras Públicas, MARN, Universidades privadas, alcaldías y la Policía Nacional Civil.

Actualmente la Maestría tiene 24 estudiantes.

Entrenamientos de Ph.D.

En los últimos 5 años solo 2 miembros del área de CC del ambiente han sido enrolados en programas de Doctorado: 1 en la UAB y otro en la U. de Harvard estas han sido becas completas. Las becas son de tiempo completo y sus obligaciones en la Fac. fueron absorbidas por los otros miembros del staff.

La proyección de la UES para los próximos 5 años es la de favorecer la formación de recursos humanos de elevado nivel, sobre todo en aquellas áreas de interés de la Institución, siendo una de ellas la de Ciencias del Ambiente y salud. La UES aspira a que por lo menos el 30% de su staff obtenga grado de MSc y Ph.D en los próximos años, para ello utilizara diversas modalidades de entrenamiento: programas locales, regionales, e internacionales a tiempo parcial o tiempo completo. Esto es mas difícil lograrlo para aquellas unidades académicas con poco personal docente y muchos estudiantes.

Investigación

La UES tiene un Consejo de Investigaciones Científicas (CIC-UES), ha sido concebido como un organismo Universitario adscrito a la Rectoría de la Universidad de El Salvador para asegurar su desarrollo técnico, administrativo y financiero con el objetivo de fortalecer la investigación científica y tecnológica (C y T) de la UES, propiciando para ello la formación de recursos humanos de elevado nivel científico. Su Misión es la de contribuir al desarrollo de El Salvador, mediante la Investigación Científica y Tecnológica, en beneficio del Desarrollo Social y Económico del País.

Fundado en Mayo del año 2000, su primera tarea fue la de realizar un diagnóstico de lo que la institución, de manera casi espontánea, había acumulado en investigación C y T hasta Dic. 2000 y luego, sobre la base de los hallazgos, elaborar la política de desarrollo CyT de la Universidad y diseñar las herramientas necesarias para la implementación de la política. Información acerca de esto puede encontrar en el sitio Web del CIC-UES:<https://www.cic.ues.edu.sv>

Actualmente el CIC-UES cuenta con un presupuesto de \$ 500,000 anuales para invertir en el desarrollo científico de la Institución y aportar de manera directa al desarrollo del país. Este fondo se invierte de la siguiente manera: financiamiento de proyectos de investigación, entrenamiento de los docentes investigadores en instituciones extranjeras (entrenamientos, pasantías, maestrías, doctorados, presentación de resultados de investigación en eventos internacionales). El financiamiento de los proyectos de investigación aprobados por el CIC-UES incluye gastos de contratación temporal de personal de apoyo, equipamiento, consumibles, diversos tipos de entrenamiento de los docentes y estudiantes que participan en el proyecto y difusión e introducción de los resultados. Por ahora no se financian gastos de administración de los proyectos.

El CIC-UES está elaborando el calificador a aplicar a los docentes que realizan investigación para, de acuerdo a la puntuación obtenida, pagar un complemento salarial proporcional a la actividad desarrollada. Esto demorará en aplicarse alrededor de un año. Los docentes están muy entusiasmados con esta modalidad de compensación salarial.

La UES invertirá de manera decidida en los próximos años, en el desarrollo CyT en 7 áreas prioritizadas de investigación, Medio ambiente, salud y Recursos naturales es una de éstas 7 áreas estratégicas. La inversión estará focalizada en apoyar proyectos de investigación que además permitan la formación de recursos humanos al más alto nivel científico, para ello la UES busca colaboración con Instituciones extranjeras para desarrollar proyectos de investigación que den como resultado además la formación de estos recursos humanos, o sea que permitan obtener el grado de MSc y Ph.D. como producto de desarrollo de investigaciones científicas de mutuo interés, que permitan a su vez a los jefes de proyecto la formación escalonada de recursos humanos especializados en investigación.

Dra. Erlinda Hándal Vega
Directora Ejecutiva
CIC-UES

Appendix 2.1

Universidad de El Salvador, universidad Autonoma de Barcelona

Maestria en medio ambiente y recursos naturales

Nómina y título de tesis de investigación realizada por estudiantes de la promoción 1997–2001

No.	NOMBRE	FECHA	TEMA DE TESIS
1	Alvarado de Zavala, Sonia Cristina	08/03/01	Cuantificación de plomo, cadmio y mercurio y la determinación de parámetros físicos, químicos y microbiológicos en aguas del embalse de la central hidroeléctrica Cerrón Grande.
2	Alvarado Guevara, Julio César	13/02/01	Descentralización del servicio de agua potable en seis municipios de El Salvador y su incidencia en la disminución de enfermedades de origen hídrico en comparación con seis municipios centralizados.
3	Bonilla, Hugo Adiel	15/03/01	Problemática Legal actual de las áreas naturales protegidas en El Salvador.
4	Castellanos, María Teresa	15/03/01	Lineamientos para una propuesta de política en materia de sustancias, residuos y desechos peligrosos.
5	Castellón Murcia, Juan Carlos	15/03/01	Estructura de un marco normativo para El Salvador sobre patentes de la Biotecnología, obtenciones vegetales, organismos modificados genéticamente y acuerdos relacionados con la prospección de la biodiversidad.
6	Castillo Alvarenga, María del Carmen	15/02/01	Partículas contaminantes del aire y síntomas de enfermedades respiratorias en la Facultad Multidisciplinaria Oriental.
7	Cortez de Galán, Miriam Elizabeth	27/07/01	Estudio del agroecosistema del distrito de riego y avenamiento No. 1 Zapotitán, San Andrés, La Libertad, El Salvador.
8	Dueñas, Héctor Alfredo	08/03/01	Estrategias de Protección contra la contaminación para el campo occidental de pozos de Opico de ANDA, en el acuífero Opico-Playón-Quezaltepeque, durante enero a junio del 2000.
9	Figueroa de Murillo, Coralia	14/03/01	Determinación de Cromo, Arsénico, Cobre y Níquel en el Cerrón Grande.
10	Flores, José Fernando	08/03/01	Origen y desarrollo del cultivo del café en El Salvador y su influencia Ecológica
11	Gómez Vaquerano, Lucía Alicia	28/07/01	Proceso para declaratoria de áreas naturales protegidas en El Salvador
12	Hernández de la Cruz, Agustín	28/07/01	El derecho agrario y los recursos naturales
13	Ibarra Turcios, Angel María	06/03/01	Prevención y mitigación de desastres: Propuesta de gestión ecológica de riesgos a partir de las lecciones del Huracán Mitch.
14	Lemus Morales, Xiomara Yamileth	14/02/01	Acumulación de metales pesados en <i>Eichornia crassipes</i> "jacinto de agua" presente en el embalse del Cerrón Grande.
15	Mejía Orellana, Luis Alberto	28/07/01	Ecología y evaluación del impacto de la pesca artesanal de peces juveniles en la bahía de Jiquilisco, pacífico centroamericano, El Salvador, Centroamérica.

16	Menjivar Fuentes, José Nilton	07/03/01	Efectividad de los extractos acuosos de cuatro especies vegetales en el control de <i>Varroa jacobsoni</i> (Dermanyssidae, Acarina), parasito en <i>Apis mellifera</i> (Apidae, Hymenoptera), La Libertad. El Salvador.
17	Ortiz León, Juan Edgardo	27/07/01	La educación ambiental y su enseñanza en la formación inicial de maestros de ciencias naturales de la Universidad de El Salvador.
18	Paredes, Lucas Roselia	08/03/01	Determinación experimental de la pérdida de agua por la presencia de jacinto acuático (<i>Eichornia crassipes</i>) y aporte de sedimentos de esta planta en el embalse del Cerrón Grande.
19	Quintanilla Gómez, José Rigoberto	08/03/01	Caracterización Biofísica de la subcuenca del río Cacapa en el departamento de La Paz, El Salvador.
20	Rodríguez Espinal de Flint, Lastenia Helvecia	15/02/01	Plantas Tóxicas presentes en El Salvador.
21	Salazar Osegueda, Miguel Gonzalo	07/03/01	Comparación de la entomofauna en dos sistemas de cultivo del cafeto (<i>Coffea arabica</i> var. Bourbon): tradicional y orgánico.
22	Salguero de Fuentes, Blanca Nory		La leña como fuente de energía y estrategias para su obtención en los hogares del Municipio de San Rafael, departamento de Chalatenango.
23	Sánchez de Campos, Daisy Concepción	27/07/01	Estado de la formación ambiental de los alumnos del tercer grado del municipio de San Salvador al implementar la educación ambiental como eje transversal en los contenidos programáticos.
24	Sánchez Lemus, Rosa Miriam	28/07/01	Situación actual y análisis jurídico-social de la finca El Espino.
25	Vásquez de Godoy, Elda Guadalupe	06/03/01	El aporte de El Salvador al proceso de integración centroamericana desde el punto de vista ambiental.
26	Vides, Irma Lucía	15/02/01	Gases contaminantes del aire y síntomas de enfermedades respiratorias en la Facultad Multidisciplinaria Oriental.

Appendix 3

Response from UNAN-Managua

University as a knowledge base.

What activities have been accomplished during the past 5 years to transfer knowledge on environmental and health issues from the university to society?

Medical Faculty

The Medical Faculty has been evaluating communities related to environmental conservation in five marginal districts of Managua. This activity is part of the curriculum from the second year of study of the Medical Faculty.

We have also conformed one research group to analyze health problems derived from the environment deterioration. Here is an example of some research themes developed during the past 5 years:

1. The piretroide impregnated bed nets and its interaction with Immunglobulin E.
2. Dermatitis in the workers of national cement factories.
3. Pay Implementation for Environment Services at the Natural Reserve “El Chocoyero”. Study alternatives.
4. Environment Impact Measurement of Lead on the ground and workers Risk exposed to artesian Workshops Battery.
5. Pollen and other Particulates as Air Pollutants.
6. Contamination of the water bodies from cheese production.
7. Respiratory symptoms of children of “Villa Libertad” and its relation with polluting agents of the environment.
8. Use of gramoxone and effects in the human health by farmers of the “Comarca Rio Nuevo”, Sébaco, Matagalpa.

Almost all of these research results were presented in the community where they were developed.

CIRA/UNAN

This research center has developed research projects directly in cooperation with communities and municipalities to support not only diagnostical research about environmental deterioration especially of water resources but also to aid in developing sanitation plans and action plans to improve these conditions. Just a few examples:

1. A Project developed in cooperation with the municipality and mayors office of Granada “ PRO-UESTA PARA LA GENERACION DE LAS BASES CIENTÍFICO-TÉCNICAS Y SOCIALES PARA LA FORMULACION DE UN PLAN DE SANEAMIENTO AMBIENTAL DE LA CIUDAD GRANADA Y SU ÁREA DE INFLUENCIA” (Proposal for the Generation of the Scientific Technical and Social Bases for the Designing of a Plan for the Environmental Sanitation of the City of Granada and its Area of Influence).

2. A research project developed in coordination with the Organization of International Migration titled “DIAGNOSTICO DE LA CALIDAD TOXICOLÓGICA DE LAS AGUAS Y SUELOS Y CALIDAD BACTERIOLÓGICA DE LAS AGUAS DEL MUNICIPIO DEL POSOLTEGA. PROYECCIÓN Y EFECTOS POTENCIALES EN LA SALUD Y EL MEDIO AMBIENTE” (Diagnosis of the toxicological quality of water and soil and the Bacteriological quality of water in the municipality of Posoltega.)

Our center has also developed programs in certain regions of Nicaragua with specific environmental problems due to agricultural usage of the soil. One such area is the Leon-Chinandega where persistent organic chloride pesticides were applied massively in cotton cultivation. After detecting influence on human health with the following studies:

- a. Lacayo M. L., Cruz A. C., 1997. Plaguicidas Organoclorados en Leche Materna en Mujeres del Departamento de Chinandega.
(Organochloride pesticides in maternal milk of women of the Department of Chinandega).
- b. Cruz, Adela. Pesticidas Organoclorados na Gordura Corporal de Mulheres Nicaragüenses.
“Organochlorides in Body Fat of Nicaraguan Women”
- c. Cuadra L. J., Cruz G. A., Lacayo R. M., 1997. Plaguicidas Organoclorados en Sangre de Madres del Departamento de Chinandega.
(Organochloride pesticides in blood serum of mothers of the Department of Chinandega)
- d. Determinación de Niveles de Plaguicidas Organoclorados en Sangre y su Correlación con Leche Materna y Grasa Corporal Humana.
(Determination of Levels of Organochlorides in Blood correlated with content in maternal milk and human fat).

After the studies showed high levels of pesticides, the program continued with a series of investigations of the quality of subterranean, surface waters and costal lagunes.

- i. Alvarez, C.J.A. Tesis de Maestría, 1994. Niveles de Contaminación de las Aguas de la Cuenca del Río Atoya por Residuos de Plaguicidas Organoclorados y Organofosforados aplicados en el Cultivo de Algodón.
- ii. Lacayo Romero M.L., Picado F., Lopez A., Cruz A., Montenegro-Guillen S., Carvaino F. P., 1998: Organochlorine pesticides in sediments and biological tissues of the main pacific coastal lagoon of Nicaragua.
- iii. Vammen, K., Cruz O., Vargas M.E., Cruz G.A., Delgado Q. V., López G.A., Medrano E., Cuadra L....1999, Diagnostico de la Calidad Toxicológica de las Aguas y Suelos y Calidad Bacteriológica de las Aguas del Municipio del Posoltega. Proyección y Efectos Potenciales en la Salud y el Medio Ambiente.
- iv. Pitty T.J., Cruz M. O., Martínez V., Altamirano M., Delgado Q. V., Cruz G. A. 1999. Estudio Isotópico y de la Contaminación del acuífero León – Chinandega, Nicaragua. Reporte AIEA.
- v. OIEA, CIRA/UNAN, Estudio Isotópico y de la Contaminación del Acuífero de León-Chinandega, OIEA, CIRA/UNAN, 1997–1999.
- vi. Delgado V., 2003. Tesis de Maestría Sistema de Flujo Subterráneo y Calidad de Agua en un Acuífero de la Planicie Costera del Noroeste de Nicaragua.

- vii. Calderón H., 2003. Tesis de Maestría. Flujo Subterráneo y Modelo de Transporte Advectivo de una Subcuenca en el Acuífero León – Chinandega, Nicaragua.
- viii. Cuadra, Wilber, 2003. Tesis de Maestría (en proceso). Gestión del Riesgo de contaminación de suelo en el Acuífero de León-Chinandega por Residuos de Toxafeno en el Cultivo del Algodón en Chichigalpa y Posoltega.

The studies have been carried out together with the municipalities of the area and all results have been reported to the proper authorities. Also the information has been presented in community meetings on request of organizations of the local population.

What inquiries have been received on information on environmental and health issues from local and national government authorities during the past 5 years?

CIRA/UNAN

Our research center has been approached by Municipal authorities looking for advice in regards of environmental problems in their territories. Mainly the difficulties have been related to wastewater and sewage impact upon fresh water bodies. The Ministry of Environment has also requested technical support for helping in making arrangements for a network of laboratories capable to provide analytical services in fulfilling the information needs to enforce the environmental law regarding wastewater guidelines.

Also CIRA is constantly working together with municipality organizations such as AMUGRAN (Association of Municipalities of the Watershed of Lake Nicaragua) in environmental problems of this watershed area.

What improvements of national legislation and regulation of environmental and health issues have been realized during the past 5 years by initiatives and knowledge support from the university?

CIRA/UNAN

Our research center has been approached by Municipal authorities looking for advice in regards to environmental problems in their territories. Mainly the difficulties have been related to wastewater and sewage impact upon fresh water bodies. The Ministry of Environment has also requested technical support for helping in making arrangements for a network of laboratories capable to provide analytical services in fulfilling the information needs to enforce the environmental law regarding wastewater guidelines.

