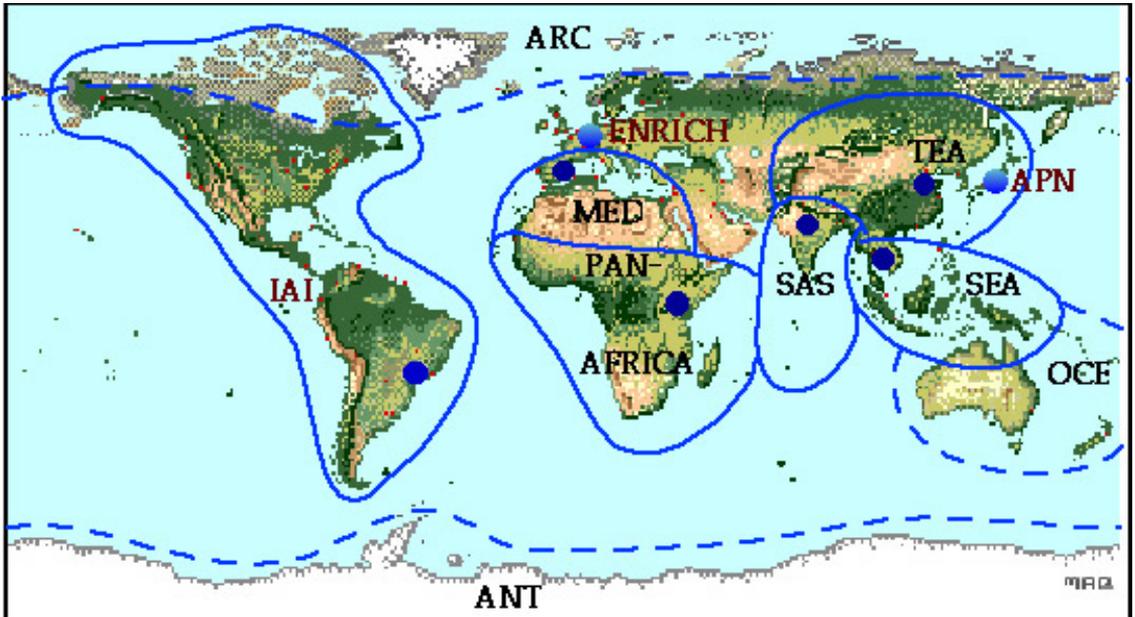


IGBP REPORT 44

International Geosphere–Biosphere Programme



**START Implementation Plan
1997-2002**

IGBP REPORT 45

START Implementation Plan 1997-2002

Edited by

Roland Fuchs, Hassan Virji, and Cory Fleming

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Implementation Plan

This document describes an IGBP Implementation Plan approved by the Scientific Committee for the International Geosphere-Biosphere Programme (SC-IGBP)

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Cover Illustration: The START Regional Networks under development, including the locations of the regional Secretariat offices. (See Figure 2 for more detailed description of figure)

Layout and Technical Editing: Lisa Wanrooy-Cronqvist

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Contents

Foreword	5
The Challenge	7
The START Initiative	9
START Regional Networks	10
The Way Forward	15
START Programmatic Themes	16
Objectives, Activities and Expected Outputs	21
Objective 1: Global Change Research on a Regional Level	22
Objective 2: Human Resource Development	26
Objective 3: Support of Policy Formulation	28
Objective 4: Institution and Network Development	31
START Regional Workplans	35
Funding, Management and Evaluation	37
Budget Categories	37
Management Structure and Programme Implementation	38
Toward a New Partnership — The Role of START’s Partners	40
Implementation and Evaluation	42
Appendix I	45
START Regional Network	45
Appendix II	51
START Fellowship/Visiting Lectureship Programme	51
Appendix III	55
START Activities: Research Workshops and Training	
Courses Sponsored/Co-Sponsored by START	55
START Financial Supporters	60
International Global Change Research	
Programmes and their Programme Elements	61
List of Acronyms	67
List of IGBP Publications	71

Foreword

The primary goals of the SysTEM for Analysis, Research and Training in global change science (START), which is co-sponsored by the International Geosphere-Biosphere Programme (IGBP); the International Human Dimensions Programme on Global Environmental Change (IHDP); and the World Climate Research Programme (WCRP) are to promote regional global change science and to enhance the capacity of individuals, institutions and developing regions to undertake such research.

START capacity building initiatives include the recognition that human capacity building is much more than training and that, as with all development, sustainable development is best. Once-off training exercises are easy to organize, but are the least effective method of capacity enhancement and result in large cost/benefit ratios. In contrast, sustained development of human capacity through continual involvement with research maximizes efficiency and minimizes the cost/benefit ratio.

In striving for sustainable capacity building, it needs to be recognized that a pool of scientists with basic training is available in developing countries. The need is to catalyse the involvement of talented scientists in on-going and new initiatives. *Passive* participation in training activities should be minimized; *active* participation in long-lasting initiatives should be maximized. It should also be recognized that self-help, personal and institutional, is a vital ingredient for success. The more capacity building is associated with research (and particularly on-going research), the more likely it is to be sustainable and to lead to continuing activity. In addition, activities minimising the likelihood of a brain drain from a home country should be preferred in all capacity-building exercises (graduate studies abroad may well accelerate the brain drain). To maximize home-country sustainable development, ways should be sought to strengthen regional graduate studies programmes (*e.g.*, using secondments, fellowships, *etc.*).

In all educational enrichment activities it is best to train the trainers to maximize the multiplier effect. Enhancing the capacity of early mid-career people will, in the long run, increase the multiplier effect and accelerate home-based capacity building.

START employs a variety of approaches to achieve its goals. These include capacity building initiatives that seek to promote Training Workshops on such topics as data handling, remote sensing and modelling, as well as Science Planning Workshops to consider participation in existing activities, to initiate new programmes and to integrate and synthesize results as projects progress. A major initiative relates to the START Fellowships Programmes that are directed from home countries to developed countries, from a home country to a regional centre, or from a developed to a home country. Participation in IGBP/IHDP/WCRP core and inter-core projects and programmes is stressed and encouraged at all times. Examples include: PAGES PEP Transect activities; IGAC work on aerosols; the START/IGBP/IHDP/WCRP project on predicting climate variability and food production in S E Asia; and the Kalahari Transect and Miombo Woodlands research in Africa. Further examples are: participation in START Regional Research Programmes such as those associated with LOICZ and LUCC in South East Asia; INDOEX in South Asia; and regional modelling of global change and its impacts in Temperate East Asia. Finally, the organization of Science Management Meetings is necessary to optimize progress in on-going activities, as is the holding of Scientific Conferences to encourage production, dissemination and publication of research outcomes.

By following these principles and operating in the way outlined, START seeks to enhance regional global change research while at the same time enhancing the individual and institutional capacity to conduct such research. The details as to how START operates, and how it plans to encompass its vision and meet its objectives are given in the START Implementation Plan. As in all bold initiatives, it will be not so much the ideas as their implementation that will govern the success of the operation. We are confident that START will succeed.

Peter Tyson
Chair, START SSC

Berrien Moore
Chair, IGBP SC

Larry Gates
Chair, WCRP JSC

Eckart Ehlers
Chair, IHDP SSC

The Challenge

There is a growing recognition that the world's nations are on a growth trajectory that is "unsustainable, inequitable, and unstable" (see IGBP Report 15). Both governments and the scientific community are increasingly concerned with the effects of human activities on the global environment. Human activities are inducing environmental change ranging in scale from earth-wide changes — such as rising atmospheric levels of CO₂ and mean sea-level rise — to localized changes — such as acid rain, desertification and deforestation, which cumulatively have global importance. Both types of global environmental change will greatly affect the environmental resource base for the world's economy and may pose significant threats to human health, and agriculture and food security.

Originally viewed as a problem mainly for a few industrialized nations, environmental change and degradation are seen now as survival issues for many developing countries whose economies are often highly dependent on their physical environment. Indeed, the developing countries are considered the most vulnerable to the projected consequences of global environmental change, especially when combined with the impacts of more localized environmental degradation.

In addressing the related problems of economic development and regional and global environmental change, governments have come to recognize that improved scientific knowledge of the earth's systems is required for establishing wise policies and designing preventive, adaptive and remedial measures. The community of nations has developed a series of responses through international agreements and conventions — AGENDA 21 and the Conventions on Climate Change, Ozone, Desertification, and Biodiversity — aimed at achieving long-term sustainable development while preserving various elements of our earth's environment.

Such agreements typically obligate signatory nations to engage in environmental monitoring, accounting and impact assessment. Adopting options to mitigate impacts are involved as well. Concerted efforts have been undertaken by most of the developed nations of the world to design national strategies regarding global environmental change. In contrast, however, most developing countries currently lack sufficient numbers of qualified scientists; the scientific and assessment infrastructures necessary to provide the assessments; and the data and information required by their decision-makers to meet national and international obligations. As a result, the actual implementation of such international agreements and conventions has been seriously hindered.

The international scientific community, for its part, has launched a series of scientific programmes — the International Geosphere-Biosphere Programme (IGBP), the International Human Dimensions Programme on Global Environmental Change (IHDP), and the World Climate Research Programme (WCRP) — under the umbrella of “global change.” Taken together, they are intended to strengthen the basic understanding of how the earth’s physical, chemical, biological and socio-economic systems interact to regulate the human environment and to provide the predictive abilities necessary to underpin related policy decisions. In designing these programmes, scientists realize that on-going change represents more than a scientific challenge and that scientists have an obligation to assist policy-makers to maintain the global life support system.

Understandably, but unfortunately, the formation and implementation of these science programmes has been dominated by scientists from the developed world, who typically constitute 80% of the participants involved. Most developing nations simply lack the human and institutional resources to participate significantly in these activities. Moreover, the resources they have are often allocated to addressing local problems. Not only is the advance of science impeded, but another result is that the global change science programmes do not necessarily address regional needs and are not fully implemented at the national and regional levels. A more continuous dialogue to deepen and sustain the partnership between scientists in developed and developing countries, and between scientists and policy-makers, is needed to ensure that such needs will be addressed.

