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Report Evaluation of 30 Years of Research Cooperation between Sweden and Nicaragua

Sida

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Submitted by Kimberly Inksater,
Just Governance Group Ltd.

with contributions from
Luis David Grajeda
Nilla Ingstorp
Patric Landin
Karl Nilsson
Mercedes Urriolagoitia

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Authors: Kimberly Inksater et. al.

Coverphoto: Lener Sequeira. Nicaraguan researchers are making measurements to determine the magnetic properties of the crust in Nagarote, Nicaragua.

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Abbreviations

AAU	Aalborg University, Denmark
ALFA III	A program of cooperation between higher education institutions of the European Union and those of Latin America
CIDCA	Centro de Investigaciones y Documentación de la Costa Atlántica
CIGEO	Centro de Investigaciones Geocientíficas
CONACYT	Consejo Nacional de Ciencia y Tecnología Mexican Council of Science and Technology
CONICYT	Consejo Nicaraguense de Ciencia y Tecnologia Nicaraguan Council of Science and Technology
CNU	Consejo Nacional de Universidades National Council of Universities
CSUCA	Consejo Superior Universitario de Centro America Superior Council of Universities in Central America
CYTED	Latin American Science and Technology Development Programme
ECLAC	Economic Commission for Latin America and the Caribbean
EIAG-Rivas	Escuela Internacional de Agricltura y Ganaderia – Rivas, Nicaragua
FSLN	Sandinista National Liberation Front
GDP	Gross Domestic Product
GNI	Gross National Income
GVC	Grupo de Volontariato Civile (an Italian development organization)
HIPC	Heavily Indebted Poor Countries
ICT	information and communication technologies
IDRC	International Development Research Centre (Canada)
JGG	Just Governance Group
KTH	Royal Institute of Technology
LATINDEX	Sistema Regional de Información en Línea para Revistas Científicas de America Latina, El Caribe, España y Portugal
NUFFIC	Netherlands Organization for International Cooperation in Higher Education and Research
OAS	Organization of American States

OECD	Organization for Economic Cooperation and Development
PERii	Programme for the Enhancement of Research Information
PLC	Partido Liberal Constitucionalista
PRSP	Poverty Reduction Strategy Papers
SAREC	Swedish Agency for Research Cooperation with Developing Countries
Sida	Swedish International Development Cooperation Agency
SLU	Swedish University of Agricultural Sciences
ST&I	Science, Technology, and Innovation
TORs	Terms of Reference
UCA	Universidad Centroamericana, Managua
UNAN-León	Universidad Nacional Autónoma de Nicaragua, León National University of Nicaragua in León
UNAN-Managua	Universidad Nacional Autónoma de Nicaragua, Managua National University of Nicaragua in Managua
UNA	Universidad Nacional Agraria National Agrarian University
UNI	Universidad Nacional de Ingenieria National Engineering University
UPOLI	Universidad Politécnica de Nicaragua

Executive Summary

BACKGROUND

The Swedish government, through the Swedish Agency for Research Cooperation with Developing Countries (SAREC), and subsequently through the Swedish International Development Cooperation Agency (Sida), has provided bilateral support to scientific research in Nicaragua since 1981. The research collaboration between Sweden and Nicaragua has evolved from a series of isolated research initiatives to a program that supports institutional capacity building with the four public universities as well as national initiatives for the development of policies, practices, and systems to promote scientific research, technology, and innovation. It is estimated that the total investment in scientific research in Nicaragua has been 600 million Swedish Kroner over 30 years.

The cooperation commenced following the Sandinista revolution and has continued through tumultuous political, social, and economic events, including armed conflict, economic crises and natural disasters. Despite the challenges, Swedish and Nicaraguan counterparts persevered towards the objectives, aptly described by Enrique Ganuza in the 1988 publication *Research Cooperation between Sweden and Nicaragua*, in which he stated, "…SAREC has tried to contribute to the creation of research capacity in areas defined as priorities by the Government of Nicaragua. A second objective has underscored the importance of obtaining scientific results that contribute to confronting problems defined as national priorities by Nicaragua."

While SAREC/Sida did not explicitly set out a long-term strategic plan to define its vision to create research capacity, an official clarified that the goal was to achieve a sustainable national system for research, noting, "Part of such a system is the capacity to reproduce scientists. This, in practice, means the existence of national doctoral training programs of international quality. Due to the Swedish governement's decision in 2007 to cease the cooperation with Nicragua, Sida was only able to support Nicaraguan universitites to the level where two year MSc programs could be offered, thus not completing the whole cycle to ensure sustainability."

The Swedish government decided to focus its development cooperation in other countries and consequently the decision

was made to leave Nicaragua by 2011. As part of its exit strategy from Nicaragua Sida seeks to document lessons learned and results achieved over the course of its 30-year cooperation in the field of scientific research in Nicaragua. This reflection process is especially important because Sweden has been the primary and constant supporter of Nicaraguan scientific research over this 30-year period.

Evaluation Objectives

The objectives of this external evaluation are:

- To document an historical overview of the Swedish Nicaraguan research cooperation including the development of and changes to the methodology applied over the years.
- To document the outcomes in terms of research capacities and logical linkages between these outcomes and broader impacts in society.
- To provide information on the efforts made by the stakeholders to ensure sustainability and comment on their relative success/failure.
- To provide specific recommendations to Nicaraguan stakeholders (researchers, university authorities, the Government of Nicaragua, etc.) on how they can support and continue to develop research capacity and research results that contribute to reducing poverty and improving living conditions for the most vulnerable part of the Nicaraguan population.

The evaluation process was conducted over a period of several months. The evaluators reviewed over 160 documents and interviewed over 75 individuals in Nicaragua as well as the research coordinators at Swedish universities and two individuals from SAREC/Sida.

Baseline Research Capacity

Details are limited regarding the baseline scientific research capacity prior to the commencement of the Swedish cooperation in 1981, partly due to the lack of a SAREC baseline study, but primarily because the term "research" is not precisely defined in the early studies.

In *Scientific Research in a Revolutionary Setting: the Case of Nicaragua,* a 1988 SAREC publication, Carlos Vilas describes the context in 1986, five years after Swedish cooperation commenced. His observations of the situation include:

– no science publications in the country,
– no policies on scientific research or scientific development in general,
– no funding for scientific research in the public budget,

- weak infrastructure,
- limited human resources, (majority of researchers holding only Bachelor's degrees),
- weakness in the physical sciences compared to the social sciences,
- laboratory equipment that covers only basic needs,
- inadequate library and documentation systems,
- a weak national statistic system (a census had not been conducted in the previous 15 years).

Historical Periods of Swedish Research Cooperation with Nicaragua

1. Dispersed Research Projects to Promote Development 1981-1987

In the immediate aftermath of the Sandinista revolution, SAREC and Swedish university researchers initiated contacts with a range of government agencies and with the National Autonomous University of Nicaragua in Leon (UNAN-León). During this period two universities were formally established, having evolved from previous campuses or faculties in different universities, as was the case respectively with the National Autonomous University of Nicaragua in Managua (UNAN-Managua) in 1982 and the National Engineering University (UNI) in 1983.

This initial phase of Swedish support had the two-fold effect of contributing to scientific research in the physical sciences related to national economic priorities and cultivating relationships between Swedish and Nicaraguan academics. The research and the relationships between Swedish and Nicaraguan researchers became the basis for support over the coming decades.

2. Transition from research projects to academic capacity building (1987-1998)

The March 1987 seminar in Stockholm appears to mark the first formal reflection on the SAREC research in Nicaragua. Support continued for research experiments and projects but academic training in Sweden became an additional strategy to build Nicaraguan capacity. SAREC/Sida made a concentrated effort to build a critical mass of researchers in the four public universities. The main achievement in this phase was the consolidation of relations among Sida, Swedish universities, and researchers in Nicaraguan public universities for the purpose of building individual research capacity.

3. Strengthening Institutional Research Capacity and Ownership (1998 – 2004)

The recent report, *Outcome Assessment of Swedish Cooperation with Nicaragua 2001-2008*, noted that from "1999 Swedish cooperation has included support to the development of national research policies and priorities, reforms of the system of higher education, research management and administration at the university level, and the building of platforms to facilitate interaction of national innovation systems." JGG evaluators confirm an increased precision and concentration in project assessment memoranda developed in 1998 and thereafter.

In 2000 a perceptible change occurred in the universities' sense of leadership and ownership and increased momentum in graduate studies completion, as well as appropriation of the program by Nicaraguan academics and, in some cases, university authorities. A number of factors appeared to have coincided, which strengthened this new approach, including: graduates staying on to work in the universities; universities implementing reform and modernization initiatives, professors associated with this cooperation program assuming leadership positions through which they could promote a research culture; and recognition of the value of Nicaragua-based decision making.

The 2003 evaluation, *Collaboration between Sweden and Public Universities of Nicaragua*, conducted by Moreno and Alveteg was recognized as a key turning point by some of the Nicaraguan partners. JGG evaluators note a shift to initiatives to consolidate the policy and institutional framework for scientific research.

4. Institutionalization Efforts (2004-2011)

The evaluators found that, from 2004 onwards, there was a consolidated, collective effort and strategic approach to strengthening the institutional culture for sustainable scientific research and innovation.

The JGG evaluators confirm heightened ownership and increased attention to the cultivation of a research culture during the period from 2006 to 2011. Developments during this period included: increased efforts to complete doctoral studies; support for information communication technology systems; innovations and support for library information systems; and modernization of laboratories. In 2006 Sida began to support CONICYT, which enabled the preparation of diagnostic baseline studies on science, technology and innovation as well as a draft law and policy on Science, Technology and Innovation.

Outcomes Achieved

Research Capacity Development

Strengthening research capacity has been the primary strategy of Swedish support over the last thirty years. Academic training for Nicaraguan researchers has been ongoing for approximately 25 years. The creation of a critical mass of scientists with doctoral degrees from Swedish universities was the central activity from the late 1980s until the present.

To date, 108 Nicaraguans have graduated in physical and health sciences, agricultural and natural resources and engineering. By the end of the Swedish cooperation it is expected that 29 individuals will complete doctoral studies, which will raise the total doctoral graduates to 66.

Degree Obtained	UNAN Leon	UNAN Managua	UNI	UNA	Total
Doctorate	18	4	4	11	**37**
Licentiate	12	7	16		**35**
Masters	11	2	1	22	**36**

The long-term support was effective in creating a critical mass in specific subject areas such as agricultural science, forestry management, geosciences, ecology, biotechnology, occupational health, infectious diseases, and demography and health. The existence of academic masters programs, designed by doctoral graduates, is an indicator that a critical mass of research capacity has been created. UNAN-León has designed a medical science doctoral program (pending final approval by the university management). UNAN-Managua has plans to develop a PhD program in geosciences.

Research infrastructure

Swedish financing has contributed to excellent physical conditions for scientific research. The JGG evaluators observed the majority of physical, laboratory, and information technology infrastructure funded through the research cooperation program.

Laboratories: At least eleven laboratories were established through the SAREC/Sida program at the four public universities involved in the program.

Information and Communication Technologies (ICT): Support to ICT infrastructure at the four universities commenced in 2003 based on a demand-driven plan that identified priorities. Each university increased internet and intranet access by means of fibre optic cables, broadband internet access, servers, computer equipment, and software. Once the infrastructure

and technology was operational modern online administrative management systems were designed and implemented. Researchers from each university acknowledged the profound impact of interconnectivity between university buildings, electronic mail, and library information systems.

Research Information Strengthening: The Research Information Strengthening Program (PERii), an initiative of the National University Council (CNU), began in 2008. One of the most important aspects of PERii has been the introduction of scientific research databases to the CNU member universities. In order to promote online bibliographic research as an integral aspect of university studies, infrastructure and capacity-building activities were designed. Librarians at each university received training and transferred knowledge to students, lecturers, researchers, and university administrators. The number of users accessing the databases varied among universities and databases but has steadily increased since 2008.

Research Management and Culture at Public Universities
University Research Policies and Procedures The Research and Postgraduate Commission of the National University Council (CNU) was organized in 2000 for the purpose of creating a national research system and a national postgraduate system. The Commission works to promote institutional policies and structures with directors or vice rectors of research, and create research networks on specific themes that link universities and public officials.

The 2004-2008 period represented the first time the universities had submitted a significant number of proposals related to institutional-strengthening, and, from 2008, all of the universities submitted proposals for institutional strengthening initiatives. The earliest research and postgraduate policies formulated and approved appear to be three policies formulated and approved in 2003 and 2004 at UNAN-León.

University Customs and Attitudes: Formal policies on scientific research and postgraduate studies do not, on their own, guarantee that research is given priority and supported. Formal policy formulation may be simply the first step to an eventual institutionalization of research through various mechanisms and practices.

In the case of UNAN-Managua and UNA the lack of policies has not impeded the development of scientific research through postgraduate studies. In these universities, the principled integration of research as fundamental to the university's mission, has resulted in ingrained institutional "cultural values and practices" that recognize the value of scientific research.

Interviewees in UNI and UNAN-León observed that the university culture gave priority to undergraduate lectures to the extent that scientific research and postgraduate activities became difficult to undertake due to time constraints. All researchers interviewed reiterated the importance of undergraduate teaching but acknowledged that it is essential to find a balance between teaching responsibilities and research activities.

National Policies and Institutions to Promote Science, Technology, and Innovation (ST&I)

Government Policies and Institutions: Swedish-Nicaraguan cooperation in the area of scientific research has occurred, for the most part, without a strategic national vision or path defined by the Nicaraguan government. The Swedish cooperation was consistent with national development plans, although these periodic plans did not directly address scientific research until recently when the government introduced its Human Development Plan. Nicaraguan Council on Science and Technology (CONICYT) has developed, with Sida support, a national ST&I policy and a law to create an ST&I system which is pending congressional approval.

Inter-University Initiatives: National Council of Universities (CNU) began to receive support from the SAREC/Sida program in 1994 and has represented an important collective inter-university mechanism to conduct diagnostic assessments, formulate recommended standards for research and postgraduate studies, and construct national systems in higher education. The Research and Postgraduate Commission has been responsible for organizing the exchange of scientific knowledge through conferences and seminars, diagnostic studies related to research capacity, and the commission has fostered the development of a National Higher Education Research System. Inter-university cooperation remains limited and represents an untapped potential.

The Impact of Scientific Knowledge on Development

Knowledge Dissemination: The Swedish cooperation has supported various models for knowledge dissemination. According to a 2009 CNU health research impact study, during the period of 2004-2008 scientific knowledge production in Nicaragua amounted to 294 documents published in international journals. Of these, 47% were in medical sciences and health, 16% in agricultural sciences and biology, 12% in natural sciences, and 10% in social sciences.

The three major contributing institutions in that period were: UNAN-León, the Ministry of Health and UNAN-Managua. The researchers involved with Swedish cooperation

have published over 300 articles in indexed and/or peer reviewed scientific journals. Nicaraguan university partners have also launched five scientific journals.

Knowledge Networks for Research and Development: While networking and collaborative initiatives in Nicaragua could still be improved, individual researchers and the research centres have substantially increased participation in informal and formally constituted collaborative arrangements and/or networks.

Social Impact of Research Results: University researchers have applied their knowledge for the social benefit of Nicaraguans through three categories of activities: law and policy reform, contributions to improve the quality of life, and contributions to improve productivity (and ultimately the standard of living).

Examples of impact in each of the three categories include:	
Three categories of social impact activities	**Examples**
Contributions to law and/or public policy reform	• Reproductive health census data from UNAN-León researchers influenced law on violence against women and included in the first human development national report produced in 2000 by UNDP.
	• UNAN-Managua supported legislative proposal on solid waste disposal
	• UNI participated in a forum on mobile phone service and health risks
	• UNA professors participate in the formulation of laws on: biodiversity, biosecurity, food security and nutrition, forest growth, national waters
Contributions to improved quality of life of Nicaraguans	• UNAN-Leon researchers introduced the rotavirus vaccine in the national vaccination schedule/protocol
	• UNAN-Managua geoscientists study geological fault lines and advise municipality of Managua regarding construction and disaster prevention
	• UNI professors Support municipal governments in creation of online government services
Contributions to improved standard of living	• Alternative pest and crop management methods developed by UNA researchers improve production.

Sustainability

Political sustainability

Long-term state policies are not common in developing countries precisely because of the development context characterized by weak governance structures and mechanisms, and this culture of short-term state policies is also the case in Nicaragua. The current status of scientific research capacity will be optimized when Nicaragua has a long-term vision for its development that can remain consistent over time.

The first advances toward a national ST&I policy have been made in 2010 through the National Plan for ST&I and the draft legislation on point. This new legal – policy framework will permit CONICYT to foster science and technology research in order to resolve "scientific and technological" problems.

Institutional sustainability

University Research Culture: Research in universities is susceptible to political changes. When elected university authorities change, the status of research development at the particular university may be affected, but this risk will be reduced when a research culture has been institutionalized to the extent that it becomes an integral aspect of the university's mission.

The following summarizes some aspects of the institutionalization of scientific research culture in each university (beyond specific Swedish-supported initiatives):

- UNA: There is an integrated institutional approach to research promotion and implementation in each faculty. Policies and procedures are developed and implemented through a Research and Development Council.
- UNI: A new integrated approach to research, academic programs, and outreach for national development is expressed in the recently approved Education Institutional Model (EIM). The Model has stimulated new methodologies that, when fully implemented, will foster a stronger and more integrated research culture. UNI is developing institutional relationships with industry representatives to promote technological innovations.
- UNAN-Managua: Institutionalized commitment to research as a central aspect of the university's academic mission permits scientific research for the purpose of social and economic development to flourish without specific policies on research. A critical mass in the Multidisciplinary Environmental Research program enables researchers to flourish in national and Central American research networks.

- UNAN-León: The research culture appears strong due to the highly acclaimed performance of graduates in the three research centres supported by Swedish cooperation. The research centres, established to ensure retention of the first generation of graduates, promoted the Faculty of Medicine's reputation for excellence.

Knowledge Capacity: The evaluators are confident that research capacity will be sustained and transferred as a result of the Swedish cooperation. The formation of critical mass around thematic research areas in the universities will facilitate future research. The capacity is reflected in publications, enhanced programs, and human capital at the universities. Many of the graduates from the Swedish cooperation program are now in leadership positions at their universities and have been able to foster a research culture referred to in the preceding subsection

Infrastructure: The likelihood that infrastructure installed in recent years will be sustained depends upon the ability of the university to secure additional financial support. It is unclear if the universities will be able to accommodate increases in ICT expenses in the future. Laboratory equipment requires ongoing maintenance and funds will be required for this purpose, according to the researchers interviewed. The library information technology has potential for sustainability due to the broader initiative to create a national scientific information system

Social sustainability

National networking: The CNU provides an important associative mechanism, especially for the promotion of national research standards and national scientific congresses. The evaluators are not aware of any joint inter-university research proposals from among the participants of the Swedish cooperation program to date. There is evidence of national networks organized around research topics. An area of concern is the apparent lack of inter-institutional research cooperation among the four public universities.

Regional and international networking: Researchers are participating in a significant number of networks that will sustain their research capacities. Regional and international networks will support knowledge development and the sustainability of research activities and should be encouraged through the universities, CONICYT, and CNU within their institutional plans.

Financial Sustainability

Universities have increasingly contributed financially to scientific research. In 2006 Sida contributed 48%, the partner universities contributed 42%, and other donors and organizations contributed 10%. The proposed law on the National System for ST&I recommends that 1% of Nicaragua's national budget be assigned to ST&I activities. Increased public funds for scientific research will provide increased sustainability to existing research initiatives in Nicaragua's public universities.

Despite increased funding from the universities to the research initiatives the evaluators recognize that the state's financial allocation to the institutional budgets is insufficient to sustain the research projects and research capacity-building. In previous evaluations, with the exception of the ICT evaluation, financial sustainability was raised as a concern. JGG evaluators confirmed that each university has been developing relations with other financial partners.

Conclusions

Scientific Research Capacity

Scientific research capacity, in the priority subject areas of physical and health sciences, has been strengthened significantly in the four public universities as a result of SAREC/Sida cooperation over 30 years. Nationally, the percentage of academic researchers among total number of university professors in Nicaragua remains low.

Progress over 30 years is illustrated in the following table:		
Indicator or Characteristic	**1977–1985**	**2007–2010**
# of research centres in higher education centres	4	54
# of research centres dedicated to physical and health sciences	1	23
# of national journals	0	25 (Latindex)
# of public policies related to scientific research	0	1
# of PhDs	N/A	140 (in 10 CNU affiliates) 124/140 from 4 partner universities
# of researchers affiliated with centres of higher education	N/A	373
244/373 are from 4 partner universities		
# of publications by Nicaraguan authors	N/A	294 (2004-2008)

- After 2003 the numbers of PhD graduates increased and complementary institutional strengthening initiatives were implemented.
- The capacity development strategy was relevant and pertinent to the situation in Nicaragua; however, the institutional strengthening and research management focus was introduced later in the cooperation and may have reduced ideal "research culture" outcomes.
- Recognition that evidence-based research is central to university education, beginning at the undergraduate level, is emerging.
- Recent initiatives related to ICTs, library information services, intellectual property, educational reform and research management have impacted positively on the modernization of university policies, management systems and infrastructure. These will contribute to the sustainability of Swedish investment in human capital.
- The evolution of the "sandwich model" from one supervisor in Sweden to combined supervision in Sweden and Nicaraguan represented the increasing capacity in Nicaragua and subsequently increased efficient completion of doctoral studies programs. Sida's willingness to approve graduate studies in Latin American countries and Spain enhanced accessibility to graduate studies.
- Knowledge dissemination through academic publications and scientific events both internationally and nationally increased in recent years as a research projects supported by Sida came to fruition.

Science and Development

Swedish cooperation has been guided by the premise that *knowledge generated from scientific research will contribute to effective social and economic development in Nicaragua*. This will depend on three conditions:

- existence of a clear national vision for development
- a solid relationship between universities and public policy-makers based on formal policy and institutional mechanisms to promote ST&I,
- established mechanisms for final users to access and apply scientific knowledge.

The evaluators conclude that:

- The lack of a clear national vision has limited strategic scientific research.
- A new national ST&I policy will promote the institutionalization of mechanisms to foster scientific research.
- University – policy maker relations, for the purpose of de-

veloping evidence-based public policy, are in development.
- University, government, and private sector commitment to scientific research and technological innovation is emerging.
- Knowledge dissemination to university authorities, policymakers, and business representatives in accessible formats was not specifically considered over the course of the cooperation program.

Impact of Research on Society
- Social impacts were achieved due to the relevancy of the scientific research projects undertaken by masters and doctoral students.
- The most significant social impacts relate to contributions to law and policy reform and the application of scientific research findings to improve quality of life. Research findings have been applied to improve health of Nicaraguans through:
  - Improved diagnostic testing
  - Improved suicide prevention
  - Improved health care for women and children
  - Improved vaccinations
  - Improved water quality
  - Improved food standards and
  - Improved workplace standards for farmers, miners and other workers.

- Information and communications technology knowledge has been applied to increase public access to municipal government services, and general internet access.
- Geological technical knowledge has been applied to reduce potential loss of life and destruction that could result from construction in unsound locations.
- Agricultural production improved in various crops that were the focus of master's and doctoral research. New crop management techniques for coffee and food crops improved production and will consequently (presumably) improve living standards.

Sustainability

Political sustainability: Public policy and institutional mechanisms to define and foster Nicaragua's scientific and technological capacity for innovation and development need to be strengthened in order to sustain (and promote) the scientific research community.

Institutional sustainability: Research has historically not been viewed as the principal mandate of universities in Nica-

ragua and thus change in institutional culture has been gradual. The most impressive result of the Swedish cooperation is the scientific community created in various thematic areas. Sustaining this human capital will depend on increased institutional support.

Social sustainability: Local, national, regional and international collaboration and networking has promoted sustainability in two ways: i) peer-to-peer knowledge exchange enhances research process and, ii) the collaboration and participation of potential users and beneficiaries of research projects enhances the likelihood that research findings will be considered and applied.

Financial sustainability: Prospects for financial sustainability will increase with the strengthening of the three dimensions discussed above. Political sustainability should increase national opportunities and funds for scientific research. Increased collaboration with a variety of actors and increased participation in thematic research networks will enhance research opportunities and funding arrangements. Finally, and most importantly, a university's commitment to scientific research will permit its scientists to flourish within the university environment and in the national, regional and international context.

Recommendations

Swedish Actors (Foreign Ministry and Sida)

1. Develop a multi-faceted strategy for long-term scientific research cooperation in developing countries that will support the creation of the necessary conditions for research to contribute to development. This would include simultaneous efforts to promote research capacity of individuals, institutional research policies, national research plans and public institutional mechanisms to foster the research-development nexus.
2. Support national policy development on ST&I and research in higher education to provide the scientific community with the necessary political context for research and innovation to flourish while simultaneously building individual research capacity within public universities.
3. Support the development of indicators and standards to measure social impact of scientific research in the developing country. The development of national indicators (and a baseline) would facilitate measurement of the program's contribution to solutions to economic and social development problems.
4. Introduce initiatives that strengthen university institutions (similar to those in the last phase of cooperation with Nicaragua) at the outset of a bilateral research program. This

will help to achieve a deeply rooted institutional research culture that will sustain research projects and capacities into the future. These initiatives could be accompanied by a strategy and participatory methods that facilitate dialogue and ownership of changes by a range of institutional actors at the universities.

5. Ensure postgraduate academic training is developed within the framework of a university's strategic plan, institutional policies and procedures and an open competitive selection process. This will ensure graduate students and graduates are fully integrated into institutional structures and may avoid the "elite" label and/or the isolation of researchers.