There is now a very important effort being made to design a general water resources law in which the director of CIRA is one of the main advisors of the committee to unite different proposals for the water law which is planned to be approved this year.

What is the strategy/plans for knowledge transfer on environmental and health issues from university to society for the forecoming 5 years?

The UNAN Managua has the strategy and plan to create multidisciplinary groups internally in the Faculties and at the University for study of the environment problems. We hope to have a minimum of four multidisciplinary groups at the UNAN.

The study of environmental problems is part of our research priorities and politics.

CIRA/UNAN

This research center is now very strongly involved in a Masters Programm of Science of Water. The emphasis is being put on contributing to the development of information that can be used for

specific watershed management plans. The objectives of this program are to form professionals capable of contributing actively in national and regional efforts to improve the management of quality of the water resources in Nicaragua and to contribute to information of the watersheds through student research.

Undergraduate training

What are the subjects of teaching and their proportions at the undergraduate level?

where we have greater presence from environments components are in:

Biology for Teaching, Biology for Science, General Ecology, General Medicine, General Nursing

What environmental and health science topics are covered in classes?

What are the total number of students attending undergraduate training, and the numbers studying environmental and health oriented subjects during the last 5 years?

What are the percentages of students enrolled in undergraduate education that passed the various examination degrees (bachelors, masters, etc.) during the last 5 years?

What are the plans for the next few years for teaching on environmental and health issues (e.g. for changing recruitment, structure of teaching programme)?

Masters Training

What Master's programmes are given, what is the financial source, how many students are enrolled and how many received the degree the last 5 years?

What international Master's programmes are given in environmental and health sciences (programme located at your university but with students from other universities and with a major contribution from foreign teachers)?

CIRA/UNAN

The Masters Programme in Science of Water (specialized area: water quality and aquatic ecology) is part of a Central American Network called, Red Centroamericana de Manejo de Recursos Hídricos (CARA) which includes the University of Costa Rica (Maestría: Manejo de Recursos Hídricos e Hidrogeología, Área de especialización: Agua Subterránea), University of San Carlos in Guatemala (Maestría: Planificación y Manejo de Recursos Hídricos en Agronomía, Área de Especialización: Agua y Agricultura), the University of Calgary and the University of Waterloo. The financial source of the network and the masters program at this time is Canadian International Development Agency (CIDA). This financial support will extend up until 2005 and therefore the three programs and the network are developing a new sustainability plan to maintain the masters programs working as a network.

The masters program has completed one cycle with 10 students. The second cycle is now in process with 8 students. Four students have graduated from the first cycle. Six students have finished all the classes but are still working on their thesis in order to graduate.

In the first cycle of the Masters Programme it was necessary to have faculty members from Canada support the semester courses. Due to a special training program of Nicaraguan faculty members in the first three years of the project, the faculty is now fully Nicaraguan except for some intensive short courses where Canadian professors have been invited. Two members of the faculty received their Masters Degree in Hydrogeology from the University of Calgary in 2003–2004 and one professor received special training in contaminant Hydrogeology in the University of Waterloo.

What Master's programmes abroad did your students of environmental and health sciences attend the last 5 years, how many of your students went abroad to obtain a Master's degree in environmental and health sciences?

CIRA/UNAN

Here I am not referring to students but faculty members of this research center. As mentioned above faculty members received their Masters degree abroad in the University of Calgary and one special postgraduate training in University of Waterloo. Also 4 members of the faculty are studying in the Multidisciplinary program for environmental research (PMIA) in the University of Lund in Sweden. Two students have received their licentiate and are working on their doctorate at this time. This program is financed from SAREC.

Known destinations of Master's students in environmental and health sciences (Government services, management, hospital, high school teacher, consultant, etc)?

Destinations of Master's students of 1. cycle in Science of Water

See annex 1

What are the plans for the next few years for programmes on environmental and health sciences?

CIRA/UNAN has established its strategic plan from 2001–2006 in “Plan Estratégico de Desarrollo del CIRA/UNAN para el periodo 2001–2006” (Strategic Plan for Development of CIRA/UNAN from 2001 to 2006). The plan defines 8 specific objectives: 1) Amplify the research area of CIRA/UNAN 2) Develop a system of information which facilitates Integrated Watershed Management in response to national problems with water resources, 3) Develop an internal information system of all research projects, 4) Optimize the efficiency of the institution in research and private services along the quality assurance norms ISO/IEC 17025, 5) Contribute to bettering national capacities for the prevention of environmental contamination, 6) Contribute to the improvement of the quality and production in national industries that also permits prevention of contamination, 7) Produce information which contributes to solving health problems in the population related to water resources, 8) Contribute to the formation of professionals in management of water resources and environmental education which supports an improvement in living conditions of the population and 9) Promote publication of scientific information produced in projects of CIRA/UNAN. For more details see annex 2 (Plan Estratégico de Desarrollo del CIRA/UNAN).

Annex 3 gives a list of ongoing projects and others in the planning phase.

PhD training

How many of the staff members of environmental and health sciences were enrolled in a PhD training programme during the last 5 years?

What organization was the host of the programme and who paid for the training?

CIRA/UNAN

Three students of the PMIA program are now enrolled in PhD training programmes. SAREC is financing their training programme in the University of Lund.

How many percent of their full time were staff members engaged in PhD training programmes? How were they replaced in faculty while they attended the PhD programme?

4 staff members have been involved in PhD training programmes. There existed no system to replace them during their participation. Some of the programmes were for interchanging intensive periods and others for example three years constant.

Known destinations of PhD-s in environmental and health sciences (Government services, management, hospitals, high school teacher, consultant, etc)?

If the PhD's stayed at the university – what tasks were they offered?

All 4 staff members involved in PhD programmes are working in CIRA in the highest responsible positions, director, vice director, quality control manager, research project leaders, tutor of research thesis and professors of the Masters programme.

What are the plans (needs, dreams) for the next few years for PhD training programmes in environmental and health sciences?

As mentioned there are three staff members involved in PhD training at this time.

We think it is necessary to involve research staff in PhD training but we would like to also emphasize participation in Masters Programmes as our staff has not reached this general level up until now. We also think it is important that these programs have a limited duration as it is hard to replace the staff members in training and the research objectives of CIRA/UNAN are affected.

We think it would be favorable to look for PhD training in themes which would enhance our present research and Master's program such as Limnology, Contaminant Hydrogeology, Ecotoxicology, Chemical Toxicology (strengthen analytical aspects), Quality Control Management and Watershed Management.

Research

What research projects have been carried out in environmental and health sciences during the last 5 years? What research funding has been raised in environmental and health sciences in the last 5 years and what are the sources of those funds?

Medical Faculty

1. The piretroide impregnated bed nets and its interaction with Immunglobulin E.
2. Dermatitis in the workers of cement factories.
3. Pay Implementation for Environment Services at the Natural Reserve “El Chocoyero”.
Study alternatives.
4. Environment Impact Measurement of Lead on the ground and workers Risk exposed to artesian Battery Workshops.
5. Pollen and other Particulates as Air Pollutants.
6. Contamination of the water bodies that they are being affected by the cheese production.
7. Respiratory symptoms of children of “Villa Libertad” and its relation with polluting agents of the environment.
8. Use of gramoxone and effects in the human health by agriculturists of the “Comarca Rio Nuevo”, Sébaco, Matagalpa.

Medical Faculty

The principal research fund is from Asdi/Sarec, in addition to Funica Faitan. Funica Faitan is a non government organization that works with the universities for the agro-industrial development and also for environment conservation.

CIRA/UNAN

- Basic Study of Monitoring of the Quality of the Water in the Río San Juan Watershed (“Estudio Básico Monitoreo de la Calidad del Agua en la Cuenca del Río San Juan”) financed by Organization of American States OEA.
In collaboration with INETER (Institute of Territorial Studies of Nicaragua), University of Central America, Nicaragua and Ministry of Environment, Nicaragua.
- Project Prevention of Industrial Contamination: Component-Development of National Laboratories to Improve the Capacity for Environmental Monitoring (Proyecto Prevención de la Contaminación Industrial, Componente: Desarrollo de los Laboratorios nacionales y la Capacidad de Monitoreo Ambiental) financed by Environmental Programme Nicaragua-Finland.
In collaboration with the Ministry of Environment and 18 national environmental laboratories.
- Environmental Contamination due to Mercury in Lago Xolotlán, Nicaragua in Relation to the Risk for Human Health (Contaminación Ambiental por Mercurio en el Lago Xolotlán, Nicaragua, en Relación a la Evaluación de Riesgo a la Salud Humana) in cooperation with the Institute for Minamata Disease in Minamata, Japan financed by Interamerican Development Bank.
In collaboration with the Faculty of Medicine of the UNAN and the Institute for Minamata in Minamata, Japan.
- Regional Project RLA/8/031, Integrated Management of Water Resources in Latin America: Study of the Alluvial Aquifer, Valley of Esteli financed by International Atomic Energy Agency.
In collaboration with the IAEA and Integrated Project Esteli-Ocotlán.
- Reinforcing the Capacity of the Microbiology Laboratory in CIRA/UNAN for the Evaluation of Sanitary Impact Related to Economic Activity financed by Interamerican Development Bank, BID.
- Sustainability of Quality Control Systems in Laboratories Using Analytical Nuclear Techniques and other Complementary Techniques (Sostenibilidad de los Sistemas de Calidad en los Laboratorios que Utilizan Técnicas Analíticas Nucleares y Complementarias), Regional Cooperative Agreements for the Promotion of Science and Nuclear Technology in Latin America, (Acuerdos Regionales Cooperativos para la Promoción de la Ciencia y la Tecnología Nuclear en América Latina) ARCAL financed by the International Atomic Energy Commission.
In collaboration with laboratories from 12 Latin American countries integrated into the project.
- Nicaraguan Institute for Small and Medium Industries, Sanitary Quality of Food. Direction of Research, UNAN and CIRA/UNAN, Microbiology lab financed by Interamerican Development Bank (INPYME, Calidad Sanitaria de Alimentos, Microbiología, Dirección de Investigación UNAN financiado por BID).
In collaboration with the Direction of Research UNAN.
- A Contribution to Scientific Technical Information for the Development of a Strategy for the Protection of the Watershed of the Nicaraguan Lake, CIRA/UNAN and the Association of Municipalities in the Watershed of the Nicaraguan Lake financed by Program for Small Funds for Research, International Development Research Center, environmental Management Secretariat Latin America and the Caribbean. (Un Aporte de Información Científico-Técnica para el Desarrollo de una Estrategia de Protección para la Cuenca del Gran Lago de Nicaragua, Programa de Pequeños Fondos para Investigación del SEMA/IDRC, Consorcio Asociación de Municipios del Gran Lago de Nicaragua AMUGRAN-CIRA.)
In collaboration with the Association of Municipalities in the Watershed of the Nicaraguan Lake and the municipalities.

- Centralamerican Network of Water Management Programs, Masters Programme in Science of Water financed by Canadian International Development Agency. See www.caragua.org. For list of student thesis in Masters Programme for Science of Water (annex 4 and 5) and students thesis graduated with Masters in Hydrogeology, Calgary, Canada see annex 6.
In collaboration with the University of Calgary, University of Waterloo, University of Costa Rica and University of San Carlos Guatemala.
- Environmental Research Multidisciplinary Programme, UNAN-Managua/University of Lund financed by SAREC. Student's thesis graduated with Licentiate from University of Lund, Sweden. See annex 6.
In collaboration with CIGEO and the Medical Faculty of the UNAN.

What proportions, on average, of the research funds have been used to cover expenses for salary, consumables, equipment, and administration?

Most research projects involve more training components accompanied less by consumables and equipment. Very few project pay consultant expenses and salaries.

It is important to accompany research projects with prospects for modernizing the analytical capacity of CIRA because the advantage of having a good functioning analytical capacity is very important for future research projects.

Medical Faculty

The funds were used to cover consumable (80%) and equipment (20%).

For faculty staff members that received research funding – how much of their total work time (approximate range in %) were allocated to research activities?

Medical Faculty

At the faculty levels the works time allocated to research activities is around 10–20%.

CIRA/UNAN

The percentage of work time allocated to research activities roughly estimated is 40% on an average of the whole staff. This is due to the necessity to sustain the lab with private services and also a lot of effort has to be invested in the accreditation process of our research center, laboratory and Masters degree. In future plans we hope to increase the time for research activities reducing time for private services.

What research projects in environmental and health sciences include collaboration with a) other faculties within the university, b) other national universities, c) other CA universities, d) other international universities?

Answered in research project list above

What activities were accomplished at the university during the last 5 years to stimulate staff member's interest in research and development?

Actually there is no direct economic program for stimulation of interest in research. There is a certain indirect program through opportunities for training.

There are annual scientific congresses in which all faculties participate and professors and students present the results of their latest research projects.

What are the plans for the next few years for research in environmental and health sciences? What areas of the research field do you want to develop, how may fund raising improve, how about collaboration and organization of infra-structure?

CIRA/UNAN

For the next years we are planning to emphasize more research that produces information that supports the development of watershed management plans. This is the main focus of the student research in our Masters Program and also from faculty members.

Our research center is developing its Strategic Plan for Development for the period of 2001–2006. This plan consists in stimulating education specifically in the science of water, the creation of an information system of water resources which supports decision-making, establishing a national reference laboratory to raise the quality of analytical determinations in national environmental laboratories and promote research of water resources focused on producing information watershed management that involves also the population in the planning and investment projects. For more details see annex 2.

Staff Members

How many staff members are there in environmental and health sciences?

What (approx.) percentage of them are below 40 and above 60 years old?

How many of those staff members have a final degree as a) bachelor, b) licentiate, c) master, d) PhD?

CIRA/UNAN

CIRA has 50 staff member, with 22 under 40 and none above 60 years old. Four staff members have their final degree as a PhD, 19 master's degree, 2 licentiate degrees and 25 bachelor's degrees.

What scientific papers were published during the last 5 years by faculty staff members in environmental and health sciences? (this refers to official journals in CA or other international journals, in Spanish or English)

1. Cano R., Raudez M. & Hooker E., (2000). The Natural Diet of *Apocyclops panamensis* at a Shrimp Farm on the Pacific Coast of Nicaragua (Accepted date February 10, 2004) will be published in Zoological studies Vol. 43, No.2 in 2004 as the Proceeding of the 8th International Conference on Copepoda.
2. Ahlgren G., Ahlgren I., Hernández S. & Mejía M. (2002). Fatty Acid Quality of Seston and its effects on small fish in the Lakes Xolotlan and Cocibolca, Nicaragua. Verh. Internat. Verein. Limnol./28/786 – 791/ Stuttgart, July 2002/
3. Hooker E., Chow – Wong N., Rivas K., Erikson R., Ahlgren I. & Ahlgren G. (2001). Primary Production and Stimation of Potential Fish Yield in Lake Cocibolca, Nicaragua. Verh. Internat. Verein. Limnol./27/3589/-3594/ Stuttgart, September 2001/
4. Cassinath N., Garcia R., Vargas M.E., Bethune D., McCullough J., Wilson L. J. & Preston N. (2003). Trabajando juntos. Manual de Campo para Trabajo Comunitario en Proyectos de Agua. University of Calgary, Canada.
5. Reid J. W. & Moreno L., (1999) The Western and Southern Distribution of *Mesocyclops edax* (S. A. Forbes) (Crustacea: Copepoda: Cyclopoida). Proceeding of the Biological Society of Washington 112 (3): 581 – 591.
6. Ahlgren, I., Erikson, R., Moreno, L., Pacheco, L., Montenegro-Guillén, S. & Vammen K. (2000). Pelagic Food Web Interactions in lake Cocibolca, Nicaragua. Verh. Internat. Verein. Limnol. 27 pp 1740 – 1746.