In addition to the global change research programmes, the international community of nations has agreed to develop a new code of conduct under the United Nations (UN) Framework Convention on Climate Change (FCCC). The convention-related assessments are being conducted by the UN Intergovernmental Panel on Climate Change (IPCC). Despite increased participation of developing country scientists in such assessments, the current situation is still one in which the developing countries remain overly dependent on both the scientific findings and policy advice — advice which they often mistrust — emanating from the developed world.

Clearly, a world must be sought in which there is a more equitable and accessible distribution of scientific knowledge on environmental changes that can be used as a basis for achieving environmentally sustainable development. The challenge is to meet the needs of developing countries with respect to global change science and its application for sustainable development. This requires:

- Sufficient numbers of trained scientists to participate in the global change science programmes and to address questions of monitoring, accounting and impact assessment
- Full participation by developing country scientists in planning and implementation of regional environmental change science research that is both globally significant and locally relevant
- Standardized data, information and assessments as required for science and decision-making

- A mechanism for regional cooperation to address more efficiently and coherently issues of environmental change and their relation to sustainable development at scales ranging from the national to global
- A mechanism for ensuring a more continuous dialogue between the science and policy-making communities.

The START Initiative

In recognition of the need for new institutional arrangements aimed at building indigenous capacity world-wide to cope with the scientific and policy aspects of environmental change and sustainable development, and as called for in AGENDA 21, the international scientific community has launched an initiative called Global Change SysTEM for Analysis, Research and Training (START). START involves the establishment of a system of regional networks with particular emphasis on the developing regions. The primary mission of these networks is: (i) to conduct research on regional aspects of global change; (ii) to assess the impacts of the regional findings; and (iii) to provide regionally important integrated and evaluated information to policy-makers and governments. START's overall objective is to build, through regional research activities, a world-wide indigenous capacity to tackle the scientific and policy aspects of environmental changes and sustainable development.

The START initiative is co-sponsored by the three international global change science programmes, IGBP, IHDP, and WCRP (see Figure 1 and Appendices). START has also been endorsed by various components of the UN system, including the General Assembly, the United Nations Environmental Programme (UNEP) and UNESCO. START has an excellent working relationship with the IPCC and an evolving relationship with the UN FCCC Secretariat. The International Group of Funding Agencies for Global Change Research has recognized START as the key mechanism for securing participation from developing country scientists in global change research.

START conducts its activities through regional networks of existing institutions as well as individual scientists who have agreed to cooperate on global change activities, realizing that such collaboration provides many efficiencies and accelerates scientific advances.

From its inception, START has placed priority on the development of regional networks in the developing countries because of their role in and sensitivity to global change as well as their capacity-building needs, both at national and regional levels. START, therefore, seeks to mobilize the resources necessary to augment existing scientific capabilities and infrastructures in developing countries, using regional networks as a basic framework. Consistent with its mission, the START initiative helps build indigenous capacity of the developing regions of the world to enable fuller participation in the various scientific projects of the global change research programmes and to conduct globally significant research of regional relevance.

At the same time, START also supports policy formulation and implementation at national and regional levels by fostering a dialogue between the global change science and policy-making communities. Such a dialogue serves to assist policy-makers in the development and design of wise policies for environmental management and in meeting their international obligations.

START Regional Networks

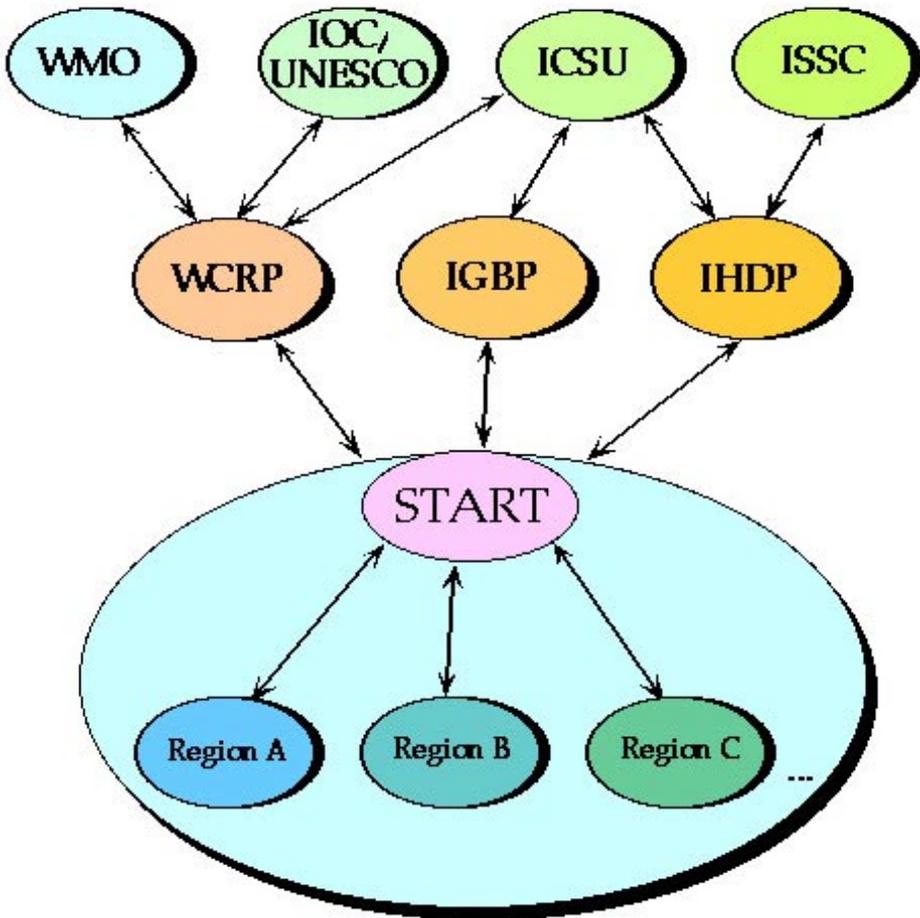
Comprised of institutions and individuals committed to the implementation of co-operative global change research and related activities, and also linked to the programme elements of the sponsoring programmes, the START regional networks are a means of:

- Mobilizing a critical mass of researchers and institutional resources at national and regional levels
- Promoting regional cooperation in global change research by developing regional and national communities of scientists
- Developing greater efficiency in research through division of responsibilities and by following common methodologies
- Developing greater coherence among global, regional and national global research agendas
- Fostering the standardization, collection, analysis and exchange of scientific data, including that required by national and regional policy-makers
- Developing better links between regional science agendas and policy concerns
- Sponsoring global change activities of national and regional relevance and seeking necessary support
- Enhancing the exchange and the communication of research results
- Providing scientific information to the public
- Preparing assessments and options for policy-making bodies.

Figure 1

START - Organizational Relationships

ICSU	International Council of Scientific Unions
IGBP	International Geosphere-Biosphere Programme
IHDP	International Human Dimensions Programme on Global Environmental Change
IOC	Intergovernmental Oceanographic Commission
ISSC	International Social Science Council
START	SysTem for Analysis, Research and Training for Global Change
WCRP	World Climate Research Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
WMO	World Meteorological Organization



START Accomplishments

The START initiative was formally launched when the International START Secretariat was established in 1992. Since then, activities have been initiated in the following six regional networks, largely covering developing countries in Africa and Asia (see Figure 2):

Northern Africa *	South Asia
Southern Africa *	Southeast Asia
Mediterranean	Temperate East Asia

Exploratory efforts have begun for the Middle East, the Central and Eastern European States/Newly Independent States (CEES/NIS) countries, and Oceania. START-affiliated networks are under development for the Arctic (in cooperation with the International Arctic Science Committee [IASC]) and the Antarctic (in cooperation with the Scientific Committee on Antarctic Research [SCAR]).

A parallel and intergovernmental effort in the Americas, the Inter-American Institute for Global Change Research (IAI), is a close partner and has collaborated on a number of projects with START. START also works closely with two other intergovernmental bodies engaged in global change science, the Asia-Pacific Network for Global Change Research (APN) and the European Network for Research in Global Change (ENRICH).

Progress in the development of START's system of regional networks has been rapid. Science planning meetings, research workshops, and training courses have already been held in all six regions under the auspices of regional committees.

Since its inception, START has sponsored or participated in over 50 scientific workshops and other training opportunities world-wide. (See START Activities in the Appendices). Significant regional science research and global change impact assessment related efforts have been initiated in most START regions. The first START science and policy forum was recently conducted in Southeast Asia to foster dialogue between the science and policy-making communities.

With respect to human resource development, START has initiated a fellowship/visiting scientist programme, a guest lectureship programme and a visiting professorship programme. The awards made through these programmes have an immediate and direct impact in improving both national and regional capacity to achieve sustainable development through increased scientific knowledge of the impacts of global change.

Table 1 summarizes the full range of activities undertaken by each of the START regional networks. Further background material on the START initiative can be found in the Appendices.

* The Pan-African START Secretariat has been established in cooperation with the Kenya National Academy of Sciences (KNAS) at the University of Nairobi to serve the communication and administrative needs of both the Northern Africa Committee (NAFCOM) and Southern, Central and Eastern Africa Committee (SAFCOM). The two committees meet jointly to facilitate collaboration on research interest of mutual interest.

Figure 2

Illustration of the START Regional Networks under development, including the locations of the regional Secretariat offices. Dashed outline indicates planned regional networks (for the Pan-Africa region, comprising both the Northern Africa and Southern Africa sectors of Sub-Saharan Africa, a single Pan-African Regional Secretariat has been established at Nairobi, Kenya as of 1 January 1997). Shown also is the Inter-American Institute for Global Change and its regional office, a parallel intergovernmental effort that will perform networking functions in the indicated region of the Americas. Also indicated are the European Network for Research in Global Change (ENRICH) and the Asia-Pacific Network for Global Change Research (APN), related parallel intergovernmental networks.