Nicaraguan Research Actors (Universities, CNU, CONICYT)

6. In order to sustain and improve scientific capacities achieved with Swedish cooperation, develop or strengthen research promotion policies and strategies through a participatory and institutional manner, taking into consideration multiple dimensions of sustainability.
7. Encourage postgraduate studies in similar or complementary thematic areas so that research teams are formed and research projects can be sustained through a critical mass of scientific knowledge.
8. Support the integration of graduates into national and international networks to sustain high caliber scientific research and knowledge sharing. In particular it is important to sustain an inter-university network for communication and collaboration among researchers from the four universities, in coordination with CNU.
9. Develop mechanisms to promote the dissemination of scientific knowledge in both academic and plain language media in Nicaragua. This will enable research findings to be understood by university authorities, public officials and civil society for the eventual application of research findings.
10. Strengthen collaboration among the private sector, public institutions and civil society organizations to improve understanding of the nexus between scientific research and development by:
    I. collaborating with the social science academic community to promote public debate on a long term vision for Nicaragua's integral development.
    II. developing and implementing mechanisms that promote research collaboration between universities and the external actors mentioned.

III. continuing to develop technological innovation efforts at UNI (Technology Park, Innovation Incubator) and existing public-private-civil society collaborative projects initiated at UNA, UNAN-Leon and UNAN-Managua.

11. Strengthen the research culture at universities by:
    IV. integrating evidence-based research and scientific research methods in undergraduate programs in all faculties, if this reform has not been undertaken.
    V. increasing financial support to research infrastructure by considering public-private partnerships.
    VI. ensuring balanced teaching/research workloads for postgraduate lecturers.
    VII. promoting efficient and effective administrative procedures to facilitate the timely execution of research activities.
12. Increase active inter-university cooperation on research projects, research infrastructure and knowledge exchange in order to avoid duplication of efforts and optimize human and financial resources.

1. Introduction

1.1 BACKGROUND

The Swedish government, through the Swedish Agency for Research Cooperation with Developing Countries (SAREC), and subsequently through the Swedish International Development Cooperation Agency (Sida)[1], has provided bilateral support to scientific research in Nicaragua since 1981. The research collaboration between Sweden and Nicaragua has evolved from a series of isolated research initiatives to a program that supports institutional capacity building with the four public universities as well as national initiatives for the development of policies, practices, and systems to promote scientific research, technology, and innovation. It is estimated that the total investment in scientific research in Nicaragua has been 600 million Swedish Kroner over 30 years.

From 1978 to 1981, SAREC supported research initiatives by Nicaraguan academics in exile in Costa Rica through the Superior Council of Universities in Central America (CSUCA), the regional network of public universities. In 1981, after the triumph of the Sandinista National Liberation Front (FSLN) and the formation of a coalition government, SAREC and Nicaraguan government officials agreed on research projects designed to contribute to the social and economic development of the country.

The cooperation evolved from specific research initiatives in the 1980s, meant to increase domestic productivity and reduce reliance on imports, to a concerted effort to build academic research capacities at public universities, and the corollary public policies to support scientific research as a means to foster development in Nicaragua.

In a developing country with scarce human and financial resources, the strengthening of the capacity for scientific research in public universities, together with supportive public policy initiatives is a long-term project that generally spans decades. In 2007 the Swedish government decided to focus its development cooperation in specific priority countries and consequently the decision was made to leave Nicaragua, among other countries, by 2011. Despite significant progress this decision is considered premature by Sida officials, based

1 SAREC was incorporated into Sida in 1995.

on research programming experience in various developing countries in Africa as well as Nicaragua and Bolivia.

1.2 EVALUATION OF THIRTY YEARS OF COOPERATION

As part of its exit strategy from Nicaragua Sida seeks to document lessons learned and results achieved over the course of its development cooperation in Nicaragua. This reflection process is especially important because, according to documents reviewed and field interviews, Sweden has been the primary and constant supporter of Nicaraguan scientific research over this 30-year period.

Through a competitive bid process Sida contracted the Just Governance Group Ltd. (JGG) to undertake the end of cooperation evaluation. The Evaluation Terms of Reference (TORs) can be found in *Annex A*.

The objectives of this external evaluation are:

- To document an historical overview of the Swedish - Nicaraguan research cooperation, including the development of and changes to the methodology applied over the years.

The evaluation will assess the cooperation methodology (aid modalities) to build scientific research capacity over the 30-year period. The evaluation will identify internal and external success factors and challenges.

- To document the outcomes in terms of research capacities and logical linkages between these outcomes and broader impacts in society.

Results will be assessed in terms of institutional academic capacity, research results, and impacts in Nicaraguan society. This objective applies to the six institutions currently involved in research cooperation. These institutions include four public universities and two national coordination bodies.

- To provide information on the efforts made by the stakeholders to ensure sustainability and comment on their relative success/failure.

The evaluation will examine efforts made by the national actors, Swedish universities and Sida, to sustain the results achieved in terms of the mobilization of human and financial resources.

- To provide specific recommendations to Nicaraguan stakeholders (researchers, university authorities, the Govern-

ment of Nicaragua, etc.) on how they can support and continue to develop research capacity and research results that contribute to reducing poverty and improving living conditions for the most vulnerable part of the Nicaraguan population.

The recommendations will be practical and developed in a collaborative manner. The recommendations will be based on the lessons learned and conclusions identified by the Nicaraguan and Swedish partners, as well as the observations made by the JGG evaluation team.

The evaluation team reviewed over 45 documents in late July and early August in order to understand the breadth of the research initiatives supported during the 30-year period. See *Annex B* for the complete list of over 160 documents reviewed. The initial documents reviewed provided the basis for the preparation of the Inception Report, submitted in late August 2010. The Inception Report provided the framework and general context for the remainder of the evaluation process, especially the data collection phase. See the Evaluation Matrix in Annex C and Interview Guides in *Annex D*. Both instruments were contained in the Inception Report.

Subsequently, the JGG team conducted interviews in Nicaragua. Over a three-week period in September, the team interviewed over 75 individuals, the majority of whom were researchers and authorities with the four public universities in Nicaragua: the National Engineering University (UNI), the National University of Nicaragua in Managua (UNAN-Managua), the National Agrarian University (UNA), and the National University of Nicaragua in León (UNAN-León). See the final Schedule of Interviews in *Annex E*[2].

The team was significantly supported by the internal evaluation work conducted by the program coordinators and researchers from each university in anticipation of the evaluation. The self-evaluation reports submitted to the external JGG evaluation team included not only systematized data but also important critical reflections and lessons learned. These self-evaluation reports and other documents produced by the universities, the Nicaraguan Council of Science and Technology (CONICYT), and the National Council of Universities (CNU), provided abundant information to the Just Governance Group.

In the last days of the field mission in Nicaragua the evaluation team organized its interview notes and major findings from the interviews and group discussions so that the analysis

2 Annex E can only be found in the original version of the evaluation in Sida's digital archive.

in the report would incorporate the reflections of the key stakeholders and clarify key issues.

In October interviews were conducted with Sida officials and representatives of Swedish universities that have participated in the program, those being: Uppsala University, Chalmers University, the Royal Institute of Technology (KTH), University of Lund, and the Swedish University for Agricultural Science (SLU). Additional documents collected during the field mission and in subsequent literature searches were reviewed by the lead evaluator. In total, over 160 documents from various sources, internal and external to the cooperation initiatives, were reviewed by the evaluation team.

2. Historical Context

This section presents a descriptive historical record of the initial research capacity and the conditions at the outset of the research support and outlines the major phases of the scientific research cooperation between Sweden and Nicaragua, as identified by the JGG evaluators. The challenges to scientific research over three decades cannot be isolated, and progress made in scientific research cannot be attributed solely to the efforts supported by Sweden, but also reflects national governmental initiatives and initiatives developed by Nicaraguan counterparts with other international agencies. Consequently, this historical account is set in the social, economic, and political context of Nicaragua over the three-decade period.

The first subsection characterizes in general terms the status of scientific research in Nicaragua at the end of the Somoza dictatorship and in the early years of the Sandinista revolution when the Swedish-Nicaraguan cooperation began. This initial situation represents the baseline for the purpose of the present evaluation.

Subsequently, four chronological phases of the bilateral partnership and their corresponding advances and challenges are set out within the major elements of the national context during the period. The evaluators found that Swedish research cooperation has moved through four sequential phases in Nicaragua as Sida accumulated significant experience in scientific research programming in developing countries and as the Nicaraguan partners and context evolved. Each phase is characterized by a predominant approach promoted by Sida and its end is marked by an explicit or implicit transition:

- 1981 – 1987: Dispersed, stand-alone research projects based on priorities identified jointly by Swedish and Nicaraguan actors,
- 1987 – 1998: Academic capacity building; strengthening the research capacity of university professors,
- 1998 – 2004: Strengthening a culture favourable to research in public universities and development of supportive national policies,
- 2004 – 2011: Institutionalization efforts from 2004.

2.1 BASELINE SCIENTIFIC RESEARCH CAPACITY

Pre-Revolution

The earliest documented diagnostic study located by the evaluation team is a 1977 publication entitled *Diagnóstico Preliminar sobre la ciencia y la tecnología en Nicaragua*, which was based on a 1976 survey supported by the Organization of American States (OAS) towards the end of the Somoza dictatorship. The study summarizes basic quantitative data regarding research institutes and projects undertaken in public and private sectors.

In the category "public sector higher education centers" the study noted four research institutions with 70 active projects dedicated to: agriculture (20 projects), health and hygiene (40), basic research (7), environment and natural resources (2), and construction (1).

At the time of the survey, the government had 10 institutes with 152 active research projects. The majority of the projects were in the agricultural sector (114 projects). Only one project was designated as basic research and two projects related to health and hygiene.

There were three other institutes in the country at the time, two of which were in the private business sector and one in a private higher education centre. The total number of projects registered was 241 (200 in implementation and 41 recently concluded). The projects were additionally categorized according to the type of research undertaken: 180 applied research, 31 experimental, 23 basic research, 5 research dissemination, and 2 related activities.

While the above information is the earliest data found by the JGG evaluators related to scientific research activities in Nicaragua, it is important to note that an active research project was defined by the respondent institutions and not by the study's authors. The authors of the study noted with concern that their mandate did not specifically define "research and development project." Therefore the research projects identified by the three categories of institutions (public, private, and higher education centres) included research activities within broader projects and, in the case of some higher education centres, undergraduate research theses were considered as research and development projects. Likewise, the study referred to scientists as individuals with a university undergraduate degree, equivalent experience or technical training in the same area of research as the study in which he or she was coordinating.

Revolution and Contra War

In 1979, the Sandinista Revolution heralded in a period of change for Nicaraguans after almost 50 years of rule by the Somoza family. In 1985 the Planning and Budget Secretariat of the revolutionary government conducted its own study, *Diagnóstico de la investigación científica y tecnología en Nicaragua*.[3] While JGG evaluators were unable to locate a copy of this study it is referenced in the earliest SAREC-published study of the context of scientific research in Nicaragua. Two articles in the 1987 SAREC publication[4] provide a more comprehensive assessment of the level of development of applied scientific research in Nicaragua approximately four to five years after SAREC first began to support research projects in the country.

The "state of the art" document prepared by Carlos Vilas is presented as the first such analysis in the post-revolutionary period. The situation at this time must be considered in the context of the contra or counter revolutionary war financed by the United States government. While some academics fled Nicaragua in 1979, approximately 251 researchers were killed in ambushes while carrying out their activities.[5]

Vilas's major findings are consistent with the trends noted in the 1977 questionnaire referred to above, with some variations. For example, 30 research institutions were conducting scientific research in centres of higher education, government, and the private sector. The evaluators note that this number does not necessarily constitute a dramatic improvement from the 1977 study in which 17 institutes were deemed active. The 1985 government study[6] reported that 66 institutions were conducting scientific research projects involving over 650 researchers. This latter 1985 study appears to have incorporated all institutions that supported natural science research projects; whereas the 1977 study considered institutions whose principal activity was applied research in the agricultural and natural sciences. Presumably Vilas also examined research institutes (universities) dedicated to research in the physical sciences.

It is important to note that in these early diagnostic studies the definition of scientific research is ambiguous and not clearly set out. The evaluators confirmed that scientific research

3 Diagnostico de la Investigación científica y tecnológica en Nicaragua: Informe General, 1985. Directorate of Science and Technology, Secretariat of Planning and Budget, Managua, March 1987.

4 Carlos Vilas, Scientific Research in a Revolutionary Setting: The Case of Nicaragua and Enrique Ganuza, Research Cooperation Between Sweden and Nicaragua, in Nicaragua, SAREC Documentation, 1988.

5 Vilas, 1988, paragraph one of Summary and Conclusions.

6 Diagnostico de la Investigación científica y tecnológica en Nicaragua: Informe General, 1985. Directorate of Science and Technology, Secretariat of Planning and Budget, Managua, March 1987.

education programs were not in existence at universities at the outset of Swedish cooperation, and thus it cannot be concluded that the early research initiatives applied recognized "scientific" research methods. The evaluators also noted that over the decades of cooperation the term "scientific research" has at times been used to refer to research in the physical and natural sciences rather than the scientific research method which can be applied equally in the physical and social sciences.

Important information characterizing the situation in 1986, as described by Vilas, is summarized below:

- there are no scientific publications in the country (only social science publications),
- there are no policies on scientific research or scientific development in general,
- there is no budget for scientific research in the public budget,
- infrastructure is weak,
- human resources are limited, with the majority of researchers holding Bachelors degrees, and therefore scientific method is weak,
- the physical sciences are extremely weak compared to the social sciences,
- laboratory equipment covers only basic needs,
- library and documentation systems are inadequate,
- the national statistic system is very weak.[7]

According to Vilas, the following institutes conducted physical science research in 1986:

- UNAN-Managua School of Physics was designing a solid-state physics laboratory with Swiss support.
- UNA Department of Agricultural Economy professors and students conducted research with support from the Netherlands.
- UNAN-León conducted research related to medicinal plants, social medicine, and communicable diseases with SAREC support.
- UCA conducted ecological and zoological research.
- Higher Institute of Agricultural Science conducted research in the areas of agronomy, animal husbandry, plant pathology, and forestry.

Two physical science research centres associated with universities were noted in the 1986 study: 1) the Aquatic Resources Research Centre at UNAN-Managua (Institute of Limnolo-

7 It was noted that a national census had not been conducted in 15 years.

gy) supported by Danish cooperation and, 2) a very small solar research station with support from the Institute of Energy, UCA, and financing from SAREC.

Government research centres conducted applied and experimental research in the areas of agricultural and animal sciences, health, and occupational health and safety. Vilas categorizes decentralized public institutes, such as the Institute of Mining (supported by SAREC) and the Institute of Natural Resources and Environment, separately from the abovementioned research centres that exist within Ministerial structures.

Research studies at public universities were restricted to hydrology studies at UNAN-Managua (CIRA/Institute of Limnology) and microbiology research, supported by SAREC, at UNAN-León.

2.2 DISPERSED RESEARCH PROJECTS TO PROMOTE DEVELOPMENT (1981-1987)

2.2.1 Context

The initial years of cooperation occurred in the tumultuous period characterized by post-dictatorial revolutionary transition followed by the contra war. In the early years of Sandinista rule, a joint committee comprised of several leaders provided government leadership. Members included Daniel Ortega, Sergio Ramírez, Violeta Chamorro, Alfonso Robelo, and others. Daniel Ortega emerged as the leader of the Sandinistas and was elected president in 1984.

However, the opportunities offered by political change and increased international support for economic, social, and political reform at the end of the Somoza dictatorship were hampered by the economic conditions during the period immediately following the Revolution and by ongoing armed conflict in the country. The 1980s represented a challenging decade for Central America in general and Nicaragua in particular with regards to armed conflict, economic growth, and development. Nicaragua, as well as neighbouring Central American countries, struggled with the effects of the external debt crisis, economic stagnation, and foreign intervention in the intra-state armed conflicts.

Following the Sandinista revolution in 1979, the government's economic priorities included nationalization of key industries. Already facing difficult terms of trade, Nicaragua was further impacted by the US embargo on trade with Nica-

ragua, imposed in 1985. In the latter half of the 1980s the social programs for the poor were difficult to sustain as foreign aid diminished and resources were allocated to fight the counter-revolutionary forces. Swedish and Nicaraguan university representatives interviewed during the course of this evaluation recalled the difficult conditions during this period: inflation was rampant so SAREC officials delivered cash to their counterparts, basic staples were extremely scarce and research equipment rudimentary. The US funding of the Contra's operations both overtly and covertly affected the new government's stability and over half of Nicaragua's national budget was devoted to military activities.

> *Living standards sank abruptly during this period. By the end of the decade, the average real wage had dropped to less than 10 percent of its 1985 value, nearly half the labor force was unemployed or underemployed, and the poverty rate was rising. Infant mortality, which had declined sharply in the early years of Sandinista rule, began to rise again. The death rate per 1,000 live births was 97 in 1978, the last full year of the Somoza regime; 63 in 1985; and 72 in 1989. For several years, the Contra war disrupted social and economic life across the country, but especially in contested zones like northeastern Nicaragua and the northern central highlands. In such areas, Contra forces targeted both economic and social infrastructure, including agrarian reform farms, schools, and health facilities. More than 20,000 Nicaraguans died in the fighting, and thousands of others were left maimed or crippled.*[8]

Domestically, the government sought to achieve greater peace and stability within its borders. In 1986, they signed an accord with leaders of the Miskito Amerindians, granting autonomy to their region. Also in 1986, the International Court of Justice ruled that the United States had violated international law by mining the harbours in Nicaragua and ordered damages of 17 billion payable by the United States to Nicaragua. This decision was not recognized by the US.

In this political, social and economic context, SAREC supported applied research projects that were designed to provide Swedish research expertise to initiatives that would generate concrete benefits to Nicaragua.

2.2.2 Research Projects

The social, political, and economic context posed significant challenges to the research cooperation between Sweden and Nicaragua. The objectives described in SAREC's 1988 publi-

8 http://countrystudies.us/nicaragua/25.htm. See also: http://ctp.iccas.miami.edu/Research_Studies/ATaboadaTeran and http://www.globalresearch.ca/articles/TOB110A.html.

cation are stated as follows: "…SAREC has tried to contribute to the creation of research capacity in areas defined as priorities by the Government of Nicaragua. A second objective has underscored the importance of obtaining scientific results that contribute to confronting problems defined as national priorities by Nicaragua."[9]

The first objective, contributing to the building of research capacity, has remained constant over three decades, although the evaluators note that the strategies for building this capacity have evolved from stand-alone research projects, to individual capacity building, increasing institutional competencies, and finally, public policy development. The second objective is based on the underlying purpose for support to research capacity in developing countries. The objectives articulated by Ganuza are corroborated in policies on research cooperation produced by Sida in the later phases of the Swedish cooperation.

In the Vilas article in the same 1988 publication, early project assessments and evaluation interviews all confirmed that early research initiatives sought to invigorate the economy and improve social conditions through improved agricultural crops, mining exploration, alternative energy sources, and the industrialization of medicinal plants. Nicaragua is agrarian based, and food security, especially in the aftermath of the revolution, became a national priority. In 1980 an agreement was signed between the Ministry of Agriculture and SLU which provided the basis for one of the earliest projects, research on the red bean, a staple of the Nicaraguan diet.

> *"As early as 1981, SLU, SAREC, and INTA (the predecessor of UNA) agreed to cooperate on research related to bean cultivation. The cooperation was probably facilitated by the fact that the then head of SAREC was a former SLU faculty member. Afterwards, it appeared that an important aspect of research for the Nicaraguans was to find a way to protect bean seeds from plant diseases. … Later, the other scientific fields were added."*
>
> Interview with Professor Emeritus, Lars Ohlander

Social science research was also supported from 1983 to 1997 with CIDCA, the Research and Documentation Centre of the Atlantic Coast.

In the first several years of cooperation (the early1980s) the Nicaraguan partner agencies were predominantly government ministries and institutes such as the Institute of Mining,

9 Enrique Ganuza, Research Cooperation between Sweden and Nicaragua in Nicaragua, SAREC Documentation, 1987.

the National Energy Institute, the Institute of Agricultural Technology, and the Ministry of Industry. The medicinal plant research involved UNAN-León researchers from 1981, in conjunction with the Ministry of Industry and the University of Uppsala in Sweden. This university was the first public higher education institution to become involved with Swedish research cooperation; however the first medicinal plant research did not prove successful. The research projects with the abovementioned Nicaraguan institutions were supported by academics from various Swedish institutes. See *Annex F*[10] for a brief historical description of each of the four public universities.

In this period there were changes to the Nicaraguan authorities responsible for managing the cooperation program. Initially, it was managed by the International Fund for Reconstruction but subsequently, from 1984, it was coordinated by the Ministry of External Cooperation. Despite official bilateral agreements the economic and political context at times required alternative project management, including cash transactions, to overcome local conditions.

In 1983–1984 SAREC officials convened meetings between Swedish professors and Nicaraguan university authorities. In 1983 UNAN-León expanded its research themes to include the occupational health and safety of miners, and agricultural workers and infectious diseases.

That same year, the National Engineering University (UNI) was founded, (through unification of two engineering faculties from UCA and UNAN-Managua), and the following year, discussions began between the first rector of UNI and representatives of KTH. The first agreement between SAREC and UNI was signed in 1985 for research in chemical engineering related to drying and crystallization. Also in 1985, the above-mentioned bean project, which originated with the Ministry of Agriculture, was transferred to the Faculty of Agricultural Sciences, UNAN-Managua.

This initial phase of Swedish support had a two-fold effect: it contributed to scientific research in the physical sciences related to national economic and social priorities, and it cultivated relationships between Swedish and Nicaraguan academics. This became the basis for support over the coming decades.

A review of assessment memoranda suggest that research projects were slow to advance. The 1987 article by Enrique Ganuza noted the following advances, presented in Table # 1 below.

10 Annex F can only be found in the original version of the evaluation in Sida's digital archive.

TABLE 1: Summary of Research Results in Phase One (1981–1987)

Research Theme	Nicaraguan Research Institute(s)	Swedish Counterparts	Year Research Commenced	Application of Research Findings
Geosciences	Nicaraguan Institute of Mining	Geological Survey of Sweden (SGU – Sveriges Geologiska Undersökning)	1981	Geological profile improved mineral exploration and the understanding of tectonic movements in Central America.
Red bean husbandry	Agricultural Directorate of Ministry of Agriculture until 1986; Higher Institute of Agricultural Sciences from 1986	Swedish University of Agricultural Sciences , Uppsala (SLU), and International Tropical Agriculture Center in Colombia (CIAT)	1982	Cultivation techniques changed (increased horizontal distribution) to increase productivity; more efficient phosphorous fertilizing practices; red bean predators catalogued and new sowing practices introduced.
Infectious diseases	Department of Microbiology and Parasitology, UNAN-León	Swedish National Bacteriological Laboratory	1983	Resistance to antibiotics identified in diarrheic studies; new diagnostic methods developed for parasitological studies; penicillin should be restricted as treatment in respiratory tract infection in children.
Social sciences	Centre for Research and Documentation of the Atlantic Coast	Stockholm University	1983	External evaluation noted that research has contributed to solutions to concrete problems. Results not explained.
Social medicine (Public Health)	Department of Preventative Medicine, UNAN -León	Karolinska Institute	1983	No results. Initial clinical studies of health conditions of miners in El Limon in coordination with community, Ministry of Mining, and Ministry of Health. Information being analyzed.
Occupational health	Ministry of Health and Department of Preventative Medicine, UNAN-León	Karolinska Institute	1986	No results. Baseline data collected regarding exposure to pesticides in agricultural sector.
Mental health	Department of Psychiatry, UNAN-León	University of Umea	1987	No results. Newly organized research initiative.
Energy	University of Central America; Institute of Energy	Swedish Meteorological and Hydrological Institute	1982	No results. Seven solar observation stations constructed. Solar driers constructed and tested with peasant farmers. Research on potential use of cotton waste as fuel.
Chemical Engineering	University of Engineering	Royal Institute of Technology, Stockholm	1985	No results. Projects on drying and crystallization at initial stages.
Organic Chemistry	Department of Chemistry and Department of Pharmacy	Royal Institute of Technology, Stockholm	1981	No results. SAREC doubts relevance of studies.

2.3 TRANSITION FROM RESEARCH PROJECTS TO ACADEMIC CAPACITY-BUILDING (1987-1998)

2.3.1 Context

1987 marked a year of political change in Nicaragua. In January of that year the legislature approved the new Constitution which proclaimed, in Article 116, that education is a "fundamental factor for the transformation and development of the individual and society" and has as its objective the development of critical, scientific, and humanist conscience in Nicaragua.[11]

Other constitutional provisions are more specifically related to the purposes of this evaluation:

- Article 117 describes the role of education, which includes the promotion of scientific research, and
- Article 125 provides universities and centres of higher technical education with academic, financial, organic, and administrative autonomy.[12] Additionally, this article explicitly commits the Nicaraguan state to promote and protect scientific and technological research and ensure intellectual property rights.

This new constitutional framework marked political progress in a difficult period during which the Nicaraguan economy struggled and citizens felt the impacts of its near failure. The inflation rate reached 33,000% in 1988 and reserves dwindled. Price controls had led to serious shortages in basic foodstuffs. Throughout the decade, Nicaragua's economic growth rate *declined* by 3.5%.[13]

In August 1987, Nicaragua signed the Arias peace plan for Central America. Implementation of the peace plan was sporadic but led eventually to elections in February 1990, in which the coalition UNO, consisting of 14 political parties, took power and Violeta Barrios de Chamorro became president of Nicaragua.

11 [partial text of 116 translated by author] Constitución Política de la Republica de Nicaragua, articulo 116: La educación tiene como objetivo la formación plena e integral del nicaragüense; dotarlo de una conciencia critica, científica y humanista; desarrollar su personalidad y el sentido de su dignidad; y capacitarlo para asumir las tareas de interés común que demanda el progreso de la nación; por consiguiente, la educación es factor fundamental para la transformación y el desarrollo del individuo y la sociedad.