7. Moreno, L. y Pacheco L. (2001). Los Copépodos de Vida Libre de la Región del Pacífico de Nicaragua. Revista de la Universidad Centroamericana Encuentro. Diversidad Biológica en Nicaragua, Año XXXIII/No. 58/2001 pag. 34–40.
8. Montenegro R. (2004). Reduced grazing rates in *Daphnia pulex* caused by contaminants: Implications for trophic cascades (Journal of Environmental Toxicology and Chemistry ETC, in press, 2004).
9. Montenegro R. (2002). Ecological implications of DDT and glyphosate – linking toxicology and trophic cascading. Tesis de aspirante a Doctor (Phl). ISBN 91-631-3371-7.
10. Lacayo, M. (2003) Degradation of toxaphen in water during anaerobic and aerobic conditions, Environmental Pollution.

What Master's theses were supervised by staff members of environmental and health sciences during the last 5 years?

CIRA/UNAN

See Master's theses of 10 students of first and second cycle of the Master's Programme, Science of Water, annex 4 and 5.

Other thesis being supervised at this time:

For the Masters Programme in the UNAN of Environmental Management:

Silvia Hernández. Theme: Water Quality in 4 Tributaries of the Watershed of Lake Cocibolaca, in process.

Helen García. Theme: Toxicological evaluation of the Principal Tributaries of River San Juan.

For the Masters Programme in the UNAN, Esteli, Management of Environment and Natural Resources:

Selvia Flores. Theme: Estimation of Nutrient Load from the Drainage System in the Eastern Area of Lake Cocibolaca.

Silvia Fuentes. Theme: Physical-Chemical and Bacterial Quality of the San Juan River and Some Tributaries.

What specific activities are planned for the next few years to stimulate the academic development of staff members in environmental and health sciences?

Most of the actual projects (mentioned above) include training opportunities, courses, postgraduate studies and PhD programs (PMIA).

Proposed research capacity building programme

What major effects do you expect the proposed long term research capacity building programme will have on environmental and health sciences activities at your university? What are the most important benefits for your university of the regional approach of the programme?

We expect that this program will strengthen our capacity for research in environmental and health sciences and raise the knowledge level of our faculty which in turn will prepare us to propose solutions to environmental and health problems in Nicaragua which involves understanding the processes of toxic pollution and its effects on human health and living conditions. Also it is very important for our University to have the opportunity to interchange experiences on a regional level and cooperate in Central American regional research projects as environmental and health problems are very similar and are of course caused by similar phenomena.

For CIRA it will be also be especially interesting to develop more research directed to ecotoxicological research in tropical aquatic systems.

What improvements would you suggest be made to the current proposal to better satisfy the needs at your university – another focus, other activities, another organization, etc.?

It is very important to really guarantee the regional character of the program in all components. In all countries there should be equal opportunities for training and capacity building and also part of the Masters programs should be located in other countries besides Costa Rica to guarantee that all regional universities will be strengthened. All components, training for faculty and students, development of Masters programs, cooperative research projects should be assured as regional efforts. As the other regional Universities (with exception of Costa Rica) are not familiar with the project proposal in its final form and the details, we suggest giving all participants a chance to revise the final program proposal and opportunity to suggest modifications if necessary. The creation of the Regional coordinating Committee and Scientific committee is essential to assure the regional character.

What are the major limitations at your university for a successful participation in the programme?

The UNAN could possibly cooperate better in a regional program if the research activities in the UNAN were given more emphasis in its organizational structure and stronger priority in planned activities.

Appendix 3.1

ESTUDIANTES EGRESADOS Y GRADUADOS DE LA MAESTRÍA EN CIENCIAS DEL AGUA 2001-2002

ESTUDIANTE	SITUACIÓN ACADÉMICA	EMPLEADOR Y POSICIÓN LABORAL ACTUAL	EMPLEADOR Y POSICIÓN LABORAL ANTES DE LA MAESTRÍA
1. Lic. Mayra Altamirano Carcache	Egresada	UNAN/Managua – Escuela de Biología Docente Hidrología y Fauna	UNAN/Managua Escuela de Biología Docente Zoología, Biología y Fauna
2. Ing. Juana Ruíz Mendieta	Egresada	Hidrogeóloga INETER	Consultora independiente
3. MSc. Svetlana Dumailo	Graduada	Universidad BICU. Responsable del Centro de Investigaciones Acuáticas	El mismo
4. Ing. Yelba Flores	Graduada	CIRA/UNAN Hidrogeóloga	Hidrogeóloga Analista INETER
5. MSc. Rosa María González	Graduada	UNAN/Managua Docente de Química	El mismo
6. Lic. María Luisa Talavera	Egresada	CIRA/UNAN Analista Investigador Sección de Zoología	El mismo
7. MSc. Thelma Salvatierra S.	Graduada	CIRA/UNAN Analista Investigador Sección Zoología	CIRA/UNAN Proyecto derivado del trabajo de tesis: Gestión Integrada de Cuencas
8. Lic José Francisco . Mercado Jiménez	Egresado	MAG-FOR Analista meteoróloga	El mismo
9. Ing. Zeneyda Rizo Osorio	Egresado	Consultora independiente Geología	Contratado Empresa minera
10. Ing. Wilbur	Egresado	Consultora	desconocido



**Universidad Nacional Autónoma de
Nicaragua**

**Centro para la Investigación de
Recursos Acuáticos de Nicaragua**



Plan Estratégico de Desarrollo del CIRA/UNAN para el periodo 2001-2006

Codificación del documento

Julio 2001

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Contenido

<u>I.</u>	<u>PRESENTACIÓN DEL PLAN ESTRATÉGICO DE DESARROLLO</u>	<u>4</u>
<u>II.</u>	<u>DIAGNÓSTICO INSTITUCIONAL</u>	<u>5</u>
	CARACTERIZACIÓN GENERAL	5
	EVOLUCIÓN HISTÓRICA	5
	IDENTIFICACIÓN DE LA SITUACIÓN INSTITUCIONAL ACTUAL	6
	ANÁLISIS DEL MEDIO EXTERNO	6
	ANÁLISIS DEL MEDIO INTERNO	7
<u>III.</u>	<u>PERSPECTIVAS A MEDIANO Y LARGO PLAZO</u>	<u>9</u>
	VISIÓN	9
	MISIÓN	9
	OBJETIVOS ESTRATÉGICOS	10
<u>IV.</u>	<u>PROGRAMACIÓN PARA EL SEXENIO 2001-2006</u>	<u>10</u>
	OBJETIVOS INMEDIATOS	11
	1. INVESTIGACIÓN	11
	2. PROYECCIÓN	20
	3. DOCENCIA	24
	4. DIVULGACIÓN	26
<u>V.</u>	<u>ESTRATEGIA A SEGUIR</u>	<u>27</u>
<u>VI.</u>	<u>MARCO PARA LA EVALUACIÓN DEL PLAN ESTRATÉGICO</u>	<u>28</u>
<u>VII.</u>	<u>CRONOGRAMA DE EJECUCIÓN</u>	<u>29</u>
	<u>ANEXOS</u>	<u>27</u>

I. Presentación del Plan Estratégico de Desarrollo

El CIRA/UNAN es una institución de investigación para el manejo de recursos hídricos, adscrita a la Universidad Nacional Autónoma de Nicaragua (UNAN). El quehacer del Centro se inserta dentro del Sector Ambiente, el cual, al igual que otros sectores en Nicaragua y en la región, ha venido experimentando importantes cambios en los últimos años. Estos cambios han favorecido la instauración de un sistema de mercado, donde la participación del sector privado en el manejo ambiental es cada vez mayor que la del Estado.

Ante esta situación, el CIRA/UNAN, como institución universitaria, reconoció la necesidad de contar con instrumentos de planeación a mediano y a largo plazo que le permitan colocarse y mantenerse en posiciones de vanguardia en la esfera de sus competencias. Es así que en 1997 se propuso seguir un modelo de planeación estratégica, y se elaboró el primer Plan Estratégico de Desarrollo para el periodo 1997-2001.

Para continuar con el esfuerzo de establecer una guía que oriente la acción de la institución a mediano y largo plazo, se elaboró un nuevo Plan Estratégico para el sexenio 2001-2006. La perspectiva de planificar estratégicamente a 6 años fue propuesta porque este es un espacio de tiempo suficientemente amplio y divisible en periodos más cortos, ejecutables y evaluables. Además el sexenio coincide con el desarrollo de tres ciclos de formación del nuevo programa de *Maestría en Ciencias del Agua*, el cual es uno de los proyectos más importantes que el CIRA/UNAN está asumiendo.

Este Plan Estratégico comprende un conjunto articulado y jerarquerizado de objetivos, uno de los cuales corresponde al propósito final que se pretende alcanzar con la realización del mismo. La visión que se define en el Plan es el objetivo supremo, y la misión, su objetivo subordinado. Hacer cumplir la visión y misión es el fin último de todas las actividades emprendidas por las distintas unidades del Centro. Los objetivos estratégicos generales establecen los lineamientos a largo plazo para lograr la misión y visión. Cada uno de estos lineamientos es el resultado esperado del logro de otros objetivos parciales, que pueden llamarse objetivos específicos o inmediatos, como es el caso del presente documento.

Todo objetivo inmediato comprende uno o varios resultados, los cuales son esfuerzos tangibles específicos y cuantificables, necesarios para alcanzar el objetivo dado dentro del periodo establecido, en este caso 6 años. Cada uno de estos resultados se logra a través de la realización de una o varias actividades. Entonces, si todos los resultados de un objetivo inmediato dado se consiguen, se puede decir que se ha alcanzado el objetivo propuesto.

Para la elaboración de este plan, se llevó a cabo un proceso de evaluación y consulta del Plan Estratégico de Desarrollo 1997-2001. Igualmente, se hizo un diagnóstico de la situación institucional actual. Se analizó el ambiente interno y el entorno en el cual se desenvuelve actualmente la institución, identificándose

aquellos aspectos negativos y positivos que puedan permitir o impedir alcanzar los objetivos del Centro. Tanto el proceso de evaluación del plan anterior, como el de formulación del presente, fue realizado con la participación de todos los directivos e integrantes de las unidades de investigación, administración y gremios de la institución. Esto es muy importante puesto que ha permitido generar responsabilidades directas en el cumplimiento de la visión, misión y objetivos estratégicos del Centro.

El presente documento constituye pues el segundo resultado del proceso de planeación estratégica participativa iniciado en 1997, y es un aporte valioso a la institucionalización y mejoramiento continuo de dicho proceso en el CIRA/UNAN.

II. Diagnóstico Institucional

CARACTERIZACIÓN GENERAL

El Centro para la Investigación en Recursos Acuáticos (CIRA) trabaja en cooperación con diversas organizaciones de todo el país interesadas en el uso sostenible de los recursos hídricos. El Centro ha enfocado la investigación sobre aspectos ambientales relacionados con los recursos hídricos nacionales y sus cuencas de drenaje, generando información científica confiable, imparcial y con calidad, que es usada por los actores que inciden en la toma de decisiones y en la planificación del manejo de dichos recursos. Esta información contribuye a suministrar un conocimiento científico y tecnológico adecuado que apoya los planes de desarrollo económico del país: ayudando así a minimizar el deterioro o la pérdida de calidad y cantidad de recursos hídricos debido a actividades naturales y humanas, favoreciendo una conservación efectiva de estos recursos, y contribuyendo a elevar y mantener la calidad de vida de la sociedad nicaragüense. El CIRA/UNAN es pues, una institución orientada a generar conocimientos, estimular la investigación científica sobre los recursos acuáticos de Nicaragua y formar especialistas para el manejo de recursos hídricos nacionales y regionales.

EVOLUCIÓN HISTÓRICA

El CIRA/UNAN fue creado por la Junta Universitaria de la Universidad Nacional Autónoma de Nicaragua (UNAN), a propuesta de la Comisión Permanente del Núcleo de Managua el 26 de Julio de 1980. El Centro funciona dentro de la estructura organizacional de la Rectoría, por lo tanto su postura estratégica está relacionada con las disposiciones reglamentarias y con las autoridades administrativas de la UNAN-Managua.

Desde su creación, el Centro persigue un desarrollo que le permita instalarse como una institución de Excelencia en la Investigación y en la Docencia de postgrado, tanto a nivel nacional como regional. Sin embargo, al ser una institución universitaria, el quehacer del CIRA/UNAN es afectado por una dependencia financiera del limitado presupuesto nacional y por la falta de políticas

nacionales y de la UNAN para apoyar la investigación. En la última década, la institución se vio afectada por las modificaciones ocurridas en el sector ambiente especialmente al establecerse un nuevo mercado de servicios ambientales. Para mantenerse a flote, el Centro instituyó una nueva actividad destinada a la venta de servicios al público, tales como los análisis de laboratorio y las asesorías técnicas. Esta actividad ha tenido una considerable expansión, que si bien es cierto le ha permitido al Centro adaptarse mejor a las nuevas condiciones de mercado, se ha estado realizando en detrimento de su actividad investigativa. Como resultado, el Centro ha disminuido su producción científica, lo cual atenta contra su razón de ser.

IDENTIFICACIÓN DE LA SITUACIÓN INSTITUCIONAL ACTUAL

Para entender la problemática que enfrenta el CIRA/UNAN es importante analizar tanto los factores internos como los factores externos que lo afectan directa e indirectamente. De no ser considerados adecuadamente, estos factores podrían representar un riesgo para llevar a cabo su misión y para la realización de sus objetivos de desarrollo (es decir, su visión).

Análisis del medio externo

En el anexo 1 se presenta un panorama del entorno nacional, en el cual se desenvuelve el Centro y que influencia considerablemente su actuar y desempeño.

El análisis del medio externo permitió identificar aquellas situaciones, ajenas al control del Centro, y que son o pudieran serle adversas. Estas son:

- Una modificación del mercado en una dirección privatizadora.
- Un incipiente proceso de descentralización política.
- Un repliegue de las funciones del poder político hacia lo normativo exclusivamente.
- Reducción de la cooperación externa para proyectos de investigación.

Igualmente ajeno al control del centro pero sí al de la UNAN, se ha identificado una pobre vinculación entre las carreras de esta última y el quehacer del CIRA. Este vacío no sólo revela una falta de perspectiva de desarrollo y debilidad de proyección de la UNAN hacia la sociedad en el tema del agua. También acarrea una falta de oportunidades para que el CIRA desarrolle sus líneas de acción. Se considera que con la realización del Programa de *Maestría en Ciencias del Agua*, el CIRA podría incidir en la formación de pre-grado, así como a ayudar a superar la falta de proyección de la UNAN.

Otros riesgos que puede enfrentar el CIRA/UNAN en el futuro son:

- Abandono de las políticas ambientales por parte del nuevo gobierno electo en 2001.

- Una inestabilidad política que profundice la recesión económica que vive actualmente el país.
- Menoscabo en los presupuestos de las universidades estatales.
- Una falta de apoyo de los organismos donantes al nuevo gobierno que pueda afectar los objetivos inmediatos del Centro (establecimiento del laboratorio de referencia, el desarrollo del Programa de *Maestría en Ciencias del Agua*, etc.).
- Falta de apoyo del nuevo gobierno para la certificación de los laboratorios ambientales en territorio nacional.