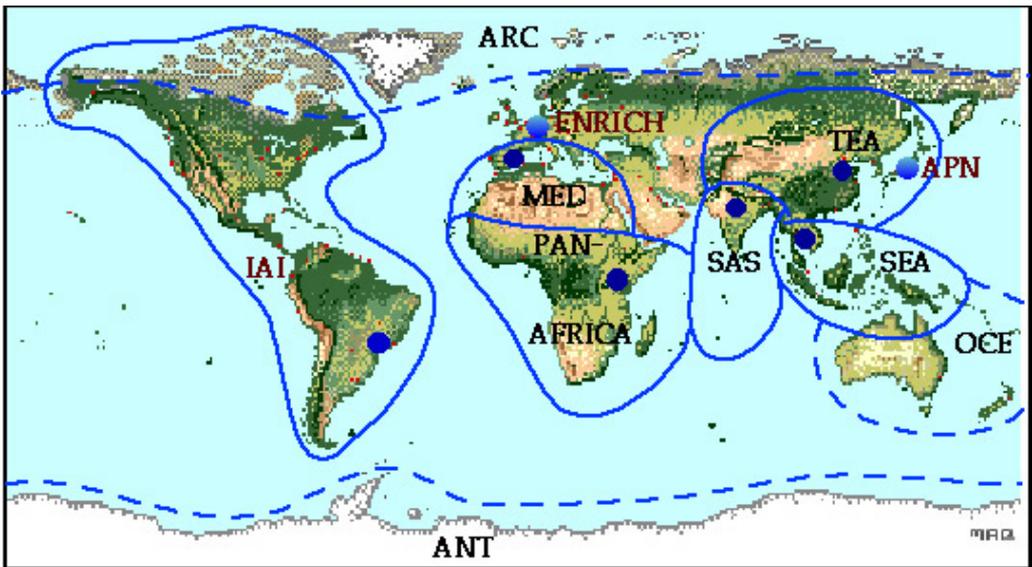


Table 1

Status of Development of START Regional Networks.

START Regions and Activities	Regional Meetings and Priorities Outlay	Establishment of Coordination Mechanisms	National and Regional Inventories	Designation of Network Components	Workshops and Projects	Training Courses and Fellowship Programmes	Regional Data and Information Systems	Regional science themes	Assessments for Policy makers
SEA	Chiang Mai Thailand 1992	Interim Secretariat Singapore 1993 Permanent Secretariat Bangkok, 1994	Scientists and Institutions 1995	Regional Center Bangkok 1994 Several nodes and sites 1995	1994 onward: 12 Workshops completed; 3 projects active	1994 onward: 4 Courses; 15 Fellowships/ Visit 5 scientists 23 Lecturers	1996 onward	Ecosystem Impacts Land use / cover change GHGs Coastal Zone	1996 onward
TEA	Tokyo Japan 1992	Beijing China 1993	Scientists Institutions 1997	Regional Center at Beijing 1995	1994 onward: 4 Workshops completed; 2 projects defined	1995 onward: 1 Course; 3 Fellowships/ Visit Scientists 4 Lecturers	1996 onward	Monsoon and ecosystem change Land use / cover change	1997 onward
SAS	Colombo Sri Lanka 1993	New Delhi India 1994	Scientists Institutions 1994	Regional Center at New Delhi 1995	1995 onward: 9 Workshops completed	1995 onward: 1 Course; 6 Fellowships/ Visit Scientists 2 Lecturers	1997 onward	Climate change & Ag. / food security Land use / cover change coastal zone Atm. Chemistry	1997 onward
NAF	Niamey Niger 1992	Accra Ghana 1993	Scientists Institutions in progress 1995/96	Regional Center at Accra 1995 One Site 1994	1993 onward: 2 Workshops completed; 2 planned for 1995	1995 Onward: 1 Course; 4 Fellowships/ Visit Scientists 2 Lecturers	1997 onward	Land use / cover change Atm. Chemistry Climate change, Agriculture & Food Security	1997 onward
SAF	Gaborone Botswana 1994	Interim Secretariat Malawi 1993 Permanent TED	In Progress 1996/97	TBD	1995 onward: 2 Workshops completed; 2 Projects active	1995 Onward: 1 Course; 10 Fellowships/ Visit Scientists 2 Lecturers	1996 onward	Land use / cover change transsects Bangladesh	1996 onward
MED	Toledo Spain 1996	Interim Secretariat co-located with MEDIAS in Toulouse, 1994	TBD	TBD	TBD	1 Fellowship/ Visit Scientist	TBD	TBD	TBD
OCE	Suva Fiji 1997	1998	TBD	TBD	TBD	TBD	TBD	TBD	TBD

The Way Forward

The START initiative is now reaching a crucial point in its overall development. As of the end of 1997, all of the START regions in Africa and Asia have in place, or have identified, at least the basic elements of their institutional and network coordinating structures. Most have organized workshops and symposia to help develop regional research activities and to assist in related capacity building. At least one is engaged in a comprehensive regional programme of substantive research, training, data management, and policy-related activities. The overall START initiative must now build on these accomplishments and move forward from the initial development phase, which necessarily emphasized organization and planning, to full implementation. This will require:

- Developing and implementing global change research at the regional level linked to the international global change science programmes while also responsive to regional and national policy concerns
- Strengthening research capabilities of national and regional scientific communities through human resource development, tightly tied to collaborative research. Activities such as training and fellowship programmes will help develop human resources as well as strengthen the institutional base for research
- Providing decision-makers with a firmer scientific base for national, regional and international policy formulation. Mechanisms will include policy-oriented research, regional assessments, workshops, briefings and fora
- Reinforcing institution and network development and other enabling activities, which in turn involves:
 - Elaboration of regional science planning mechanisms in dynamic interaction with national and regional science and policy communities
 - Strengthening the capabilities of the regional institutions to meet their responsibilities for coordination, research, data management, training, synthesis and policy-related assessments, especially in relation to national needs within the region
 - Assisting key regional network institutions and affiliated members
 - Developing regional data and information systems, including strengthening of national participation
 - Enhancing linkages among regional scientists and institutions and with the international global change science community.

START Programmatic Themes

Much of the initial effort by the regional START committees that guide regional programmes has been devoted to organizational matters and identifying regional priorities. In its latest phase, START is emphasizing the importance of research and research-driven capacity building. The beginning point for the development of regional science agendas is the set of global science plans of the sponsoring programmes, embodied in the programme elements of IGBP, IHDP, and WCRP (see Figure 3 and Appendices). Starting with a consideration of these programmes, regional START committees — operating on the basis of a bottom-up priority-setting approach — have developed initial agendas that they consider both globally significant and regionally relevant; they typically tend to incorporate global change impacts (*e.g.*, water and food security) and the links to sustainable development in addition to the fundamental science issues emphasized by the international science programmes (see Figure 4).

Therefore, these regional agendas are closely tied not only to the ensemble of programme elements developed by the international global change science programmes, but also to the major concerns of the international policy community (as expressed in AGENDA 21 and other international conventions and treaties). While differing in detail, the regional priorities, as defined by regional START committees, generally emphasize five programmatic themes.

The five START programmatic themes are:

- (1) Regional climate variability and change, including its prediction and impacts.
- (2) Changes in composition of the atmosphere and its impacts.
- (3) Land use/cover change and its impacts; including land degradation, deforestation and desertification.
- (4) Impacts of global change on terrestrial ecosystems and biodiversity.
- (5) Global change and coastal zones, land-ocean interactions and impacts on national and international waters.

These issues have emerged as high priorities at the United Nations Conference on Environment and Development (UNCED) AGENDA 21 discussions and are the subjects of major international conventions and agreements. They are also topics in which scientific advancements promise to provide the basis for early application to policy needs for sustainable development. They encompass not only the range of research interests of the various projects of IGBP, IHDP, and WCRP, but also link scientific research activities with applied interests of policy-makers.

It should be understood that START regional science agendas/plans do not constitute a separate science agenda apart from that of their global change science sponsors. They represent rather a regional implementation of the international global change science programmes, reflecting regional science and policy priorities and capacity building needs. Such regional plans often involve inter-programme and interproject collaboration.

Thus, consistent with START's primary mission, START's regional science plans:

- Respond to regional requirements and needs
- Link regional needs to global programmes and *vice versa*
- Harmonize local and regional activities.

Figure 3

Programme Elements of START's Sponsoring Programmes.