12 Article 125 of the Constitution: "Las Universidades y Centros de Educación Técnico Superior, gozan de autonomía académica, financiera, orgánica y administrativa, de acuerdo a ley"

13 Economic data not otherwise cited is from the Economic Commission for Latin America (ECLAC).

Prior to the handover to Barrios de Chamorro the Sandinista legislature passed various laws to consolidate social and institutional changes promised under the Revolution and the abovementioned 1987 Constitution. Law 89 of April 5, 1990, or the Law of Autonomy of Higher Education Institutions, introduced important parameters for the state-funded universities, including the four public universities involved in the Sida program. Three articles are especially important for this report:

- Article 2 of the law formally links higher education in the country to the political, social, economic, and cultural needs of Nicaragua.
- Article 6 defines the goals and objectives of the universities. The objective in subsection (4) mandates universities to: stimulate and develop scientific research in order to contribute to the transformation of society and the improvement and adaptation of new technologies.[14]
- Article 55(1) assigns a minimum of 6% of the national budget to the publicly funded universities and centres of higher learning identified in the law.

The Chamorro government focused its early efforts on economic rebuilding after years of fragility due to the armed conflict. The GDP began to grow again at a moderate pace of 3% and inflation was held to a rate of 11.5%. Many state industries were re-privatized and foreign direct investment grew from 2.5% of GDP in 1991 to 13.6% of GDP in 1999. In 1998, Hurricane Mitch posed a significant challenge to the country as it caused widespread destruction, a large number of casualties, homelessness, and a high level of emigration. Nonetheless, economic growth in the following year (1999) reached 7.4%, despite a trade deficit of $900 million.

Some dissatisfaction with Chamorro's rule was felt on both sides of the political spectrum – those in the private sector wanted reforms to occur at a faster pace while Sandinistas felt that many of their achievements were being cast aside. The public universities, viewed as Sandinista political strongholds, varied in their ability to promote policies for scientific research at the graduate level during this period. Nevertheless, in 1995 the Nicaraguan Council on Science and Technology (CONICYT) was legally established as an administrative, autonomous entity ascribed to the Ministry of Economic Development. Although this Council was overlooked in government priorities until governmental operational funds were assigned

14 Article 6(4) of Law 89 of 1990: "Fomentar y desarrollar la investigación científica para contribuir a la transformación de la sociedad y mejoramiento y adaptación de nuevas tecnologías."

in 2005, it started operations in 2001 with support from funding agencies such as the Inter-American Development Bank.

In 1996 the Partido Liberal Constitucionalista (PLC) won the elections and continued the "neoliberal" course of private sector development. The PLC administration was marred by corruption and the president, Arnoldo Alemán, was found guilty of money laundering and embezzlement of an estimated $100 million dollars.

Despite this crime against the country, Nicaraguans continued to benefit from the strengthening of government institutions in a more stable regional environment. Negotiated peace settlements in El Salvador (1992) and Guatemala (1996) were implemented in this period and the 1990s were characterized by a greater economic openness and progress. But in 1998 Hurricane Mitch caused infrastructure devastation and damages in the amount of several billions of US dollars and further stalled the economic development of the country. Consequently advances in social development were also limited.

Representatives of public universities interviewed during this evaluation process noted they lobbied the PLC administration to ensure receipt of their constitutionally guaranteed 6% of the national budget. Sida officials also met with government officials to ensure that Sida's funding for research cooperation not attributed to Nicaragua's national budget allocation, as had been proposed by the PLC.

2.3.2 Individual Research Capacity-Building

The March 1987 seminar in Stockholm appears to have marked the first formal reflection on the SAREC-funded research in Nicaragua. The research cooperation continued to support research experiments and projects but academic training in Sweden became an additional strategy for strengthening Nicaraguan capacity.

After the seminar the first Nicaraguan researchers began graduate courses and experimental research at Swedish universities. It was noted by some interviewees that in this initial stage of academic preparation SAREC had insisted that studies be completed with Swedish universities and did not approve or encourage graduate studies in the Latin American region. In some research areas, such as medicine, graduate programs were available in countries such as Argentina and Brazil. This preference for Swedish training presented challenges due to the language requirements for graduate studies.

Significant changes occurred as a result of the 1990 elections. The new law on the autonomy of Nicaraguan universities, mentioned above, designated the National Agrarian University (UNA) as one of four public universities, thus

amalgamating the Instituto Superior de Ciencias Agropecuarias (ISCA) and four faculties into one specialized university.

The focus on research projects with a range of Nicaraguan partners (government institutes and university faculties) continued in the early years of this phase. In 1991, when the National Energy and Mining Institutes were privatized under the liberal government of Violeta de Chamorro, geoscience research was transferred to UNAN-Managua. Medicinal plant pharmacology, mining, and alternative energy research projects ended in 1993 while forestry research began. The last phase of social science research with CIDCA was approved in 1995 and ended in 1998.

The evaluators take note of a global country evaluation of Swedish cooperation with public universities in Nicaragua that spanned the years 1979 to 1993. "Summing up, SAREC's support to research in Nicaragua has worked well in one sense, but not in another. It has financed a number of projects and programs, which have produced output in terms of research results and high-caliber training. However, the support provided has not always been clearly in keeping with development objectives of the country and has been spread out among too many institutions and projects. The capacity-building aspects have been somewhat overlooked. These factors have, in turn, tended to lower the efficiency of the assistance."[15]

Sida officials interviewed reported that the strategy for capacity building in public universities in Nicaragua began in 1994 or 1995. In this period Sida began to implement recommendations from the Ownership and Cultivation of Knowledge document prepared by Berit Olsson in 1991. The intention to move to an institutional approach was a result of internal policy changes at SAREC/Sida, based on both internal reflection and the findings of external evaluations of research cooperation programs conducted in 1994. These evaluations also noted the ongoing approach of supporting dispersed research projects.[16] This approach likely limited the development of research capacity: only 15 papers were published in international journals between 1973 and 1984.[17]

For example, the 1994 Brunners and Eduard evaluation of scientific research in Nicaragua criticized the absence of an institutional-strengthening approach with the universities, and the concentration of responsibilities in Swedish counterparts. The decision was taken in SAREC/Sida to move to-

15 Behar and Lundahl 1994, referenced in Moreno and Alvateg, Collaboration between Sweden and the Public Universities of Nicaragua, Sida Evaluation 03/31.

16 Now's the Time – Evaluation of Swedish Cooperation for Development with Nicaragua, DS 1994:112.

17 Ibid.

wards an institutional-strengthening strategy but this required a gradual transition. The JGG evaluators found evidence that the transition from support for individual research capacity building and dispersed research projects to support for a more institutional approach occurred later, in 1998. An external evaluation, Selected Aspects on the University System of Nicaragua (Sida Evaluation 98/13) conducted in 1998, found that Sida and the Nicaraguan counterparts did not have a clear strategy on how to bring about organizational change in the universities.

The JGG evaluators perceived a concentrated effort to build a critical mass of researchers in the four public universities within the thematic areas historically supported in the physical or hard sciences in this period. They cannot confirm a shift to institutional-strengthening until later. The evaluators found that the period between1987-1998 was significant in terms of changing the initial focus from dispersed research projects to academic research capacity building. This transition to building the capacity of academic researchers in public universities consolidated inter-university and university-Sida relationships. The following table illustrates the history of the inter-institutional cooperation.

TABLE 2: History of Cooperation between Sida and Nicaraguan Universities

	UNAN-León	UNAN-Managua	UNI	UNA
First formal institutional contacts	1983	1990	1984	1990
Nicaraguan Faculties involved in cooperation	Medicine	Geoscience Research Institute CIGEO	Chemical Engineering; Computer sciences	The university is involved in an institutional manner
Swedish counterpart	Karolinska Institute University of Umeå University of Uppsala	University of Lund	KTH University of Lund	Swedish University of Agricultural Sciences
Research themes	Social medicine (1983) evolved into: • Occupational health (1988) • Reproductive Health (1990) • Demography and Health (2000) • Infectious diseases (1983)	Geosciences from 1991 Multidisciplinary Environmental Research Program from 1998	Drying and crystallization; Computer science	Range of research themes: Plant science from 1980s to forestry, ecology and animal science
Graduate studies in Sweden commence	1986	1991 (although researchers at Mining Institute began research training in 1987)	1987	1986 (through Faculty of Agricultural Sciences at UNAN Managua prior to the establishment of UNA)

2.4 STRENGTHENING INSTITUTIONAL RESEARCH CAPACITY AND OWNERSHIP (1998 – 2004)

2.4.1 Context

During this period Nicaragua saw strong economic growth across a number of sectors, including the information and communication technologies industry and coffee exportation, which grew 79.2% during the early part of the current decade.

Some economic diversification occurred: agriculture remained prominent while industrial employment declined; employment in the service sector increased; and during this period, women entered the workforce in large numbers, unfortunately mostly in low-paying marginal positions. Unemployment remained at 11.6% in the early portion of this period.

This period saw the consolidation of democratic institutions despite some ongoing political tensions. In 2001, PLC was re-elected, but with a new president, Enrique Bolaños. International observers characterized the elections as free, fair, and peaceful. Bolaños's administration focused on management of the economy and fighting corruption. However, political divisions continued to hamper his government's efforts for political change.

Over this period, steps were taken to begin addressing the challenge of sustainable and social development. In 2000, Nicaragua took advantage of the HIPC program to achieve debt relief and began implementing its PRSP in 2002. Nicaragua signed the Central American Free Trade Agreement (CAFTA) in 2004. This came into force between the USA and Nicaragua in April 2006.[18]

2.4.2 Building Institutional Research Capacity and Ownership

The recent report, entitled Outcome Assessment of Swedish Cooperation with Nicaragua 2001-2008, noted that from "1999 Swedish cooperation has included support to the development of national research policies and priorities, reforms of the system of higher education, research management and administration at the university level, and the building of platforms to facilitate interaction of national innovation systems." The JGG evaluators confirm an increased precision and con-

18 http://www.state.gov/r/pa/ei/bgn/1850.htm

centration in the project assessment memoranda developed in 1998 and thereafter.

The 1998 project assessment memorandum states the expected results for the three-year period in the four public universities:

- Postgraduate studies completed.
- Professors who have obtained doctoral titles continue research in the faculties.
- Other research candidates have joined the programs.
- Institutional research structures are further strengthened.

During this period, the strengthening of institutional systems, policies, and practices were initiated by UNAN-León and UNI; however, the evaluators did not find evidence of a programming strategy aimed at institutionalizing policies and practices to promote and sustain scientific research in all universities and in public policy venues.

In 2000 a perceptible change occurred in the universities' sense of leadership and ownership. Nicaraguan and Swedish university representatives interviewed in the course of this evaluation observed the shift and the increased momentum in graduate studies completion as well as an appropriation of the program by Nicaraguan academics and, in some cases, university authorities. A number of factors appear to have coincided to promote this new approach to institutional aspects of research capacity:

- A critical mass of graduates continued to work in the universities,
- Universities undertook reform and modernization initiatives and introduced Research and Postgraduate Studies offices (vice rectors),
- Professors associated with the Swedish cooperation program began to assume leadership positions through which they could promote a research culture,
- A Sida official emphasized decision making should be Nicaragua-based.

During this period Sida published the 2001 Research Policy which identified two major goals:

- To contribute to strengthening research capacity in developing countries, and
- To promote development-oriented research.

In 2001 the four universities also began to work collectively on an Information and Communications Technology project.

The 2003 evaluation Collaboration between Sweden and Public Universities of Nicaragua, conducted by Moreno and

Alveteg,[19] was highly critical of various aspects of the lack of progress. Here, some of the most important observations of that 2003 evaluation are noted:

- Efficient administration of research funds still remains a significant problem.
- The "open sandwich" model, (described below in Section 3.1.1), has reached a critical point and changes are required. In addition, diversification and finding other alternatives for training is necessary.
- More than half the students abroad have problems with English and also insufficient academic levels.
- Decisions on distribution of funds and budget planning were primarily made by Swedish counterparts.
- Some Swedish counterparts do not have the necessary commitment or interest to participate in this collaborative enterprise.
- In some of the universities, despite 12–18 years of the initiated bilateral program, no PhD graduation has been achieved.
- There is a lack of time for doing research. (Many researchers work in teaching or administration and have second jobs.)
- Little scientific cooperation with local, national or international (other than Sweden) researchers has been accomplished by the Nicaraguan investigators.
- The number of women trained at graduate level is very low.
- Swedish counterparts take the major part in decision making, including the distribution of funds and budget planning.

During the course of this 30-year period the 2003 evaluation was recognized by some of the Nicaraguan partners as a key turning point. Effectively, JGG evaluators note a shift to initiatives to consolidate the policy and institutional framework for scientific research. A sense of ownership and re-definition of responsibilities also contributed to the new momentum, as expressed by a Swedish project coordinator:

> *"Roles and responsibilities have changed throughout the years. In the beginning the universities did not have the capacity to define their own research questions – although they knew the broad thematic areas. Now, they define it themselves. Plus, they are responsible for financial administration, which was not the case in the beginning."*
>
> Professor Joaquin Martinez, KTH

19 Collaboration Between Sweden and the Public Universities of Nicaragua – Sida Evaluation 03/31.

2.5 INSTITUTIONALIZATION EFFORTS (2004–2011)

2.5.1 Context

Daniel Ortega won the presidential elections of November 5, 2006, with 38% of the vote, defeating a divided opposition. In early 2008, opposition candidates contested municipal elections, claiming the results were fraudulent, and thus marring Nicaragua's growing reputation for democratic governance.

Nicaragua remained dependent on importing oil, resulting in negative trade conditions and the inability of the state to support social and economic wellbeing. The world economic crisis in 2008 affected Nicaragua profoundly, simultaneously reducing demand for coffee and other exports, and increasing the cost of oil.

The Sandinista government drafted a Human Development Plan in 2006, revised it to account for the effects of the world economic crisis in late 2008, and finally presented the Plan in 2009. This Plan targets the elimination of poverty and increases the role played by government in managing the economy, as compared to the previous administrations.

The Plan identifies the need to raise the quality and relevance of higher education, specifically to improve and update the curriculum at undergraduate and graduate levels. It also articulates the government's goal to develop higher levels of scientific research and technological innovation in order to support contributions by higher education centres to the solution of national problems and the eradication of poverty. The Plan also calls on universities to strengthen higher education on the Caribbean coast and promote multiculturalism.

Nicaragua remains the poorest country in Central America. In 2008 the gross national income per capita was $1,050, with half of the population living below the poverty line. One in five people lives in extreme poverty. After experiencing GDP growth rates of 3.2% in 2007 and 3% in 2008, annual growth in 2009 was only 1.5% and inflation was 4.3%. While the combination of Hurricane Felix and the food/oil price crises took the inflation rate to 25% in mid-2008, inflation reached an all time low of 0.9% in 2009. The economic recovery in the United States will affect Nicaragua, as 30% of Nicaraguan exports are directed to the United States and expatriate workers' remittances (mainly from the United States and Costa Rica) represent more than 13% of GDP. Current estimates predict GDP growth rates of about 2.0% in 2010, and

2.5% in 2011. Inflation is expected to reach 7% in 2010 and 2011.[20]

The challenge remains for Nicaragua to stabilize economic growth and democratic institutions in order to foster sustainable development that leads to social gains.

2.5.2 Institutionalization

Although there was increased attention to strengthening institutional aspects of scientific research in the previous period, the evaluators found that there was a consolidated collective effort and strategic approach to strengthening political and institutional culture for sustainable scientific research and innovation from 2004 onwards. National coordination mechanisms and systems and university research management initiatives at the public universities were clearly and necessarily given more priority in the final project implementation periods.

The evaluators found that various university authorities who were interviewed placed a high value on research initiatives, based on the belief that science, technology and innovation in Nicaragua will lead to economic growth and social benefits. Sida's original objectives, discussed by Enrique Ganuza in the 1988 publication, are based on this same supposition that research in the physical and natural sciences should ultimately benefit Nicaraguan society through innovation. However, the experience of other countries demonstrates that research will not inherently lead to innovation and positive impacts in society without public policies and institutional mechanisms to foster the generation of knowledge and its application.[21]

In 2006 Sida began to support the Nicaraguan Council for Science and Technology (CONICYT).Although CONICYT was established formally in 1995, it did not receive an operational budget from the Nicaraguan government until 2005. The Sida support to CONICYT enabled diagnostic baseline studies on science, technology and innovation to be carried out and the development of laws and a policy on S&T.

In 2007 the Innovative University initiative, supported by Sida in collaboration with Chalmers University, began to implement activities to promote innovation policies and practices within 10 universities associated with CNU. Activities included the promotion of university-industry relations as well as knowledge generation, protection (intellectual property), and dissemination.

20 World Bank, 2008

21 The evaluators reviewed public policies and programs to enhance research & development in various countries in the region including, Chile, Argentina, and Mexico.

Evaluator Thomas Alveteg conducted an external evaluation in 2006 and was able to note significant advances from the 2003 evaluation. The following advances were among those noted:

- Since last evaluation in 2003 there has been a qualitative leap in most of the components.
- Improved efficiency over past five years is a result of the combination of improved management structures and administration of the programmes, detailed yearly planning, and follow-up (better monitoring internally and by SAREC). The average time for completing a PhD is now down to 4.5 years.
- The sense of ownership increased. Since 2001 the universities manage a larger part of the budget and have direct influence on the selection of supervisors and counterparts. And since 2003 decision making by Nicaraguan counterparts increased.
- The role of the state science council (CONICYT) and its efforts to promote innovation systems is important and well worth supporting. But political instability is a concern since it affects the institution and its work.
- Investment in supporting libraries and information and communication technologies has also started to have an impact on the efficiency of the research training.
- The vast majority of PhD students have remained at the university after finishing their degrees. The critical mass of researchers is still small, but increasing.

Areas noted for improvement in the 2006 evaluation were:

- The impact of the research capacity-building in the Nicaraguan society as a whole is still relatively small.
- There is a lack of coordination among the Ministry for Education (basic education), technical training (INACYT), and the universities (CNU) with regard to policies and strategies for education and research.

Alveteg concluded that the SAREC/Sida strategy to promote national ownership and a research culture (including policy development, improved research management and administration) had started to pay off. The JGG evaluators confirm this heightened sense of ownership and increased attention to the cultivation of a research culture during the period from 2006 to 2011. For example:

- Individuals and university officials increased efforts to complete doctoral studies.

- Support to information communication technology systems at the universities continued as a collective initiative until 2008 and on a bilateral basis in the current and last project period.
- Support to innovation initiatives and library information systems commenced in 2006 and 2008, respectively. Both initiatives promote research skills among academics and within university structures.
- Laboratories were also modernized during this period with the purchase of new equipment.

A Swedish project coordinator corroborates this finding:

"In the first ten years not so much happened in terms of research. … There were a lot of discussions between and among the Swedish and Nicaraguan partners about how the situation should be improved. Apparently we learned something, considering the situation improved remarkably. In 2003 the first PhD student graduated. Now they can undertake their own research."

Professor Ingvar Lundberg, Uppsala University

The 2008 edition of Sida's research guidelines clearly gives priority to Sida's support to public universities in an effort to strengthen national research systems through three types of support:

- national research policies and strategies,
- research management (the administration and management departments of universities that help to facilitate research programs), and
- research capabilities (academic studies, facilities, and technology).

The need to promote a "research culture" through the institutionalization of structures, policies, and practices that promote scientific research has been a much needed but weak aspect of Swedish cooperation in Nicaragua.

The new Strategy for Sida's support for development research cooperation 2010-2014 seeks to strengthen and improve research related to poverty reduction in developing countries. The new strategy sets out three areas of support:

- research capacity-building in developing countries and regions (i.e. the capacity to plan, implement, and use research).
- research of relevance to developing countries (to produce quality research by the scientific community for poverty reduction), and

- Swedish research of relevance to developing countries.

The actual results (policies, practices, capacities, and research) observed by the JGG evaluators will be set out in the following section of the report.

3. Outcomes Achieved

This section of the evaluation report describes the degree of successful achievement of results after thirty years of support to research institutes, universities, higher education coordinating bodies, and government agencies.

The Terms of Reference for this evaluation, the documents reviewed, and the interview responses, reveal two major conceptual assumptions[22] regarding the scientific research cooperation between Sweden and Nicaragua. The evaluators identified the following assumptions:

1. The knowledge generated from scientific research will contribute to the resolution of social and economic problems confronting Nicaragua.
2. Scientific research capacity will be strengthened through graduate training for university faculty members, preferably in Sweden.

The JGG evaluators found that the first of these assumptions was not explicitly or comprehensively explored in strategy documents or project plans during the cooperation. Admittedly, there was increased consideration given to promoting the presumed link between research, technology and innovation at the end of the cooperation but an analysis of conditions or enabling factors for scientific research to effectively contribute to Nicaragua's development has not been explicitly addressed by the stakeholders. This is noteworthy because the first period of cooperation in the 1980s stated that an "…objective has underscored the importance of obtaining scientific results that contribute to confronting problems defined as national priorities by Nicaragua."[23]

In general, Sida's policies and strategies have not expanded on the agency's approach to strengthening research capacities with developing country partners. The 1991 document entitled, *The Ownership and Cultivation of Knowledge: The rationale for Swedish support to universities in developing countries*, written by Berit Olsson, is the most expansive document providing guidance for support to national policy development, university plans

22 Please see the conceptual assumptions discussed by Lea Velho in Moreno and Alveteg, Collaboration between Sweden and the Public Universities in Nicaragua, Sida Evaluation 03/31.

23 Enrique Ganuza, Research Cooperation between Sweden and Nicaragua in Nicaragua, SAREC Documentation, 1987.

and policies, and research capacity. The document is based primarily on SAREC's experience in various African countries.

The evaluators note that Sida's 2001 *Policy on Research Cooperation* affirms the two assumptions above. This policy document provides orientation to Sida's research programming. It identifies four levels of research capacity: individual, institutional, national, and regional.

The 2001 *Policy on Research Cooperation and the recent 2010–2014 Strategy for Sida's Support for Development Research Cooperation* premise Swedish research cooperation on the belief that scientifically based knowledge will effectively reduce poverty.

The 2008 Guidelines, *Support to National Research Development*, is the first official Sida policy document that explicitly describes the need to strengthen university management policies and practices in addition to academic research capacity. The 2008 guidelines focus cooperation on building capacities in three areas: research capabilities; research management, and national research policies and strategies. This latter area of support to policies and strategies is important to the first assumption noted above.

The strengthening of these three areas of scientific research capacity was not the ultimate goal of Swedish cooperation; rather the higher purpose of scientific research cooperation was (and is) to positively influence social and economic development in Nicaragua. The actual impacts of the scientific knowledge produced with support from SAREC/Sida in Nicaraguan society will be examined in the final subsection below.

3.1 RESEARCH CAPACITY DEVELOPMENT

Strengthening research capacity has been the primary strategy of Swedish support over the last thirty years. The creation of a critical mass of scientists with doctoral degrees from Swedish universities was the central activity from the late 1980s until the present and last period of assistance.

The 2006 evaluation *Sida/SAREC Bilateral Research Cooperation: Lessons Learned*[24] described research capacity development as occurring over a period of 10 to 15 years and moving through three stages.[25] These stages are summarized briefly below:

24 Boeren et al, Sida/SAREC Bilateral Research Cooperation: Lessons Learned, Sida Evaluation 06/17.

25 Ibid pages 20-21.

- Stage 1: Academic training. Support to degree programs, equipment and laboratories, and research management training.
- Stage 2: Reduced need for degree programs but increased need for financing for postgraduate research projects. Researchers have national and international research partners and are publishing regularly in international journals.
- Stage 3: Research projects "become strong and independently productive". Costs for equipment maintenance may increase but Swedish support is gradually reduced as the projects achieve financing from other sources.

The evaluators of the 2006 study concluded that the projects in Nicaragua were in stage 1 and entering stage 2. That assessment may be accurate in a limited sense; however, JGG evaluators observe that the stages do not sufficiently consider the development of institutional research policies, strategies, and practices at the universities or in the public (government) and private sectors. These corollary political and cultural aspects of scientific research capacity development were generally absent from the Swedish support to Nicaragua until the last decade and this has consequently limited the progress through the three stages of academic research capacity.

The results achieved in research capacity, in these limited terms of academic training and research infrastructure (laboratories and equipment), are assessed immediately below.

3.1.1 Human Resource Training

Academic training for Nicaraguan researchers has been ongoing for approximately 25 years. The majority of the academics studied in Sweden although more recently individuals have studied in other countries such as Mexico and Spain. The stated objective was to create a critical mass of researchers in various subject areas related to the physical sciences. This strategy has not been fulfilled completely due to the thematic dispersion recognized by previous evaluators. Still, a significant number of individuals in the four public universities have graduated to the present date. The total number of graduates to date was not consistently available in the self-evaluation reports submitted to the JGG evaluators. In some instances the figures for outcomes in 2008, prepared for Sida's country assessment, were higher than the figures provided by the universities in their self-evaluation reports due to the fact individuals who were expected to graduate did not.

TABLE 3: Academic Achievement to December 2010

Degree Obtained	UNAN-León	UNAN-Managua [26]	UNI	UNA	Total
Doctorate	18	4	4	11	37
Licentiate [27]	12	7	16		35
Masters	11	2	1	22	36

It is important to note that at least 29 individuals are pending graduation at the doctoral level by the end of the period of Swedish support according to the information provided by UNA (7), UNI (5), UNAN-León (4 CIDS, 1 CEI, 4 CISTA), and UNAN Managua (8). Eleven individuals from UNI are pending completion of studies at the Licentiate level and seven individuals from UNAN-Managua are expected to graduate at the licentiate or masters level. It is expected that by 2011, when the Swedish cooperation ends, 66 individuals will have achieved their doctoral degrees.

The sandwich model as a method for supporting the research capacity of Nicaraguan academics has been applied by Sida in research cooperation since the recommendation of an independent review of SAREC modalities in 1985.[26] The sandwich model adjusts the regular "residency" requirements for PhD students, allowing them to spend periods of time studying in Sweden and the remainder of their time in Nicaragua. Students have had either one Swedish doctoral supervisor (the open sandwich model), or both a Swedish and a Nicaraguan advisor (the closed sandwich model).