Sin embargo, la exploración del entorno también permitió identificar condiciones que han contribuido al crecimiento de las capacidades del CIRA/UNAN y que concuerdan con lo anhelado en su visión, como se presentará más adelante. Estas condiciones ofrecen excelentes oportunidades para influenciar las políticas nacionales de control de la contaminación ambiental y el manejo de los recursos hídricos:

- El CIRA/UNAN, por sus capacidades instaladas ya es reconocido como laboratorio líder en el ámbito nacional.
- Los dos primeros ciclos de formación del programa de *Maestría en Ciencias del Agua* cuentan con el respaldo de universidades y organismos internacionales.
- El Centro cuenta con un relativo apoyo de la UNAN para las actividades de investigación y docencia.
- El inicio de un proceso de ampliación en la investigación de los recursos hídricos, especialmente en el campo de las aguas subterráneas.
- El centro cuenta con un programa de servicios privados que cubren una parte de los gastos de insumos y personal.
- Se han establecido alianzas con instituciones nacionales e internacionales bajo el auspicio de agencias donantes.
- Los organismos donantes y el mercado favorecen la realización de Estudios de Impacto Ambiental para proyectos de inversión.
- Hay un creciente reconocimiento de las capacidades científico-técnicas de las universidades estatales que garantizan continuidad en la solución de los problemas nacionales en la esfera tecnológica y ambiental.

Análisis del medio interno

El análisis del entorno no sólo es importante para discernir las oportunidades atractivas en él. También es necesario analizar el medio interno para saber si se dispone de las habilidades (o fortalezas) para lograr la misión y visión con tales oportunidades. Este ejercicio permite igualmente distinguir los retos que enfrenta

el Centro a lo interno de sí mismo, como lo evidencia el resultado del análisis de fortalezas y debilidades que se desprende de la evaluación del Plan Estratégico de Desarrollo 1997-2001.

Entre las principales fortalezas del CIRA/UNAN se tiene que:

1. Se cuenta con recursos humanos con capacidades teórico-prácticas y amplia experiencia en el campo de las ciencias del agua.
2. Se está desarrollando una vigorosa actividad de capacitación tendiente a establecer un sistema de aseguramiento de la calidad, investigaciones en el campo de la hidrogeología y en bioremediación; y a reforzar la capacidad teórica del cuerpo docente de la maestría.
3. Se están desarrollando nuevas metodologías para atender demandas y resolver problemas del medio ambiente y de los usuarios del CIRA/UNAN.
4. Hay planes de ampliación de las instalaciones del centro para acoger las nuevas actividades planificadas.
5. El personal del CIRA/UNAN está apropiándose de la cultura de calidad.
6. Se cuenta con el apoyo de organismos internacionales para optar a programas de capacitación que amplíen la visión del personal respecto al abordaje y solución de problemas ambientales.

No obstante, se enfrentan las siguientes debilidades:

1. Hay una gran dependencia económica de la venta de servicios.
2. No existe un Plan de Desarrollo Científico que sirva de guía para el desarrollo institucional y personal. Por tanto prevalecen debilidades en los planes operativos y en la asignación de los recursos materiales.
3. Se sigue observando una baja producción de proyectos de investigación. El análisis de esta problemática debe de ser tomada en cuenta para la formulación e implementación del plan de desarrollo científico y el plan de incentivos económicos.
4. Hace falta un reglamento de organización interna que, entre otras cosas, ayude a determinar las atribuciones y las responsabilidades del personal, especialmente en lo que se refiere a estructura y funcionamiento; y que sustente la gestión del sistema de calidad.
5. En cuanto a la dirección, el consejo de dirección no ha asumido el liderazgo que le corresponde.
6. Se carece de un programa para organizar foros de discusión sobre temas actuales relacionados al quehacer investigativo del centro.
7. Claramente hace falta un plan de incentivos que estimule la producción científica y la promoción de proyectos de aplicación. Es necesario hacer énfasis en la evaluación del desempeño laboral y en la promoción de la cultura de calidad, del compromiso con la institución y de la ética profesional.

8. No hay un plan de capacitación especializada que esté debidamente armonizado con la formación académica y quehacer de cada investigador, con el plan de desarrollo científico y con los planes de fortalecimiento institucional.
9. No se ha logrado institucionalizar una forma de comunicación directa (despachos ampliados) con la Dirección para que ésta oriente políticamente el desarrollo de los planes operativos
10. No se implementa una evaluación sistemática de los planes operativos de corto plazo, ni del Plan de Desarrollo institucional, tanto a nivel del centro como de los departamentos e individualmente.
11. No existen planes contingentes para suplir ausencias del personal.
12. Los planes operativos no se han desarrollado tomando en cuenta la necesidad de obtener los medios de protección de la salud (riesgo profesional) y de seguridad ambiental e industrial.
13. Se enfrenta un problema de obsolescencia de equipos y falta de financiamiento para su sustitución.

III. Perspectivas a mediano y largo plazo

Dentro de la formulación del presente Plan, se enfatizó que el logro de la visión del CIRA/UNAN era la esencia de su ser y su porvenir como institución. Se revisó entonces la postura estratégica del Centro para asegurarse que ésta fuera coherente. La postura estratégica del CIRA/UNAN, la cual trasciende el horizonte cercano, comprende la visión, misión y objetivos estratégicos del Centro, todos los cuales son definidos a continuación.

VISIÓN

La visión constituye el propósito más importante del CIRA/UNAN y se inspira en los más altos valores éticos de honestidad, profesionalismo, humanismo, trabajo en equipo, responsabilidad, integridad y alta calidad y objetividad de la información científica que produce. Dicha **visión** es la de convertirse en un centro de excelencia en la investigación y en la docencia superior de postgrado en el campo de los recursos hídricos y en el ámbito nacional y regional. Así mismo, el CIRA/UNAN aspira a transformarse en el Instituto Nicaragüense de Calidad del Agua.

MISIÓN

En base a esta visión, el CIRA/UNAN se ha planteado como **misión**:

1. Generar y proveer información científica confiable sobre la calidad de los Recursos Hídricos.

2. Contribuir a mejorar y mantener la calidad de vida de la sociedad nicaragüense en un ambiente protegido.
3. Formar especialistas en investigación y gestión de los Recursos Hídricos.
4. Proveer y difundir información para formar opinión pública sobre la problemática de los Recursos Hídricos, su aprovechamiento y protección, por parte de los Nicaragüenses.

OBJETIVOS ESTRATÉGICOS

Para realizar su misión y visión, y mantenerse en posiciones de vanguardia ante los cambios constantes del entorno nacional e internacional, se establecieron una serie de objetivos estratégicos que trascienden el periodo de vigencia del presente Plan Estratégico. Los **objetivos estratégicos** del CIRA/UNAN son:

- Obtener y mantener la excelencia en sus procesos de investigación, oferta de servicios, y la formación de profesionales.
- Lograr, con la información que genera y los profesionales que forma, incidir efectivamente en las Políticas Nacionales y Regionales, y en la opinión pública, en asuntos relativos al Manejo de los Recursos Hídricos.
- Apoyar las iniciativas estatales, municipales y de mercado, tanto de carácter económico, como social y ambiental, relacionadas con la esfera de competencia del Centro.
- Propiciar alianzas con Instituciones del Estado, la Empresa Privada, Organismos No-Gubernamentales, Comunidades de cuencas y Organismos Internacionales, para buscar soluciones que potencien las capacidades del Centro y su nivel de incidencia en la problemática ambiental y socioeconómica nicaragüense. Así mismo, estas alianzas pueden ayudar a resolver proyectos puntuales planteados por los clientes del CIRA, que impliquen el uso de técnicas y conocimientos aún no desarrollados en el centro.
- Lograr y mantener el reconocimiento nacional e internacional para la calidad y pertinencia de sus investigaciones, servicios y programas de formación.
- Administrar de manera eficiente todos los recursos humanos, físicos y financieros de la institución.

IV. Programación para el sexenio 2001-2006

En un intento de corregir las debilidades mencionadas y lograr los objetivos a largo plazo, particularmente en lo que respecta a la misión del CIRA/UNAN, se han definido nueve objetivos inmediatos a cumplirse en un horizonte de 6 años. Dichos objetivos fueron agrupados en 4 categorías: investigación, proyección social, docencia, y divulgación.

Algunos de estos objetivos estaban comprendidos dentro del Plan de Desarrollo anterior y no se cumplieron. Otros no habían sido debidamente planteados por lo que fueron replanteados en el presente documento. Un tercer grupo de objetivos corresponde a nuevas necesidades del Centro. A continuación se presenta el detalle de los objetivos inmediatos.

OBJETIVOS INMEDIATOS

1. Investigación

O1. Ampliar el área de investigación del CIRA/UNAN.

RESULTADO 1

El CIRA/UNAN habrá formado un departamento de Hidrogeología que se dedicará a impulsar la investigación en Hidrogeología en Nicaragua y la región Centroamericana.

Actividades

1. Capacitar al personal del CIRA/UNAN en la ciencia de la hidrogeología a través de programas de maestría y cursos de refuerzo.
2. Establecer relaciones de cooperación con las instituciones del sector público o privadas para estimular la investigación en Hidrogeología.
3. Desarrollar temas de investigación en hidrogeología relacionados con procesos de contaminación que atañen a problemas prioritarios de los Recursos Hídricos de Nicaragua.
4. Ejecutar los proyectos propuestos.
5. Participar en la capacitación en Hidrogeología en el marco de la *Maestría en Ciencias del Agua* y otros.
6. Equipar al Departamento de Hidrogeología para facilitar su funcionamiento.

RESULTADO 2

Se habrá ampliado la capacidad analítica, científico-técnica y académica del Centro, en el empleo de técnicas nucleares aplicadas a problemas ambientales y de salud.

Actividades.

1. Aprovechar estudios pasados para divulgar la capacidad del Centro en el área de técnicas nucleares aplicadas a estudios ambientales y de salud.
2. Insertarse en proyectos de la Comisión Nacional de Energía Atómica (CONEA) relacionados con la aplicación de técnicas nucleares a problemas ambientales y de salud.

3. Establecer contactos con instituciones nacionales y regionales que requieran estudios, en los cuales se empleen técnicas nucleares que el Centro esté en capacidad de aplicar actualmente y en un futuro cercano.
4. Gestionar la continuación de la capacitación del personal del CIRA para ampliar la capacidad científica y académica en el uso de técnicas nucleares aplicadas al medio ambiente, a la producción nacional y a la salud.
5. Gestionar la capacitación del personal del CIRA/UNAN en las técnicas nucleares con la finalidad de apoyar estudios realizados en otras áreas de este Centro.
6. Elaborar un plan de inversión asociado con proyectos que cuenten con fuentes de financiamiento de la Agencia Internacional de Energía Atómica (IAEA), u otras.
7. Agilizar las gestiones para implementar a la mayor brevedad posible el Proyecto ya aprobado por la IAEA sobre Radioactividad en Alimentos, lo cual ampliará la capacidad analítica del Centro al adquirir nueva tecnología para determinar emisores gamma.
8. Fortalecer el área de radioquímica ambiental a través de la incorporación de personal capacitado.

RESULTADO 3

En apoyo a la misión y visión del CIRA, el departamento de Microbiología habrá elevado su capacidad científico-técnica relacionada con los recursos hídricos.

Actividades

1. Organizar y fortalecer la sección de Microbiología Sanitaria con la creación de cuatro áreas específicas:
 - a. Seguridad alimentaria para la detección de organismos patógenos en agua potable y alimentos.
 - b. Técnicas de PCR para apoyo diagnóstico en salud por enfermedades hídricas.
 - c. Parasitología y microbiología de aguas residuales y sedimentos.
 - d. Competencias para aislamiento de *Leptospira* sp. en aguas naturales.

2. Capacitar al personal del departamento de Microbiología en cursos que apoyen la misión y visión del CIRA.
 - a. Formulación y evaluación de proyectos.
 - b. Aplicación de sistema HACCP.
 - c. Evaluación de Impacto Ambiental.
 - d. Auditorias higiénico sanitaria ambiental.
 - e. Capacitación continua.
3. Promover la participación del personal del depto en el empleo de nuevas técnicas y validación de métodos.
 - a. Aplicación de PCR en agua.
 - b. Aislamiento de leptospira sp. en aguas naturales.
 - c. Método de aislamiento en agua potable de Gardia Lambia y Criptosporidium sp.
 - d. Método de aislamiento en aguas tratadas para pseudomonas sp.
 - e. Método de aislamiento de bacterias férricas en aguas naturales.

RESULTADO 4

El Departamento de Micropoluentes habrá ampliado su capacidad para llevar a cabo proyectos de investigación de tóxicos que representen un riesgo para el ambiente y la salud.

Actividades

1. Establecer vínculos de cooperación con instituciones gubernamentales (MARENA, MINSA, MAGFOR) y no-gubernamentales, con el objetivo de identificar y priorizar investigaciones sobre los microcontaminantes de mayor riesgo que se utilizan actualmente en el país.
2. Capacitar al personal de micropoluentes en el análisis de estos microcontaminantes, así como en la formulación de proyectos.
3. Desarrollar nuevas metodologías que permitan determinar la presencia de estos microcontaminantes en diferentes matrices (aguas, suelos, material biológico) y evaluar sus efectos en la salud.

4. Gestionar la adquisición de nuevos equipos que faciliten la determinación de estos microcontaminantes y aumenten la precisión y exactitud de su detección.
5. Formular y ejecutar proyectos de investigación relacionados con el impacto de los agroquímicos y metales pesados en la salud y el medio ambiente.

O2. Desarrollar un sistema de información que facilite el Manejo Integrado de Cuencas para dar respuesta a los problemas nacionales de los Recursos Hídricos.

RESULTADO 1

El CIRA/UNAN habrá establecido vínculos de cooperación con instituciones que manejan información, y que tienen capacidad de decisión, sobre los recursos hídricos para desarrollar e implementar las necesidades de información definidas en el SANDIA REPORT (Montenegro *et al*, 1999).

RESULTADO 2

La Dirección del CIRA/UNAN, en conjunto con estas instituciones, habrá actualizado el plan para desarrollar un sistema de información de los recursos hídricos nacionales.

RESULTADO 3

El CIRA/UNAN, en conjunto con estas instituciones, habrá logrado el financiamiento para desarrollar un sistema de información de los recursos hídricos nacionales manejados por todas las organizaciones involucradas.

** se definirá las actividades después de las elecciones nacionales.*

O3. Desarrollar un sistema de información del CIRA/UNAN.

RESULTADO 1

La dirección de CIRA/UNAN cuenta con una biblioteca de información accesible al grupo de dirección del centro.

Actividades

1. La Dirección del CIRA/UNAN seleccionará los temas pertinentes, así como los documentos que serán organizados en la biblioteca de la dirección.

RESULTADO 2

El CIRA/UNAN habrá creado y centralizado una base de datos que contenga los resultados de servicios privados y proyectos de investigación realizados en el Centro.

Actividades

1. Asignar el personal que se dedicará a la organización y procesamiento de la base de datos del centro.
2. Crear un formato estándar para que cada departamento ingrese información y consulte la base de datos.
3. Cada departamento reunirá copia de toda la información producida por el mismo, sea esta procesada o no.
4. Cada departamento ordenará la información por área, cuerpo de agua y año, y la ingresará a la base de datos.
5. Organizar la información de todos los departamentos en una base de datos centralizada.

RESULTADO 3

El Centro de Documentación del CIRA habrá logrado organizar la literatura científica en una forma accesible al público y a los investigadores del Centro.

Actividades

1. Reunir copia de toda la información producida por el Centro, sea esta procesada o no.
2. Reunir copia de la información disponible en el Centro que no haya sido producida por él (comisiones, de tipo personal, etc.).
3. Ordenar la información por área (química, biología, etc.), por proyecto, cuerpo de agua, y año.
4. Incorporar esta información científica a la base de datos del Centro de Documentación.
5. Elaborar e implementar un plan creativo de actualización bibliográfica.