ACSYS	Arctic Climate System Study (WCRP)
BAHC	Biospheric Aspects of the Hydrological Cycle (IGBP)
CLIVAR	Climate Variability and Predictability Research Programme (WCRP)
GAIM	Global Analysis, Interpretation and Modelling (IGBP)
GCTE	Global Change and Terrestrial Ecosystems (IGBP)
GECHS	Global Environmental Change and Human Security (IHDP)
GEWEX	Global Energy and Water Cycle Experiment (WCRP)
GLOBEC	Global Ocean Ecosystem Dynamics (IGBP/SCOR/IOC)
(IGBP)-DIS	Data and Information Systems (IGBP)
IDGC	Institutional Dimensions of Global Change (IHDP)
IGAC	International Global Atmospheric Chemistry (IGBP/CACGP)
IT	Industrial Transformation (IHDP)
JGOFS	Joint Global Ocean Flux Study (IGBP/SCOR)
LOICZ	Land-Ocean Interactions in the Coastal Zone (IGBP)
LUCC	Land Use/Cover Change (IGBP/IHDP)
PAGES	Past Global Changes (IGBP)
SPARC	Stratospheric Processes and their Role in the Climate (WCRP)
START	Global Change System for Analysis, Research and Training (IGBP/IHDP/WCRP)
WGNE	Working Group on Numerical Experimentation (WCRP)
WOCE	World Ocean Circulation Experiment (WCRP)

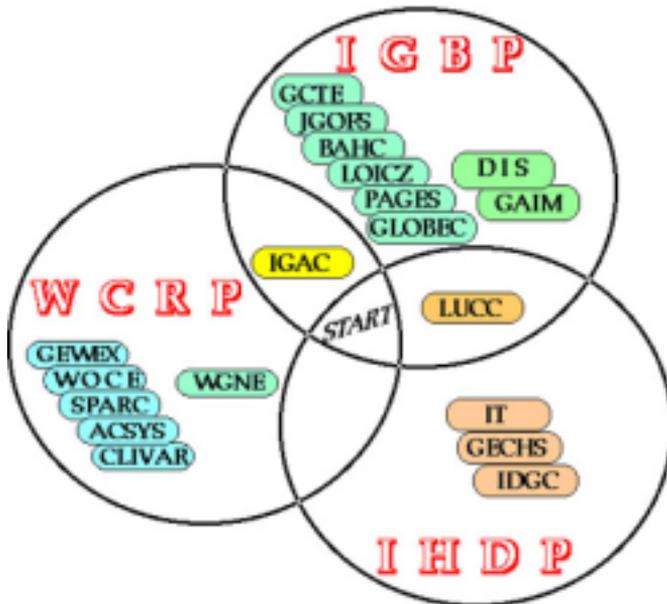
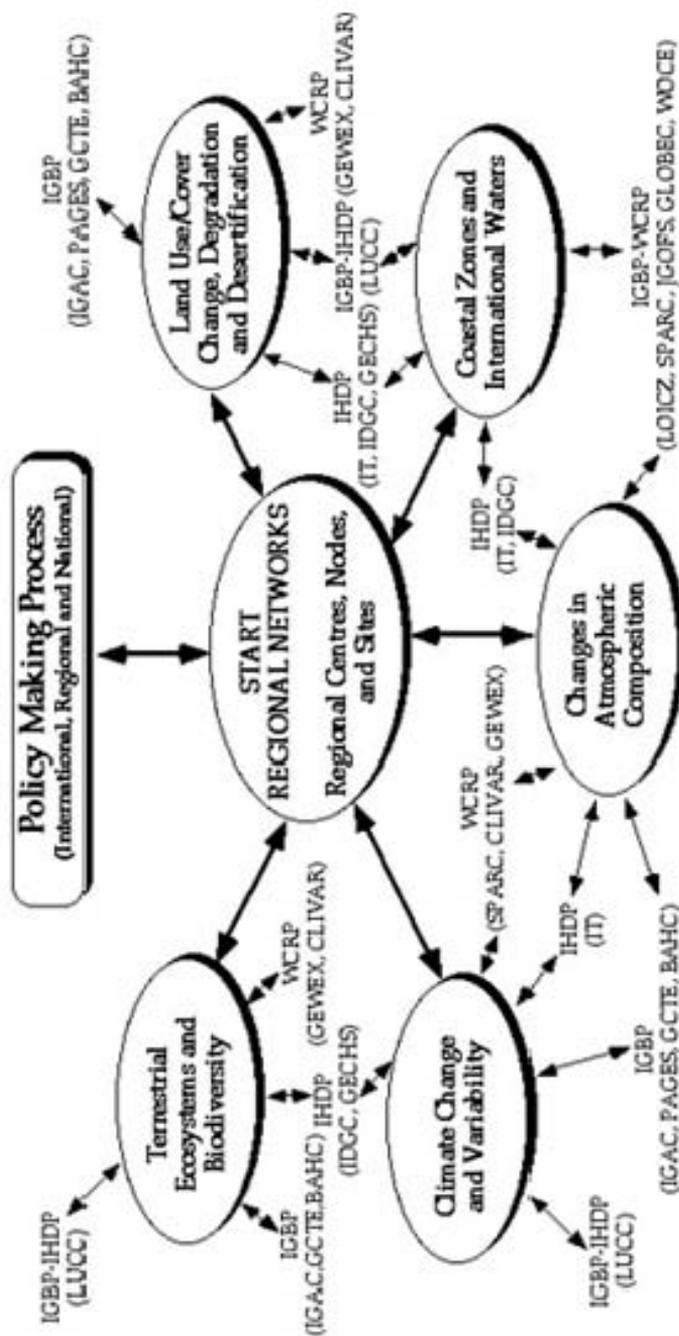


Figure 4

START Regional Networks and Thematic Programme Linkages.



Objectives, Activities and Expected Outputs

The START implementation plan is intended as a flexible and general framework, under which detailed annual plans would be proposed and prepared for each START region. The key elements of the START Implementation Plan are based upon the principles widely recognized as essential for successful network development ², namely:

- Shared values and common interests
- Effective governance and policy-making structure
- Close linkages to donors and clients
- Sound pragmatic workplans, including joint research planning
- Stable funding and external support
- Adequate scientific capacity
- Regular workshops and meetings
- Effective coordination and leadership.

With these principles in mind, the START Implementation Plan links the needs of the developing countries with respect to both global change science and national sustainable development. The overall programmatic development effort has four main objectives which can be broadly categorized as:

Objective 1:	Global Change Research on a Regional Level
Objective 2:	Human Resource Development
Objective 3:	Support for Policy Formulation
Objective 4:	Institution and Network Development

² Adapted from: Plucknett, Smith, and Ozgediz. 1990. Networking in International Agricultural Research, Cornell University Press.

Fulfillment of these four objectives will require: strengthening the research base of national institutions; network development and communication; science planning and coordination; design and execution of collaborative research projects; enhancement of scientific capacity by implementation of fellowships/visiting scientist and guest lectureship programmes at national and regional levels; improving the knowledge base for national and regional policy-makers through the conduct of short courses; conduct of integrated science assessments; and regional science and policy forums.

While recognizing that the various START regions are at different stages of development, the following general description of objectives is applicable to all regions. More detailed workplans are being developed for each of the START regions.

Objective 1 Global Change Research on a Regional Level

Under this objective, START seeks to stimulate interdisciplinary and scientifically significant research on the regional origins and implications of global environmental changes. Particular emphasis will be placed on research on the themes of climate variability and change, changes in atmospheric composition, land use/cover change, ecosystem impacts, and coastal zones, with priority given to research which is responsive to regional concerns while clearly linked to the global change science programmes.

Two distinct types of activities are envisaged to fulfill Objective 1: (i) collaborative research; and (ii) research workshops.

Activity 1 Conduct Collaborative Research

Within each START regional network, collaborative research will be coordinated by the START regional centres, but performed largely through affiliated national institutions within each region. While emphasizing the five broad START programmatic themes, priority in selection of specific projects under these themes will be given to projects that:

- Require international cooperation
- Are interdisciplinary and bring together the physical, biological and social sciences
- Reflect priorities of the regional science community in the context of the international global change science programmes
- Address issues of concern to both the science and policy-making communities.

The expected outputs of activities under this objective will include:

- Enhanced scientific understanding, at the regional and national level, of global change processes and their impacts. Findings on impacts would be invaluable inputs into the policy formulation process
- Strengthened collaboration between national, regional and international research efforts
- Distributed regional data and information systems and integrated scientific databases.

Activities under these broad themes include:

Activity 1a Regional Climate Variability and Change, Including its Prediction and Impacts

There is a widespread concern across developing regions, which are usually highly dependent on agriculture and, therefore, water resource availability, regarding the effects of climate variability and change. Therefore, a major thrust initially under this theme would be development of regional climate modelling capability and improved forecasts of seasonal to interannual climate anomalies and their possible applications for such purposes as water resource management, agricultural production, fisheries management and improving public health. The advances in seasonal climate forecasting resulting mainly from research on El Niño and the Southern Oscillation within WCRP's completed project TOGA could, therefore, be brought to direct application in many developing regions, as indeed is already occurring in South America. This programmatic theme will be developed in concert with the relevant programme elements of START's sponsoring programmes as well as an on-going international effort to establish regional applications centres linked to the proposed International Research Institute for Climate Prediction (IRI). (This activity was initiated in 1996 for Southern Africa and will be initiated in 1998-1999 for Asia).

Activity 1b Changes in Atmospheric Composition and its Impacts

Another major concern is changes in atmosphere composition which, in addition to being a long-term cause of climate change, may have more immediate impacts on ecosystems, *e.g.*, on plant growth or through acid rain deposition. Work under this activity is closely linked to the UN FCCC as well as IGBP/CACGP's global change science programmes such as the International Global Atmospheric Chemistry Project (IGAC). (Activities have already been initiated in Africa and South Asia).

Activity 1c Land Use/Cover Change and its Impacts and Land Degradation, Deforestation, and Desertification

Land use/cover change is widely recognized as a significant factor in a variety of environmental issues — including changes in atmospheric composition, climate, hydrology, ecosystems, deforestation, biodiversity and land degradation — although the processes involved still hold many uncertainties. Activities under this theme will focus on understanding the regional dynamics of land use change; developing models to predict and project regional and national land use/cover change; and understanding the biophysical implications of this change for sustainable land management and land use policies. Work under this theme will be tied closely to the IGBP/IHDP programme element on Land Use/Cover Change (LUCC) and other related programme elements. (Activities under this theme have already been started in both Africa and Asia).

Activity 1d Impacts of Global Change on Terrestrial Ecosystems and Biodiversity

This programmatic theme is aimed at understanding and predicting the impacts of changes in climate, atmospheric composition, and human activities, including land use change, on terrestrial ecosystems ranging from intensively managed agricultural systems to protected ecosystems in nature reserves. A particular emphasis of this set of activities will be the transfer of the scientific expertise required to translate the results of global change science programmes into the improved management of terrestrial ecosystems undergoing global change, with particular reference to the critically important areas of agriculture, forestry and biodiversity. This effort will provide the scientific information required by decision-makers considering alternative development strategies that involve greenhouse gas emissions, biodiversity conservation and sustainable use of biotic resources. This effort will be executed in close cooperation with the IGBP's Global Change and Terrestrial Ecosystems (GCTE) project and other relevant programme elements.