Previous evaluations offered diverse opinions on the advantages and disadvantages of these models, particularly the open sandwich model. Researchers interviewed in the course of this evaluation identified the following advantages of the sandwich model:

- Teaching positions in Nicaragua were maintained throughout their studies
- Nicaragua-specific research could be conducted (thus promoting the underlying aim that knowledge resulting from research will resolve problems confronting the country)
- Families were not up-rooted

The following disadvantages of the sandwich model were identified by respondents:

- Delays in completing degrees resulted due to participants' dual responsibilities for teaching and research while in Nicaragua.

26 Moreno and Alveteg, Collaboration between Sweden and the Public Universities of Nicaragua, Sida Evaluation 03/31 at page 183.

- The need for English language skills was an obstacle for entry into the program or presented significant challenges in the first years in Sweden
- Significant periods of family separation presented personal challenges.

The JGG evaluators observed that the efficiency of the "sandwich" model improved in recent years with the "closed" sandwich model. Graduate students benefited from having Nicaraguan supervisors at their universities (from the first generation of doctoral graduates) as well as a Swedish professor in the partner university. The evaluation findings demonstrated a significant range in the time taken to complete doctoral studies. The reasons for the lengthy period of studies include: teaching commitments at the home faculties in Nicaragua, family circumstances, and the level of structure provided by the Swedish university and supervisor.

- UNA students planned to complete studies within 5 years; however 73% of the students took longer to graduate, with the average being 6.5 years.
- UNAN-León researchers averaged 9 years in the first cohort of studies but have now reduced completion time to 4 years.
- UNI students have taken slightly longer than students at other universities. Some doctoral studies have been completed in 10 to 12 years; however the 2006 Lesson Learned evaluation noted that the two UNI PhD programs were only delayed by one semester. For engineering students the time taken to complete a full-time PhD degree ranges between 6.5 to 7.5 years.[27]
- UNAN-Managua students commenced training later but their combined Licenciate and PhD training has ranged from 5 to 9 years.

Despite the challenges in completing graduate studies the long term support was effective in creating a critical mass of graduates in some subject areas. Dispersion of research topics in the first decade of the program may have reduced the final outcome but, in general, the evaluators found a critical mass in agricultural science, forestry management, geosciences, ecology, biotechnology, occupational health, infectious diseases, and demography and health. In subject areas with few graduates in the same university there is a risk that graduates will not continue postdoctoral research studies. For example, in UNAN-Managua there are significant numbers of graduates

27 www.hsv.se

in geosciences, biotechnology, and ecology but graduates in occupational medicine and physics noted that an absence of peer groups within their faculties presented a challenge to developing research projects.

University representatives and graduates noted that fundamental or pure research and particular areas of scientific research have restricted applications in the current context in Nicaragua. This was noted as an obstacle to continuing basic research in universities seeking to promote applied research. For example, chemical engineering graduates commented on the limited opportunities for pure research and somewhat limited opportunities for applied research due to a limited manufacturing industry in the country.

The existence of academic masters' programs, designed by doctoral graduates, is an indicator that a critical mass of research capacity has been created. The following table illustrates the type and number of programs. Maestría Centroamericana en Evaluación de Riesgos y Reducción de Desastres, Central American Masters in Risk Evaluation and Disaster Reduction.

Only UNAN-León has designed a medical science doctoral program, but it is pending final approval by the university management. UNAN-Managua has plans to develop a PhD program in geosciences.

TABLE 4: Masters of Science Academic Programs Initiated

University	Name of Program	Number of Promotions	Number of Graduates
UNAN-León	Occupational Health	1	0
	Medical Microbiology	2	3
	Epidemiology	4	27
UNAN-Managua	Central American Masters in Risk Evaluations and Disaster Reduction	3	29
UNI	Masters of Science in Chemical Engineering [30]	1	N/A
	Master s in ICT Management [31]	1	N/A
UNA	Agro-ecology & Sustainable Development	1	1
	Management & Conservation of Renewable Natural Resources	1	0
	Rural Development	6	4
	Agribusiness	6	3

28 http://www.sarec-fiq.edu.ni/pmciq
29 http://www.maestriagtic.uni.edu.ni

3.1.2 Research Infrastructure

Laboratories

Swedish financing has contributed to excellent physical facilities for scientific research. The JGG evaluators observed the majority of physical, laboratory, and information technology infrastructure funded through the research cooperation program. In some cases the self-evaluation reports recognize that their laboratories may be the highest quality among public universities in Central America. A list of laboratory equipment is contained in Annex G.[30]

At least 11 laboratories were established through the SAREC/Sida program:

- 3 at UNAN-León: contaminants laboratory; microbiology laboratory; and demographic and health surveillance platform.
- 5 at UNAN-Managua: geotechnical; mineralogy; geographic information, photo interpretation/microscopy and biotechnical laboratories
- 4 at UNI: drying laboratory; environmental engineering laboratory; process engineering laboratory; telecommunications laboratory.
- 2 at UNA: bromathology and molecular laboratory; experimental stable for cattle; five other laboratories improved. .

Challenges or deficiencies noted by the researchers and evaluators during the current evaluation include:

- Protocol documents for the use of equipment are pending preparation in some laboratories.
- The cost of maintenance is high.
- The availability of replacement parts is limited.
- Electricity black-outs negatively affect equipment and potentially compromise the integrity of samples.
- Records of experiments and testing are not consistently kept at all of the laboratories.

Information and Communication Technologies

It became evident that the research capacity in Nicaragua would be limited and inefficient without increased access to information and communication technologies (ICT). Support to ICT infrastructure at the four universities commenced in 2003, based on a demand-driven plan that identified priorities. The first inter-university project began in 2000 with an intensive and collective planning phase to design a master plan. The implementation of the plan covered the period

30 Annex G can only be found in the original version of the evaluation in Sida's digital archive.

2003–2005 and was later extended to 2008 but in this extension each university implemented their own ICT plans.

Each university increased internet and intranet access by means of fibre optic cables, broadband internet access, servers, computer equipment, and software. Once the infrastructure and technology was operational modern online administrative management systems were designed and implemented. Researchers from each university acknowledged the profound impact of interconnectivity between university buildings and also to electronic mail and library information systems.

The 2007 evaluation of the ICT initiative observed significant advances in a short period of time, concluding that the project improved capacities at the four universities, moving them from a basic level of computing and networking to a level comparable with universities in more developed countries. Furthermore, at all four universities, there are examples wherein research being undertaken currently could not possibly have been performed without the contribution. University management, researchers, and technicians confirmed the indispensable advances to research efficiency due to the information technology infrastructure. The 2007 evaluation by Greenberg noted some of the successes and challenges in the implementation of the ICT project:

- The goals of networking campuses, increasing the number of computers for academic and administrative staff, and ICT support for research have all been met.
- Some problems arose in the implementation of the physical network infrastructure at UNAN-León; the quality of equipment purchased was not as high as in the other universities.
- Bandwidth is more expensive in Nicaragua than expected.
- There have been delays in the acquisition of equipment due to rigid procurement rules. In the end, the universities were given permission to bypass some of the national rules and were permitted to follow Sida acquisition procedures.
- There were some problems with the Swedish counterpart due to differing opinions as to expectations, responsibilities, and outcomes as well as language problems.
- The original plan was for all universities to share common administrative applications.
- The four universities have common financial systems and library systems, but their student information and human resources systems are distinct.

UNI technicians provided data on the extent of the ICT infrastructure installed on two campuses: 1,046 network points, 852 personal computers, and 144 unshielded twisted pair ca-

bling boxes were installed. UNAN-Managua reported that 607 individuals had been trained and an ICT policy document had been implemented. To illustrate the change in infrastructure between 2003 and 2010 on eight UNAN-Managua campuses the following table was prepared for the evaluators.

TABLE 5: UNAN-Managua ICTs in 8 Campuses

Campus Building/Location	Connected Buildings		Computers with Internet Access		Fibre Optic in metres	
	Before	After	Before	After	Before	After
RURD	3	53	30	1,360	0	4,950
RUCFA	0	9	25	184	0	950
CIRA	2	10	20	50	0	200
FAREM-CARAZO	0	6	15	150	0	500
FAREM-ESTELI	0	6	15	127	0	150
FAREM-CHONTALES	0	4	0	96	0	0
FAREM-MATAGALPA	0	5	0	120	0	0
RURMA	0	4	0	10	0	0
TOTAL	**5**	**97**	**105**	**2,097**	**0**	**6,750**

In addition to these technological advances, JGG evaluators observed facilities and systems first-hand at UNAN-León and noted the impact, including: 16 online university courses, national and international video conferencing, and modern computer laboratories within the historic university buildings.

Research Information-Strengthening

As mentioned above, the introduction of advanced ICT in the universities facilitated the introduction and use of online bibliographic information. The Programme for Enhancement of Research Information (PERii), an initiative of the National University Council (CNU), commenced in 2008 with assistance from the International Network for the Availability of Scientific Publications (INASP).

One of the most important aspects of PERii has been the introduction of scientific research databases to the CNU member universities. In order to promote online bibliographic research as an integral aspect of university studies infrastructure and capacity-building activities were designed in five components. The self-evaluation report from PERii highlights the following short-term results:

TABLE 6: Results from PER II Initiatives

Component	Results
Access to high quality online sources	• 3 database subscriptions selected in a participatory manner • 28,827 scientific articles accessed between April 2008 and October 2010
Librarian capacity building	• 297 librarians trained in online information resources
Strengthening ICT	•ICT assessments completed at university libraries • infrastructure improved (computers, servers, connections improved) • 75 ICT personnel trained in wide band administration and Linux
Strengthening national publications	• 336 academics and researchers trained in use of online information and scientific writing • 162 individuals involved in editing national journals received orientation
Increased presence of Nicaraguan research in open publications	• 25 national journals included in LATINDEX (www.latindex.org) • 5 national scientific journals incorporated in Latin American Journal Online (www.lamjol.info)

Once the librarians at each university received training they transferred knowledge to students, lecturers, researchers, and university administrators through general information sessions and specialized tutorials. The number of users accessing the databases varied among universities and databases but has steadily increased since 2008. See Annex H[31] for annual statistics demonstrating the use of the databases nationally. The JGG evaluators note with interest the innovative and frequent promotional techniques at UNAN-León and the significant number of individuals accessing online bibliographic information compared to the other universities. The library is also conducting ongoing monitoring and evaluation to improve their services to the university community. A 2008 survey conducted at UNAN-León asked lecturers and researchers to explain the purpose of their use of the online bibliographic databases, elicited the following responses:

- 53% accessed the databases to support their lectures,
- 32% for research, and
- 9% for project development.

31 Annex H can only be found in the original version of the evaluation in Sida's digital archive.

3.2 RESEARCH MANAGEMENT AND CULTURE AT UNIVERSITIES

3.2.1 University research policies and procedures

The Research and Postgraduate Commission of CNU was organized in 2000 for the purpose of creating a national research system and a national postgraduate system. The Commission works through two modalities:

- the promotion of institutional policies and structures with the directors or vice rectors of research, and
- the creation of research networks on specific themes (health and agriculture) that link universities and public officials.

The JGG evaluators noted a number of diagnostic tools prepared by the abovementioned Commission. These tools include: a list of variables and indicators to characterize research and postgraduate studies (2004), instruments (questionnaires) to gather information on postgraduate programs (2008), and a self-evaluation guide to analyze postgraduate programs (2008).

Projects within the overall SAREC/Sida cooperation program were bilaterally negotiated with each university and each university had a number of projects to implement in one period. The evaluators note that the 2004-2008 period represented the first time the universities had submitted a significant number of proposals related to institutional-strengthening. Examples of the initiatives from that time period include:

- at UNAN-León, strengthening of higher education management and research for development capacities,
- at UNA, strengthening of the Research and Development Council, curriculum development and implementation of courses with new pedagogical techniques, and strategic institutional management.
- at UNI, improved research, academic and administrative management, strengthened lecturers' capacity in educational research, and support to small research projects.
- at UNAN-Managua, no particular management initiative distinct from the research initiatives coordinated by the Research Directorate of the university.

From 2008 all of the universities submitted proposals for institutional strengthening initiatives.

The earliest research and postgraduate policies formulated

and approved appear to be three policies formulated and approved in 2003 and 2004 at UNAN-León. The Research and Postgraduate policy, approved in April 2003, sets out definitions prior to declaring institutional policy. In the declaratory policy section the first two articles clarify the important role of research and postgraduate studies:

- Research and postgraduate studies are integral to the academics at UNAN-León, along with undergraduate teaching, social influence, and institutional management (section 4.1).
- Research and postgraduate studies are the processes through which UNAN-León contributes to the transformation and development of Nicaraguan and Central American society (section 4.2).

At the time of the present evaluation the new leadership at UNAN-León confirmed its commitment to these principles. However, the financial structures and processes for the actual implementation of scientific research projects within the university are under review.

The 2003 policy statement was implemented through practices and procedures described in additional documents ratified by the University Council in 2004, those being: the Postgraduate Studies Regulations approved in July 2004 and the October 2004 Policy for the Creation and Functioning of Research and Postgraduate Studies Centers. The objective of these documents was to ensure that scientific researchers, including the medical faculty graduates participating in the Swedish cooperation, were able to continue international caliber research within UNAN-León, and ultimately to contribute to social development in Nicaragua.

Each university has approached the development of research policies and procedures in distinct ways appropriate to its own institution. For example:

- UNA, with its leadership having participated in the SAREC/Sida program, is committed to integrating scientific research into the undergraduate curriculum and through the application of a variety of incentives and mechanisms.
- UNI generated a new Educational Institution Model in 2008 after a participatory and consensus-building strategic planning process. Research and teaching are accepted as interconnected and essential aspects of the university's vi-

sion[32] under this new model. During this reform process a draft Research Policy was formulated.
- UNAN-Managua developed a draft policy but does not have any official normative orientation to guide its research initiatives.

The JGG evaluators observed that formal approval of a research policy does not automatically support a research culture. In fact, in UNAN-Managua postgraduate studies and research for university lecturers has been promoted through tacit application of informal research promotion policies and procedures. Furthermore, the policy statements and mechanisms not only promote scientific research within the university but seek to promote research for the purpose of contributing to the development of Nicaraguan society.

In 2009 the Research and Postgraduate Studies Commission of CNU tasked the research director in the vice rector's Office of Research and Development at UNI with the elaboration of a diagnostic assessment of the status of Policies on Research, Innovation, Intellectual Property, and Postgraduate Studies at the CNU member universities. The following table summarizes the status of policy development at the time the study was conducted by the Research and Postgraduate Studies Commission in 2009. [33]

32 Vision: "The National University of Engineering is an institution which is consolidating its position as national leader in the teaching of engineering and architecture and is a referent in scientific research and technology, constructed through the interaction of diverse actors, the social sectors, economies and different cultures of the country. Thus contributing to growth, national development, function and the wellbeing of Nicaraguan society."

33 The study is designated "Draft".

TABLE 7: Summary of the Status of Policies at Participating Universities

Type of Policy	UNAN-León	UNAN-Managua	UNI	UNA
Research	Yes.	No. However, the teaching policy permits research activities within teaching responsibilities. Research is developed within academic units.	Research, Postgraduate and Outreach Articulation Model approved by the Rector within the framework of New Educational Institution Model. Learning and Knowledge Communities are mechanisms to develop research.	Research for knowledge-generation purposes is one of the main aspects of the university's mission.
Innovation	No.	No. There are practices and mechanisms that promote innovation.	No. Learning Communities are developing innovation policies. Movement of Innovators is in development.	No. The Research, Outreach and Postgraduate Office and the University Innovation Commission at UNA promote innovation.
Postgraduate Studies	Yes; integrated within research and graduate studies policy; a specific set of regulations was also approved.	No. National and regional standards are considered in guidelines for development of academic programs.	A draft postgraduate policy is under review. Postgraduate regulations in place.	Postgraduate Studies System Guidelines 2002, were updated in 2004. Postgraduate Development Plan 2005-2010
Outreach	Yes.	No. Strategic and operational plans identify social outreach and collaboration as priorities. Inter-institutional agreements.	The New Educational Institution Model emphasizes outreach. New policy is being drafted by one of the Learning Communities.	No. Implicit in UNA's commitment to knowledge-generation. Outreach Commission promotes outreach.
Intellectual Property	Draft.	No.	Draft.	No. University Innovation Commission formulating policy.
Technology Transfer	In development.	No.	Considered within the draft intellectual property policy.	No. Partially considered in intellectual property policy and professional services.
Research Centres	Yes. Included in two set of policies: research and graduate studies and a specific policy on the creation and operation of research centres.	Draft proposal that will regulate research centres and research programs. Under revision by the University Council.	Draft proposal on administration of research centres and programs.	No. Research System proposal defines creation of centres within faculty structure.
Research fostered within budget policy	Yes; 1% of the university budget approved in December 2007 under new Statutes.	Budgeting principles and practices support programs and research with high social impact value.	Less than 1% of budget is assigned to research.	International cooperation.

Promotion of research groups/ networks	Yes, within Research and Postgraduate Policy	No. Networking is promoted.	Promoted within the New Educational Institution model and the Learning Community modality.	Research is organized within UNA by research groups.
Other policies to promote research and postgraduate studies	Incentive fund implemented from 2007 (for publications in indexed journals). Work regulation for academics.	Regulation of Postgraduate and Continuing Studies (2008)	Policy on remuneration for professional services offered through UNI is in formulation.	Entrepreneurship strategies are in place to promote links between research and development.

3.2.2 University Culture

The JGG evaluators found, and the above table confirms, that formal policies on scientific research and postgraduate studies do not, on their own, guarantee that research is given priority and is supported. The formulization and formal adoption of policies that promote research may be, depending on the degree to which research is promoted through the university leadership, simply the first step to an eventual institutionalization of research through various mechanisms and practices.

In the case of UNAN-Managua and UNA the lack of policies has not impeded the development of scientific research through postgraduate studies. In fact, in the case of these two universities, the principled integration of research as a fundamental aspect of the university's mission, has resulted in ingrained institutional "cultural values and practices" that recognize the value of scientific research.

Interviewees with researchers in UNI and UNAN-León observed that the university culture gave priority to undergraduate lectures to the extent that scientific research and postgraduate activities became difficult to undertake due to time constraints. All researchers interviewed reiterated the importance of undergraduate teaching but acknowledged that it is essential to find a balance between teaching responsibilities and research activities.

Research culture is strong within the three SAREC/Sida-supported research centres at UNAN-León. However, the overall institutional culture at UNAN-León has not fully integrated scientific research and postgraduate studies as activities that are central to its mission. The new strategic plan may enhance this integration of research into the university culture. The evaluators observed UNI in a transitional phase in which research, technology, and innovation has been prioritized and will be fully implemented when mechanisms and procedures are established.

Two university authorities interviewed noted that an image of elitist Swedish-supported researchers developed because

specific faculties were supported over a lengthy period of time. A Sida official acknowledge that, in order to address the envy mentioned, and create a positive atmosphere for research, SAREC/Sida provided funds for competitive grants open to all professors at all universities.

One university vice rector stated that the emphasis on the international scientific publication of research results, is not valuable, considering Nicaraguan development needs. During interviews with the evaluators, university representatives and public officials remarked that national dissemination of research results in clear, accessible language is important to consider in tandem with dissemination through national and international academic publications.

The evaluators noted the absence of best practices regarding the promotion of ownership until the latter period of cooperation with Nicaraguan universities. The best practices for institutional and national ownership are derived from the Paris Declaration on Aid Effectiveness. Once ownership became integral to international development cooperation discourse, Sida encouraged Nicaraguan universities to assume greater ownership. For example, funds were transferred and administered within the university financial systems and general institutional strengthening initiatives were supported. These activities were greatly appreciated by the university leadership interviewed, although some regretted the late implementation of strategic institutional activities. The evaluators acknowledge that changing an institutional culture is a long term process. External interview respondents also noted the tradition in Nicaragua has been to educate professionals for the labour force and not produce scientific researchers.

3.3 NATIONAL POLICIES AND INSTITUTIONS TO PROMOTE SCIENCE, TECHNOLOGY & INNOVATION

The conceptual assumption of the nexus between scientific research and development has underpinned Swedish research cooperation. Desk research and interviews with university representatives and public officials made evident that a number of conditions are necessary to ensure research will lead to economic and social development. The conditions identified were: a long term vision for the country, effective public policies, and stable institutional mechanisms to oversee policy implementation through specific programs. A critical mass of

scientists trained and educated through individual and institutional research capacity-building activities, will not in and of themselves impact a country's development unless other political and institutional factors are considered and implemented. Swedish research cooperation in Nicaragua was based, for the most part, on the premise that a bottom up approach in which a critical mass of scientific researchers, once sufficient, will stimulate an enabling environment for science and development. This approach was necessary because there was no national level counterpart mandated to promote research in higher education institutions. Once CONICYT began to function Sida was able to engage with a national level body tasked with promoting research and the nexus between scientific and technological research and national development priorities.

3.3.1 Government Policy and Institutions

It is important to emphasize that Swedish-Nicaraguan cooperation in the area of scientific research has occurred, for the most part, without a strategic national vision or path defined by the Nicaraguan government. The absence of a national research and development vision restricts public policy initiatives, institutions, and scientific research to those problems that are immediate and acute as opposed to those with a long-term or strategic view. Admittedly, the Swedish cooperation was consistent with Nicaragua's national development plans but these plans did not specifically address scientific research until the most recent plan currently in force.

Admittedly, the political, economic, and social context and the brain drain resulting from the armed conflict in the late 1970s and 1980s impeded long-term vision and scientific research. Political ideological divisions prohibited progress in the 1990s as well. As mentioned above in the historical review section, the Nicaraguan Council for Science and Technology (CONICYT) was established in 1995 but did not become operational until 2001 when the 19 council members were named by the Bolaños government. Council members include business, university, government, and civil society representatives. Only two university representatives are named to the Council: one representing public universities and one representing private universities.

The Council is affiliated with the Vice President's Office but enjoys administrative and functional independence. In 2004 the technical secretariat of the Council became associated with the Sida research cooperation program and since that time has undertaken initiatives to develop the legal and policy basis for a science and technology system in Nicaragua.

Achievements include:

- a catalogue of science and technology actors in each sector (academia, business, and government),
- a national plan for the promotion of Science, Technology and Innovation (ST&I), recently approved in October 2010, and
- a draft law pending final passage in Congress.

The National Plan for Science, Technology and Innovation is based on the previously mentioned nexus between ST&I and economic and social development, and adopts the terminology developed by international organizations such as OECD and ECLAC. The Plan proposes a National Innovation System (NIS) to achieve its general objective of stimulating sustainable economic and social development in Nicaragua with ST&I as the principal driver. The Plan describes eight programs:

- human resources for ST&I
- a national researchers' system
- the retention, repatriation, and mobility of human resources
- the promotion of awareness of the development, dissemination, and use of ST&I
- research, development, and innovation for modernization of productivity
- connections among ST&I actors
- ST&I measurement indicators
- ST&I investment incentives

The draft law on Science, Technology and Innovation sets out objectives and strategies to stimulate linkages between research and development through knowledge-development, experimental research, and the application of new technology for the purpose of innovation. The draft legislation would require the state to assign 1% of the national budget to science, technology and innovation programs. The proposal would also grant CONICYT administrative autonomy with the mandate to oversee a National Science, Technology, and Innovation System comprised of a variety of public, academic, and business sectors. Academic representation would be expanded with an increased presence of members of CNU.

A strengthened Science, Technology, and Innovation Council is an important catalyst for research promotion but is also necessary to provide momentum to the dialogue among academics, policymakers, and entrepreneurs. Currently this type of tripartite decision making is formalized in the occupational health and safety sector for the obvious reason that tripartite mechanisms are well established in international and national

labour law. Nicaragua, unlike Argentina, Mexico and Chile, does not appear to separate ST&I mechanisms from policy decision making. CONICYT has both policy making and system administrator functions for the promotion of ST&I.

Swedish support has contributed to regenerating CONICYT from a dormant institution, helping it become a framework that can set standards and eventually support program implementation. The evaluators confirmed the cautious assessment by Nicaraguan researchers that ST&I is in its infancy in Nicaragua. The almost complete absence of investment in ST&I by the private sector is an obstacle to the proposed collaborative process. For example, entrepreneurs and former researchers confirmed that medium and large manufacturers in Nicaragua rely on external expertise and technology for resolving technical problems.

3.3.2 Inter-University Initiatives

The National Council of Universities (CNU)[34] was formed in 1990 after the promulgation of the Law on Autonomous Universities. It is an independent organization, comprised of the ten universities[35] in Nicaragua that receive public monies, with the mandate to: formulate and implement national policy on higher education and regulate authorization of new higher education institutions. Its mission is to provide Nicaraguan society with well-prepared, innovative, humanistic, and competitive human capital that will contribute to social and economic development. CNU organizes its inter-university work through three modalities: systems, projects, and commissions. At present there are 23 commissions that have the responsibility to nationalize common approaches and standards relating to a particular topic.

CNU began to receive support from the SAREC/Sida program in 1994 and has represented an important collective inter-university mechanism to conduct diagnostic assessments, formulate recommended standards for research and postgraduate studies, and construct national systems in higher education. The Research and Postgraduate Commission, considered the most important academic commission, has been responsible for organizing the exchange of scientific knowledge through conferences and seminars, diagnostic studies related to research capacity and, most importantly, since 2005, the commission has fostered the development of a National Higher Education Research System (SINIES in Spanish). A

34 See CNU website: http://www.cnu.edu.ni/

35 The members of CNU are: the four public universities participating in the Swedish cooperation program, two community universities in the Atlantic Coast, and four private universities receiving public monies: University of Central America, the Polytechnic Institute, the Catholic University of the Dry Tropic and the Dominican School.

2004 assessment of the research capacity in the 10 universities belonging to the Council identified weak inter-university research activities. The JGG evaluators, and indeed the Nicaraguan researchers participating in this evaluation, recognize that at present inter-university cooperation remains limited and represents an untapped potential.

3.4 THE IMPACT OF SCIENTIFIC KNOWLEDGE ON DEVELOPMENT

3.4.1 Research Conducted

The SAREC/Sida program supported research directly through the masters, licentiate, and doctoral research projects and also through financial support to competitive research funding mechanisms implemented by the universities and CNU. The following table lists the major research projects undertaken at the universities through their academic programs or research centres. The information is reproduced based on the research projects identified in the university's internal evaluation reports, interviews, and reports of research seminars.