6. Incrementar los niveles de gestión del centro de documentación para la consecución de nueva bibliografía.
7. Gestionar fondos para el reforzamiento del Centro de Documentación.
8. Establecer un mecanismo eficiente y eficaz para la selección y compra de artículos científicos relacionados a un interés institucional concreto.
9. Organizar el intercambio de publicaciones con otras instituciones del sector.
10. Integrar el Centro de Documentación al sistema de organización y procesamiento de datos de la institución.
11. Involucrar a la responsable del Centro de Documentación en todas las actividades de carácter científico-técnico del centro.

O4. Optimizar la eficiencia como institución de investigación y servicios cumpliendo con los lineamientos de las normas ISO/IEC 17025.

RESULTADO 1

Se habrá elaborado un presupuesto en función de las prioridades establecidas por el Plan Estratégico de Desarrollo del CIRA.

Actividades

1. Determinar la lista de las necesidades prioritarias indicadas en el cronograma del Plan Estratégico de Desarrollo, tomando en cuenta las debilidades a lo interno del centro.
2. Identificar y gestionar las posibles fuentes de financiamiento.
3. Readecuar periódicamente el presupuesto para responder a las mayores prioridades presentes y futuras.
4. Establecer un fondo especial de reserva para la adquisición y renovación de equipos, el cual será conformado con un porcentaje de toda las fuentes de ingreso del Centro.
5. Elaborar periódicamente proyectos para gestionar la compra de nuevos equipos de laboratorio que garanticen la calidad y aumenten la eficiencia de los resultados de análisis.

RESULTADO 2

Se habrá reorganizado y optimizado el funcionamiento del personal del CIRA/UNAN.

Actividades

1. Gestionar la aprobación del reglamento interno que defina las funciones y atribuciones de los órganos y funcionarios del CIRA.
2. Mejorar el repartimiento de las competencias y responsabilidades del colectivo del CIRA, en base a su reglamento interno.
3. Establecer un sistema de evaluación continua del desempeño del personal y proponer medidas para su mejoramiento.

RESULTADO 3

Se contará con un manual de procedimientos de las operaciones de la gestión administrativa.

Actividades

1. Determinar el flujo de las operaciones en función de la eficiencia y la equidad.
2. Determinar las responsabilidades que correspondan a las personas involucradas en el proceso.
3. Establecer los procedimientos operacionales aprobados hasta conseguir que sean automáticos.

RESULTADO 4

Se habrá elevado la producción científica en atención al Plan de Desarrollo Científico.

Actividades

1. Determinar las líneas de investigación por área que respondan a las necesidades nacionales.

2. Elaborar el Plan de Desarrollo Científico (Adendum al Plan Estratégico) con un horizonte de 6 años.
3. Redefinir la Política de incentivos a la producción científico-técnica.
4. Promover la elaboración de proyectos en las áreas establecidas en el Plan de Desarrollo Científico propiciando la discusión en diferentes foros.
5. Promover la participación interdepartamental e interdisciplinaria en la preparación y ejecución de los proyectos.
6. Promover la existencia de lineamientos de investigación individuales.
7. Establecer un mecanismo que permita evaluar la contribución científica individual en los proyectos de investigación.

RESULTADO 5

Se contará con un Plan de Capacitación para seis años en concordancia con el Plan Estratégico de Desarrollo y las líneas de Investigación del CIRA/UNAN.

Actividades

1. Elaborar un diagnóstico de las necesidades de capacitación del CIRA que permita potenciar las fortalezas de las líneas de investigación y el Plan Estratégico de Desarrollo.
2. Seleccionar los candidatos según las necesidades de investigación y el incremento de la capacidad instalada, además de los requisitos exigidos por los programas de capacitación tanto internos como externos.
3. Desarrollar un Plan de multiplicación de los conocimientos y capacidades adquiridas por los beneficiarios del Plan de Capacitación y los conocimientos generados a lo interno del Centro.
4. Relacionar en lo posible el Plan de Capacitación con el Plan de Incentivos a la Producción Científico-Técnica.

RESULTADO 6

Los jefes inmediatos y superiores habrán corregido las debilidades de su unidad estructural, en base a los objetivos del Plan Estratégico de Desarrollo.

Actividades

1. Elaborar un diagnóstico de situación en cada una de las unidades estructurales, comparando cómo estamos versus como deberíamos estar.
2. Elaborar una propuesta de solución de las debilidades encontradas.
3. Articular estas propuestas de solución en medidas concretas que estén acordes con el Plan Estratégico.

RESULTADO 7

El CIRA/UNAN habrá logrado la certificación de su sistema de aseguramiento de la calidad y la acreditación de los ensayos utilizados en la investigación y en la oferta de servicios.

Actividades

1. Elaborar y mantener actualizado el manual de aseguramiento y control de la calidad del centro como lo exige la Norma Técnica Nicaragüense NTON 04 001-98 y la Norma ISO/IEC 17025.
2. Elaborar los manuales de procedimientos normalizados de operación (PNO) en cada uno de los departamentos del Centro.
3. Elaborar el manual de Estructura y Funciones del CIRA/UNAN de acuerdo con los requisitos de la Norma ISO/IEC 17025, como parte de los documentos necesarios par solicitar la certificación del Centro y acreditación de los ensayos.
4. Establecer todos los componentes de validación de métodos, tales como tarjeta de control, determinación de límites de detección, implementación de las curvas de calibración, cálculos de incertidumbre, etc.; y reforzar su aplicación en la periodicidad necesaria para el aseguramiento de la calidad de todos los análisis.
5. Elaborar un manual de calibración con su programa de ejecución y definir una forma de identificación de equipos calibrados, tales como balanzas, cristalería volumétrica, instrumentos que dependen de la regulación de la temperatura, etc.

6. Revisar y actualizar los manuales de mantenimiento preventivo de los equipos de cada departamento con el objetivo de asegurar los controles de calidad del Centro.
7. Elaborar los manuales de seguridad y de servicios de los laboratorios.
8. Establecer y mantener un programa de auditorías internas de calidad como parte del proceso previo y posterior a la solicitud de acreditación de los ensayos que se llevan a cabo en los laboratorios del Centro.
9. Introducir todos los cambios de infraestructura e instrumentos de control necesarios para lograr la seguridad laboral en el laboratorio.
10. Fortalecer al Departamento de Aseguramiento y Control de Calidad con los insumos y los recursos necesarios para que el sistema de aseguramiento y de control de calidad se convierta en el eje transversal por el cual cruzan los ámbitos de investigación, docencia y servicio.
11. Gestionar y lograr la acreditación de los ensayos realizados por el Centro, de acuerdo a los requisitos del MIFIC (NTON 04-001-98). Se dará prioridad a los ensayos relacionados con la calidad de agua potable, y posteriormente, a los relacionados con las aguas residuales.

2. *Proyección*

05. *Contribuir a elevar las capacidades nacionales para la prevención y el control de la contaminación ambiental.*

RESULTADO 1

El CIRA/UNAN habrá logrado el funcionamiento efectivo como laboratorio de referencia, lo cual garantizará el apoyo técnico y la supervisión a la Red de Laboratorios Ambientales a nivel nacional.

Actividades

1. Avanzar en el proceso de acreditación como laboratorio de referencia de los laboratorios ambientales de Nicaragua.
2. Establecer una base financiera para el funcionamiento del Laboratorio de Referencia.
3. Establecer intercomparaciones de ensayos nacionales con una periodicidad regular para la red de laboratorios.
4. Participar en intercomparaciones internacionales como laboratorio de referencia.
5. Continuar con la planificación, organización y dirección de cursos de capacitación sobre aseguramiento y control de calidad analítica de los

laboratorios como parte de la función que debe realizar el laboratorio de referencia.

RESULTADO 2

El CIRA/UNAN apoyará el establecimiento de la Red de Laboratorios Ambientales en aspectos legales, organizativos y administrativos relacionados con el reforzamiento del sistema de calidad y su acreditación.

Actividades

1. Contribuir a establecer la base legal de la Red de Laboratorios en convenio con MARENA.
2. Continuar con la capacitación, adiestramiento y supervisión de los laboratorios de la red para facilitar el proceso de certificación del sistema de calidad de todos los laboratorios.
3. Gestionar el apoyo financiero para llevar a cabo actividades de la Red de Laboratorios Ambientales.
4. Gestionar la capacitación de expertos en auditorías de control de calidad.

RESULTADO 3

En apoyo al desarrollo de la Red de Laboratorios Ambientales y en su rol de Laboratorio de Referencia, el CIRA/UNAN habrá contribuido a establecer un sistema de monitoreo de los efluentes para el cumplimiento de la legislación ambiental vigente (Montenegro y Hooker, 2000) .

Actividades

1. Reforzar el apoyo a MARENA para establecer un sistema efectivo de monitoreo de los efluentes y cuerpos receptores.
2. Reforzar el apoyo a MARENA para establecer un sistema de información sobre la caracterización de las empresas por rama industrial.
3. Reforzar la capacitación del personal de CIRA/UNAN en aspectos técnicos y administrativos para el control de los efluentes industriales. Esto incluye caracterización por rama industrial, medición de caudal, muestreo, análisis de muestras, reporte de resultados, evaluación de los mismos, reporte de caracterización, recomendaciones técnicas y económicas para facilitar las actividades 1 y 2.
4. Capacitar al personal del CIRA/UNAN en la realización de auditorías ambientales en industrias.
5. Fortalecer la sección de Bioensayos para establecer las técnicas necesarias que contribuyan a la determinación del grado de toxicidad de los efluentes y de los cuerpos receptores.

RESULTADO 4

El CIRA/UNAN habrá consolidado su capacidad técnica e investigativa para realizar Estudios de Impacto Ambiental para proyectos productivos y de desarrollo que puedan afectar a los Recursos Hídricos.

1. Capacitar y orientar al personal de CIRA en la realización de Estudios de Impacto Ambiental para proyectos e infraestructura que susceptibles de afectar a los Recursos Hídricos.
2. Ofrecer el servicio de elaboración de estos estudios.

O6. Contribuir a mejorar la calidad y el rendimiento productivo en las industrias nacionales, minimizando los daños al medio ambiente.

RESULTADO 1

El CIRA/UNAN, en alianza con otras instituciones, profesionales y centros especializados, habrá conformado un equipo multidisciplinario para ampliar su oferta de servicios de consultoría y asistencia técnica a las industrias nacionales, contribuyendo así al mejoramiento de la calidad y rendimiento productivo en éstas.

Actividades

1. Revisar los lineamientos para la *Política Industrial de Nicaragua*, con el objetivo de determinar los sectores industriales a los cuales podría apoyar el CIRA/UNAN.
2. Determinar y establecer contactos con aquellas instituciones, centros y profesionales con los cuales el CIRA puede aliarse para ofrecer servicios de consultoría y asistencia técnica.
3. Contribuir a mejorar la calidad y producción en las granjas camaroneras nacionales por medio de la aplicación de conocimientos y técnicas practicados en el CIRA (Estudios del ciclo de asociaciones de fitoplancton, medidas de producción primaria, etc.).
4. Organizar y brindar cursos de capacitación a los productores de granjas camaroneras.

RESULTADO 2

El CIRA/UNAN, en alianza con otras instituciones, profesionales y centros especializados, habrá conformado equipos multidisciplinarios que apoyen a las industrias nacionales para mejorar el manejo de aguas residuales y desechos sólidos.

Actividades

1. Capacitar al personal del CIRA en tecnologías limpias para el manejo, reuso y tratamiento de aguas residuales industriales, así como para el manejo de desechos sólidos.
2. Determinar y establecer contactos con las instituciones y profesionales aliados del CIRA, para conformar los equipos multidisciplinarios.
3. Organizar, con el apoyo de estos profesionales, cursos de adiestramiento orientados a capacitar al personal de las industrias.
4. Brindar asesorías técnicas a las industrias sobre el ahorro de agua, reuso y reciclaje de las aguas residuales, así como de otras innovaciones que promuevan el uso eficiente de agua, minimizando la generación de efluentes y la contaminación de cuerpos receptores.

07. Generar información que contribuya a resolver problemas de salud de la población, relacionados con los Recursos Hídricos.

RESULTADO 1

El CIRA/UNAN habrá desarrollado la capacidad para ofrecer programas de mitigación que resuelvan problemas sanitarios y de contaminación relacionados con el uso de los Recursos Hídricos en comunidades y áreas afectadas por fenómenos ambientales y sociales.

Actividades

1. Crear una Comisión Adhoc para dirigir los programas de mitigación en comunidades o áreas que enfrenten problemas sanitarios y de contaminación de sus recursos hídricos.
2. Capacitar al personal en la elaboración de proyectos de diagnóstico y de mitigación de problemas.
3. Identificar temas focales en donde se puedan llevar a cabo proyectos e incluirlos en el Plan de Desarrollo Científico.
4. Desarrollar la capacidad para reaccionar ante las necesidades de la población creadas por fenómenos sociales y ambientales.
5. Crear un sistema de información relacionado especialmente con los problemas de salud por enfermedades de transmisión hídrica y su mitigación.
6. Ofrecer programas ejemplares de mitigación por medio de campañas de divulgación.

7. Crear foros de discusión para difundir los resultados de proyectos realizados, contando con la participación de actores locales, la población civil, instituciones del estado, y la comunidad científica en general.

3. Docencia

O8. Contribuir a la formación de profesionales en gerencia de Recursos Hídricos y educación ambiental que aporten al bienestar de la sociedad nicaragüense.

RESULTADO 1

El CIRA/UNAN habrá institucionalizado el programa de *Maestría en Ciencias del Agua* que involucre a profesionales de las instituciones y organizaciones que toman decisiones sobre el manejo de los recursos hídricos e influyen en la educación ambiental.

Actividades

1. Formar profesionales en tres ciclos de la *Maestría en Ciencias del Agua*, en procesos de contaminación y en política, socioeconomía, y legislación de los recursos hídricos.
2. Contribuir con las tesis de los estudiantes, a la investigación y producción de información sobre los recursos hídricos.
3. Gestionar el financiamiento para reproducir la capacidad docente y asegurar el segundo y tercer ciclo de la maestría.

RESULTADO 2

El CIRA/UNAN habrá conformado y realizado un programa de capacitación de cursos cortos intensivos en áreas de alta relevancia nacional y regional relacionadas con los Recursos Hídricos.

Actividades

1. Preparar un programa de cursos que se puedan impartir en el CIRA, tanto dentro de la maestría como a lo interno del Centro.
2. Llevar a cabo cursos cortos intensivos, como parte de la Maestría pero dirigidos al público general, en técnicas específicas como Sistemas de Información Geográfica (SIG), modelaje de flujo, desarrollo participativo en la gestión de proyectos, socioeconomía de los Recursos Hídricos, legislación ambiental, estudios de impacto ambiental y gerencia de cuencas.
3. Ejecutar cursos de adiestramiento en áreas de especialización del CIRA como por ejemplo en la determinación de fitoplancton, zooplancton y

zoobentos, y su aplicación en los análisis de biodiversidad; calidad de agua (microbiológica y química); determinación de contaminación por plaguicidas y metales; dataciones empleando técnicas nucleares.

4. Divulgación

O9. Promover la publicación del material científico producido por el CIRA/UNAN.

RESULTADO 1

Se habrán logrado publicar trabajos de investigaciones pasadas y futuras en boletines nacionales e internacionales.

Actividades

1. Promover la participación del personal científico-técnico en la elaboración de artículos científicos y su publicación.
2. Conformar un comité técnico que garantice el rigor científico y la calidad de los artículos a publicar, tanto en medios nacionales como extranjeros.
3. Gestionar la publicación de artículos a través del comité técnico.
4. Incluir en el Plan de incentivos la publicación de artículos científicos.
5. Divulgar los resultados de proyectos de investigación a través de su presentación en Congresos Nacionales e Internacionales.
6. Gestionar, a través del comité técnico, la elaboración y publicación de una Revista del CIRA de circulación frecuente.