Activity 1e Global Change and Coastal Zones, Land-Ocean Interactions and International Waters

Coastal zones are home for 60% of the world's population; most of the world's larger cities are located within the coastal zones. In many developing countries especially, coastal zones have been subjected to intense exploitation and weak regulation; they are particularly vulnerable to such aspects of global change as modification of coastal ecosystems, rise in sea level, and changes in the regional climate regime. Work under this theme will be primarily based upon the IGBP programme element on Land-Ocean Interactions in the Coastal Zones (LOICZ) and shares similar objectives including the transfer of the scientific skills for analyzing potential impacts of global change on coastal regions, assessment of human impacts on coastal zones and seas, and further development of the scientific and socio-economic basis for im-

proved management of the coastal environments. It would also involve links to other relevant programme elements dealing with ocean ecosystems and fluxes in biogeochemical materials. (Such an effort has already been initiated in cooperation with LOICZ in Southeast Asia, with the support of the Netherlands Foundation for the Advancement of Tropical Research (WOTRO).

Activity 2 Conduct Research Workshops in Global Change

The research workshops will be of the following types:

1. **Research Design** — One type will be concerned with research design for collaborative regional research projects, linked to the five START programmatic themes. Research design workshops may be of a “scoping” character to help identify on-going regional research that can be built upon or incorporated into a collaborative project. These workshops will also focus on research design and development of standardized data and methodologies.
2. **Research Methods** — These workshops will be concerned with instruction on specific research methodologies, as related to planned or on-going network research activities.
3. **Research Results** — These workshops will review the results of an on-going or completed project and consider its dissemination and application.

Workshops will generally be co-organized with relevant elements of START’s sponsoring programmes and may also be co-sponsored by appropriate scientific organizations, governments or UN agencies.

Expected Outputs

- Design and development of scientifically-valid and policy-relevant research projects
- Development of related research methodologies and transfer of relevant skills
- Dissemination of research findings to diverse audiences through workshop reports and other means.

Objective 2 Human Resource Development

This objective includes enhancing scientific capacity through training, research fellowships, and related activities. Through this objective, the pool of available intellectual resources and technological skills at the national level and in the regional networks will be increased, as will the linkages to the global community of scientists.

This objective will be attained in each of the START regional networks through activities, coordinated by the International START Secretariat, involving the regional centres, affiliated institutions within the network and, as appropriate, laboratories and scientists in overseas institutions. Such capacity building activities will be closely linked to on-going or planned research. National research communities and START's regional networks and centres will help identify national and regional needs and priorities for research staff training. Activities under this objective will involve the START Fellowship/Visiting Scientist Programme, the START Guest Lectureship Programme, the START Visiting Professorship Programme, and support of developing country scientists at international scientific fora.

Activity 1 Strengthen START Fellowship/Visiting Scientist Programme

START fellowships are offered at the dissertation and post-doctoral levels. They are not intended as solely individual awards; not only are the candidate's qualifications considered but also institutional needs and evidence that the candidate will subsequently be involved in regional network research or training. This programme will allow fellows within the region to work under senior mentors in leading laboratories or institutions wherever research is being conducted on regionally relevant issues. Fellowships for students at the dissertation-level will typically involve "sandwich-type" programmes. Under this arrangement, a student is enrolled in a PhD programme in the home country but spends a short period of time at a developed country institution, taking advantage of expertise or equipment otherwise not available. The student then returns to the home country institution to complete the PhD. This aim of this programme is to simultaneously strengthen regional institutional capacities and avoid contributing to a "brain drain" effect. The duration of these fellowships will ordinarily be a minimum of one semester and two semesters at the maximum.

A parallel programme allows more senior scientists from developing countries to undertake short-term visits of one to two months to major international laboratories to learn of recent advances in research and their applications. Both activities lend themselves to the development of long-term partnerships along programmatic themes between institutions in the developed and developing regions. Again, awards are made following criteria which include institutional needs and involvement in the regional programme. (START has already initiated such activities under Phase 1 of this project. See Appendices).

Expected Outputs

- Enhanced national and regional research capacity in developing regions, focusing on the programmatic themes linking environmental change and sustainable development
- Increased research collaboration between scientists from developed and those from the developing countries.

Activities 2 and 3 Extend START Guest Lectureship and Visiting Professorship Programmes

Guest lecturers and visiting professors will be assigned to each regional network following a nomination selection process. Guest lecturers are short-term visitors, typically for one week to a month. Visiting professors are ordinarily appointed for a minimum of one semester. Based at the START regional centre or an affiliated network institution, the visitors would be expected to interact closely with the staff at the host institution and elsewhere in the region by providing tutorials, lectures and advice. The aim is to strengthen existing research and training activities and assist in establishing new lines of research, including policy-related research. In the selection of guest lecturers and professors, priority would be given to scientists willing to develop long-term links between their own and the host institution (“twinning arrangements”) and personally willing to commit to an extended relationship with the host institution. (START has already initiated such activities under this project. See Appendices).

Expected Outputs

- Improved access for institutions and scientists in the developing regions to advances in global change science, theory and methodologies
- Assistance in research design to institutions and scientists in the developing regions
- Development of long-term partnerships between institutions in START regions and major international institutions.

Activity 4 Support Attendance of Developing Country Scientists at Major International Global Change Science Meetings

Establishing a personal network with established scientists and institutions is critical for young scientists. Attending major international science meetings will enable young scientists to meet fellow researchers, exchange data and research techniques, and obtain feedback which will improve their own research efforts, among other benefits. Those selected must participate actively in the meeting (*e.g.*, by presenting papers) and be committed to involvement in follow-up activities.

Expected Outputs

- Enhanced understanding by developing country scientists of recent developments in global change science
- Increased involvement of developing country scientists in the international research activities of the sponsoring programmes.

Objective 3 Support of Policy Formulation

Support of policy formulation will be achieved through a series of integrated assessment, synthesis and policy formulation related activities. The knowledge gained through the research activities of the START networks may thereby be translated into practical strategies for the management of the environment in a sustainable manner. Within the policy-making community, priority will be given to those directly involved in the implementation of relevant international conventions.

Activity 1a Conduct Regional Assessments of Environmental Change

Often policy-makers do not need “new” information *per se*, but rather require integration and evaluation of information and research results. The connection between the global change science and policy-making communities, therefore, requires sustained and full communication. To this end, scientists at the regional centre or a research node will periodically assess the regional implications of global change research findings, as well as advances in mitigation and adaptation strategies. In addition to general overviews, the assessments may concentrate on one of the five START programmatic themes (*e.g.*, land use, climate variability and change, *etc.*) for a more detailed regional assessment based on related national and regional research and its policy implications. These periodic reports, in addition to being widely distributed, will serve as a basis for the science and policy dialogues (see Activity 2 below).

Expected Outputs

- Series of published regional reports reviewing global change science advances and potential applications for policy-makers.

Activity 1b Training in Integrated Assessment Modelling for Developing Countries and Countries with Economies in Transition

In the 1995 Second Assessment Report, the IPCC discussed the potential utility of Integrated Assessment Models to combine the knowledge from a wide range of disciplines into analyses of key issues related to policy formulation. This rapidly evolving methodology can be an effective communications tool between scientists and decision makers on the implications of international and domestic policies related to climate change. The IPCC also noted the still limited inclusion of scientific underpinnings. Especially, the lack of adequate portrayal of the social and economic dynamics of the developing economies and economies in transition limits the use of this important tool on a broader basis.

START has taken up this important challenge. A core group of scientists has been convened which includes those from leading institutions involved in the use of integrated assessment modelling as well as scientists from the START regions. This group has developed an initial strategy with three objectives:

- To build capacity among researchers in developing countries and transition economy countries in the development and use of Integrated Assessment tools
- To improve regional representation of developing and transition economy countries in leading Integrated Assessment Models and incorporation of the driving forces of global change and resource issues of importance to such countries
- To inform policy-makers in such countries on the use of Integrated Assessment Models to support analyses of climate change policy options.

Expected Outputs

- Enhanced capabilities in the developing countries and countries with economies in transition on the use of Integrated Assessment Modelling (IAM) tools
- Collaboration with major IAM institutions on conduct of integrated assessments for specific sectors
- Improved IAMs for regions with developing economies and economies in transition.

Activity 2 Organize Science and Policy Dialogues

These dialogues will bring together scientists, private and public sector decision-makers (*e.g.*, environmental advisers, development planners) and environmental journalists; one potential basis for the meeting discussion will be the periodic regional assessment. Such dialogues, rather than being a one-way transfer of science knowledge, will be structured so as to maximize interactions and provide an opportunity for decision-makers to comment on the appropriateness of the information they receive and their own unmet needs. The dialogues will present an opportunity for policy-makers to learn about new developments in global change science; to pose questions to scientists in the field; and to help shape the future science agenda for the region.

Expected Outputs

- Increased interaction between global change science and policy-making communities
- Transmittal of information regarding regional global change science activities to national governmental and policy-making communities
- Feedback to the scientific community of the needs and priority interests of national-level structures and policy-making communities.

Activity 3 Conduct Targeted Research Directly Linked to Support of Policy Formulation

To help ensure implementation of research that addresses the needs of policy-makers, the policy-making community at both the national and regional levels will be involved in shaping the detailed research agenda and its priorities. Research involved in this activity would be conducted as a direct response to requests from the environment/development policy-making community. It would therefore be highly targeted, applied research for example, to assist the policy community with its obligations and responsibilities in regard to the global change related conventions.

Expected Outputs

- Research findings of immediate interest to policy-makers.