TABLE 8: Summary of Major Research Projects Undertaken

Research Centre	Research Projects
UNAN-León	
Infectious Diseases Research Centre	• The rotavirus diarrhea in children • Infant Diarrhea E. enterotoxigenic • Prevalence of intestinal parasites in Nicaragua • Diagnosis of Entamoeba histolytica in Nicaragua • Chagas' disease in Nicaragua • Giardiasis in Nicaragua. • Structural and immunochemical study of endotoxins of bacteria that cause infant diarrhea • Antimicrobial resistance in bacteria • Protozoan intestinal parasites • Infant diarrhea viruses, bacteria and vaccine clinical trials • Dengue • Hepatitis • Rheumatic fever • Antimicrobial resistance in bacteria causing various infectious episodes
Occupational Health and Environment Research Centre	• Health of miners • Organophosphate-induced neurobehavioral effects and delayed neuropathy • Effects of pesticide exposure on skin • Pesticide exposure and effects on neurological development of children of agricultural workers • Work and environmental perspectives on chronic renal disease in Nicaragua • Economic and health impacts of pesticide exposure • Society's expectations of universities as interpreted by university managers and academics • Work, organization and human resources

Demography and Health Research Centre	• Demographic and Health Surveillance System • Maternal health initiatives based on community census • Suicide • Reproductive health and violence against women • HIV/AIDS and sexual behaviour
UNAN-Managua	
Geoscience RESearch Centre (CIGEO)	• Evolution of volcanic structures • Hydrogeological, geophysical and hydro chemical research in Leon – Chinandega plains • Seismic amplification evaluation • Dynamic properties of soil in Managua area
Multidisciplinary Environmental Research Program	• Solid waste management modelling – Managua case study • Microbial degradation of toxaphene • Groundwater occurrence and risk of pollution in mountain watershed • Organic contaminants in aquatic eco-toxicological bioassays • Fluvial transport and risk of mercury in gold mining area • Child labour and health hazards due to chemical exposure in waste disposal sites • Ecological implications of DDT and glyphosate • Environmental biotechnology • Bioremediation with bacteria and fungus in laboratory experiments with aerobic and anaerobic bioreactors • Bioremediation with amaranth plants in contaminated sites • Transformation of used oil into bio diesel • Transformation of used cooking oil into cleaning liquid
National Agrarian University (UNA)	
Examples from VI and VII Scientific Meeting of UNA researchers	• Strengthening rural outreach to improve food security among peasant farming families through communal university plan • Economic importance of micropropagation of crops • Alternative energy in productive activity in Nicaragua • Cocoyam and the dasheen mosaic virus • Organic strawberry cultivation • Pests and fungal disease in cashew cultivation • Alternative botanical and chemical pest control in tomato cultivation • Organic and synthetic fertilizers in soy cultivation • Comparative physical, chemical and biological analysis of three coffee production systems • Effects of diet and supplements on sheep • Incidence and economic impact of lesions in the bovine channel • Disease Assessment in pine trees • Chemical and Botanical management of white mite • Reforestation in dry tropical forest with planting • Effects of nitrogen in corn production
National Engineering University (UNI)	
Chemical Engineering Faculty	• Drying and crystallization • Process engineering • Environmental engineering
Electronics and Communication Faculty	• Data communication • Applied electronics • Industrial control systems

3.4.2 Knowledge Sharing Mechanisms

Knowledge Dissemination

The Swedish cooperation has supported various models for the dissemination of knowledge resulting from research carried out in Nicaragua. According to a 2009 CNU health research impact study[36], knowledge production during the period of 2004–2008 amounted to 294 documents published in specialized international journals. The thematic breakdown of these publications was as follows:

- 47% medical sciences and health (139 publications),
- 16% agricultural sciences and biology,
- 12% natural sciences,
- 10% social sciences.

The three major contributing institutions in that period were: UNAN-León, the Ministry of Health, and UNAN-Managua.

The academic focus of the Swedish cooperation has benefited academic publications and events. Research results are primarily disseminated via national scientific events, such as those organized by the universities or the National Council of Universities, as well as through international conferences and journal publications. The following information provides examples of research dissemination activity by the university partners.

TABLE 9: Summary of Publications by Researchers in Public Universities

University Partner	Number of publications in peer-reviewed and indexed journals	Number of books, chapters in books, or doctoral theses	Number of presentations at scientific events
UNAN-Managua	• 26 publications in international scientific journals	• 4 doctoral theses • 10 masters / licentiate theses	• 24 presentations at international scientific events • 37 presentations at national scientific events
UNAN-León	• 160 publications in indexed and peer reviewed journals • journals; one of which earned the national prize for best research	• 17 doctoral theses • 19 masters' theses • 8 chapters in books • 2 books	• more than 280 presentations in international and national scientific events
National Agrarian University (UNA)	• 26 publications in reviewed journals • 140 publications in indexed journals	N/A	• 29 presentations in international scientific events • 21 presentations in national scientific events
National Engineering University (UNI)	• 12 publications in international peer reviewed journals • 18 publications in national journals	• 4 doctoral theses • 13 masters' theses	• 100 presentations in international proceedings

36 Impacto Cientifico y Social en el Area de las ciencias Medicas y de la Salud, Nicaragua (CNU: Managua, 2009)

Despite the increase in knowledge dissemination via academic fora, various university authorities (rectors and vice rectors) and external actors in the public and private sectors who were interviewed in the course of the evaluation observed that scientific research findings were not sufficiently circulated among professionals and businesses, thus limiting the possibility that these research findings could be applied to resolve national problems.

Nicaraguan university partners have also launched scientific journals. One journal, Nexo, is peer-reviewed and the remainder are indexed and/or catalogued:

- Nexo (UNI)[37]
- La Calera (UNA)[38]
- Tierra (UNAN-Managua)[39]
- Ciencia (UNAN-Managua)[40]
- Universitas (UNAN-León)[41]

Knowledge Networks for Research and Development

In the 2003 evaluation the evaluators found that the Nicaraguan researchers had developed few collaborative initiatives with other local, national or international researchers beyond their Swedish counterparts. While networking and collaborative initiatives in Nicaragua could still be improved, as noted by the university researchers themselves, the JGG evaluators found that individual researchers and the research centres had increased participation in a variety of informal and formally constituted collaborative arrangements and/or networks. These networks provide various benefits to the Nicaraguan researchers involved with this Swedish cooperation program, including: information exchange, peer-to-peer knowledge sharing, experimental research arrangements, collaborative knowledge transfer, and joint research initiatives.

A review of interview notes and the internal evaluation reports permits the categorization of over 100 networks and collaborative arrangements entered into by Nicaraguan researchers into the following profile:

Nicaraguan collaborators and networks

- municipal governments
- the national government (government ministries, CONICYT, institutes, public regulatory agencies, hospitals)
- industry (sugar producers, internet service providers' association, coffee producers, cattle breeders, food manufacturers)

37 http://www.latindex.unam.mx/buscador/ficRev.html?opcion=1&folio=18766
38 http://www.latindex.unam.mx/buscador/ficRev.html?folio=12666&opcion=1
39 http://www.latindex.unam.mx/buscador/ficRev.html?folio=18814&opcion=1
40 http://www.latindex.unam.mx/buscador/ficRev.html?folio=18809&opcion=1
41 http://www.latindex.unam.mx/buscador/ficRev.html?folio=18066&opcion=1

- organized and unorganized workers (unions, agricultural cooperatives, small farmers)
- civil society organizations (non-governmental organizations, communal associations)
- universities and research centres

International academic and funding collaborators and networks

- specialized international agencies (such as the Pan American Health Organization, International Labour Organization)
- universities in Europe (Italy, Finland, Germany, Spain, Switzerland, Denmark), the United States and Latin America (Mexico, Cuba, Chile, Argentina, Brazil, El Salvador, Panama, Costa Rica), and Africa (Mozambique)
- international inter-university networks and projects (Italian-Central American inter-university network on natural threats)
- development cooperation agencies (Switzerland, Japan, Spain, IDRC)

The research centres associated with the Faculty of Medicine at UNAN-León have constructed the broadest network locally, nationally, and internationally due to the nature of their medical research, while others lead or participate in national and Central American networks. The following are some examples of collaborative networks that have been established.

The Biotechnology Laboratory at UNAN-Managua belongs to the Nicaraguan Institute of Biotechnology (INBION). The initiative arose from the need to optimize human and material resources in a more rational and effective manner by integrating a group of highly qualified scientists from three key sectors (industry, government, and universities) in order to promote Nicaraguan Science and Technology with the aim of influencing the socio-economic development of the country. Currently there are nine national institutions that form this institute: UNAN-Managua, UPOLI, UNA, UNI, UNAN-León, EIAG-Rivas, INTA, MAFOR, and a private company, Tecuilcan.

At UNI, the Chemical Engineering program has initiated international networks with research groups from European and South American universities within the CYTED and ALFA III programs. The Electrical and Computer Engineering program has also initiated international collaboration with Latin American universities in the framework of the Latin American and Caribbean organizations (LACCIR) in ICT research projects.

3.4.3 The Social Impact of Research Results

The university researchers have applied their knowledge for the social benefit of Nicaraguans through three categories of activities:

- law and policy reform,
- contributions to improve the quality of life, and
- contributions to improve productivity (and ultimately the standard of living).

The absence of clear standards, indicators, and benchmarks for measuring the impact of scientific research presents challenges for evaluators and researchers alike, as was recognized by university researchers interviewed in Nicaragua during the course of this evaluation. International debate on measuring the impact of scientific research has not produced recognized measures to date. An impact study of health research supported by CNU in 2009[42] suggests social impact be measured by three types of impacts to assess the change in quality of life and standard of living of the society "due to the creation, dissemination, use, and appropriation of the products generated by scientific and technological activities."[43]

In the context of this evaluation there were insufficient resources and time to effectively measure impacts. While the Swedish cooperation was based on the assumption that research capacity would eventually impact positively on development neither Sida nor the university researchers systematically measured the impact of research projects. JGG evaluators were only able to identify social impacts, as they relate to changes in the quality of life or standard of living measures referred to above, based on interviews with researchers, external actors and document review.

The table below summarizes some of the social impacts achieved by academic researchers at the four public universities participating in the SAREC/Sida program. On subsequent pages case studies reflecting research initiatives attributed to Swedish cooperation are included.

42 Impacto Cientifico y Social en el Area de las ciencias Medicas y de la Salud, Nicaragua (CNU: Managua, 2009)
43 Ibid at 4.

Table 10: Social Impacts Achieved by Researchers at the Participating Universities

Three categories of social impact activities	UNAN León	UNAN Managua	UNI	UNA
Contributions to law and/or public policy reform	As members of National Occupational Health and Safety Council, contribute to policies and regulations related to: workplace medical exams, ergonomics, and child labour	Support to legislative proposal on solid waste disposal	Participation on Commission to ensure food safety standards (see Codex Alimentarius below)	Support to Organic Produce Law on behalf of a women's cooperative and ecological producers' network
	Advise Ministry of Health on health priorities in the country	Participation on National Climate Change Commission	Public forum on mobile telephone service and health risks (see description below)	National Human Development Plan
	Reproductive health census data influenced law on violence against women and was included in the first human development national report produced in 2000 by UNDP.			Active participants in the formulation of laws on: biodiversity, biosecurity, food security and nutrition, forest growth, and national waters
Contributions to improved quality of life of Nicaraguans	Introduced the rotavirus vaccine in the national vaccination schedule/ protocol	Successful laboratory experiments applying bioremediation to water and soil contaminated by pesticides	Support to municipal governments for creation of online government services	
	Improved water quality in León as a result of testing for amoebas			
	Incorporation of diagnostic testing for parasites not previously considered in general stool exams			
	Laboratory services provided at reduced cost for specific infectious diseases for residents of León	Study geological fault lines and advise municipality of Managua regarding construction and disaster prevention		
	Student research in factories; medical attention to workers			
	Study chronic renal failure in 600 people in two communities; assess psychosocial, mental health, and human rights impacts	Respiratory health of children living near landfill site studied		
Contributions to improved standard of living				Alternative pest and crop management methods developed by UNA researchers and applied in Nicaragua and the region improve production.

Impact of a Participatory Program of Integrated Management of Pests in Agricultural Crops

Over a four year period between 2004 and 2008 a series of experiments was conducted on the management and control of the major pests of tomato, peppers, and gourd crops in the municipality of Tisma in Masaya. The objective of the research experiments was to evaluate the alternative management of pests. The trials were carried out in a participatory manner in fields of producers in the area under the leadership of Dr. Edgardo Jimenez Martinez of the National Agrarian University. There were eight trials: 3 in tomato crops to assess alternative management of the white fly and fruit worms; 3 trials in pepper crops to assess the management of mites; 1 trial of cucumbers to evaluate alternative control of pests; and 2 trials of mixed crops to understand the different effects of pests on mixed crops compared to single crops. The crops were planted at the beginning of each year in the fields of 25 producers who benefited directly from the experiments. Another 45 producers participated in the field work, training workshops, and the analysis of the alternative management techniques assessed.

After four years of uninterrupted work in Tisma various problems with pests, diseases, varieties, irrigation, and marketing continue to be detected. However, producers regained confidence in the tomato crop due to its recovery and a 20% increase in production. The pepper crop was slower to recover; however producers reported a 30% increase in production in 2009. Future studies in the integrated management of pests will focus on the problems that producers have identified with vegetable and basic grains.

University students were also involved in the experiments: 16 undergraduate students used the trials as the basis for their research papers and 80 participated in field work.

Antenna System and Electromagnetic Radiation Forum (2004)

The dilemma between the possible risk to public health and advances in telecommunications was discussed during the "First Antenna System and Electromagnetic Radiation Forum", which dealt with the uses, impacts, myths, and realities of mobile phones in Nicaragua. The forum was organized and moderated by members of the National Engineering University's Faculty of Electronics and Computers research program. It was attended by representatives of: the National Engineering University, the Pan American Health Organization, mobile service providers, the National Assembly, TELCOR (the public telecommunications regulatory agency), the Ministry of Health, civil society, and others. The principal result achieved was the freezing and eventual abandonment by the

parliamentary Communications Commission of the proposed law that would have virtually eradicated mobile telephone service in Nicaragua.

Codex Alimentarius (2002-present)

Several members of the Faculty of Chemical Engineering research team have been active members of the Codex Alimentarius Commission of Nicaragua. The Commission is responsible for developing food standards, guidelines, and related texts such as codes of practice under the joint World Food Organization - World Health Organization Food Standards Programme. The main objectives of this program are to protect the health of consumers, ensure fair trade practices, and promote coordination of all food standards work undertaken by international governmental and nongovernmental organizations.

Pesticide poisoning in Nicaragua – five decades of evidence[44]

Problem: The evidence of the last 50 years demonstrates convincingly the negative impact of pesticide use in Nicaragua, where high rates of acute pesticide poisoning have been documented. Recent changes in the institutional approach in the health, environment, and agricultural sectors have led to significant improvements. Measures to address the problem have included restrictions and bans on certain pesticides, pesticide management projects, integrated pest management, and the promotion of chemical safety practices. However, this is not enough. Structural changes are needed to reduce reliance on chemical pesticides and to enhance measures to protect workers' health and the environment.

Major research findings: Research conducted by the National Autonomous University of Nicaragua (UNAN) in León with the Nicaragua Ministry of Health and the Pan-American Health Organization (PAHO) showed that the annual incidence of Acute Pesticide Poisoning was 2.3% in the general population and 8.3% among sprayers. About 66,000 cases were estimated to occur annually, but only 5% of the medically treated cases were reported to the Ministry of Health. The poisonings led to about 340,000 lost days of work. 77% of cases were caused by pesticides proposed to be banned or restricted in Central America, and the main causes for exposure among sprayers were leakage of the backpack pump and incomplete or no use of personal protective equipment.

Use of research findings: The research findings informed recent policy and programmatic changes. In the environment sector,

44 Based on the article: Patricia Castillo, "Control Biologico de Plagas" in Freddy Alemán et al, Innovaciones en las Universidades Nicaragüenses: Casos Exitosos (CNU: 2010)

chemical safety has been reinforced. In the agricultural sector, Integrated Crop Management has been promoted. In the health sector, Nicaragua has developed a national toxicology centre and a pesticide program integrated within a health surveillance system. Nicaragua has implemented integrated pest control programs and has prohibited two of the most toxic pesticides. Ongoing research continues, feeding into these reforms. A series of new methods has been developed to assess pesticide exposure, which makes the ongoing monitoring of exposure easier.

Research Experience of the UNAN – León in the Study of Childhood Diarrhea in Nicaragua [45]

Problem: While infant mortality rates in Nicaragua had declined over the 1980s and 1990s, acute diarrhea was still a major cause of mortality and morbidity in children under five, especially in poor, rural areas. As it was difficult to address the causes of infant mortality from diarrhea (poverty, malnutrition, and poor sanitation), Nicaragua attempted to combat the problem with vaccinations.

Major research findings: The Department of Microbiology of the Faculty of Medicine at the UNAN – León conducted a series of community-based epidemiological studies on the prevalence of different pathogens and the specific genotypes of the microorganisms causing acute diarrhea in children. Once the prevalent pathogens were identified, the team participated in safety and efficacy trials of rotavirus vaccines, along with safety and efficacy trials for other vaccines being introduced to the National Immunization Program. It was part of the GlaxoSmithKline trials for monovalent Rotarix, the first human rotavirus vaccine, and provided evidence of the safety and efficacy of the vaccine. In response to a 2005 diarrhea epidemic, the UNAN-León participated in Ministry of Health efforts to work with MERK SHARP DONE to introduce the RotaTeq vaccine. Together with five other sites, the UNAN-León is part of the diarrhea surveillance system in Nicaragua, monitoring the prevalence of acute diarrhea in vaccinated vs. unvaccinated children. The results were expected in 2010. Meanwhile, the UNAN-León also studied the prevalence of different strains of the Norovirus, another common cause of diarrhea in the area.

Use of the research: As the research was conducted in close collaboration with the Ministry of Health's National Immuniza-

45 Based on the article: Felix Espinoza, "Experiencia de Investigación de la UNAN-León en el estudio de la diarrea infantil en Nicaragua" in Alemán et al (2010).

tion Program and with vaccine-producing pharmaceutical companies, the findings were of direct use in informing the development of vaccines and testing their efficacy and safety. Being part of the vaccine trials, in turn, strengthened the epidemiological diarrhea surveillance capacities in León. The UNAN-León played a lead role in setting up a Central American network for rotavirus monitoring and trained counterparts in Ecuador, Chile, and Costa Rica in the identification of rotavirus and calicivirus strains.

Citizen Security in León: Accumulated Experience[46]

Problem: Insecurity in León had been rising in 2005 and 2006, particularly in the form of youth crime, which presented risks both for the youth involved and the general population. The City of León wanted to make León the safest city in Nicaragua and wanted to do so through a multi-sectoral, community-based approach.

Major research findings: In 2005, the UNAN-León collaborated with the municipal police in a study of local perceptions of insecurity. They found that 67% of the adult population had the perception that citizen security had deteriorated. Increased consumption of alcohol and drugs were thought to be contributing factors. When the study was repeated in 2009, it showed that perceptions of insecurity had remained constant and that crime statistics had declined, especially among youth. Contributing factors to an enhanced sense of security were: having a sector police chief, having a neighbourhood watch committee, and the presence of regular police patrols.

Use of the research: The UNAN-León participated actively in the Departmental Youth Support Group of León, which organized regular multi-sectoral meetings with a range of local organizations and institutions to develop joint action plans responding to youth needs and priorities. The UNAN-León research informed these activities and action plans by updating a database on local youth gang dynamics and providing diagnostic information for the development of the youth strategies. The multi-sectoral group drew on the research findings to disengage youth from gang activities by offering sports alternatives, signing social commitments, reintegrating youth into the educational system, providing jobs and scholarships, clearing rehabilitated youth's records to allow them to find employment, technical training, and educational talks.

46 Andrés Herrera Rodríguez y Braulio Espinoza Mondragón, "La seguridad ciudadana en León" in Alemán et al.

4. Sustainability

JGG evaluators, in keeping with evaluation practice in the international development context, assess the sustainability of results by examining the degree to which the cooperation initiative will generate enduring benefits after Swedish support has terminated in 2011. Sustainability is not only a matter of financial support; rather it is a multi-dimensional concept that requires a similarly multi-faceted assessment.

Key factors that affect the potential sustainability of a development initiative are:

- public policies and laws (political sustainability)
- institutional human resource capacity and management practices (institutional sustainability)
- participation and collaboration of multiple actors (social sustainability)
- increased financial resources (financial sustainability)

Each development initiative will require particular strategies to ensure that the above-mentioned factors of sustainability are met. The scientific research cooperation between Nicaragua and Sweden has aimed to strengthen policies and capacities to ensure that scientific research can positively impact Nicaragua's social and economic development.

4.1 POLITICAL SUSTAINABILITY

Long-term state policies are not common in developing countries precisely because of the development context characterized by weak governance structures and mechanisms, and this culture of short-term state policies is also the case in Nicaragua. For example, the current National Human Development Plan covers the period from 2009 to 2011 and the National Plan for ST&I, which albeit explicitly recognizes its restricted coverage, proposes activities for the period 2010 to 2013.

Nicaragua's current capacity for scientific research will be optimized when the country has a long-term vision for its development that can remain constant over time. Such a long term development "identity" will orient research and technological innovation initiatives to a greater degree. A longer-term strategic policy would also permit universities and research centres to engage in long-term cooperation agreements to cover a full cycle of research experiments.

The evaluators do recognize that the first advances toward a national ST&I policy have been made in 2010 through the National Plan for ST&I and the draft legislation on point. This new legal – policy framework will permit CONICYT to foster science and technology research in order to resolve "scientific and technological" problems[47]. The priority areas for the three year period (2010-2013) are: health, environment and natural resources, energy, agriculture and agribusiness, with biotechnology and ICT being cross cutting technologies.

4.2 INSTITUTIONAL SUSTAINABILITY

4.2.1 University Research Culture

The 2003 external evaluation noted "research at the Nicaraguan University is very susceptible to political changes"[48]. This observation continues to be relevant today. When elected university authorities change, the research development at the particular university may be affected, but the JGG evaluators suggest this risk will be reduced when a research culture has been cultivated as an integral aspect of the university's mission.

The university researchers and research centres involved in Swedish cooperation all promote scientific research through seminars, research journals and competitive funding mechanisms; however, university structures and practices may not adequately sustain scientific research in an integral institution-wide manner. The findings in section 3.2 demonstrate that formal policies and procedures are not sufficient on their own to ensure that an institutional culture that values, promotes, and sustains scientific research has taken root in a permanent manner. The commitment to the overarching purpose of scientific research for social and economic development is evident in each university. However, the methods applied to institutionalize international calibre scientific research differ among the four universities.

The following is a summary of institutionalization of the status of scientific research culture in each university (beyond specific Swedish-supported initiatives):

- UNA: There is an integrated institutional approach to the promotion and implementation of research in each faculty.

47 See Mission and Vision on website: http://www.conicyt.gob.ni/index.php?option=com_content&view=article&id=33&Itemid=29

48 Moreno and Alveteg (2003) at page 25.

Policies[49] and procedures are developed and implemented through a Research and Development Council. UNA is recognized in study cataloguing Nicaraguan research as the higher education institution that generates more knowledge through research[50]. There is significant collaboration with agricultural and livestock producer associations and public officials through research and professional services. The probability of sustained commitment to scientific research as an institutional priority is very high.

- UNI: A new integrated approach to research, academic programs, and outreach for national development is expressed in the recently approved Education Institutional Model (EIM). The Model has stimulated new methodologies that, when fully implemented, will foster a stronger and more integrated research culture than is currently evident. UNI is developing institutional relationships with industry representatives to promote technological innovations through the Innovation Incubator and the Industrial Park. There is a high probability of sustained commitment to scientific research if the new EIM is broadly accepted and implemented and relationships are consolidated and institutionalized.
- UNAN-Managua: Institutionalized commitment to research as a central aspect of the university's academic mission permits scientific research for the purpose of social and economic development to flourish despite a lack of specific policies on research. Recent changes to university authorities do not appear to have negatively affected practices that favour research. A critical mass in the Multidisciplinary Environmental Research program enables researchers to flourish in national and Central American research networks.
- UNAN-León: The research culture appeared very strong due to the highly acclaimed performance of graduates in the three research centres that have been supported by Swedish cooperation. These research centres, established to ensure retention of the first generation of graduates, promoted the Faculty of Medicine's reputation for excellence, but apparently did not shift the university's academic policies that give priority to undergraduate teaching. The change in university leadership has not reduced UNAN-León's stated commitment to promoting scientific research for development; however, the policies and procedures favourable to research, formalized in 2003 and 2004 and

49 Universidad Nacional Agraria, Sistema Universitario de Ciencia, Tecnología e Innovación de la Universidad Nacional Agraria (Managua: August, 2010); Programa de Estimulo a la Producción Intelectual en la Universidad Nacional Agraria (no date).

50 A study conducted by Albertus Magnus Institute for CONICYT and CNU.

practiced since that time, are now under review for financial and administrative reasons. Management systems and operational regulations can promote or inhibit scientific research in an institution.

4.2.2 Knowledge Capacity

In the course of this evaluation a Sida official stated that "Swedish research cooperation had to end prematurely in Nicaragua without having achieved a sustainable national system for research. Part of such a system is the capacity to reproduce scientists. This, in practice, means the existence of national doctoral training programs (thus not needing to go abroad) of international quality. Sida was only able to reach the level where MSc programs could be offered, thus not completing the whole cycle to ensure sustainability."