RESULTADO 2

Se habrá organizado regularmente en el CIRA, foros de discusión sobre temas de investigación actual y de interés nacional.

Actividades

1. La Subdirección Técnica organizará con los Jefes de Departamento, Profesores de la Maestría y la Encargada de Proyectos, dos eventos al mes para estimular el establecimiento del foro.
2. Se escogerán temas actuales sobre los recursos hídricos nacionales. Estos podrían ser sobre problemas relacionados con los Recursos Hídricos; aspectos contemplados en las tesis de la Maestría; o en los proyectos de investigación del CIRA y reportes de progreso; temas de interés sobre nuevos trabajos de investigación mundial; temas seleccionados por profesores o investigadores visitantes; etc.

RESULTADO 3

Se habrá establecido el sitio WEB del CIRA y de la *Maestría en Ciencias del Agua* como un instrumento de divulgación del centro a nivel nacional e internacional.

Actividades

1. Continuar con la elaboración del sitio Web del CIRA, que cuente con la participación de todo el personal del Centro.
2. Incluir información sobre el desarrollo institucional tales como resúmenes del Plan Estratégico de Desarrollo, Manual de Calidad del Centro, Manual de Seguridad en el Laboratorio, etc.
3. Incluir información sobre la *Maestría en Ciencias del Agua* y sus actividades.
4. Actualizar periódicamente el sitio, incluyendo los reportes sobre proyectos de investigación en progreso y sus conclusiones, así como otra información de interés.
5. Incluir algunos tópicos o establecer enlaces hacia otros sitios Web nacionales e internacionales.
6. Incluir las actividades de CIRA en el sitio Web del CIRA.

V. Estrategia a seguir

Los nueve objetivos inmediatos que se plantean en este plan dan las pautas para acercar el quehacer cotidiano del centro a su aspiración de convertirse en el centro de excelencia en investigación y docencia superior de postgrado, así como para ampliar sus actividades en el campo de los Recursos Hídricos a nivel nacional y regional. Después de haber enfatizado la investigación en aguas superficiales durante cerca de 20 años, y la venta de servicios en los últimos 5 años, el CIRA/UNAN expande su misión para profundizar la labor investigativa e incluir nuevas áreas relacionadas con los recursos hídricos. Igualmente, el CIRA/UNAN busca profundizar la docencia, la proyección como institución universitaria de servicio a la sociedad, y la divulgación de su quehacer. Al término de los próximos 6 años, el CIRA/UNAN habrá dado un paso importante en el cumplimiento de esta nueva misión, manteniendo en mente el mejoramiento continuo de sus productos y servicios conforme al marco de normativas internacionales de control de calidad.

VI. Marco para la Evaluación del Plan Estratégico

Una de las observaciones más relevantes que surgieron del proceso evaluativo del Plan de Desarrollo 1997-2001 fue que éste carecía de un programa para su evaluación periódica y reporte de la misma. Esto dificultó realizar una evaluación adecuada del alcance de los resultados esperados al final del trienio.

Para evitar problemas similares en los planes subsiguientes, se estipuló que éstos debían contener orientaciones claras de cómo medir y monitorear las actividades y resultados planeados para la consecución de los objetivos específicos (o inmediatos) definidos para cada período. El presente marco para la evaluación del Plan Estratégico de Desarrollo 2001-2006 pretende guiar este proceso, haciéndolo más periódico y operacional. Una de las principales ventajas de la evaluación periódica, y su respectivo reporte, es que permitirá darle seguimiento y actualizar el Plan Estratégico de Desarrollo a medida que se vaya implementando, evitándose así sorpresas desagradables al final del sexenio. El plan deberá actualizarse anualmente.

A fin de facilitar la medición y evaluación del desempeño del plan se establecieron una serie de indicadores. Estos son instrumentos que permiten mostrar los cambios que se han efectuado desde la situación inicial, reflejando claramente si los resultados planeados han sido alcanzados o no. Una vez hecha esta comparación se pueden definir más fácilmente las acciones correctivas a tomar, e implementarlas prontamente.

En el anexo 2 se presentan los indicadores para cada objetivo inmediato. Estos se han dividido en indicadores de rendimiento y de cumplimiento. Los primeros son indicadores del progreso en el logro de los resultados, los segundos demuestran el cumplimiento de los mismos. Así mismo, en el anexo 2 se detallan las fuentes de verificación de la información sobre los indicadores, los responsables para recabarla, y la frecuencia con que se debe hacerlo.

En el proceso de evaluación del Plan Estratégico de Desarrollo participarán todos los elementos de la estructura institucional del Centro, desde el nivel más específico hasta el más agregado. Los Planes Operativos Anuales de cada colectivo se elaborarán en base a lo requerido en el Plan Estratégico de Desarrollo del Centro. De modo que para empezar, el POA actual 2001 deberá ser revisado y actualizado en base al presente plan.

Para realizar la evaluación del Plan Estratégico cada departamento registrará semestralmente su avance en el cumplimiento de las actividades, correspondientes a aquellos resultados y objetivos que le competan. Al final de cada año, cada departamento realizará una evaluación del plan enfatizando el cumplimiento de los resultados bajo su responsabilidad. Dichas evaluaciones serán remitidas a la Dirección, quien producirá un consolidado que será presentado y discutido en el consejo de Dirección, enfatizando el avance en el cumplimiento de los objetivos inmediatos. La evaluación final del Plan estará a cargo del Consejo de Dirección. En el anexo 3 se presenta un formato para darle seguimiento a la implementación del plan.

La evaluación periódica del Plan se complementa con la debida comunicación de sus resultados, tanto a lo interno de la institución, como a lo externo según sea necesario. Por lo tanto, deberán realizarse reportes escritos de dichas evaluaciones, y en caso de considerarse necesario, reportes orales. A manera de guía, los reportes escritos deberán contener la siguiente información:

- Información del progreso general del plan en dos períodos:
 - Desde el inicio del plan
 - En el período más reciente (trimestre, semestre, año, etc.).
- Progreso en el alcance de los resultados contra lo que estaba planeado y desviación de los planes.
- Explicaciones del porqué de éstas desviaciones.
- Reporte sobre los resultados no esperados.
- Recuento de los cambios ocurridos en el contexto, de los riesgos, problemas, etc., y recomendaciones sobre los pasos o acciones a tomar.
- Reporte sobre la implementación de recomendaciones previas.

VII. Cronograma de ejecución

Para concluir este Plan Estratégico, se presenta en el anexo 4 el cronograma para su implementación. Además de especificar los tiempos para la ejecución de las distintas actividades, dicho cronograma detalla las unidades responsables de su ejecución.

Referencias

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- Montenegro, S., Engi, D. y K. Vammen. 1999.** “Managing Nicaraguan Water Resources. Definition and Relative Importance of Information Needs”. Sandia Report SAND98-2828. Sandia National Laboratories. January, 1999.

ANEXO 1

CONTEXTO NACIONAL

El CIRA-UNAN es una dependencia de la Universidad que dentro del contexto nacional se inserta en el Sector del Ambiente que incide en el desarrollo y mejoramiento de la salud de la sociedad nicaragüense. Para facilitar la comprensión de este proceso de desarrollo de las facilidades instaladas en el Centro, conviene hacer un análisis de ese contexto.

El Sector Ambiente en Nicaragua, presenta una situación cambiante, de alta vulnerabilidad, marcada por las transformaciones que se llevan a cabo en los ámbitos político, económico y social del país; dentro del proceso de globalización mundial de los mercados (ésta trae como prioridad la tecnificación y la especialización que nos vincula con el sector productivo y con el gobierno de la república de Nicaragua) y las correspondientes reformas o adecuaciones del Estado nacional.

De manera muy general, estas transformaciones siguen siendo las siguientes:

A NIVEL MACROECONÓMICO

La posición económica del país es frágil. El PIB, a pesar de la tendencia al crecimiento que muestra desde 1994, todavía no supera los índices históricos de 1975, ni el rezago respecto a los Estados Centroamericanos. En este sentido, se observa una elevada deuda externa, tres veces superior al PIB; los desequilibrios de la balanza comercial y de pagos, la escasa diversificación y volúmenes de exportaciones y la dependencia de tecnologías e insumos importados limitan seriamente las posibilidades de un mayor crecimiento económico.

Los productos de exportación, esencialmente del sector agrícola, han sido prácticamente los mismos en los últimos cincuenta años. Los únicos productos que han cambiado son los no tradicionales, los cuales están destinados a mercados europeos y de EUA.

Los nicaragüenses muestran índices de consumos que no se corresponden con los de la producción nacional que todavía tienen un rezago de más de 25 años.

La baja inversión registrada en las dos últimas décadas ha generado una infraestructura inadecuada en energía, transporte y comunicaciones. La demanda y la generación han crecido, pero se han modificado las fuentes. En 1990, el 60% de la energía era generado por fuentes renovables: hidroeléctricas y geotermia. En 1999, solamente el 22% tuvo ese origen, aumentando el nivel de dependencia y la vulnerabilidad frente a las alzas del petróleo.

En el ámbito general se observa una marcada desigualdad de distribución del ingreso y de la tecnología, profundizando la brecha entre ricos y pobres.

Por otra parte hay que señalar que el mercado ha favorecido casi exclusivamente al sector comercio, puesto que el intercambio se desarrolla sobre la base de un constante ajuste de precios, en una economía dolarizada cuya excepción ha sido el mercado de trabajo, con salarios casi congelados y con una alta tasa de desempleo abierto que en 1999 se ubicaba en el 10.7 % de la PEA. El grupo de ciudadanos entre los 15 a 24 años de edad presenta tasas de desocupación dos veces superiores a las del grupo de 25 a 49 años. Un 30% de las mujeres rurales en 1999, se encontraba en desempleo. El 41.3% de la PEA urbana todavía enfrenta problemas de subocupación.

Los índices de productividad media por sectores de la actividad económica, en los últimos diez años muestran una tendencia a la baja, lo cual indica una dificultad para la generación de nuevos empleos. Por otra parte, el salario mínimo no permite la satisfacción de una canasta básica de consumo familiar. Según encuesta del Ministerio del Trabajo, en 1999 el 56% de la PEA urbana ocupada percibe ingresos de C\$1,000 mensuales, como salario o por cuenta propia. En la misma fecha una canasta de 53 productos básicos costaba C\$1,667. Un 27% de la población urbana ocupada tenía ingresos entre C\$1,000 y C\$2,000 y solamente el 17% tenían ingresos superiores a los C\$2,000.

DIFERENCIAS SOCIALES

En materia de la distribución del ingreso, se observa lo siguiente:

El 10% de la población más pobre elevó su participación en el ingreso de 0.4%, en 1993, a 0.8%, en 1998; en contraste el 10% de la población de mayores ingresos aumentó de 42.7% a 44.7%. El 1% de los más ricos pasó de 13.2% en 1993 a 15.6% en 1998. Lo que significa que estas dos últimas clases perciben más del 50% del ingreso.

En materia de educación, la población de 20-29 años presenta un promedio de 6.3 grados de escolaridad y 2.6 para los mayores de 50 años, para un promedio nacional de 4.9 grados.

En relación con la pobreza, la escolaridad promedio de quienes están en extrema pobreza es de 2.3 grados, mientras que los sectores no pobres promedian 6.2 grados.

Entre 1992 y 1998 la población de estudiantes universitarios aumentó de 29,789 a 62,170 lo que representa casi el 12% de los jóvenes de la edad correspondiente. La educación superior, sin embargo, enfrenta el reto de mejorar la pertinencia de las carreras ofrecidas y superar los estándares de calidad y eficiencia.

La influencia de la educación técnica sigue siendo muy limitada, aunque se observa cierta transformación en los planes curriculares y de reorientación de sus programas, haciéndola más atractiva para la población. Sin embargo entre la población estudiantil y entre las familias sigue fundado el ideal de seguir las llamadas carreras liberales de la educación superior.

En el sector salud en los últimos 40 años la esperanza de vida aumentó de 48 a 68 años; en los últimos 24 años la tasa de mortalidad infantil descendió de 100 a 40 por cada 1,000 nacidos vivos. Estos resultados parecen alentadores, sin embargo persisten disparidades entre la población urbana y la rural, especialmente en las regiones Central y Autónoma del Atlántico Norte, que presenta una tasa de mortalidad materna de entre 236 y 267 por cada 100,000 lo que duplica en casi el doble del promedio nacional.

A NIVEL POLÍTICO

Las políticas impulsadas por los últimos dos gobiernos muestran una visión que decanta la solución del desarrollo en una incipiente delegación hacia el municipio que contrasta con una fuerte actividad de la institución del mercado, en una dinámica de transferencia de las empresas prestadoras de los servicios públicos hacia el sector privado, que al aumentar su peso específico tiene cada vez mayor influencia en la determinación de las políticas públicas. En esta dinámica el gasto social se ha visto severamente reducido, lo que a su vez restringe la atención de la salud, la educación y la protección del ambiente.

El desarrollo errático del sector financiero del país muestra una débil banca privada y el abandono del Estado hacia los criterios de eficiencia y la libre oferta y demanda del mercado. Esta política ha sido mantenida con una fuerte inyección de fondos públicos, de al menos 150 millones de dólares en la quiebra del INTERBANK y Banco del Café; que a su vez significa una mayor presión fiscal para el ciudadano y significa poner en riesgo la inversión del Estado en el gasto social.

Con la intención de incentivar al sector productivo del país, la carga tributaria establece un sistema regresivo que, en un 85%, se apoya en los impuestos indirectos o de consumo, es decir, el que tiene menos paga igual al que tiene más, abandonando el principio de equidad social (Gutiérrez, 2000)

Por otra parte se han dictado leyes que establecen un tratamiento excepcional para incentivar la inversión privada, con reformas tributarias a la renta de las empresas, a la inversión extranjera y al sector turístico. En contraste, se han limitado estos beneficios a las organizaciones sin fines de lucro, posiblemente, porque estas han mostrado un mayor compromiso social y una actitud más crítica frente a las políticas del gobierno.

Esta situación tiende a favorecer el incremento de la empresa privada que, por el nivel tecnológico del país y alta vulnerabilidad económico y social del país, presiona contra los recursos naturales de la nación.

A NIVEL DEL AMBIENTE

El ambiente, como fuente de riqueza, belleza paisajística, de biodiversidad y de agroturismo, en cuanto hábitat de la sociedad, presenta aspectos de vulnerabilidad derivados de esquemas de desarrollo y de uso de los recursos naturales que no han observado el suficiente cuidado para garantizar su sostenibilidad. La expansión de la frontera agrícola, o la conversión de bosques a agricultura y pastos, la deforestación, el cultivo de laderas, son factores que han contribuido a acelerar los procesos de erosión y depreciación de la tierra, con gran impacto en el microclima y el ciclo hidrológico, con la consecuente pérdida de la biodiversidad y el incremento de la vulnerabilidad ambiental. La escasez y pérdida de la calidad del agua se está convirtiendo en un problema crítico. Todas las poblaciones del Pacífico y del Centro del país enfrentan problemas de abastecimiento y calidad del agua que demanda soluciones de alta inversión. En el país, el consumo per cápita de plaguicidas ha crecido en un 350% entre 1990 y 1998, incremento que se corresponde con el aumento del rendimiento de los cultivos y que se debe a un aumento de resistencia de las plagas.

Este proceso de uso intensivo de agroquímicos desde los años 50 ha causado un fenómeno de contaminación por compuestos tóxicos persistentes, el cual representa un serio problema para el uso de los recursos hídricos nacionales. Por lo tanto, el concepto de que Nicaragua, como país agrícola y no-industrializado, se salva de la contaminación fuerte que sufren los países industrializados, ya no es válido.