Activity 4 Conduct Short Courses, Workshops and Briefings in Support of Policy Formulation

These courses will be conducted at START regional centres and affiliated institutions in cooperation with other relevant institutions (*e.g.*, IPCC). They will have the express purpose of bringing national and regional policy-making and implementing communities the latest methodologies for linking environmental change science and policy needs. While short courses would be tailored to national and regional needs, they will potentially cover such topics as:

- Impact assessment analysis, including integrated assessment methodologies
- Consequences of regional global change for environment and society
- Adaptation and mitigation strategies and identification of options
- Information needs and tools for decision-making.

In order to further enhance the interaction of the science and policy-making communities, other activities will also be considered, as may be appropriate to each region, for example:

- Special workshops and briefings as requested by policy-making agencies
- Placement of researchers as interns or secondments in policy-making agencies, on a rotational basis, to serve as “translators” between the science and policy-making communities.

Expected Outputs

- Increased numbers of national and regional policy-makers trained in impact assessment and other methodologies required for global change applications to policy-making
- Enhanced interaction between global change science and policy-making communities.

Objective 4 Institution and Network Development

This objective is directed toward improved national and regional capacity to conduct collaborative environmental change research, training and activities in support of policy formulation. The enabling activities under this objective are an essential prerequisite for achieving Objectives 1, 2, and 3.

Activity 1 Strengthening of National and Regional Science Planning and Coordination Mechanism

Regional science planning is the responsibility of the regional START committees (RSCs). Currently, the committees are comprised primarily of representatives of the international global change science programmes, although members of the regional policy-making community may also be members or invited participants. The committees meet at frequencies of every six to twelve months. The RSCs serve as the primary mechanism for formulating plans for regional network development and overseeing the activities of the regional network. They also provide a means for coordinating the national and regional work programmes with the plans of the international global change science programmes which sponsor START, as well as the needs of the regional policy-making community. Moreover, the RSCs’ members are expected to help devise strategies for securing the institutional, human and financial resources from national and regional sources which are needed to sustain the effort over the long-term.

Under this plan, the existing management structure for the START regions will be expanded to facilitate better links between scientists and policy-makers and a closer match between scientific activities in countries and the region and the needs of the policy-making community. Discussions to this end are in progress.

Expected Outputs

- Development and maintenance of an effective national and regional global change science planning and coordination mechanism
- Strengthening of national and regional institutional and human resource bases for research in policy relevant areas
- Improvement of linkages among international global change science programmes, regional institutions and scientists, and national governmental and policy-making structures
- Identification of appropriate regional network components and development of fully functioning regional networks
- Development of an annual global change science workplan for each region.

Activity 2 Support a START Regional Centre Within Each Region

The establishment of START regional centres in developing regions is critical for the conduct and coordination of environmental change research and related activities, and their application to the needs of policy-makers. Such centres are hosted by and located within existing institutions with demonstrated capacities for global change research. Therefore, they do not require substantial infrastructure development. Furthermore, they are centers for distributed networks which undertake cooperative activities in a decentralized manner, permitting use of a number of specialized research facilities within the region.

Each regional centre serves as the information and coordination centre for a regional network and provides a multi-disciplinary setting within which the results gathered from various disciplines and regional institutions concerned with global change phenomena can be synthesized into a policy-relevant regional framework. Capacity will be developed at each START regional centre to operate, manage and archive regional data and other information on global change research. Efforts will also be undertaken to synthesize and integrate results from various research activities conducted in the network.

When fully operational, the START regional centres may also prepare regional analyses and assessments of impacts of global environmental change and the implications of alternative policies for long-term sustainable development. The centres also will foster similar activities at national levels and help identify needs for research capacity building. The centres also will provide facilities for training scientists and policy-makers from the region. Finally, the START regional centres may also serve as regional offices for START's sponsoring programmes — IGBP, IHDP, and WCRP — or their individual programme elements.

Selection of the site for a regional centre follows a process of proposal review and site visits and is based on the recommendation of the RSCs.

Expected Outputs

- Fully operational regional centres for all START regions in Africa and Asia to provide secretariat and coordinating functions as well as network support for research and training, modelling, data and information systems, and policy assessments.

Current START Regional Centres and Secretariats

START regional centres have already been selected for the following regions:

Temperate East Asia	Chinese Academy of Sciences, Beijing, China
Southeast Asia	Chulalongkorn University, Bangkok, Thailand
South Asia	National Physical Laboratory, New Delhi, India
Northern Africa/ Southern Africa	Pan-African START Secretariat at the Kenya National Academy of Sciences/University of Nairobi serves the administrative needs of both Northern and Southern Africa
Mediterranean	Interim Secretariat currently at MEDIAS, Toulouse, France.

Activity 3 Strengthen Affiliated Institutions

Affiliated institutions are components of START regional networks. Such institutions will have agreed to participate in regional collaborative research activities and to commit in-kind resources. The capacity of the affiliated institutions to conduct research will also be enhanced by activities detailed elsewhere in this document, including:

- Provision of basic equipment for communication as well as managing data and information
- Provision of tutorial and advisory services by visiting staff (*i.e.*, under the START Guest Lectureship and Visiting Professorship Programmes)
- Participation by the staff of affiliated institutions in the various advanced training opportunities to be offered (*i.e.*, START fellowships/visiting scientist awards, short courses, *etc.*)
- Development of links with international science programmes and leading global change science centres.

(Various elements of this set of activities readily lend themselves to the establishment of long-term partnerships or “twinning relationships” between national institutions in developed and developing countries).

Expected Outputs

- Such strengthened institutions will provide improved national and regional capacity to engage in collaborative research, capacity building, and policy support functions as part of the START regional networks.

Activity 4 Develop a Data and Information System (DIS) for Each Region and Link Institutions and Scientists Through Communication and Networking Activities

Global change research activities require highly diverse data and information. The challenge is not only to archive, preserve, and make data available for research activities, but to also combine data from various disciplines and sources. These data must be standardized and organized, so that they can be used by scientists for analysis. Without such an effort, there will be major problems in the compatibility of measurement definitions, documentation and inconsistent results.

Each regional centre will serve as the site for a regional database serving the data and information needs of researchers and policy-makers throughout the region, initially by compiling meta-information directories. For this purpose, electronic communications equipment, software, a data and information systems specialist, related tutorial efforts and training activities for both scientists and policy-makers, will be needed.

A major objective of the regional network will be the establishment of an interactive network of institutions, scientists and policy-makers. To promote this interaction, communication efforts obviously are of prime importance. Newsletters and other regional publications and, ultimately, the development of an electronic communications network will be required.

The rapid spread of the Internet and the World Wide Web (WWW) will soon bring into reach unprecedented opportunities for scientists in developing countries to access the most recent research developments in global change science and to engage in interactive dialogues with colleagues around the world. START, therefore, is placing special emphasis on this aspect of capacity building through a series of regional training workshops to ensure full utilization of these emerging capabilities.

Finally, national institutions in the regions also will be linked by participation of their staff in research planning meetings and workshops, since face-to-face contact is also vital to research collaboration and network development.

Expected Outputs

- Improved national and regional capacity to generate required data
- Compilation of national and regional data catalogs
- Development of IGBP-DIS nodes at each regional centre as well as at selected institutions within the regional network

- Improved access for scientists to global change research data and information
- Active regional networks of national institutions engaged in collaborative regional research on a range of global change research topics
- Production of annual/bi-annual regional newsletter
- Compilation of regional directories of scientists and institutions
- Preparation of material for WWW Internet site (already initiated in 1996)
- Enhanced communication among network institutions and scientists.

START Regional Workplans

START regions use the objectives described above as guides in producing their respective regional workplans. Translating these objectives and their associated activities into specific workplans for each START region is a coordinated effort of the RSCs, science advisory panels, involving the international global change science programmes, and the International START Secretariat. The specific workplans of each RSC reflect the priorities and needs of a particular region, as well as the START programmatic themes. (Initial regional research programmes, either on-going or planned, are shown in Figure 5).

Figure 5

Current Regional Research Programmes and Projects.



Funding, Management and Evaluation

Despite broad and enthusiastic support from the scientific community within the developing regions, and strong endorsements from various multilateral agencies, START remains precariously funded. To raise the substantial funds required for implementation of the START initiative will require the support of a number of partners (see below “Towards a New Partnership.”) Current funding from the donor community tends to be short-term and annual in nature, as well as limited in scope. However, to achieve a consistent pattern of development and to fulfill its main objectives, the START effort requires an assured base of multi-year support. Only with such support can the long-term viability of the START system of networks be ensured.

Substantial in-kind support is being provided by the developing countries, particularly in the nations which host a START regional secretariat/regional centre. Staff time, office and training facilities, and communication expenses are provided largely by the host institution of each START regional secretariat/regional centre. In addition, research participants and science advisors are volunteers, representing another large, if difficult to quantify, in-kind contribution. In 1995-96, the estimated in-kind contribution for all six START regional networks totaled nearly US \$1.2 million, reflecting the serious commitment on the part of the developing countries to support the START initiative and comprising a substantial part of the overall START budget.

Budget Categories

The overall operating budget for START worldwide falls into three broad categories:

Core Budget

Project Budget

Programme Budget

The budget is derived from various sources (See List of START Financial Sponsors in the Appendices).

The Core Budget has two elements: (i) it provides support for the administrative and operational costs of the START Secretariat, including staffing, meetings of the START Scientific Steering Committee (SSC) and START Bureau; and (ii) it provides partial enabling support to regional coordinating secretariats which are supported primarily through national/host institutions and other national contributions. (Currently, funding for the Core Budget is provided primarily by the US Global Change Program through the US National Science Foundation (NSF) for the International START Secretariat. Regional secretariats are supported largely by host country institutions. Additional support is provided by various national contributions).

The Project Budget involves support for specific short-term activities and projects, which may range from several months to years in duration. They include cooperative research activities with programme elements of the sponsoring programmes; START-initiated regional projects; and projects of national funding agencies which are closely linked to regional projects. Funds for such activities and projects will be sought from a variety of sources including foundations, national governmental science agencies, and international organizations. In addition to national projects linked to regional programmes, major sources for project funding currently include: United Nations Development Programme/Global Environmental Facility (UNDP-GEF); US NSF; United States Agency for International Development (USAID); Canadian International Development Agency (CIDA); the European Commission; and APN. Funding for collateral projects linked to START regional networks also is obtained from the Australian Agency for International Development (AusAID) and the Netherlands' WOTRO.