The evaluators did not find evidence to suggest that Swedish cooperation planned to create a sustainable national system for research. Rather, the main stated objective was to build research capacity in specific subject areas within the four public universities and support research that contributes to the resolution of problems faced by Nicaragua in its development path. While Sida has provided support to the inter-university coordination mechanism, CNU, since 1995, and more recently to a range of research-enabling initiatives, such as PERii, Innovative University, and CONICYT, the central emphasis has been on building research capacity through academic training. The evaluators did not receive a long-term strategic plan developed with Nicaraguan counterparts that identified clearly the final desired scenario or the route to achieve it. The Foreign Ministry develops country strategies over a five year period given that most cooperation initiatives are limited to that timeframe. According to a Sida official, and confirmed in SAREC documents, support to national research systems may take 30 to 40 years and therefore national counterparts are expected to develop their long term strategies. In the case of Nicaragua, this can be done at the collective level through CNU and also at each university. According to the same Sida official funding was provided from 2004 for this purpose.

Generally, the evaluators are confident that the research capacity already achieved will be sustained and transferred as a result of the Swedish cooperation. The formation of a critical mass of research activity around thematic areas in the universities will contribute to undergraduate programs, masters programs, at least two doctoral programs in development (at

UNAN-León[51] and UNAN-Managua) and future research projects. The capacity is reflected in publications, enhanced programs, and human capital at the universities.

The evaluators did note a possible risk in university partners that have doctoral graduates without peers to conduct research in their subject area. This was confirmed by the Swedish project coordinator:

"Sida's withdrawal comes at a critical and unfortunate moment. Two more years would have been very useful in creating the needed critical mass. In particular two of the four fields that have received support are not as strong as the other two. The multidisciplinary cooperation requires a certain level in all four fields, and it is highly uncertain if such a level can be sustained."

Professor Gerhard Barmen, University of Lund

The National ST&I Plan reveals that 437 publications by Nicaraguan authors were registered by the Institute for Scientific Information between 1999 and 2008. The Plan traces the source of the research and acknowledges the capacity that exists in institutes of higher learning:

The publications (from 1999-2008) came from 84 research organizations in Nicaragua: 57.7% corresponded to higher education, 25.9% to government organizations, 12.6% to NGOs, 2.1% to agencies, and only 1.8 % to the private sector. Of these 84 organizations, seven were responsible for approximately 75% of publications, including five members of the CNU universities: the UNAN-León, in the area of health, the UNAN-Managua, in the area of geosciences, the UNA in the field of agricultural sciences, the UCA, in the area of environment, and the UNI in the area of technological research. The UCA is the university with the highest coverage in the scientific production, reflecting the diversification of institutions and research units…[52]

The following table demonstrates institutional and academic achievements that will factor positively in helping to sustain the advances gained after three decades.

51 Spanish cooperation has expressed interest in supporting this PhD program. The university is also seeking funds from the EU.

52 [translated by autor] CONICYT, Plan Nacional de Ciencia, Tecnologia e Innovacion 2010-2013 (Managua: 2010) , page 45.

TABLE 11: Institutional Knowledge Capacity and Transfer

Indicators	UNI	UNAN-León	UNA	UNAN-Managua
# of courses improved	27	7 (programs)	4 Masters	1 Master
10 postgraduate courses				
# of students involved in research projects	460	150 (annual)	--	35
# of postgraduate theses supervised (related to Swedish cooperation)	23	40	52	41
# of graduates from local master's and doctoral programs	--	11	5	29
# and type of research projects outside of research supported by Sida	64	18	21	9
# of program graduates that work in other Nicaraguan universities	--	1	--	--
# of program graduates that work in the private sector in Nicaragua	4	3	1	1
# of program graduates who have left Nicaragua	1	1	1	1
Source: Internal Evaluation Reports submitted by the Universities				

Many of the graduates from the Swedish cooperation program are now in leadership positions at their universities and have been able to foster a research culture referred to in the preceding subsection. Other researchers, such as those at UNAN-León and UNAN-Managua, remain dedicated to research and lecturing within their universities. In the case of UNAN-León a culture favourable to research needs to be cultivated to ensure the retention of the human capital in the university.

4.2.3 Infrastructure

The likelihood that infrastructure installed in recent years will be sustained depends upon the ability of the university to secure additional financial support.

With regard to Information and Communication Technology (ICT):

- The current level of ICT operations is sustainable at each of the universities. Each university has a critical mass of ICT talent for sustaining the existing ICT infrastructure and operations. The technical personnel appear extremely competent for the tasks.
- It is unclear if the universities will be able to accommodate increases in ICT expenses in the future (due to increased demand, etc.). Some of the universities are receiving or seeking support from other cooperation agencies given the absence of a budget allocation from their institutional budgets. However, if the Nicaraguan economy grows as

anticipated the public universities will be the recipients of increased funding based on the 6% allocation guaranteed by the Constitution.
- Administrators at several universities commented that they now have a respectable base for soliciting funds from other sources to continue the expansion of ICT and related services.

Laboratory equipment requires ongoing maintenance and funds will be required for this purpose, according to the researchers interviewed.

Library information technology has potential for sustainability due to the broader initiative to create a national scientific information system. Nonetheless, librarians commented on the cost of the database subscriptions to which each university has a responsibility to contribute. To reduce costs the PERii project is contemplating the possibility of integrating other universities into a national library systems consortium. PERii staff recognizes that university authorities must also commit to assigning funds to library information technology from institutional budgets.

4.4 SOCIAL SUSTAINABILITY

4.4.1 National Networks

In the Lessons Learned and Conclusions section of this report collaborative relationships and participation in networks were shown to be significant in the more recent period of Swedish cooperation. The area of concern, recognized by the program researchers as well, is the lack of concrete inter-institutional research cooperation among the four public universities. While an agreement was signed in April 2008 by authorities of the four public universities, the Nicaraguan coordinators of the Swedish cooperation, and the Swedish counterparts for the purpose of forming a network and identifying joint action, limited progress has been made on the initial plan.

It is important to note that the CNU provides an important associative mechanism, especially for the promotion of national research standards and national scientific congresses. The evaluators are not aware of any joint inter-university research proposals from among the participants of the Swedish cooperation program to date.

There is evidence of national networks organized around research topics. The new inter-institutional initiative on biotechnology represents an important collective mechanism to promote academic excellence and scientific research in bio-

technology. The establishment of the Biotechnology Institute of Nicaragua will seek to maximize resources from the five universities, three public institutes, and one private enterprise who are institutional members.

Other national networks, such as the National System for Disaster Response and Prevention, incorporate the universities' academic and technological expertise with governmental and civil society actors for social purposes. The participation of researchers in these fora also leads to consultancies for technical services. UNAN-Managua and the Infectious Disease Research Centre at UNAN-León recognize these professional services having as dual functions: they generate income and they also facilitate knowledge transfer for the public good.

4.4.2 Regional and International Networking

Regional and international networks can serve the same multiple purposes as national networks, such as:

- providing joint research opportunities (national or multinational),
- building peer-to-peer relationships for knowledge exchange,
- supporting inter-university standards for research and accreditation (e.g. in CSUCA)

Some examples of networking that increases the sustainability of research capacities are:

- UNAN-León's international networks have enabled them to lead Nicaraguan research in multinational comparative research projects with organizations such as the World Health Organization.
- UNAN-Managua's Geoscience Research Centre participates in the Central American disaster prevention network as an academic advisor. This degree of specialization has led to further collaboration on seismic activity with Japanese researchers.
- UNAN-Managua's Biotechnology Laboratory submitted a proposal to CONACYT in Mexico for a joint research project with the molecular biology division of the Potosino Institute on Scientific and Technological Research in Mexico.

These regional and international networks will support knowledge development and the sustainability of research activities and should be encouraged through the universities, CONICYT, and CNU within their institutional plans.

4.5 FINANCIAL SUSTAINABILITY

The proposed law on the National System for ST&I recommends that 1% of Nicaragua's national budget be assigned to ST&I activities. The current national expenditure is .05% of the GDP.[53] Increased public funds for scientific research will provide increased sustainability to existing research initiatives in Nicaragua's public universities[54]. CONICYT will be responsible for administering a fund for ST&I when the legislation is passed and programs are implemented.

Universities have increasingly contributed financially to scientific research. For example, in 2006 Sida contributed 48%, the partner universities contributed 42%, and other donors and organizations contributed 10%.[55]

Despite increased funding from the universities to the research initiatives the evaluators recognize that the state's financial allocation to the institutional budgets is insufficient to sustain the research projects and research capacity-building. In previous evaluations, with the exception of the ICT evaluation, financial sustainability was raised as a concern. Previous evaluators observed that the issue was not addressed sufficiently. JGG evaluators confirmed that each university has been developing relations with other financial partners. For example:

- The Demographic and Health research centre at UNAN-León has been successful in securing competitive research funds in partnership with universities from the United States.
- The Infectious Disease Centre at UNAN-León has received research funding from various sources including, Merck, University of Tennessee, University of North Carolina, Glaxo Smith Kline (signed a research contract for the rotavirus vaccine) and Gorgas Institute.
- The Occupational Health Research centre at UNAN-León has received approximately $600,000 in funds distinct from Sida through agencies such as Fogarty (through the University of Texas), CUPID, and the University of Verona, Italy.
- UNI has received funds from agencies such as: NUFFIC (Holland), GVC, (Italy), Sucher & Honzer Graz, (Austria), CYTED (Spain), TWINLATIN (European Union), and AAU (Denmark).

53 Plan Nacional de Desarrollo Humano 2009-2011 at page 35.

54 Currently the university with the highest number of research centres and researchers is the Central American University. See Torres Godoy, Diagnostico de las Capacidades Cientificas y Tecnologicas de las Instituciones de Educación Superior y Técnica de Nicaragua, at page 15 and 18.

55 Information provided by each university to Sida in 2006 based on infrastructure and salary for researchers.

- UNAN-Managua has entered into agreements with governmental cooperation agencies from Switzerland and Japan as well as inter-university agreements with universities in Mexico, Spain, and Cuba for the development of a PhD program in geosciences.
- UNA has, in the past, entered into funding arrangements with national and regional research funders and the Inter American Development Bank. At present UNA has 22 research project proposals and has presented 17 to various international agencies. UNA is developing relations with universities in Austria, Finland, Spain, and the United States and at the same time a sustainability plan is under development with support from an external consultant.

CONICYT has also taken steps to secure funding for ST&I by proposing that 1% of the national budget be assigned to these activities. Furthermore, CONICYT has also secured funding from the EU 7th framework programme.

The challenge for the partner universities will be to find agencies interested in institutional capacity development rather than, or in addition to, project-specific funding arrangements. The evaluators are confident that financial sources will support the scientific research as long as university authorities, CNU, and CONICYT provide the political and administrative support needed to ensure efficient and effective implementation of bilateral and multilateral funding agreements.

5. Lessons Learned and Conclusions

5.1 SCIENTIFIC RESEARCH CAPACITY

The Swedish strategy since the 1990s has focussed on the development of research capacity in public universities through the creation of the following capacities:

- Critical mass of researchers with master's and doctoral degrees in thematic areas such as health sciences, agricultural, earth sciences, biology and engineering.
- Infrastructure and systems that support scientific research.
- Institutional policies and structures that promote a culture of research in universities.

• *Scientific research capacity, in the priority subject areas of physical and health sciences, has been strengthened significantly in the four public universities as a result of SAREC/Sida cooperation over 30 years. Nationally, the percentage of academic researchers among total number of university professors in Nicaragua remains low.*[56]

TABLE 12: Comparative Research Capacity (1977-1985 and 2007-2010)

Indicator or Characteristic	1977-1985	2007-2010
# of research centres in higher education centres	4	54 [59]
# of research centres dedicated to physical and health sciences	1	23 [60]
# of national journals	0	25 (Latindex) [61]
# of public policies related to scientific research	0	1
# of PhDs	N/A	140 (in 10 CNU affiliates) 124/140 from 4 partner universities [62]
# of researchers affiliated with centres of higher education	N/A	373 244/373 from 4 partner universities [63]
# of publications by Nicaraguan authors	N/A	294 (2004-2008) [64]

56 Edmundo Torres Godoy, Diagnostico de las Capacidades Cientificas y Tecnologicas de las Instituciones de Educacion Superior y Tecnica de Nicaragua (2009) at page 18, using data from 2007, demonstrates the percentage of researchers among teaching faculty at the 10 universities associated with CNU. Of the four public universities UNAN-Leon had the highest number of researchers (107) of the total number of professors (666) or 16.1%; followed by UNI 54/414; UNA 20/175 and UNAN Managua 63/792.

57 Torres Godoy, Table 4

58 Torres Godoy, Table 5 page 15

59 Ruth Velia Gomez, Auto Evaluación Programa Fortalecimiento de la Información para la Investigación (Managua, Diciembre, 2010).

60 Torres Godoy, Table 7 at 18.

61 Ibid

62 CNU, Estudio del Impacto de las Investigaciones del Área de las Ciencias Medicas y de la Salud de las Universidades Miembros del CNU (Managua: 2009).

- *The cumulative effect of thirty years of Swedish cooperation became visible subsequent to 2003 as the number of PhDs graduates increased and complementary institutional strengthening initiatives were implemented.*
- *The capacity development strategy was relevant and pertinent to the situation in Nicaragua; however the evaluators conclude that the institutional strengthening and research management focus was introduced later in the cooperation and may have reduced ideal "research culture" outcomes.* While academic capacity and support to infrastructure was supported from the first decade of cooperation, the institutional strengthening was implemented in a concerted fashion only in the last five years. An integral institutional focus was applied at UNA; however increased involvement of authorities (rectors, vice rectors and deans) in project design may have promoted a greater sense of ownership of the activities that promote research culture.
- *Recognition that evidence-based research is central to university education, beginning at the undergraduate level, is emerging.* The evaluators note the advances made at UNA to fully integrate scientific research in undergraduate and graduate education across all faculties. At both UNI and UNAN-León the new educational model and the strategic plan are pending full implementation. The evaluators recognize that historically universities in Nicaragua have focussed on transmitting knowledge through lectures rather than research therefore this recent recognition of the importance of research at all levels of academic study is an important side effect of the Swedish cooperation. The institutionalization of evidence-based research and critical thought is consistent with article 116 of the Constitution and could be promoted through policy directives in the country's educational system at all levels.
- *Recent initiatives related to ICTs, library information services, intellectual property, educational reform and research management have had a positive impact on the modernization of university policies, management systems and infrastructure and will contribute to the sustainability of Swedish investment in human capital.* The advances in these areas in the last periods of Swedish cooperation in Nicaragua have increased a sense of ownership and the commitment to research in the partner universities.
- *The evolution of the "sandwich model" from that of one supervisor in Sweden to combined supervision in Sweden and Nicaragua reflects an increasing capacity in Nicaragua and subsequently more efficient completion of doctoral studies programs. Likewise Sida's willingness to approve graduate studies in Latin American countries and Spain*

enhanced accessibility to graduate studies for researchers who could not identify research supervisors in Sweden. The JGG evaluators reiterate observations from previous evaluations that the sandwich model presented an obstacle for women, especially mothers of young children, in that it required residency in Sweden for intermittent but extended periods of time. Some academics interviewed noted the preference for students with families to accept international scholarships that permitted full time study and family accompaniment.

- *Knowledge dissemination through academic publications and scientific events both internationally and nationally increased in recent years as research projects supported by Sida came to fruition.*

5.2 SCIENTIFIC RESEARCH AND DEVELOPMENT

In a context characterized by dynamic political change and the absence of longer-term government plans and policies it was very difficult for SAREC/Sida to undertake long term planning based on a strategic vision of the changes expected in thirty years time. Given this situation the cooperation program responded, especially in the latter phases of cooperation, to demands identified by Nicaraguan actors.

Despite this limitation the evaluators confirmed, based on findings from the field mission, the implicit underlying assumption or premise that has guided Swedish cooperation in practice: knowledge generated from scientific research will contribute to effective social and economic development in Nicaragua. According to various actors interviewed during the field mission the achievement of this premise will be determined by the existence of three conditions:

- existence of a clear national vision for development ,
- a solid relationship between universities and public policymakers based on formal policy and institutional mechanisms to promote ST&I,
- established mechanisms for final users to access and apply scientific knowledge.

The outcomes detailed in this report suggest that these conditions were partially met in Nicaragua. The specific conclusions related to these conditions are:

- *The lack of a clear national vision has limited strategic scientific research.* Nicaragua has not defined a national vision to guide its path to development. In other words there is not a collective and inclusive definition of the Nicaragua envisioned in the future. The short term approach to public policy, the

lack of national consensus on development and the dispersion of efforts inhibits steady and directed progress in scientific research, technology, and innovation. It is important to note that the absence of this national vision is not entirely unexpected given the dramatic fluctuations in Nicaragua's political and economic situation over the last 30 years.

- *A new national ST&I policy will promote the institutionalization of mechanisms to foster scientific research.* Until now the policy vacuum in the country has restricted institutionalization of ST&I initiatives at universities and in tripartite fora.
- *University – policy maker relations, for the purpose of developing evidence-based public policy, are in development.* Inter-institutional agreements are currently being drafted. Relations between researchers and public officials are often based on mutual interest and personal relations rather than inter-institutional memoranda of understanding or a coherent, strategic system. There are some exceptions to this general conclusion :
  - Occupational health and safety policymakers refer to scientific research to substantiate public policy and standards.
  - Health officials specializing in laboratory-based research understand the connection between research, medical practice and public policy and have consolidated their cooperation with researchers at UNAN-León. The policy makers do not necessarily consider scientific data for public policy formulation.
  - Historically, agriculture has been important to the Nicaraguan economy and therefore relations between universities and public institutions have been longer standing.
- *University, government and private sector commitment to scientific research and technological innovation is emerging.* The factors linking scientific research and economic and social development are not always well understood by policymakers or business enterprises or in some cases by university authorities. They often minimize the need for a long-term commitment to scientific research, especially fundamental research. As a developing country with high indices of poverty, scientific research in Nicaragua is viewed as a short-term instrumental tool. The development context is characterized by the need for urgent solutions to national problems related to productivity and social development. The private business sector gives priority to solutions to practical problems that will lead to an increased profit margin. In the public sector knowledge is required to resolve urgent needs. New ST&I initiatives in the public sec-

tor and at universities such as UNI will foster improved understanding and commitment to research for development.

- *Knowledge dissemination to university authorities, policymakers and business representatives in accessible formats was not a specific activity considered over the course of the cooperation program.* While academic publications and seminar papers have been circulated in Nicaragua some policymakers and business representatives noted that dissemination of knowledge in clear, accessible, common language formats is important for the promotion of a research culture in the three sectors. These types of communication tools may contribute to strengthening the commitment to research and postgraduate studies in the public universities in Nicaragua by developing mutual understanding of the potential impacts of the research projects undertaken by graduate students in Sweden. Policymakers and business enterprises require a plain language description of research findings in order to assess their applicability in the Nicaraguan context.

In summary, the evaluators conclude that the three abovementioned conditions identified as necessary to ensure scientific research impacts on social and economic development, have been realized to varying degrees. Interviews confirmed the first condition, a clear national vision, is weak but the other two conditions (formal policies and institutional mechanisms to promote ST&I and national dissemination of knowledge products) are emerging.

5.3 IMPACT OF RESEARCH ON NICARAGUAN SOCIETY

- This evaluation did not have the mandate to measure actual change in quality of life and standard of living attributed to the application of scientific research projects supported by Swedish cooperation. However, the evaluators collected information that demonstrated *social impacts were achieved due to the relevancy of the scientific research projects undertaken by masters and doctoral students.*
- *The most significant social impacts relate to contributions to law and policy reform and the application of scientific research findings to improve quality of life. Specifically:*
  - *Academic and technical contributions to laws and policies in a broad range of topics have the potential for a positive impact on development in Nicaragua generally.*
  - *Research findings have been applied that improve the health of Nicaraguans through:*

- *improved diagnostic testing*
- *improved suicide prevention*
- *improved health care for women and children*
- *improved vaccinations*
- *improved water quality*
- *improved food standards and*
- *improved workplace standards for farmers, miners and other workers.*
  - *Information and communications technology knowledge has been applied to increase public access to municipal government services and access to the internet in general.*
  - *Geological technical knowledge has been applied to reduce potential loss of life and destruction that could result from construction in unsound locations.*
- *Agricultural production has improved in various crops that were the focus of masters and doctoral research.*
  - *New crop management techniques for coffee and food crops have improved production and will consequently (presumably) improve living standards.*

5.4 SUSTAINABILITY

Sustainability has been incorporated into best practices in international development programming. *While the evaluators conclude that insufficient deliberate attention has been accorded to sustainability factors over the course of the cooperation period there are indications that the scientific research capacity that has been developed over the past 30-year period can be sustained with complementary efforts of a political, institutional, social and financial nature.*

Political sustainability The broader national policy framework related to research was not a consideration of the Swedish cooperation program until 2006 when CONICYT began to receive support. Due to this support CONICYT has been able to create mechanisms to design and implement national policy on ST&I that will contribute to economic and social development in Nicaragua in the long term. In this regard Sida has responded to recommendations from previous evaluations that Sida engage in policy dialogue with diverse Nicaraguan actors to foster the research - development nexus. The JGG evaluators understand that Sida is now assessing their support to research innovation projects in order to develop a specific strategy.

- *Policy and institutional mechanisms to define and foster Nicaragua's scientific and technological capacity for innovation and development need to be strengthened in order to sustain (and promote) the scientific research community.*

Institutional Sustainability The university is the institution directly responsible for inculcating scientific research and as such the evaluators conclude that encouraging involvement of a broader range of university actors (authorities, researchers, financial administrators, deans, and trade union representatives) in earlier phases of the cooperation might have further enhanced the institutional research culture. However, the evaluators do recognize that the establishment of a culture favourable to research has historically not been viewed as the principal mandate of universities in Nicaragua and thus change in institutional culture has been gradual.

- *The most impressive result of the Swedish cooperation is the scientific community created in various thematic areas.*
- *Sustaining this human capital will depend significantly on increased institutional support through research-promoting policies, procedures and infrastructure.*

Social Sustainability Local, national, regional and international collaboration and networking has promoted sustainability in two ways: i) peer-to-peer knowledge exchange enhances research process, and ii) the collaboration and participation of potential users and beneficiaries of research projects enhances the likelihood that research findings will be duly considered and applied.

- *Increased institutional (university) support for network building will enhance academic and financial collaboration.*

Financial sustainability The evaluators believe that prospects for financial sustainability will increase with the strengthening of the three dimensions discussed above. Indeed the dimensions of sustainability are interrelated and mutually connected. For example, political sustainability should increase national opportunities and funds for scientific research. Likewise increased collaboration with a variety of actors and increased participation in thematic research networks will increase research opportunities and funding arrangements. Finally, and most importantly a university's commitment to scientific research will permit its scientists to flourish within the university environment and in the national, regional and international context. It is important to note that researchers are motivated by academic curiosity and the opportunities availed to them to contribute to Nicaragua's development, and not by financial gain. Thus, their primary mandate is not to perform consultancies for fundraising. Indeed, if researchers do not maintain their research competence they will not be successful at securing external grants.

TABLE 13: Summary of Sustainability

Dimensions of Sustainability	Indicators	Degree of Advances	Likelihood the results achieved through Swedish cooperation will be maintained
Political	Long term vision for the nation	None	Very low
	Long term ST&I policy and strategies	Legislative proposal has long-term potential; policy restricted to short term	Low
	Institutional mechanisms to promote ST&I	Fledgling mechanisms	Low-Medium
Social	National networks	Fledgling national networks	Low-Medium
	Regional and international networks	Active participation in regional and international networks	Medium-High
Institutional and Technical	Research Culture - university policies, procedures, and practices that promote research	Varies considerably among the four universities	Medium
	Human capital	Significant results and high number of pending graduates; sustainability of research activity dependent on other factors	Medium-High
	Infrastructure	Impressive results in a short period of time; dependent on financial support	Medium
Financial	National sources	Limited policy and resources for research; funds for consultancies	Low
	International sources	Swedish cooperation has enhanced international networking considerably and new alliances have been formed	Medium

6. Recommendations

Swedish Actors (Foreign Ministry and Sida)

1. Develop a multi-faceted strategy for long-term scientific research cooperation in developing countries that will support the creation of the necessary conditions for research to contribute to development. This would include simultaneous efforts to promote the research capacity of individuals, institutional research policies, national research plans, and public institutional mechanisms to foster the research – development nexus.
2. Support national policy development on ST&I and research in higher education to provide the scientific community with the necessary political context for research and innovation to flourish while simultaneously building individual research capacity within public universities.
3. Support the development of indicators and standards to measure the social impact of scientific research in the developing country. The development of national indicators (and a baseline) would facilitate measurement of the program's contribution to solutions to economic and social development problems.
4. Introduce initiatives that strengthen university institutions, (similar to those in the last phase of cooperation with Nicaragua), earlier in a bilateral research program. This will help to achieve a deeply rooted institutional research culture that will sustain research projects and capacities into the future. These initiatives should be accompanied by an explicit strategy to apply participatory methods that will facilitate dialogue and ownership of changes by a range of institutional actors at the universities.
5. Ensure that postgraduate academic training is developed within the framework of a university's strategic plan, institutional policies and procedures, and an open competitive selection process. This will ensure graduate students and graduates are fully integrated into institutional structures and may avoid the "elite" label and/or the isolation of researchers.

Nicaraguan Research Actors (Universities, CNU, CONICYT)

6. In order to sustain and improve scientific capacities achieved with Swedish cooperation, develop or strengthen research promotion policies and strategies through a participatory and institutional manner, taking into con-

sideration multiple dimensions of sustainability.