El huracán Mitch mostró la acumulación de las alteraciones introducidas en el ambiente, provocando la mayor cantidad de daños en las zonas más degradadas, marginales y pobres del país, tales como en Occidente. Este desastre natural demuestra la vulnerabilidad de las Políticas Ambientales, las cuales son afectadas por una falta de voluntad política a nivel macro para dar respuestas adecuadas a los problemas de nivel micro.

DEMOCRACIA Y ESTADO DE DERECHO

La Constitución Política de la República contiene los instrumentos legales que permiten la construcción del Estado de Derecho, sin embargo, las constituciones en Nicaragua no se han caracterizado por su permanencia. El ideal representa un desafío para gobernantes y gobernados. Se han dictado leyes para la promoción y defensa de los derechos humanos y se han creado algunas instancias dirigidas a hacerlos efectivos, como la Procuraduría de los Derechos Humanos, Las Casas de Justicia, Las Comisarías de la Mujer y la Niñez, La Procuraduría del Ambiente, la Ley del Poder Judicial.

Pero aún se requiere de otros mecanismos legales y, tal vez lo más importante, los mecanismos financieros que aseguren la efectividad de su cobertura.

Los altos niveles de corrupción que la población percibe del gobierno, son un obstáculo para la implantación y desarrollo del ideal de Estado de Derecho y una seria amenaza para sumir más en el desamparo a los sectores más desprotegidos y marginados.

Los recientes acuerdos entre los dos grandes partidos políticos del país, han implicado cambios en la Ley Electoral, en el número y composición de la Corte Suprema de Justicia y el Consejo Supremo Electoral, modificando las bases de la participación política, la permanencia de los demás partidos políticos, la impartición de justicia sesgada por intereses partidarios o económicos. Estos cambios plantean un desafío importante en la participación ciudadana y al proceso de fortalecimiento de la Democracia y el Estado de Derecho.

Appendix 3.3

Resumen de proyectos de CIRA/UNAN 2004

I. Proyectos o Eventos Actualmente Funcionando o en Proceso de Organización

- Contaminación Ambiental por Mercurio en el Lago Xolotlán, Nicaragua, en Relación a la Evaluación de Riesgo a la Salud Humana, BID, Instituto de la Enfermedad de Minamata, Japon.
- Reforzamiento de la Capacidad del Laboratorio de Microbiología del CIRA/UNAN, para la Evaluación del Impacto Sanitario Relacionado con la Actividad Económica, BID
- Tesis de Investigación de 8 Tesis Estudiantes, Maestría en Ciencias de Agua.
- Preparación de la Base Científico-Técnica y Documental Necesaria para la Nominación de las Lagunas Playitas, Moyúa y Tecomapa a Humedales RAMSAR, SAREC pequeños Proyectos.
- Curso de distancia en Limnología, CARA.
- Aseguramiento de Calidad, Curso, OIEA.
- Proyecto Regional RLA/8/031, Manejo Integrado y Sostenible de los Recursos Hídricos Subterráneos en América Latina: Estudio del Acuífero Aluvial del Valle de Estelí, OIEA.
- SAREC, Programa Multidisciplinario
- Congreso Internacional CARA, Marzo 2005.

II. Proyectos Entregados Esperando Aprobación

2004

- La extensión del “Estudio Básico Monitoreo de la Calidad del Agua en la Cuenca del Río San Juan”
- INPYME, Calidad Sanitaria de Alimentos, Microbiología, BID, (Dirección de Investigaciones, UNAN)
- Un Aporte de Información Científico-Técnica para el Desarrollo de una Estrategia de Protección para la Cuenca del Gran Lago de Nicaragua, Programa de Pequeños Fondos para Investigación del SEMA/IDRC, Consorcio Asociación de Municipios del Gran Lago de Nicaragua AMUGRAN-CIRA.

2005

- Reconstrucción Histórica del Estado Trófico del Lago Cocibolca por Medio de un Estudio Paleolimnológico y un Análisis de las Actividades Antropogénicas en la Cuenca. Proyecto de la OIEA en el marco del Programa de Cooperación Técnica para el 2005 hasta 2007.

III. Proyectos Elaborados y Pendientes a Presentación y Aprobación de Financiamiento

- Gestión Integrada de los Recursos Hídricos de la Cuenca del Río Ochomogo y el Acuífero de Nandaime Enfocado al Desarrollo Agropecuario Sostenible para presentarlo a IICA. Proyecto del Equipo de Hidrogeología de Contaminantes.

IV. Proyectos en Elaboración

- Sostenibilidad de la Maestría en Ciencias de Agua para III Ciclo en 2005 y otros cursos de Posgrado.

Appendix 3.4



Universidad Nacional Autónoma de Nicaragua (UNAN-Managua)
Centro para la Investigación en Recursos Acuáticos de Nicaragua
(CIRA-UNAN)



Maestría en Ciencias del Agua

Tesis de Estudiantes del 1. Ciclo de la Maestría en Ciencias de Agua

No.	Nombre Completo	Tema de Tesis
1	Rosa Maria González Tapia	<i>Estudio sobre la Calidad del Agua y Riesgos de Contaminación de los pozos de Abastecimiento Público, Río Viejo y Grande de Matagalpa en el Valle de Sébaco, Matagalpa 2002.</i>
2	Thelma Zulema Salvatierra Suárez	<i>Plan de Gestión y Desarrollo Integral en las Subcuencas Las Playitas, Moyúa y Tecomapa, de la Cuenca del Río Grande de Matagalpa.</i>
3	Juana Del C. Ruiz Mendieta	<i>Aplicación de un modelo numérico para el manejo de la explotación de pozos de Llano Grande y Santa Clara, Valle de Apanás, Jinotega.</i>
4	Zeneyda Del S. Rizo Osorio	<i>Afectación a la Recarga por Urbanizaciones en la Sub-cuenca III del Acuífero de Managua</i>
5	Maria Luisa Talavera López	<i>Estrategias para Preservar la Calidad de Agua del Campo de Pozos del Valle de Apanás, Jinotega, Nicaragua.</i>
6	Yelba Del Carmen Flores Meza	<i>Criterios Hidrogeológicos para la Formmlación del Plan de Gestión del Acuífero Valle de Sébaco</i>
7	Mayra Altamirano Carcache	<i>Plan de Acción Participativo para Potenciar la Disponibilidad, Calidad y Accesibilidad del Agua en la Comunidad de Colonia Roque, Tipitapa</i>
8	Wilber Antonio Cuadra Jirón	<i>Contaminación del Suelo en el Acuífero León-Chinandega por Residuos Organoclorados Aplicados al Cultivo del Algodón en Chichigalpa y Posoltega.</i>
9	Francisco Mercado Jiménez	<i>Identificación de Sitios Vulnerables a la Erosión Hídrica y Propuestas para Prácticas Apropriadas de Uso y Manejo de Suelos en la Subcuenca III de la Cuenca Sur del Lago de Managua</i>
10	Svetlana Dumailo	<i>Evaluación de la Problemática Ambiental en la Laguna de Bluefields por medio del Estudio de algunos Aspectos de Sedimentación y Contaminación, RAAS, Nicaragua</i>

CIRA/UNAN

Dirección: De ENITEL Villa Fontana, 400 m Norte.
Tels. 2786981-2; Fax: 2678169

Appendix 3.5



Universidad Nacional Autónoma de Nicaragua (UNAN-Managua)
Centro para la Investigación en Recursos Acuáticos de Nicaragua
(CIRA-UNAN)



Maestría en Ciencias del Agua

Tesis de Estudiantes del 2. Ciclo de la Maestría en Ciencias de Agua

1	Ing. Daniel Corrales Pérez	Caracterización Hidrogeológica e Hidrogeoquímica del Acuífero Aluvial del Valle de Estelí
2	Ing. Elizabeth Peña	Disponibilidad y Aprovechamiento Sostenible del Acuífero de Nandaime
3	Ing. Nelson Buitrago	Evaluación del Potencial Hídrico del Entorno de la Ciudad de Boaco
4	Lic Maximina Altamirano Espinoza	Determinar el Origen de la Contaminación por Arsénico en las Aguas Subterráneas en la Sub Cuenca del Valle de Sébaco (Comunidades de las Mangas, el Zapote, Roberto Centeno, Sabana Larga Y comarca La Unión Municipio de Sébaco).
5	Lic. Yader Caballero	Disponibilidad y Calidad de las Aguas Superficiales de la Subcuenca del Río Ochomogo
6	Lic. Jorge L. Guatemala Herrera	Caracterización de la Estela de Contaminación del Basurero la Joya en Granada
7	Lic. María Elena López Blanco	Investigación Geofísica y Condiciones Geodinámicas del Medio Acuífero: Contaminación de Hidrocarburos (LNAPLs) en un Sitio del Área de Managua
8	Ing. Eddie Moises Gonzalez Valdivia	Influencia de los Imaginarios Culturales que Interaccionan en el Sistema de Producción Agrario de la Cuenca Alta del Río Estelí sobre los Recursos Hídricos

CIRA/UNAN

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Appendix 3.6

Masters and Licentiate Degree Students and Thesis of Graduation

Student	Thesis Title	University, Faculty	Date of Graduacìon
Valeria Delgado	Groundwater Flow System and Water Quality in a Costal Plain Aquifer in Northwestern Nicaragua	Department of Geology and Geophysics University of Calgary, Canada	June, 2003
Heyddy Calderon	Numerical Modeling of the Groundwater Flow System in a sub-basin of the León-Chinandega Aquifer, Nicaragua	Department of Geology and Geophysics University of Calgary, Canada	Noviembre, 2003
Francisco José Picado Pavón	Mercury Sorption Influenced by Mineral Particle size, DOC, and Bacteria-Implications for Transport in Soil and Streams	Chemical Ecology and Ecotoxicology Department of Ecology Lund University, Sweden	December 2002
Katia Lily Montenegro Rayo	Ecological implications of DDT and glyphosate-linking toxicology and trophic cascading	Chemical Ecology and Ecotoxicology Department of Ecology Lund University, Sweden	December 2002

Appendix 4

Questionnaire responses from USAC.

University as a knowledge base	School of Chemistry	Department of Toxicology
What activities have been accomplished during the past 5 years to transfer knowledge on environmental and health issues from the university to society?	University has 2 main programmes through which knowledge is transferred to the community, EPS and EDC. Other activities are research projects in water quality in different lagoons and rivers of the country, and projects in air quality in the city.	Conference to students and professionals regarding knowledge on environmental and health.
What inquiries have been received on information on environmental and health issues from local and national government authorities during the past 5 years?	Mainly for results from our current environmental research programs (air and water quality)	57 regarding metals and solvents (Pb, Hg, Ar, Hipuric acid and organic solvents).
What improvements of national legislation and regulation of environmental and health issues have been realized during the past 5 years by initiatives and knowledge support from the university?	None. There is little or no interaction among University and Congress.	To establish a programme to measure Pb in air, soil and blood sample of factory workers. From 2000 to 2004 614 analysis were carried out to measure blood Pb concentrations.
What is the strategy/plans for knowledge transfer on environmental and health issues from university to society for the forecoming 5 years?	Implementation of TV programmes through the University station (Radio-TV) of School of Chemistry.	To obtain support to have resources to continue with conferences.

Undergraduate training

What are the subjects of teaching and their proportions at the undergraduate level? (it would be fine with a page showing the structure of the teaching program, e.g., in a flow chart, which may be complemented with proportions, i.e., number of study weeks and typical number of attending students)	Analytical Chemistry 30%, Inorganic Chemistry 10%, Physical Chemistry 20%, Organic Chemistry 40%. Total length of programme 5 years.
What environmental and health science topics are covered in classes? (here it would be preferable to have a recent schedule (in Spanish) from teaching environmental and health science at various levels)	In environmental sciences: aquatic chemistry, fundamental of hydrology, subsurface water, environmental chemistry.

What are the total number of students attending undergraduate training, and the numbers studying environmental and health oriented subjects during the last 5 years?	At the School of Chemistry: 70 students. All of them (at one point in their studies) make one environmental visit.
What are the percentages of students enrolled in undergraduate education that passed the various examination degrees (bachelors, masters, etc) during the last 5 years?	Less than 40 for licentiate after 6-8 years study.
What are the plans for the next few years for teaching on environmental and health issues (e.g., for changing recruitment, structure of teaching programme)?	Implement new courses in Environmental Chemistry (2 courses). Strengthening research in environmental chemistry. External review of Chemistry curriculum.

Master's training

What Master's programmes are given, what is the financial source, how many students are enrolled and how many received the degree the last 5 years?	None, however our current development plan calls for the creation of such programs.
What international Master's programmes are given in environmental and health sciences (programme located at your university but with students from other universities and with a major contribution from foreign teachers)?	None.
What Master's programmes abroad did your students of environmental and health sciences attend the last 5 years, how many of your students went abroad to obtain a Master's degree in environmental and health sciences?	In Environmental Science: 3 students.
Known destinations of Master's students in environmental and health sciences (Government services, management, hospitals, high school teacher, consultant, etc)?	USAC, Del Valle University.

Titles of last 5 years of Master thesis within environmental and health sciences?	Carga de nutrientes y sedimentos del Río Polochic y su impacto sobre la integridad ecológica del Lago de Izabal. Indicadores Biológicos de la Calidad del Agua del río Polochic y de la Integridad Biológica del lago de Izabal. Acid rain in the volcanic region of Pacaya.
What are the plans for the next few years for programmes on environmental and health sciences?	Joint UNAM (Mexico)-USAC Masters program.

PhD training

How many of the staff members of environmental and health sciences were enrolled in a PhD training programme during the last 5 years? What organisation was the host of the programme and who paid for the training?	None.
How many percent of their full time were staff members engaged in PhD training programmes? How were they replaced in faculty while they attended the PhD programme?	
Known destinations of PhD's in environmental and health sciences (Government services, management, hospitals, high school teacher, consultant, etc)?	
If the PhD's stayed at the university - what tasks were they offered?	
What are the plans (needs, dreams) for the next few years for PhD training programmes in environmental and health sciences?	We would like that 100% (3 teachers) of staff obtained a PhD degree.

Research

What research projects have been carried out in environmental and health sciences during the last 5 years?	Medical plant defense compounds. Water quality in las Vacas river. Water quality in the National Park of Laguna del tigre. Water quality of Río Dulce and Izabal Lagoon. Acid deposition in the volcanic region. Air quality in Guatemala city.	A study to establish mercury levels in urine from odontology faculty students by chemical analysis. (223 total samples)
What research funding has been raised in environmental and health sciences in the last 5 years and what are the sources of those funds?	National funds for research. University funds. Private funds (ONG's). Typical amount \$25.000.	
What proportions, on average, of the research funds have been used to cover expenses for salary, consumables, equipment, and administration?	Equipment: 20%. Administration: 10%. Consumables: 25%. Salary: 45%.	
For faculty staff members that received research funding - how much of their total work time (approximate range in %) were allocated to research activities?	25-30%, mostly on spare time.	
What research projects in environmental and health sciences include collaboration with a) other faculties within the university, b) other national universities, c) other CA universities, d) other international universities?	None	
What activities were accomplished at the university during the last 5 years to stimulate staff members interest in research and development?	This year we have implemented the collaboration with the Chemistry Institute of UNAM as a starting point.	
What are the plans for the next few years for research in environmental and health sciences? What areas of the research field do you want to develop, how may fund raising improve, how about collaboration and organisation of infra-structure?	We need to modernize and acquire equipment, such as GC and HPLC. We want to develop environmental research. That needs improved analytical techniques, but we have no funds.	