The Programme Budget is intended to provide a long-term underpinning for the START regional enabling activities described in this plan. Included under the programme budget are such cross-cutting enabling activities as regional network planning and coordinating mechanisms, research formulation and dissemination, human resource development, and activities supporting policy formulation. Funding for such long-term programmatic activities is being sought from a consortium of donor assistance agencies. (Denmark and the Netherlands have provided funds for a pilot effort in support of the START Implementation Plan while looking toward a long-term programme supported by a broader coalition of donors).

Management Structure and Programme Implementation

START's existing management structure and planning process have evolved primarily in response to the needs of the global change science research community and has been effective for that purpose. START's current management structure has several major elements:

- At national levels, science planning with particular reference to involvement in the international global change science programmes is typically carried out by a national committee for global change, organized by a country's national academy of sciences, national research council, or the equivalent. Such committees, ideally, recommend national priorities and plans for global change science research as well as addressing needs for infrastructure, human resource capacity building, etc. The chair of such committees typically serves as the national member on a RSC.
- At the regional level, the RSCs are comprised of representatives of national communities of scientists engaged in global change research. (Often the chair of the national committee for global change or IGBP serves on the regional committee). RSCs are typically comprised of both scientists and science managers and are responsible for the guidance of network development and for the establishment of regional science priorities and workplans. In cooperation with the programme elements of the sponsoring programmes (IGBP, WCRP and IHDP), RSCs may establish scientific advisory panels to develop and monitor activities on specific global change issues within a region. The RSCs are assisted by staff of the START regional secretariats, which are usually co-located with START regional centres.
- At the international level, the START SSC is comprised of leading scientists involved in: the international global change programmes (IGBP, IHDP, and WCRP); leading science managers of major national and regional global change science programmes; and representatives from international agencies and multilateral programmes. Thirteen members, representing both the developed and developing regions of the world, form the committee (the six chairs of regional committees or directors of regional centres meet concurrently with this committee). The START SSC has responsibility for the planning and guidance of the overall START effort, including establishing the effort's priorities and reviewing START workplans. Staff at the International START Secretariat assist the SSC and provide day-to-day support for network development in the regions.

These governing bodies have distinct responsibilities with respect to programme planning for the START effort. The START SSC has, for the most part, engaged in long-term planning for the overall START effort. The RSCs (together with their respective scientific advisory panels) have focused more on short-term to mid-term, as well as annual programme planning at the regional level.

A closer engagement between the research community and the government and policy-making communities is now required at both the national and regional levels. Such an engagement will ensure the relevance of START's regional research and capacity-building activities to the needs of the governments and policy-making communities. The governments and policy-making communities are expected not only to help support global change research, but ultimately, to translate those results into political action. To achieve a closer engagement, some modification to the current process for programme planning and management is required and options are under discussion with START's programme and financial sponsors.

The future effectiveness of START will depend on achieving a more dynamic relationship, not only among researchers, but among researchers, governments, policy-makers, implementors, and funders. Dialogue between the research and policy-making communities is crucial; unless policy-makers are able to absorb and act upon research results, and the research community is responsive to the needs of the public and private sectors in regard to sustainable development, the prospects for achieving sustainable development will be dim.

Experience has shown that such a dialogue, though necessary, is not easy to achieve and sustain. It is crucial in the next phase of its development that START, with the help of the donor community and RSC, endeavour to put into place a structure that responds to the challenge of creating the required dialogue.

Toward a New Partnership — The Role of START’s Partners

Success in achieving the objectives of the START requires a true partnership between a number of agents, each with their own role to play. (Table 2) The International Group of **Funding Agencies** for Global Change Research has noted that “...science funding agencies and aid agencies should be encouraged to work together to develop increased funding for capacity building and development of research infrastructure.”³ Other partners are involved as well, including host institutions and **governments** since a basic principle for providing external support must be local initiative and commitment leading over time to self-reliance. Each member of this partnership will have responsibilities and obligations:

The Global Change Science Community

This involves not only START and its regional science structures, but also its sponsoring programmes — IGBP, IHDP, and WCRP — and their programme elements. They share an obligation to plan and implement high quality research, training, and policy-linked activities.

National Scientific Funding Agencies and Mechanisms

The scientific funding agencies’ primary role is funding sound basic science research projects, including joint ventures of the north and south and the national component of collaborative regional projects. [National contributions are also required for the basic core support of the International START Secretariat and related science planning activities].

³ International Group of Funding Agencies for Global Change Research’s response to the EVALUATION OF IGBP, June 1, 1996.

Table 2

START Funding Partners.

	<u>Objective</u>	<u>Source of Funds</u>
<u>Core Budget</u>	Intl. START Secretariat Regional Sec./Centers: TEA SAS SEA Africa MED	Host Country: Global Change Research Program (US) Host Country: China – plus supplem. DAA* India – plus DAA* Thailand – plus DAA* Kenya – plus DAA* France
<u>Project Funds</u>	Basic Global Change Research Applied/Policy-Directed Research	National Science Funding Agencies Bi-lateral S&T Programmes Multi-lateral Organizations APN ENRICH Foundations DAA* APN ENRICH UN National Sources Private Sector
<u>Programme Funds</u>	Capacity Building Policy Support Network & Enabling Activities	DAA*, ENRICH, APN. GEF World and Regional Banks Multi-lateral and Bilateral Donors

* Development Assistance Agencies

Multi- and bilateral donors are expected to: help in developing local and regional research planning and policy-making structures; promote interaction between them; help link local to regional agendas and programmes and *vice versa*; (co-)finance programmes of human resource and institutional research capacity building at local and regional levels; and fund activities in support of policy formulation and implementation.

National Governments in the Developing World

The national governments, as represented by key policy-makers, are expected to: (i) articulate national needs; (ii) help to define regional programmes; (iii) mobilize local resources; (iv) create public awareness of problems of environmental change and sustainable development; and (vi) involve the private sector as required. Funding of regional secretariats will also be primarily the obligation of the host country / institution.

Creation of a true partnership among these various communities represents a great challenge, but a goal that must be achieved to conduct and apply the findings of global change science and assure that development is truly sustainable.

Implementation and Evaluation

Implementation Schedule

An implementation schedule with anticipated milestones for each START region is provided in Figure 6.

Criteria for the Evaluation of START

The criteria for determining the success of START are set out in a number of documents and include:

- An increased understanding of global change issues at a regional level
- An increase in basic global change science research initiatives and publications
- An increase in the number of developing country scientists trained in global change research and participating in global change science programmes
- Improved regional infrastructure for global change research, including electronic communications networks
- Development of regional databases and improved access to data
- Enhanced regional cooperation for global change research and training

- More continuous dialogue between the science and policy-making communities as well as development of policy-relevant research directed toward the needs of decision-makers and the goal of national and regional sustainable development
- Increased co-funding of global change science activities by developing countries
- Measurable impacts on policy formulation
- Visible influence of the developing countries on the global change science agenda.

Evaluation Process

Evaluation of START's activities and progress takes place at different levels, including:

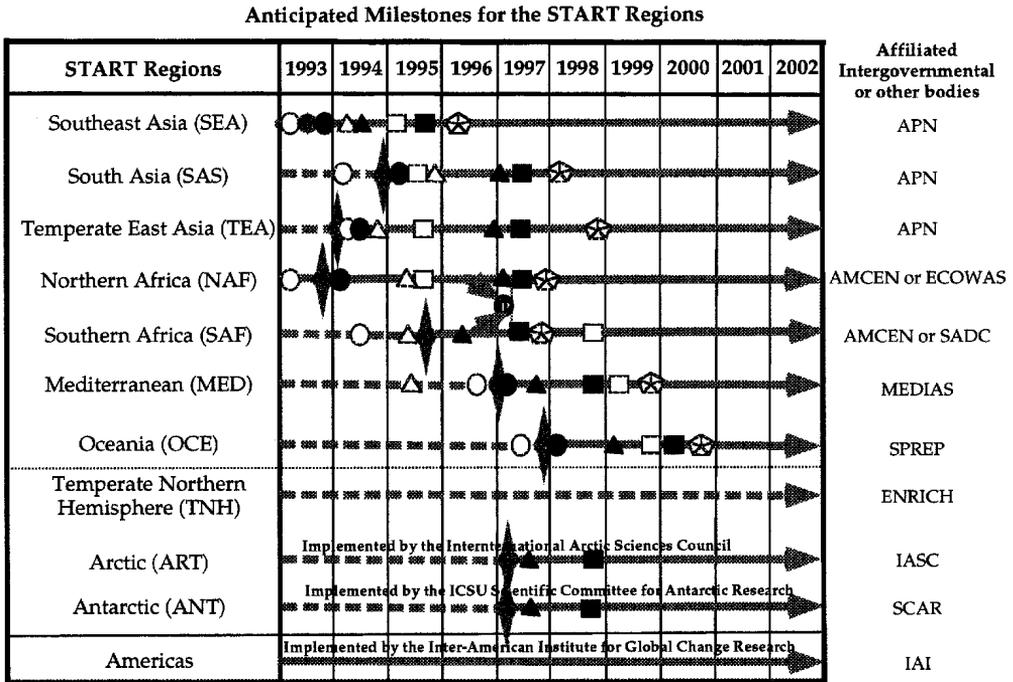
- Individual activities, *e.g.*, workshops generally are evaluated by participants; similarly fellowship, lectureship, visiting scientist awards already require evaluation by the participants and host institutions
- Regional network activities are reviewed annually by START regional committees
- The overall START initiative is currently reviewed bi-annually by the START Bureau and SSC.