7. Encourage postgraduate studies in similar or complementary thematic areas so that research teams are formed and research projects can be sustained through a critical mass of scientific knowledge. This will sustain a scientific community for postdoctoral research.
8. Support the integration of graduates into national and international networks to sustain high caliber scientific research and knowledge sharing. In particular it is important to sustain an inter-university network for communication and collaboration among researchers from the four universities, in coordination with CNU.
9. Develop mechanisms to promote the dissemination of scientific knowledge in both academic and plain language media in Nicaragua. This will enable research findings to be understood by university authorities, public officials, and civil society for the eventual application of research findings.
10. Strengthen collaboration among the private sector, public institutions, and civil society organizations to improve understanding of the nexus between scientific research and development by:
    I. collaborating with the social science academic community to promote public debate on a long-term vision for Nicaragua's integral development.
    II. developing and implementing mechanisms that promote research collaboration between universities and the external actors mentioned.
    III. continuing to develop technological innovation efforts at UNI (Technology Park, Innovation Incubator) and existing public-private-civil society collaborative projects initiated at UNA, UNAN-Leóon and UNAN-Managua.
11. Strengthen the research culture at universities by:
    I. integrating evidence-based research and scientific research methods in undergraduate programs in all faculties, if this reform has not been undertaken.
    II. increasing financial support to research infrastructure by considering public-private partnerships.
    III. ensuring balanced teaching/research workloads for postgraduate lecturers.
    IV. promoting efficient and effective administrative procedures to facilitate the timely execution of research activities.
12. Increase active inter-university cooperation on research projects, research infrastructure and knowledge exchange in order to avoid duplication of efforts and optimize human and financial resources.

Annex A: Terms of Reference

30 Years of Research Cooperation between Sweden and Nicaragua

1. BACKGROUND

Since the 1980s Swedish research cooperation with Nicaragua has developed from small relatively isolated projects into a program for building national research capacity with the general objectives to:

1. Empower national knowledge systems and create analytical capacity useful to analyse structures of poverty as well as providing a resource base for the development and implementation of development strategies.
2. Generate scientific knowledge of international quality that may contribute to the global production of knowledge as well as providing direct solutions to national necessities and priorities in reducing poverty and improving life conditions.

However, in 2007, the Swedish government's efforts to make Swedish development assistance more effective by reducing the number of cooperating countries resulted in the decision to phase out the cooperation with Nicaragua. The strategy for the exit of the Swedish cooperation was set to cover a period of 3 years.

The long term cooperation while initially slow has proved to be a fruitful venture[63], and considering that Sida is the single long-term donor in research cooperation, consolidation of the achieved results has been key during the phase out period.

The final cooperation period coincides with 30 years of research cooperation between Sweden and Nicaragua. Sida and Nicaraguan counterparts find it important to document the results and experiences of this long-standing cooperation, which is unique in its kind.

63 Alveteg, Thomas (2006) Evaluation of the Sida/SAREC Bilateral Research Cooperation Programme – Country Report Nicaragua.

2. OBJECTIVES

- To document an historical overview over of the Swedish Nicaraguan research cooperation including the development and changes of the methodology applied over the years.
- To document the outcomes in terms of research capacities and logical linkages between these outcomes and broader impacts in society.
- To provide information on efforts made by the stakeholders to ensure sustainability and comment on its relative success/failure.
- To provide specific recommendations to Nicaraguan stakeholder (researchers, university authorities, GoN etc) on they can support and continue to develop research capacity and research results that contributes to reduce poverty and improve living conditions for the most vulnerable part of the Nicaraguan population.

3. SCOPE OF THE EVALUATION

3.1 Historical background

The evaluation will cover the research cooperation period 1981 to 2011 between Sweden and Nicaragua. It will provide a historical background including different cooperating organisations and the methodological development of the cooperation itself. The latter will take into account policy changes as well as funding modalities and volumes provided by Sweden in relation to other sources for research funding . It will comment on challenges, strengths and weaknesses internal to the institutions themselves as well as external conditions contributing to failure or success.

3.2 Results focus

The evaluation will focus on the capacity building aspects of the six institutions involved in research cooperation (Universidad Nacional de Nicaragua-Managua (UNAN-Managua, Universidad Nacional de Nicaragua-León (UNAN-León, Universidad Nacional de Ingeniería (UNI), Universidad Nacional Agrícola (UNA, Consejo Nacional de Universidades (CNU) and Consejo Nacional de Ciencia y Tecnología (CONICYT) and their results (output, outcome and impact) in:

- academia institutional capacity – results in the development of institutional capacity -academic and administrative reform, research supporting infrastructure, research management, international research collaboration, efficiency, transparency, quality.

- the production of scientific results, its quality and relevance.
- the impact of building institutional research capacity in Nicaraguan society. Direct and indirect impact: of research results, of research and analytical capacity on policy and of collaboration with public institutions, private sector and civil society organisations

3.3 Sustainability

The evaluation will review efforts made to ensure sustainability both concerning human as well as financial resources. The programme, by its nature, has a sustainability aspect as it aims at developing sustainable research systems. Although financial sustainability and diversity always is on the agenda for dialogue with counterparts, the programme itself does not contain such an element. It rather aims to enable the human capacity at institutions to address issues of financial sustainability. Discussion with researchers and university authorities should include view and effort to reach self-sustainability, and reproduction and retention of human resources.

3.4 The way forward

The evaluation will include a discussion of the way forward and actionable proposals that has been developed together with counterparts.

3.5 Lessons learned and general conclusions

The evaluation will point out lessons learned that could be useful to Nicaraguan researchers and universities as well as to Sida and future research cooperation. Additionally, it will pay special attention to the lessons learnt concerning the phase out period. Has it been done in a responsible manner that promotes sustainability and continuity of the results obtained? What are the positive/negative consequences of the phasing out of the cooperation? These lessons learned should be discussed with counterparts as well as Sida staff and their view should be reflected in the document.

4. METHODOLOGY

The evaluation will follow the OECD-DAC Evaluation Quality Standards and will also be assessed according to these. The consultants shall:

- Use documentation about the support to research capacity building in Nicaragua available at Sida and the Nicaraguan universities (memos, applications, progress and audit reports, activity plans, evaluations, self-assessments and oth-

er local documents at the universities related to subject matter of this evaluation).

- Interview key persons and groups of informants at all institutions that are involved in/benefiting from research and research related activities supported by Sida. Also, interviews of groups of persons and institutions outside academia that have collaborated with researchers and/or have benefitted from research results can be interviewed.
- Use methods and techniques to collect data and information needed that are relevant to the purposes of this evaluation.
- Cross-validate and critically assesses the information sources used and the validity of the data using a variety of methods and sources of information.
- Ensure that stakeholders are given the opportunity to comment on findings, conclusions, recommendations and lessons learned.

5. EVALUATION ETHICS

The evaluation must be conducted in a professional and ethical manner. The evaluation process shows sensitivity to gender, beliefs, manners and customs of all stakeholders and is undertaken with integrity and honesty. The rights and welfare of participants in the evaluation are protected. Anonymity and confidentiality of individual informants should be protected when requested and/or as required by law.

6. QUALITY CONTROL

Quality control is exercised throughout the evaluation process. Depending on the evaluation's scope and complexity, quality control is carried out either internally or through an external body, peer review, or reference group. Quality controls adhere to the principle of independence of the evaluator.

7. RELEVANCE OF THE EVALUATION RESULTS

7.1 Formulation of evaluation findings

The evaluation findings must be relevant to the object being evaluated and the purpose of the evaluation. The results should follow clearly from the evaluation questions and analysis of data, showing a clear line of evidence to support the conclusions. Any discrepancies between the planned and actual implementation of the object being evaluated are explained.

7.2 Recommendations and lessons learned

Recommendations and lessons learned should be relevant, targeted to the intended users and actionable within the responsibilities of the users. In this case the users are Sida – especially with reference to responsible phase out of the cooperation, Research groups – with reference to how they can continue to carry out research, universities- how they can support research internally. The Government of Nicaragua – how a government can assume ownership support the creation of a national research system. Recommendations are lessons learned and generalizations of conclusions applicable for wider use.

8. EVALUATION TEAM

8.1 Composition

The composition of evaluation teams should include a mix of evaluative skills and thematic knowledge, be gender balanced, and, if possible, include professionals from the countries or region concerned. The consultant(s) shall have:

- solid teaching and research experience
- experience in assessing research capacity building
- broad knowledge of higher education and research management
- experience and organization development
- knowledge and experience of Result Based Management
- experience from international cooperation
- knowledge of universities in low income countries
- knowledge of Sida and its policies, strategies and methods for capacity
  building within research and post graduate education
- knowledge of Nicaragua, and the Central American region
- fluency in English and Spanish

8.2 Independence of the evaluation team

The evaluation team is able to work freely and without interference. It is assured of cooperation and access to all relevant information.

9. TIMEFRAME AND BUDGET

The assignment will be initiated 1 July, 2010 and completed no later than 15 December 2010. Before the assignment starts, a meeting with Sida will take place to further discuss in further detail the objects and methods for the evaluation. If the meeting with Sida cannot take place and inception note should be submitted do Sida where these issues will be ad-

dressed. The evaluation is conducted and results are made available in a timely manner in relation to the purpose of the evaluation. Un-envisaged changes to timeframe and budget must be explained in the report. Any discrepancies between the planned and actual implementation and products of the evaluation must be explained. The budget cannot exceed 600 000 SEK.

10. REPORTING

When the mission has been concluded, the major findings, conclusions and recommendations shall be compiled in a report in line with the scope of this evaluation. First, the consultants shall prepare a draft report in English, following the form for Sida evaluation reports, to be submitted electronically to Sida for comments no later than 15 November 2010. The major findings and conclusions from the draft report shall be presented and discussed in a seminar at Sida in Stockholm.

Three weeks after receiving comments on the draft report a final version shall be submitted to Sida (electronically and in two paper copies). The report shall be written in English in Word for Windows and should be presented in a way that enables publication without further editing. The report shall contain an executive summary and it should not exceed 50 pp (annexes excluded).

10.1 Analysis and content

The evaluation report answers all the questions and information needs detailed in the scope of the evaluation. Where this is not possible, reason and explanations are provided.

The analysis is structured with a logical flow. Data and information are presented, analysed and interpreted systematically. Findings and conclusions are clearly identified and flow logically from the analysis of the data and information. Underlying assumptions are made explicit and taken into account.

The evaluation report must distinguish clearly between findings, conclusions andrecommendations. The evaluation presents conclusions, recommendations and lessons learned separately and with a clear logical distinction between them. Conclusions are substantiated by findings and analysis. Recommendations and lessons learned follow logically from the conclusions.

The evaluation report contains an executive summary. The summary provides an overview of the report, highlighting the main conclusions, recommendations and lessons learned.

10.1 Explanation of the methodology used

The evaluation report describes and explains the evaluation method and process and discusses validity and reliability. It acknowledges any constraints encountered and their impact on the evaluation, including their impact on the independence of the evaluation. It details the methods and techniques used for data and information collection and processing. The choices are justified and limitations and shortcomings are explained.

10.2 Relevant stakeholders consulted

The evaluation report indicates the stakeholders consulted the criteria for their selection and describes stakeholders' participation. If less than the full range of stakeholders was consulted, the methods and reasons for selection of particular stakeholders are described.

10.3 Incorporation of stakeholders' comments

Stakeholders must be able to make comments before a final report is written. The evaluation report reflects these comments and acknowledges any substantive disagreements. In disputes about facts that can be verified, the evaluators should investigate and change the draft where necessary. In the case of opinion or interpretation, stakeholders' comments should be reproduced verbatim, such as in an annex, to the extent that this does not conflict with the rights and welfare of participants.

10.4 Transparency of information sources

The evaluation report describes the sources of information used (documentation, respondents, literature etc.) in sufficient detail, so that the adequacy of the information can be assessed. Complete lists of interviewees and documents consulted are included, to the extent that this does not conflict with the privacy and confidentiality of participants.

10.5 Independence of evaluators

The evaluation report should indicate the degree of independence of the evaluators from the policy, operations and management function of the commissioning agent, implementers and beneficiaries. Possible conflicts of interest are addressed openly and honestly. The evaluation report should indicate any obstruction, which may have impacted on the process of evaluation.

Annex B: Documents Reviewed

Project Assessment Memoranda prepared by Sida (Chronological)

1. Assessment Memo Sarec with approval, 1981-01-08, program officer - Enrique Ganuza, decision maker - Lars Anell,
2. Agreements between Sarec and Counterparts in Sweden, 1981-01-09
3. Agreements between Sarec and Counterparts in Sweden, 1982-06-22
4. Assessment Memo Sarec with approval, 1982-05-17, program officer - Enrique Ganuza,
5. Project proposal on Research on Basic Sead – Bean Program with approval, 1983-03-20, Managua Nicaragua
6. Assessment Memo Sarec, 1983-05-17, program officer - Enrique Ganuza,
7. Approval of Assessment Memo incl agreements with counterparts, 1983-06-09, program officer - Enrique Ganuza, decision maker – Per Arne Ströberg,
8. Project progress reports, Research Program cooperation between Nicaragua and Sweden, Attachment 4 - Point 3, Board Sida 1984:2
9. Assessment Memo Sarec with approval, 1984-06-20, program officer - Enrique Ganuza, decision maker – Bo Bengtsson,
10. Assessment Memo Sarec with approval of support to Geoscience, 1985-06-04, program officer - Enrique Ganuza, decision maker – Lennart Båge,
11. Assessment Memo Sarec with approval, 1985-11-07, program officer - Enrique Ganuza, decision maker – Lena Hjelm-Wallen.
12. Assessment Memo Sarec with Governmental approval, 1987-07-09, program officer - Enrique Ganuza, decision maker – Lennart Båge,
13. Assessment Memo Sarec with approval, 1989-07-07, program officer – Rolf Ericsson, decision maker – Rolf Carlsman,
14. Assessment Memo Sarec with approval, 1981-01-08, program officer - Enrique Ganuza, decision maker - Lars Anell,
15. Project Descriptions, 1991-08-02, Program Officers – G Bruhn / E Ganuza, point 2 – attachment 1, Board 1991:4

16. Assessment Memo Sarec with approval, 1991-08-02, program officer – Rolf Ericsson,
17. Financial Statement of research cooperation with Nicaragua, 1991/92 – 1992/93
18. Assessment Memo Sarec with approval, 1992-12-14, program officer – Göran Bruhn, decision maker – Anders Wijkman,
19. Approval of continued support to research cooperation with Nicaragua 1993/94, 1993-10-01, program officer – Ann Stödberg, decision maker – Anders Wijkman,
20. New Orientation on Research Cooperation in Nicaragua 1994/95-1995/96, 1994-09-23, program officer – Rolf Ericsson, decision maker – Anders Wijkman,
21. Continued Support to Research Cooperation in Nicaragua, 1994/95-1997, 1994-12-15, program officer – Rolf Ericsson, decision maker – Karin Ringberg,
22. Continued Research Cooperation in Nicaragua 1997-1998, 1996-10-22, program officer – M Lindroos,
23. Continued Bilateral Support to Research Cooperation in Nicaragua 1998-2000, 1997-03-01, program officer M Lindroos.
24. Bilateral Research Cooperation with Nicaragua 1998-2000: A summary of project abstracts, Sida
25. Continued Bilateral Support to Research Cooperation in Nicaragua 2001-2003 - Assessment Memo Sida, 2000-10-20, program officer Cecilia Sharp.
26. Project Assessment with Budgets 2001-2003, program/research officer Cecilia Sharp.
27. Development of ICT at Four Public Universities in Nicaragua – Assessment Memo Sida, 2003-02-19, program officer Tomas Kjellqvis.
28. Continued Research Cooperation with Nicaragua 2004-2008, 2004-06-11, program officers Håkan Berg & Tomas Kjellqvist.
29. Support to Consejo Nicaragüense de Ciencia, Tecnología e Innovación (CONICYT) in Nicaragua, 2006-03-16, program officer Inger Lundgren.
30. Draft Proposal: The Entrepreneurial University Program in Nicaragua CNU and Chalmers University of Technology, 2006-08-31.
31. Support for Development of Innovation Systems and Innovative Clusters in Low Income Countries, 2006-12-05, program officers Maijia Lindroos and Tomas Kjellqvis.
32. No specific title. Sida Assessment Memo for CNU PERI library proposal, 2008-01-24, program officer Inger Lundgren.

33. CNU Library Development Proposal prepared by International Network for the Availability of Scientific Publications, to accompany Sida proposal, 2008-02-12.
34. Research Cooperation with Nicaragua 2008-2011, decision date 2008-05-27, program officer Inger Lundgren.

Evaluations and Reflections (Chronological)

35. Carlos M. Vilas, Scientific research in a Revolutionary Setting: the Case of Nicaragua, SAREC Documentation (Stockholm: 1987).
36. Enrique Ganuza, Research Cooperation between Sweden and Nicaragua, SAREC Documentation (Stockholm: 1987).
37. José Joaquín Brunner and Krister Edwards, Nicaragua: Higher Education and Research, SAREC Documentation (Stockholm: 1994).
38. Yolanda Rojas and Jorgen Dahlgren, Selected Aspects on the University System of Nicaragua, Department for Research Cooperation, Sida (Stockholm: 1998).
39. Edgardo Moreno and Thomas Alveteg, Collaboration between Sweden and the Public Universities of Nicaragua, Department for Research Cooperation, Sida (Stockholm: 2003).
40. Ad Boeren et al., Sida/SAREC Bilateral Research Cooperation: Lessons Learned Department for Evaluation and Internal Audit, Sida (Stockholm: 2006).
41. Greenberg ICT Services, Evaluation of ICT Projects at Four Public Universities in Nicaragua, Sida (Stockholm: 2007).
42. Nils Öström and Elisabeth Lewin, 30 anos de cooperación de Suecia con Nicaragua, Asdi (Stockholm, Diciembre 2009).
43. Nils Öström and Elisabeth Lewin, Sistematización de la cooperación de Suecia con Nicaragua periodo 2001-2008, Asdi (Stockholm: Diciembre 2009).
44. Nils Öström and Elisabeth Lewin, Outcome Assessment of Swedish Cooperation with Nicaragua 2001-2008, Sida (Stockholm: 2010).

Sida Policies and Strategies (Chronological)

45. The Ownership and Cultivation of Knowledge: The rationale for Swedish support to universities in developing countries, Department for Research Cooperation, SAREC, Sida (Stockholm: 1992).
46. Sida Evaluation Policy, (Stockholm: 1999).

47. Research Cooperation: An Outline of Policy, Programmes and Practice, Department for Research Cooperation, SAREC, Sida (Stockholm: 2001).
48. Support to national Research Development, Department for Research Cooperation, SAREC, Sida (Stockholm: 2008 edition, original 1998).
49. Berit Olsson. The birth of Scientific Research at UEM History of Mozambican -Swedish research Cooperation 1978-2008. Sida (Maputo, Mozambique: 2008).
50. Phase-out strategy for Swedish support to Nicaragua June 2008 – December 2011. Ministry for Foreign Affairs, Sweden (Stockholm: 2008).
51. Strategy for Sida's support for development research cooperation 2010-2014 (2009).

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52. Network For The Strengthening Of Research Capacities At Nicaraguan Universities: Phase 1 (2008 – 2011) (Managua, Nicaragua: 2008).
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54. Leonel Plazaola. Resumen reunión de Sistema de Información de Investigaciones (Sistema de Registro de Investigaciones), email communication (Managua, Nicaragua: 2009).
55. Martha María Aburto Ramírez. Library Study on the use of Databases in line with the PERii Program and evaluation of the impact of PERI in the first phase of subscription of Electronic Resources, Program PERii – Nicaragua (Managua, Nicaragua: 2010).
56. Agenda of the 3rd workshop of the Public Universities Nicaragua-Sweden/Asdi (Managua, Nicaragua: 2010).
57. Annual Meeting of Nicaraguan and Swedish Coordinators from Asdi – supported research cooperation programmes (Managua, Nicaragua: 2010)

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58. Políticas de Tecnologías de Información y Comunicación, UNAN – Managua (Managua, Nicaragua: 2001).
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of Nicaragua, Managua (UNAN-Managua), National Autonomous University of Nicaragua, León (UNAN-León)and National Agrarian University (UNA) (Nicaragua, 2002).
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65. Documento Preliminar De Autoevaluación: Cooperación Unan Managua/Asdi. UNAN – Managua (Managua, Nicaragua: 2010).
66. No title. Autoevaluación UNAN-Managua/Sida Evaluation Document. UNAN – Managua (Managua, Nicaragua: 2010).
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68. Universidad Nacional Autónoma de Nicaragua: Proyecto de Tecnologías de la Información y Comunicación, UNAN – Managua (Managua, Nicaragua: 2010).

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71. Reglamento de Estudios de Postgrado, UNAN – León (León, Nicaragua: 2004).
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77. No title. Autoevaluación TIC, UNAN – León (León, Nicaragua: 2010).
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81. Proyectos realizados por el Centro de Investigación en Demografía y Salud CIDS-UNAN-León, CIDS, UNAN – León (León, Nicaragua: 2010).
82. Cursos realizados por Personal del Centro de Investigación en Demografía y Salud CIDS-UNAN-León, CIDS, UNAN – León (León, Nicaragua: 2010).
83. Tesis de Doctorado realizadas por Personal del Centro de Investigación en Demografía y Salud CIDS-UNAN-León, CIDS, UNAN – León (León, Nicaragua: 2010).

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91. Resultados Académicos (1986-2009), Universidad Nacional Agraria (UNA) (Managua, Nicaragua: 2009).
92. Freddy Aleman, Edgardo Jmenez, Ricardo Araica, Victor Aguilar and Juana Lopez, Resultados Académicos (1986-2009) – Camino Real 26 Noviembre 2009, Universidad Nacional Agraria (UNA) (Managua, Nicaragua: 2009).
93. VI Reunión Científica de Docentes Investigadores 12 y 13 de agosto, 2009, UNA (Managua, Nicaragua: 2009).
94. VII Reunión Científica de Docentes-Investigadores 2 y 3 Septiembre, 2010, UNA (Managua, Nicaragua: 2010).
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Annex C: Interview Schedule

Name	Position	Agency
Nicaraguan Counterparts		
Leonel Plazaola	Coordinador de Grupo II y Vicerrector de Investigacion UNI	UNI/ASDI/ Facultad de electronica y computacion.
Rafael Gamero	Coordinador del grupo I	UNI/ASDI/ Facultad de Ingenieria Quimica
Marvin Arias	Miembro del Grupo II y Coordinador de la Maestria en Administracion Tecnologias de la Informacion y Comunicación	UNI/ASDI/ Facultad de electronica y computacion.
Oscar Somarriba	Miembro del Grupo II e Investigador Seniors	
Norman Vargas	Miembro del Grupo II e Investigador 2da. Generacion	
Pablo Vasquez	Miembro del Grupo II e Investigador 3era. Generacion	UNI/ASDI/ Facultad de Ingenieria Quimica
Indiana Garcia	Miembro del Grupo 1	
Ana Ulmos	Vicerrectora Académica	UNI
Benjamin Rosales	Director de Investigación	UNI
Martha Elena Perez	Directora de Biblioteca	UNI
Wilmer Davila	Biblioteca	
Tinoco	Informatica y Tecnologia de la Informacion	UNI
Carlos	Informatica y Tecnologia de la Informacion	UNI
Asdrubal	Informatica y Tecnologia de la Informacion	UNI
Walter	Informatica y Tecnologia de la Informacion	UNI
Luis	Informatica y Tecnologia de la Informacion	UNI
Telemaco Talavera	Presidente	CNU (Consejo Nacional de Universidades)
Ing. Arturo Collado	Secretario Tecnico CNU Coordinador	CNU
Santos Solorzano	Apoyo de coordinacion	CNU
Jose Antonio Saldaña	Proyecto de Evaluacion y Acreditacion	CNU y UNAN-Leon
Gustavo Sequeira	Desarrollo de la Investigacion y Post Grado	CNU y UNAN-Managua
Ruth Celia Gomez	Fortalecimiento de la informacion para la Investigacion	PERii

Name	Position	Agency
Freddy Aleman	Universidades Innovadoras y Doctorado	UNA
Santos Solorzano	Apoyo de coordinacion	CNU (Consejo Nacional de Universidades
Guadalupe Martinez Valdivia	Coordinadora y Secretaria ejecutiva	CONICYT (Consejo Nicaragüense de Ciencia y Tecnología)
Abel Reyes Barreda	Director de Cie ncia y Educación	CONICYT (Consejo Nicaragüense de Ciencia y Tecnología)
Edgardo Jimenez	Coordinador de la cooperacion sueca.	UNA (Universidad Nacional Agraria)
Victor Aguilar	Vicerrector	UNA
Freddy Aleman	Director de Investigacion	UNA
Roberto Blandino	Director de la OTIC	UNA
Alberto Sediles	Estudiante de PHD	UNA
Matilde Somarriba	Vice decana de Farena y ex - estudiantes de PHD	UNA
Francisco Salmerón	Vice rector	UNA
Benigno Gonzales	Doctorado	UNA
Oscar Gomez	Doctorado	UNA
Silvia Quevedo Ponce	Oficial de Programa	Asdi
Karin Oskarsson	Oficial de Programa	Asdi
Dionisio Rodriguez	Coordinador de la Cooperacion sueca y Director de Cigeo	Cigeo (Centro de Investigaciones Geocientíficas) UNAN-Managua
Gustavo Sequeira	Director de Investigación (Fondos Abiertos)	UNAN-Managua
Cesar Rodriguez	Coordinador de Tecnologia de la informacion y comunicación	UNAN - Managua
Martha Lacayo	Directora de Laboratorio Biotecnologia	PMIA, UNAN-Managua
Elmer Cisnero	Rector	UNAN- Managua
Jaime Lopez	Secretary General, Ex Rector Administrativo	UNAN- Managua
Brenda Leyton	Ex – Becario	Cigeo
Lener Sequeira	Ex – Becario	Cigeo
Katia Montenegro	Ex – Becario	PMIA
Luis Moreno	Ex – Becario	PMIA
Francisco Picado	Ex – Becario	PMIA
Martha Lacayo	Ex – Becario	PMIA
Martin Pomares	Ex – Becario	PMIA
Marvin Corriols	Ex – Becario	PMIA
Carlos Rubi	Ex – Becario	PMIA
Francisco Espinoza	Becario	PMIA
Gema Velasquez	Becario	PMIA
Horacio Ulloa	Ex – Becario	PMIA