Staff members

How many staff members are there in environmental and health sciences? What (approx.) percentage of them are below 40 and above 60 years old?	Less than 10, all younger than 40.	3 below 40 and 2 above 60
How many of those staff members have a final degree as a) bachelor, b) licentiate, c) master, d) PhD?	2 licenciates, 2 Masters, 0 PhD.	3 are licenciates and 3 master's
What scientific papers were published during the last 5 years by faculty staff members in environmental and health sciences? (this refers to official journals in CA or other international journals, in Spanish or English)		
What Master's theses were supervised by staff members of environmental and health sciences during the last 5 years?	Guatemala city air quality, Río Dulce water quality.	
What specific activities are planned for the next few years to stimulate the academic development of staff members in environmental and health sciences?		We would like to implement environmental analysis in our laboratory.

Proposed research capacity building programme

What major effects do you expect the proposed long term research capacity building programme will have on environmental and health sciences activities at your university?	More Master's degrees, more courses for teachers.	Great for our country since we do not have too much.
What are the most important benefits for your university of the regional approach of the programme?	Training and construction of facilities.	To have the opportunity to implement new analyses in environment and health to offer them to the society.
What improvements would you suggest be made to the current proposal to better satisfy the needs at your university - another focus, other activities, another organisation, etc?	Candidates are available if focus is on PhD training.	
What are the major limitations at your university for a successful participation in the programme?	Very little and tight budget.	there is no budget.

Appendix 5

More useful information about UNA and IRET

Since its creation in 1973, UNA has expanded its academic activities to remote areas and has joined its work to the one of local governments, small and medium enterprises, social organizations, non-governmental organizations and public institutions. The main objective for these link is to generate knowledge and information about nature, society and productivity, to applied in the design and implementation of the development strategies that are fostered by the social agents UNA works with. In addition, UNA contributes with the creation of new ways to strengthen national education and to cultivate the arts and sports. Other tow important elements in UNA's mission are to renew the cultural development of the country and to support the continuous democratization process in the Costa Rican society.

Thus, the emerging university of the 70's is, 25 years later, a reality of excellence. This is shown by its wide variety of options: 82 majors and 13 master's degree and three PhD's programs that meet the requirements of local, regional and national development.

Several academic projects give different schools the opportunity to create knowledge constantly interacting with the reality of the country. Both the teaching staff and students contribute to the development of rigorous research and to give solutions to the problems faced by the nation.

Its 12 specialized institutes and 70 research laboratories have allowed UNA to develop a vast trajectory. Research and outreach results have been materialized in effective contributions to the development of Costa Rican society through numerous publications by Editorial UNA and other international publications.

Outreach is an outstanding academic area at UNA. The relationships established with communities, social organizations, non-governmental and other institutions help create knowledge and apply it to community necessities. The teaching staff and students are the main vehicle to carry out this activity, which also provides feedback for all the facets or university work.

UNA creates conditions for the protection and sustainable use of natural resources, and for the decisions made by different institutions and communities. Some activities that help in the creation of these conditions are: The Central American Institute for Studies in Toxic Substances (IRET-UNA) and its two laboratories LAREP and ECOTOX.

UNA works together with the international community to channel foreign funds for the improvement of research, teaching, outreach and the development of technology and infrastructure that benefit the different communities and productive sector of the country and the region.

Number of students : about 25.000
Cooperation agreements: about 1000
International agreements. About 400

Regional Institute of Studies on Toxic Substances of the Universidad Nacional (IRET-UNA), Costa Rica, has secured itself as an academic center of excellence. It is a State Institute with national, regional and international outreach, dedicated to improving the environment, the quality of life of the workers and the entire Central American population.

Since its very formation in the 1980s, this group of investigators has dedicated itself to research, teaching and extension on exposure and risk assessment, and on the reduction of environmental and health hazards from toxic substances, predominantly from pesticides.

The academic activities of IRET are organized in four sections: health, environment, surveillance and alternatives to toxic substances. Our laboratories Laboratory of Pesticide Residue Analysis (LAREP) and Laboratory of Ecotoxicological Studies (ECOTOX) are involved in all.

IRET-UNA realized its teaching activity through a Master Degree Program in Occupational Health (in cooperation with the technological Institute of Costa Rica, through a national and Central American Continuous Education Program and through Training Research Program for national and foreign university students. IRET is also promoting two new Master Degree Programs one in Tropical Ecotoxicology and other in Bioethics.

Personnel

IRET represents an interdisciplinary of 30 professionals team trained in 21 disciplines in health and environmental sciences, agriculture, chemistry, social sciences, psychology, informatics and administration.

Our functions

IRET consolidates and extends collaboration between institutions of higher education, social actors, national governments and international institutions in issues concerning toxic substances, (their effects on health and the environment), search for alternative clean solutions of production, and environmental and occupational health.

Collaboration

We are collaborating with and supported by:

- The Swedish International Development Collaboration Agency (Sida)
- German Agency for Technical Collaboration (GTZ)
- International Agency for Research on Cancer (IARC)
- International Atomic Energy Agency (IAEA)
- International Development Research Centre (IDRC), Canada
- WHO Network of Collaborating Centers in Occupational Health
- United Nations Development Program (UNDP)
- United Nations Environment Programme (UNEP)
- European Union
- Pan American Health Organization (PAHO)
- Superior Council of Universities of Central America (CSUCA)
- US Environmental Protection Agency (EPA)
- National Wildlife Research Centre, Environment Canada
- National Institute for Working Life, Sweden
- National Institute of Public Health, Sweden
- Karolinska Institute
- National Cancer Institute, USA
- Fogarty Fund, USA
- Costa Rica-United States of America Foundation for Cooperation (CR-USA)
- Inter-Ecclesiastic Organization for Cooperation in Development (ICCO), The Netherlands State Departments for external collaboration, the Netherlands, Norway, Spain, and Mexico

- Universities in Argentina, Belgium, Belize, Bolivia, Canada, El Salvador, Finland, France, Guatemala, Mexico, Nicaragua, Panama, Portugal, South Africa, Spain, Sweden, The Netherlands, Tanzania, U. K. and United States.

At the national level, we collaborate with other public institutions and governmental entities such as universities, research centers, ministries, the Office of Management and Budget, the Ombudsman's Office, institutions in the health, environment, and agriculture sectors, agricultural and environmental associations, trade unions and producers' chambers.

Activities

Our activities are primarily targeted at the Central American Region:

- Search and identification of alternatives to the use of toxic substances
- Facilitation and promotion of research on health and the environment on toxic substances and on general occupational and environmental health
- Teaching and capacity building in health sciences, occupational and environmental epidemiology, ecotoxicology, and sustainable agriculture
- Development of indicators of environmental quality, environmental exposures, environmental and health effects of chemical substances and occupational health
- Health promotion in selected populations

Statistical highlights

The period from March 1998 through October 2003 covers the following accomplishments:

Activity	Quantity	Activity	Quantity
RESEARCH		EXTENSION	
Research projects	40	Presentations, workshops, seminars	30 (2,000 p)
Scientific publications	54	Consultations* to the civil society, NGOs, or Governments	36
Scientific reports and other publications	54		
Participation in congresses	50		
visiting scientists	60 p		
TEACHING		TEACHING	
Courses and regional workshops	19 (282 p)	Others (graduate, pregraduate)	30 (850 p)
Research trainers	69		

*on exposures, environmental hazards or health issues connected with toxic substances. p : persons.

Ever since its foundation, the Institute has targeted its scientific activities at various sectors of society (scientific, students, governments, agriculture, industry, and the civil society) at the local, national, regional and international levels. An estimated 50,000 persons have been directly reached, including 45,000 through conferences and publications, 2,500 through extension activities, 1,200 students and 60 scientists in collaborating universities and research centers.

Appendix 6

Terms of Reference for the evaluation of regional programme for environmental and health research in Central America

1. Background

On the initiative of the Swedish government, a bilateral research cooperation was started in 1989. The purpose was to draw attention to, and support, the democratic evolution in Costa Rica and the role of Costa Rica as a regional peace mediator. Within this cooperation, a project on the health effects of pesticide use was initiated in 1991 between researchers from UniverSidad Nacional, Heredia and Institute for working life and the Institutet of environmental medicin at Karolinska Institutet. A PhD student from Costa Rica defended her thesis in 1997 on poisonings, cancer and chronic neurological effects of pesticides. Another PhD project, with the focus on the toxic effects of pesticides on the environment, was initiated 1994. The Swedish counterpart was the Department for systems ecology, Stockholm University and the thesis was defended year 2000.

These two PhD-thesis noted that longterm effect of pesticides is in general an unexplored research area and that the use of pesticides may have negative effects on the agriculture as well as ecotourism. Therefore, Sida supported a regional research cooperation programme for research and research training within the area of pesticide with a total of 3.6 milj SEK during the period 1999–2001 and a bridging phase program for 2003. The purpose of the programme was to support research on the effect of pesticides on health and on the environment by contributing to specific components such as data collection, improvement of surveillance systems and regional research training courses. Collaborating departments are located in Costa Rica, Nicaragua, Panama, El Salvador, Guatemala and Honduras and the programme is coordinated from the Central American Institute for Studies on Toxic Substances (IRET) at UniverSidad Nacional, Heredia, Costa Rica. This agreement was later extended up till 2002-12-31 because of the delay of disbursement for the year 2001 and the delay of some programme activity.

2. Purpose and Scope of the Evaluation

The support from Sida is coming to an end and the research programme has the intention to submit an application to Sida for an expanded volume of activity. To make a fair assessment of the application, an evaluation of the regional support and the work performed during the period from 1991 to 2001 and a bridging phase program for 2003. An external evaluation of the Sida-supported activity has previously not been performed.

The findings and recommendations from the evaluation will guide decisions on future Sida support. Also, the evaluation will constitute a document for future progress of the programme.

The evaluation will be carried out with concern for objectivity and impartiality, for transparency and credibility.

3. The Assignment (issues to be covered in the evaluation)

The consultant shall read the background documents leading to the support of the programme activities. Against these documents and the decisions made by Sida (promemorias), consultants shall assess to what extent the objectives of the programme have been fulfilled.

The consultant shall evaluate what relevance and impact the programme has for the region and the individual country. The consultant shall also briefly try to relate it to a long time perspective regarding poverty reduction, human rights, environmentally sustainable development and gender equality.

The consultant shall evaluate the interaction and exchange between the countries in the regions as well as with the Swedish counterparts.

The consultant shall evaluate the quality of the achieved reports and publications (within his area of expertise), as well as the possibilities to finish up and preparing for further scientific reports.

The consultant shall evaluate the possibilities for former students to continue and utilize their knowledge in further work and new positions

The consultant shall evaluate the ability of the programme to organize, manage and expanded the programme. This should be related to the specific objective in the proposul dated November 15 2002. Specifiially considering the possibilities to:

- organize the network
- organize training courses
- accomplish the reseach program
- involvement of collaboration partners in Sweden

The consultant shall discuss the financial management of funds with specific reference to the system of disbursements within the programme in a future perspective.

The consultant shall try to evaluate the cost-effectiveness of the programme and evaluate how much of the achievements could be attributed to Sida support. Present and future alternative funding sources shall also be discussed.

The consultant shall finally advise Sida/SAREC if continued support to the programme is recommendable and if so, on what level of programme activity.

4. Methodology, Evaluation and Time Schedule

The evaluation will be performed by Göran Bengtsson from the Department of Ecology in Lund, Sweden.

The consultant shall read required background documents. The evaluator will have unlimited access to registered background material at Sida.

The consultant shall make his own travel and meeting arrangements to fulfil the assignment.

The evaluator shall visit Costa Rica and interview the Central American coordinator, Dr Luisa Castillo and Catharina Wesseling or other representatives for the health section of IRET.

The evaluator shall visit research groups and former students in Costa Rica, talk to and if possible visit research groups and former students in Nicaragua and El Salvador. The evaluator shall talk to representatives from the other three participating countries (Guatemala, Panama, Honduras) to get an overview and insight into activities of the network and the research groups.

The preparation for the evaluation will start in September 2003 and the visit to Central America will be performed in December 2003. The maximum work time spent on the evaluation should be XXXX hours.

Appendix 7

Itinerary CA

Day of departure	Departure time	From	Arrival time	To	Flight no	
02-Dec	725	Köpenhamn	925	Paris	AF1251V	
02-Dec	1020	Paris	1410	Houston	AF 36V	
02-Dec	1850	Houston	2136	Guatemala	C01123V	Biltmore Express hotel. 5023374406
04-Dec	1335	Guatemala	1445	Managua	CM 115Q	El Colonial hotel, Leon; La Posada de Don Pantaleon 505 2787922
06-Dec	1505	Managua	1555	San Jose	CM 115Q	hotel Bougainvillea 5062441414
09-Dec	1132	San Jose	1246	Tegucigalpa	CM 824Q	
10-Dec	1715	Tegucigalpa	1800	San Salvador	TA 391Z	
11-Dec	1925	San Salvador	2045	San Jose	TA 523Z	hotel Bougainvillea 5062441414
13-Dec	1055	San Jose	1200	Managua	CM 116Q	La Posada de Don Pantaleon 505 2787922
16-Dec	840	Managua	1159	Houston	C01975V	
16-Dec	1630	Houston	835	Paris	AF 33V	
17-Dec	955	Paris	1150	Köpenhamn	AF2050V	

Appendix 8

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Appendix 9

List of persons interviewed and reporting

Name	Position	Unit	University
Dixiana Alvarado	Directora	Dirección Investigación Científica	UNAH
Gustavo Fontecha	Teacher	Faculty of Microbiology	UNAH
Gina Laitano	Teacher	Faculty of Microbiology	UNAH
Doris Quan	Teacher	Faculty of Microbiology	UNAH
Ada Zelaya	Teacher	Faculty of Microbiology	UNAH
Annabelle Ferrera	Teacher	Faculty of Microbiology	UNAH
Lourdes Enriquez	Teacher	Faculty of Microbiology	UNAH
Nelson Montes	Decan	Faculty of Medicine	UNAH
Lilia Meza Martinez	Vice Decan	Faculty of Medicine	UNAH
Juan Mejia Merino	Teacher	Faculty of Medicine	UNAH
Winston Mejia Merino	Teacher	Faculty of Medicine	UNAH
Lina Carmenati,	Teacher	Faculty of Medicine	UNAH
Maria de Courdes Amador	Teacher	Faculty of Medicine	UNAH
Edgar José Pineda Estrada	Teacher	Faculty of Medicine	UNAH
Emilia Aldumén	Teacher	Faculty of Medicine	UNAH
Aurora Aragón	Teacher	Occupat&Environm Health	UNAN-L
Teresa Rodriguez	Teacher	Occupat&Environm Health	UNAN-L
Pedrorias Darilo	Teacher	Natural Sciences	UNAN-L
Edmundo Torres	Vice-rector	Rectoria	UNAN-L
Sonia Marta Mora	Rectora	Rectoria	UNA
Luisa Castillo	Head of Environmental Section	IRET	UNA
Catharina Wesseling	Head of Health Section	IRET	UNA
Elba de la Cruz	Directora	IRET	UNA
Salvador Castillo Arévalo	Decan	Faculty Chemistry&Pharmacy	UES
Sandra Peraza	Teacher	Faculty Natural Sciences	UES
Erlinda Hándal Vega	Directora	Consejo Científico	UES
Katherine Vammen	Vice-director	CIRA	UNAN-M
Salvador Montenegro	Director	CIRA	UNAN-M
Gustavo Sequeira	Director of research	Faculty of Medicine	UNAN-M
Julio Traña	Director of postgraduate programmes		UNAN-M
Bessie Olivia,	Teacher	School of Chemistry	USAC
Francisco Perez,	Head Lab Instrum Anal	School of Chemistry	USAC
Oscar Cobar	Head Inst Research	School of Chemistry	USAC
Carolina Guzmán	Head	Dept Toxicol	USAC
Nils Kautsky	Professor	Dept Systems Ecology	SU
Michael Tedengren	Docent	Dept Systems Ecology	SU
Christer Hogstedt	Director	Research dept	NIPH

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