Name	Position	Agency
Trinidad Caldera	Coordinador de Proyecto	UNAN-Leon icaragüen y Salud
Rodolfo Peña	Graduado – icaragüen y Salud	UNAN – Leon
Eliette Valladares	Graduado- icaragüen y Salud	UNAN – Leon
Andres Herrera	Graduado – icaragüen y Salud	UNAN – Leon
Francisco Tercero	Graduado – icaragüen y Salud	UNAN – Leon
Salmuel Vilchez	Graduado – Enfermedades Infecciosas	UNAN – Leon
Mercedes Caceres	Graduado – Enfermedades Infecciosas	UNAN – Leon
Felix Espinoza	Graduado – Enfermedades Infecciosas	UNAN – Leon
Aleyda Tellez	Graduado – Enfermedades Infecciosas	UNAN – Leon
Byron Leiva	Graduado – Enfermedades Infecciosas	UNAN – Leon
Filemon Bucardo	Graduados – Enfermedades Infecciosas	UNAN – Leon
Octavio Guevara	Vicerrector General de Unan – Leon	UNAN – Leon
Flor Valle	Vicerrectora de Investigacion	UNAN – Leon
Felix Espinoza	Coordinador de Investigacion	UNAN – Leon
Benito Morales	Coordinador de Proyecto	icaragüens de la informacion y comunicación UNAN – Leon
Adela Morales	Directora del SIBUL	SIBUL (Sistema de Bibliotecas de la UNAN – Leon)
Luis Blanco	Director	Graduado del programa y Director de CISTA (Centro de Investigacion en Salud, Trabajo y Ambiente)
Marianela Corriorls	Salud Ocupacional	CISTA (Centro de Investigacion en salud, trabajo y Ambiente)
Arlen Soto	Estudiante	Salud Ocupacional
Edmundo Torres	Coordinador del programa, Unidad de icaragüense, icaragüen y trabajo	CISTA (Centro de Investigacion en salud, trabajo y Ambiente)
Leonardo Mendoza	Ex – Vicerrector de Investigacion	UNAN – Leon
Armando Matute	Decano	Facultad de Ciencias Medicas
Orlando Mayorga	Vice – Decano	Facultad de Ciencias Medicas
External Actors		
Néstor Martínez	Vicepresidente	AIN (Asociación Internet de Nicaragua)
Marvin Sanchez	Consultor – graduado UNI	Enitel
Enrique Silva	Consultor – graduado UNI	icaragüens de la Informacion y Comunicación Consultores (TICconsultores)
Allan Fonseca	Director de Proyectos	IDR (Instituto de Desarrollo Rural)
Ana Izaguirre	Directora de Riesgos	SINAPRED (Sistema Nacional Atencion y Prevencion de Desastres)
Yves Chaix	Consultor Independiente especializado en gobierno electronico SOA	

Name	Position	Agency
Ernesto Medina	Rector	UAM (Ex – vicerrector de la UNAN – Leon, 1994 – 2006)
Rafael Marinero	Director Regional	Proyecto Cultivar, ex funcionario Ministerio de Trabajo
	Ex – Director General de Higiene y Epidemiologia y Especialista en Salud	MINSA
Fanor Avendaño	Rector	UNEH(Universidad icaragüense de Estudios Humanisticos)
Jaime Bengoechea	Vice – Presidente	CADIN y Laboratorios Bengoechea
Roger Berrios	Director	Departamento de Estudios Economicos MIFIC (Ministerio de Fomento, Industri y Comercio
Jaime Incer Barquero	Ex – ministro (representante sociedad civil en CONICYT)	MARENA (Ministerio del Ambiente y los Recursos Naturales)
Roberto Araquistain	Vice Ministro de Medio Ambiente y Recursos Naturales	MARENA
Alcides Gonzales	Director	Centro Nacional de Diagnosticos y Referencias del MINSA (Ministerio de la Salud)
Sr. Arkangel Abaunza	Director de Políticas de Tecnología	MAGFOR
Sra. Eva Acevedo Gutiérrez		INTA
Sida and Swedish Counterparts		
Inger Lundgren	Research Advisor	Sida
Berit Olsson	Former director of SAREC	
Ingvar Lundberg	Project Coordinator	Uppsala University
Sari Scheinberg	Project Coordinator	Chalmers University
Gerhard Barmen	Project Coordinator	University of Lund
Joaquin Martinez	Project Coordinator	KTH
Lars Ohlander	Former Project Coordinator	SLU
Magnus Halling	Project Coordinator	SLU

Annex D: Interview Guides

SWEDISH ACTORS

Past and Present Sida Officials

1. What time period did you work on research cooperation with Nicaragua?
2. How did you assess the research capacity and needs of Nicaraguan partners during your work on the Nicaragua program?
3. What were the specific objectives of research cooperation during the period you worked on the program?
4. From your perspective were the objectives met?
5. Did SAREC/Sida design programs jointly or respond to proposals received from Nicaraguan partners?
6. How has Sida supported the development of national research policies in Nicaragua?
7. Please describe outcome level results with Nicaraguan partners during the period you worked on the program (expected and unexpected results).
8. What conditions or factors facilitated or enabled the successful achievement of results?
9. How sustainable are the results achieved?
10. What obstacles were encountered and how were they overcome?
11. How did you coordinate with scientific research projects supported by other donors? (identify donors).
12. Could the same or better results have been achieved through alternative modalities of cooperation?
13. How did Sida plan for the exit strategy with the research partners in Sweden and Nicaragua?

University Representatives

1. When and how did your university become involved in Swedish research cooperation with Nicaraguan researchers/universities?
2. What expertise did your university bring to Nicaraguan research partners?
3. What were the objectives of the university's participation in Sida supported projects?
4. How were roles and responsibilities for your work with Nicaraguan partners defined?

5. What results were achieved in terms of research capacity of institutions and individual researchers?
6. What is your assessment of the quality of research papers produced?
7. How was gender analysis integrated into academic research?
8. What were the advantages and disadvantages to the sandwich model?
9. To what degree will the research capacity be sustained in Nicaragua when the Sida cooperation ends?
10. Will your university maintain relations with the Nicaraguan partner institution? And if so, how and with regard to which research areas?

Nicaraguan Actors

GRUPO 1: Actores relacionados al entorno social y político (Autoridades estatales, sociedad civil, sector empresarial, agencias de cooperación)

1. ¿Cuáles son los principales obstáculos que se perciben para el desarrollo de la investigación científica en el país?
2. ¿Los actores estratégicos del país perciben las conexiones entre investigación científica e innovación tecnológica y los factores clave para el desarrollo productivo, democrático y social del país?
3. ¿Cuáles son las principales necesidades del sector empresarial en materia de investigación científica e innovación tecnológica?
4. ¿Cuáles son las principales prioridades de investigación y generación de conocimientos en distintos ámbitos del desarrollo del país?
5. ¿Quiénes son las principales fuentes o generadores de investigación científica e innovación tecnológica en el país?
6. ¿Cuál es la valoración global de la contribución de Asdi a la investigación científica e innovación tecnológica en Nicaragua?
7. ¿Cuáles son los principales cambios o avances en la investigación científica generados por el programa Asdi?
8. ¿Cuáles son las principales debilidades o vacíos del programa de cooperación?

GRUPO 2: Instancias de coordinación gubernamental: CNU, CONICYT y Ministerio de Educación

1. ¿Ahora hay una política de Estado o lineamientos generales que promueven la investigación académica y científica?
2. ¿Cuál es el lugar que ocupa la investigación científica en el actual Plan de Desarrollo del Gobierno?

3. ¿Cuáles son las leyes o normas que regulan la investigación científica?
4. ¿Cómo aporta su institución a la coordinación y promoción de investigación científica?
5. ¿Cómo Ud defina la investigación científica?
6. ¿Como funcionan las modalidades de monitoreo y seguimiento de los programas de investigación en las Universidades Públicas?
7. ¿Que metodología proponen, para el proceso de auto evaluación interna, evaluación externa interpares y acreditación que permitan un nuevo posicionamiento institucional de las Universidades Públicas en el contexto nacional e internacional?
8. ¿Se prioriza y se fomenta el debate respecto a los problemas que pone a las universidades y a las postgrados ante nuevas exigencias? [Temas como: Incremento de la desigualdad y exclusiones; disminución de la biodiversidad y el deterioro medio ambiental, y el paulatino agotamiento de los recursos naturales no renovables?]
9. ¿Siendo el problema de financiamiento importante para la sostenibilidad de los programas de investigación, que políticas y estrategias consideran pertinente para incrementar los fondos de financiamiento?

GRUPO 3: Autoridades (Rectores y Vice Rectores) de las Universidades

1. ¿Cuáles son los principales problemas estructurales para el desarrollo de la investigación científica en el país?
2. ¿Cuáles son los principales desafíos de la investigación científica en los próximos años en el país?
3. ¿Cómo ha cambiado el desarrollo de la investigación científica en su universidad en los últimos 10 años?
4. ¿Cuáles son los principales aportes de la cooperación sueca a la investigación en la universidad?
5. ¿Cual es la estrategia que implementa para la investigación científica a nivel de post grado para asegura concordancia con la realidad nacional?
6. ¿Qué tan lejos está la universidad de satisfacer los estándares internacionales de una universidad de enseñanza e investigación?
7. ¿Cuales son las ventajas o las desventajas de los programas de postgrado, sean maestrías y doctorados, que asuman el carácter de multidisciplinarios?
8. ¿Coordinan y articulan los postgrados entre las diferentes universidades, Como?
9. ¿Cual es la participación real de los post grados en el Consejo Nacional de Universidades?
10. ¿Cuáles son los principales desafíos para la continuidad y

sostenibilidad de los programas de investigación científica en la universidad?
11. ¿Qué medidas ha tomado la universidad para la continuidad y sostenibilidad de los resultados del programa de cooperación sueca?
12. ¿Cuál es el % del presupuesto de la universidad asignado al desarrollo de la investigación científica?

GRUPO 4: Autoridades universitarias responsables de los proyectos

1. ¿Qué tanto ha cambiado la universidad o dependencia con el aporte del programa de Asdi?
2. ¿Qué contribuciones ha realizado el programa a los programas de investigación y a los académicos apoyados?
3. ¿Dónde están y qué están haciendo los egresados de los programas de postgrado?
4. ¿Cuáles son los resultados específicos alcanzados por el o los proyectos ejecutados?
5. ¿Cuál es el % de tiempo dedicado a investigación por los docentes egresados de los programas de postgrado?
6. ¿Cómo defina la investigación científica? ¿Cuales son las características de una investigación científica?
7. ¿Cómo han sido fortalecidos los sistemas y estructuras que apoyan a la investigación científica?
8. ¿Cuáles son los estándares definidos para la aprobación de un proyecto de investigación?
9. ¿Cuáles son los estándares definidos para la publicación de productos de una investigación científica?
10. ¿Qué medidas ha adoptado la universidad o dependencia para la continuidad y sostenibilidad de los resultados del programa?

GRUPO 5: Beneficiarios directos del programa: egresados de postgrados, investigadores, docentes

1. ¿Qué tanto ha cambiado tu vida profesional el postgrado obtenido en el programa de Asdi?
2. ¿Cuál es tu actividad profesional principal y qué peso tiene el trabajo de investigación?
3. ¿Cuáles son tus principales metas en el trabajo de investigación científica?
4. ¿Qué limitaciones encuentra cumplir con su trabajo de investigación en la universidad?
5. ¿Cuánto tiempo ocupaste para graduarte del programa de doctorado o maestría?
6. ¿Cuáles fueron las actividades realizadas para obtener el resultado previsto?
7. ¿Cómo aplicas tus conocimientos al servicio de la sociedad nicaragüense?

Annex E: Evaluation Matrix

Key Questions	Indicators or Factors of Analysis	Information Sources
Historical Relevance and Effectiveness		
What was the social, political and economic context in Nicaragua that influenced scientific/ academic research over the course of the cooperation?	• Political and legal situation in Nicaragua from 1981 to 2010. • Social context by significant periods in recent Nicaraguan history. • Macroeconomic indicators	• Historical documents • Constitution • UNDP Human Development Reports (HDI) • University representatives • Former Sida officials
Has there been coherency between research needs in Nicaragua, national development plans and Swedish research cooperation? (relevance)	• Type and periodicity of needs assessments conducted by Sida and Nicaraguan universities or coordinating bodies	• Previous Sida evaluations of research cooperation with Nicaragua • National Development Plan • University representatives
To what degree did the projects achieve the objectives? (effectiveness)	• Stated objectives (general and specific)	• Sida documents • University representatives
Have the methods and approaches applied to research cooperation between Sweden and Nicaragua facilitated results? (effectiveness)	• Sandwich model • Institutional capacity development	• University representatives • Former students
Results Achieved		
To what degree has institutional academic and research management	• Evidence of academic policies to support graduate programs and research • Evidence of research management structures and procedures at university • Degree of researchers' access to international research databases •# of research facilities constructed and maintained	• University representatives • CONICYT • Library and information technology technicians
To what degree has the research capacity in Nicaragua improved (in the major thematic areas supported)?	• Definition of scientific research • Research results recognized by academic peers, scientific journals and international agencies •# of academic conferences organized by partner universities within Nicaragua •# of scientific journals published by partner universities in Nicaragua •# of Nicaraguan researchers invited to deliver papers at international academic events	• Best practices in scientific research cooperation • Swedish researchers • Academic journals • Conference reports • Visits to libraries, laboratories • Websites
Has gender mainstreaming occurred in research programs and research management systems?	• Male to female ratio in graduate programs • Male to female ratio among faculty • Examples of research projects that incorporated a gender analysis	• University statistics, if available • Male and female researchers and professors • Research products

How have research initiatives impacted on Nicaraguan society	• Degree and type of public access to research results • Evidence of legislation, public policies or programs based on scientific research findings • Degree of interaction between researchers and government and between researchers and civil society	• Government documents • Government officials • Civil society organizations
Have the research themes and resulting products been applied by Nicaraguan society?	• Evidence of application of research products by government agencies, civil society including the private sector.	• Ministry of Health • Ministry of Agriculture • Pharmaceutical companies • Agroindustrial companies • Other government, private sector and civil society organizations
Efficiency		
Is the relationship between results and implementation time reasonable based on the context in Nicaragua?	• Historical progress toward results as compared to level of effort, time and context (external and internal to universities)	• Progress reports • University and Sida representatives • Previous evaluation reports
Is the relationship between cost and results reasonable?	• # of Masters and Ph.D graduates retained by Nicaraguan universities vs. financial costs	• Project reports • Partners' contributions • Partner representatives
Did other donor agencies provide similar to support to the support provided by Sida?	• Examples of research support in Nicaragua by other donor countries/ agencies • Characteristics of Swedish cooperation as compared to support by other donor agencies	• Donor agencies • University representatives
Sustainability		
Can the changes achieved be maintained after Sida exits from Nicaragua?	• Evidence of sustainability plans/ strategies	• Sida • University representatives • CNU
To what degree have the project initiatives been incorporated into organizational structures or processes? Institutional sustainability	• Evidence of institutional budget support • Evidence of institutional academic and research policies • Evidence of performance evaluation within universities • Evidence of information and communication technology expertise at universities	• University representatives • Evaluation reports • Graduate students • Library and information technicians
What are the prospects for financial sustainability of the initiatives?	• Number of researchers and professors on university payroll • Diversity of financial contributors • Dedicated funds for maintenance of information systems	• University administration • Library and information technology technicians
Can human resources be sustained in Nicaragua?	• Continuity of graduates at universities • Evidence of research positions in state agencies • Evidence of research positions in private sector	• Government agencies • University representatives • Private companies • Non-government research institutes

Annex F: Historical Description of the Public Universities

UNAN-León

1680 – Seminary San Ramon established in Leon

1812 – Seminary recognized and officially becomes first university in Nicaragua, 9 years before independence from Spain

1947 – recognized as the National University under the Ministry of Education

1958 – designated as UNAN when it achieved autonomy from the government

1960s – UNAN was the second university in Central America to present a strategic Development Plan; this facilitated national and international cooperation for its programs; likewise its association with Central American universities, through CSUCA facilitated inter-university networking

1982 – divided into UNAN-León and UNAN-Managua

1995 – university reform launched in order to define transformation of teaching, research, and extension

2003 – The first Institutional Policy for Research and Graduate Studies is approved by the University Council

2004 – Policy on the Establishment and Functioning of Research and Postgraduate Centres

2007 – journal, "Universitas", launched

UNAN Managua

http://www.unan.edu.ni/informacionb.htm

1969 – Managua based campus of UNAN established in 1969 2/3 of the university population in Managua, 3 faculties: Humanities, Physical Sciences & mathematics, Economic Sciences; there was an extension of the Leon based Arts & Science Faculty as well. At end of 1960s UNAN in Managua was the second university population in Central America

1979 – Sandinista revolution sparked rapid transformation of UNAN and the Managua university campus commenced organizational change to become an independent university in 1982

1985–1990 the growth and change slowed significantly due to the economic crisis of the country

1993 – curriculum reform – adding final examination for graduation (as well as thesis) and expanded course offerings in regional campuses
1998 – transformation of all curriculum and new emphasis on research and quality academic teaching
2010 – over 30,417 enrolled at UNAN Managua (28,000 plus in undergraduate programs) – 37% of undergraduate students are enrolled in regional centres

National Engineering University (UNI)
http://www.uni.edu.ni/
First engineering courses date back to the San Ramon Seminary in Leon
1881 – in Managua an Arts and Professions (Oficios) by French engineers – focus on railway engineering due to the construction of the railroad in Nicaragua
– 1941 – School of Engineering
– incomplete

National Agrarian University (UNA)
1917 – National School of Agriculture created by executive decree
1949 – National School of Agriculture and Livestock
1980 – National School of Agriculture and Cattle becomes the Faculty of Agropecuario Science at the UNAN
1990 – Law of Autonomy of Higher Education Institutes created UNA with 4 faculties: Agronomy, National Resources & Environment, Distance Education & Rural Development, and Animal Science.
1997 – First regional campus opened in Juigalpa
1998 – UNA created the Rural Development Faculty while the other 3 faculties remained the same.
2000 – New academic programs were introduced, including: agricultural business, renewable natural resources, forestry, veterinary medicine, zoology, agricultural protection, and agriculture for sustainable development
2003 – Regional university Center that had opened in Camoapa in 1993 became a regional campus of UNA
2007 – Regional campus in Carazo opened
2008 – Program for detained individuals in penitentiary launched
2008 – 2009 – university transformation launched in order to design a new education model

Annex G: Laboratory Equipment

Note: Not all Universities provided a list of equipment.

CEI

Nuestro laboratorio ahora cuenta con equipado de alta tecnología como:

- Microscopia convencional y Microscopía Fluorescente de punta
- Equipos para Inmunoensayos (ELISA)
- Equipos de Biología molecular
  - Electroforesis vertical y horizontal
  - Inmunotransferencia
  - PCR convencional
  - PCR en tiempo real
- Refrigeradores 4°C, -20°C y -70°C
- Incubadores aeróbicos y anaeróbicos 37-52°C
- Minicentrifugas y centrifugas hasta 12000 rpm
- Computadoras
- Vortex, shakers
- Equipo de cromatografía de columna para purificación de biomoléculas
- Destiladores y purificadores de agua ultrapura
- Espectrofotómetros
- Liofilizadores
- Cabinas de extracción de gases
- Cabinas de flujo laminar
- Baños María
- pHmetros

CISTA

HPLC, GC-Ms, GC-NPD, Determinación de compuestos orgánicos (plaguicidas, PCB´s, PAHs) en matrices biológicas y ambientales

Para completar la capacidad del laboratorio, aún falta la GPC, dos campanas estractoras de gases, otra balanza, Equipo para preparar agua MILLI-Q o agua ultra pura, ampliar infraestructura (tercera etapa de CISTA que incluya condiciones climatizadas para mantener los refrigeradores, hasta la fecha los equipos se han mantenido en condiciones altas de temperatura que se sobre cargan los compresores de los equipos). Hay un problema de suministro de energía eléctrica ya que hasta la fecha no se ha resuelto la instalación de un tranformador necesario para estabilizar el suministro.

UNA

A través de los proyectos específicos doctorales han sido creadas facilidades para el éxito de dichos proyectos. Ocho laboratorios (fisiología vegetal, suelos, biología molecular, cultivo de tejidos, bromatología, nematología, entomología y microbilogía) han sido desarrollados o restablecidos para brindar facilidades a los estudiantes doctorales. Así mismo, se ha fortalecido la biblioteca de la Universidad con literatura científica y acceso a base de datos y revistas científicas internacionales.

En la actualidad existe conexión y comunicación vía internet, intranet y telefónica en todos los campi de la UNA. Se han renovado los equipos de cómputo de los profesores de la Universidad así como se han creado de centros de cómputo en la Facultades. Se cuenta además con una sala de video conferencia, equipo de radio y televisión, y una amplia gama de aplicaciones TIC.

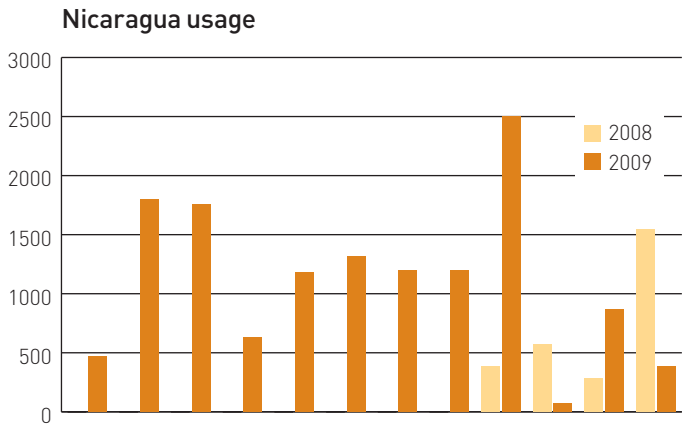
Annex H: Statistics on Database Use 2008–2010

OBS!
Är dessa siffror i tusental? bör skrivas in

Totals 2008													
Peri registrants	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Separate user sessions in month	0	0	114	0	0	0	0	0	107	846	282	66	**1415**
Serches Performed	0	0	2	0	0	0	0	0	981	3811	974	311	**6079**
ToCs downloaded in month	0	0	0	0	0	0	0	0	31	55	0	2	**83**
Abstracts downloaded in month	0	0	236	0	0	0	0	0	141	571	230	72	**1250**
Articals downloaded (PDF) in month	0	0	0	0	0	0	0	0	242	501	264	1352	**2359**
Articals downloaded (HTML) in month	0	0	0	0	0	0	0	0	141	72	20	196	**429**
Document deliveries	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Total documents obtained	0	0	0	0	0	0	0	0	383	573	284	1548	**2783**

Totals 2009													
Peri registrants	127	127	127	157	157	157	170	170	170	165	156	156	**78**
Separate user sessions in month	561	2222	334	165	204	193	240	222	317	213	106	527	**5304**
Serches Performed	1719	9362	6126	2392	4102	13606	6822	6220	9789	64	7365	1746	**69313**
ToCs downloaded in month	93	64	104	54	23	42	88	25	39	28	145	166	**871**
Abstracts downloaded in month	510	2213	2534	955	1320	1338	1232	1320	1658	168	1029	276	**14553**
Articals downloaded (PDF) in month	350	1394	1092	363	970	1035	943	1030	1567	25	466	213	**9448**
Articals downloaded (HTML) in month	113	397	655	268	201	274	152	160	907	42	401	170	**3740**
Document deliveries	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Total documents obtained	463	1791	1747	631	1171	1309	1095	1190	2474	67	867	383	**13188**

Totals 2010													
Peri registrants	0	0	0	184	184	184	185	185	185	0	0	0	**0**
Separate user sessions in month	796	992	1633	1609	807	767	662	819	1050	1666	0	0	**10801**
Serches Performed	7215	14850	23787	29389	10789	8926	9702	13944	8991	36612	0	0	**164205**
ToCs downloaded in month	18	23	14	27	7	7	8	6	0	0	0	0	**110**
Abstracts downloaded in month	1065	1192	1876	2380	796	646	590	741	1129	2740	0	0	**13155**
Articals downloaded (PDF) in month	751	774	1040	1186	618	628	677	845	1008	1544	0	0	**9071**
Articals downloaded (HTML) in month	150	312	931	858	148	153	64	135	123	906	0	0	**3780**
Document deliveries	0901	0	0	0	0	0	0	0	0	0	0	0	**0**
Total documents obtained	901	1086	1971	2044	766	781	741	980	1131	2450	0	0	**12851**


Nicaragua usage
3000
2500
2000
1500
1000
500
0
2008
2009

Annex I: UNA Scientific Publications

by National University of Agriculture (UNA)
Publications in Peer reviewed Journals

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Annex K: UNAN-Managua Scientific Publications

By National Autonomous University of Nicaragua, Managua
Publications in peer reviewed journals

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Annex L: UNAN-León Scientific Publications

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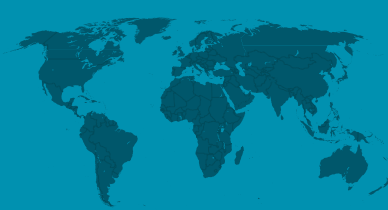
Report Evaluation of 30 Years of Research Cooperation between Sweden and Nicaragua

GLOBAL

The Evaluation covers the research cooperation between Sweden and Nicaragua during the period 1981 to 2011. It provides a historical background including the methodological development of the cooperation itself as well as policy changes and different funding modalities. It comments on challenges, strengths and weaknesses internal to the institutions themselves and to external conditions influencing the cooperation.

The evaluation focuses on research capacity building at six public institutions In Nicaragua and the results (output, outcome and impact) with respect to 1) research capacity and production of scientific results, 2) institutional capacity – (infrastructure, management) and 3) the impact of building institutional research capacity in Nicaraguan society,.

The evaluation also reviews the efforts to ensure sustainability of human and financial resources.



SWEDISH INTERNATIONAL DEVELOPMENT COOPERATION AGENCY

Address: SE-105 25 Stockholm, Sweden.
Visiting address: Valhallavägen 199.
Phone: +46 (0)8-698 50 00. Fax: +46 (0)8-20 88 64.
www.sida.se sida@sida.se

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