In addition, START anticipates periodic evaluations to be conducted by its financial and programme sponsors.⁴

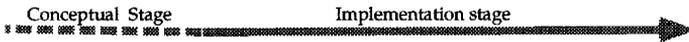
⁴ The START initiative has undergone periodic extensive external reviews, for example, in 1995 by ICSU as part of its review of the IGBP and subsequently by UNDEP-GEF which conducted a mid-term review in 1995-1996. Both were highly supportive of START.

Figure 6

Implementation Schedule.



Legend:



Symbols refer to the expected time for:

- Initial Planning Meeting
- Regional Center
- △ Training Program
- ◆ Regional START Committee
- Regional Network
- ▲ Research Projects
- Regional Secretariat
- ☆ Science-policy forum

Appendix I

START Regional Network

The components of a START regional network include:

- START regional centre
- START affiliated institutions, including regional research nodes and sites.

These interconnected components are linked to the programme elements of the sponsoring programmes. Both components are typically located in existing institutions in a region which have agreed to commit facilities and personnel to collaborative global change research activities.

A START Regional Centre

A START Regional Centre typically serves as the information and coordination centre for the entire regional network and, in addition, may perform the following region-wide tasks:

- Research, including overall coordination of regional and national global change research and environmental monitoring
- Training, including design and coordination for national and regional needs
- Establishment and maintenance of regional databases
- Regional synthesis, integrated assessments and modelling
- Prediction of regional environmental change and its consequences
- Communication of scientific results to the decision-makers and the public within the region
- Assessments for policy formulation at national and regional levels
- Promotion of national research communities in the regions.

START Affiliated institutions

Research sites are existing national institutions within the region which have agreed to participate in research on key topics of global change research. They are generally affiliated with both the START regional network and the relevant programme elements of the sponsoring programmes. In addition to research and training functions, each affiliated institution may also undertake activities bearing explicitly on policy formulation. If there are multiple institutions within a region engaged in a single collaborative research project, they may form a research consortium with one institution identified as a research node (“lead institution”). (See Figure 7).

Development Process of START Regional Networks

The START regional networks are being developed in a series of steps, designed to achieve START’s goals. These steps comprise the initial development stage: identification of regional priorities and capabilities; determination of coordinating mechanisms; establishment of regional centres; selection and designation of START affiliated institutions; and implementation of regional research, training and policy-relevant projects.

Typical Steps to Establish a START Regional Network

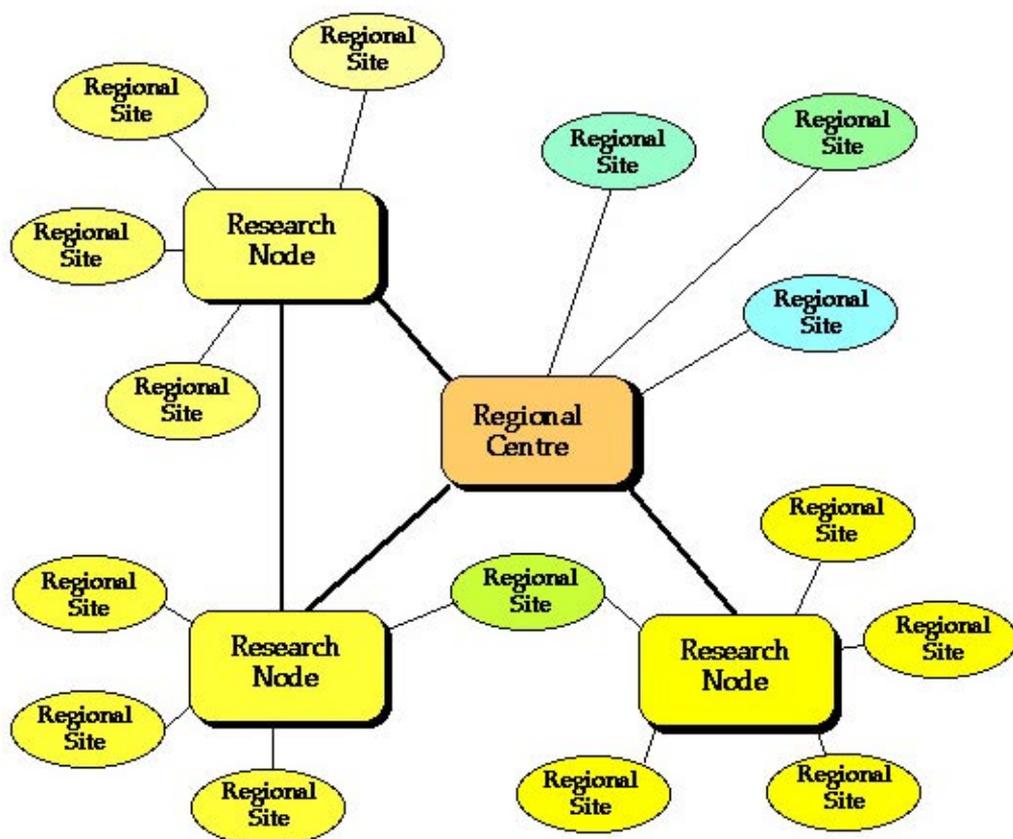
- Initial regional meeting(s)
- Identification of initial regional research priorities
- Inventory of national and regional capabilities
- Establishment of coordinating mechanism(s)
 - Secretariat
 - Regional Planning / Coordinating Committee
 - Scientific Advisory Panel (SAP)
- Designation of network components
 - Regional Research Centre
 - Regional Research Sites and Nodes
- Research workshops and programmes
- Training and fellowship programmes at national and regional levels
- Development of regional and national data and information capability
- Dissemination of publications and meeting reports
- Assessments for policy-makers.

Figure 7

Regional Research Network Institutional Architecture.

Functions:

- Regional Centre: Secretariat and overall coordination of network, data and information systems, modelling and synthesis
- Research Node: Lead institution for a thematic research activity
- Regional Site: Affiliated research institutions or stations grouped by thematic activity.



Regional Research Network Institutional Architecture

- Regional Centre: Secretariat and overall coordination of network, data and information systems, modelling and synthesis
- Research Node: Lead institution for a thematic research activity
- Regional Site: Affiliated research institutions or stations grouped by thematic activity.

Initial Development

In this first phase lasting from 1992 through 1995, the basis for the regional networks in the developing regions of the world was established and initial science priorities were developed through a process of regional consensus building at meetings and workshops. Key institutions and scientists engaged in global change research were identified. START regional planning committees were established by the START Scientific Steering Committee and the International START Secretariat. Together with these two bodies, the regional planning committees guided the organizational efforts, in collaboration with the programme elements of IGBP, IHDP, and WCRP, to prioritize and initiate regional research efforts. Decisions concerning the initial location of regional network components were also made.

Continuing this practice, the developments in each region are now guided by a START regional committee. Typically, the chair of the national committee for global change activities (usually established by a nation's research council) or a leading national public sector science manager is chosen to serve as the nation's representative on the regional committee. Invited participants at committee meetings may include representatives from the projects of the sponsoring programmes and from major international and regional environmental and developmental institutions and agencies.

Establishment of START Regional Centres

This is a key phase for START. The START regional centre serves a central role in the development of the networks by acting as an information centre and providing secretariat and coordinating functions. They also act as facilitating and supporting platforms for national programmes of research and research capacity building. In addition, the centres provide linkages to the International START Secretariat and the programme elements of the sponsoring programmes and participate in national and regional research, training and policy-relevant activities.

Selection and Designation of START Affiliated Institutions

This phase is among the most involved and, ultimately, the most important of the phases of network development. In consultation with the relevant programme elements of the sponsoring programmes, affiliated institutions for each START regional network are selected based on their capabilities and willingness to participate in specific research activities of the regional network. As needed, consortia of such institutions are formed to pursue specific research themes; for any given consortium, one institution may be designated as a research node ("lead institution").

Implementation of Research Programmes

Regional research workshops on themes drawn from the initial regional priorities provide a basis for developing targeted regional research projects involving a network of regional scientists. Typically such workshops are held in close collaboration with the relevant programme elements of IGBP, IHDP, and WCRP, related ICSU bodies, or intergovernmental structures, such as IPCC. In most instances, START research workshops are expected to generate not only recommendations for “on-the-ground” research projects, but also proposals that may be submitted for consideration to regional and international funding agencies. Training workshops, in contrast, focus on capacity building within the region but are commonly linked to existing or planned research or policy activities.

Research and training workshops have been undertaken on topics such as:

- Land use and land cover change (Thailand)
- Methodologies for assessing greenhouse gas emissions (The Philippines)
- Climate and ecosystem modelling and impacts assessment (Australia and Malaysia)
- Desertification, deforestation and climate change (Africa)
- Climatic variability and its agricultural consequences (India)
- Global change impacts on subsistence rangelands (Africa) and on mountain hydrology and ecology (Nepal)
- Economic methods and integrated assessments of coastal zones (Southeast Asia)
- A socio-economic research agenda for global change (Thailand).

The “summer” schools supported and organized or co-organized by START include:

- A symposium-*cum*-summer school on the frontiers of global change research in Beijing, China, for young Asian scientists
- An international training school on global change in Nairobi, Kenya, for young African scientists
- A summer school on IGBP-DIS for global change research in College Park, Maryland, at the University of Maryland, USA, with participants from all START regions.

Activities during the past year have involved the scientists and scientific communities of some 50 countries.

In addition to educating scientists in the region, START workshops and fora may also bring scientists together with their counterparts in the policy-making community. In the next year, for example, START will co-sponsor climate change impact assessment workshops in Asia and Africa. A Global Change Science and Policy Forum, held recently in Bangkok, Thailand, and co-sponsored by intergovernmental and governmental organizations, provided an occasion for discussing the science and policy components of key regional issues for Southeast Asia, such as land use change, climate variability, and coastal changes and processes.

Appendix II

START Fellowship/Visiting Lectureship Programme

More than 100 scientists, from 27 different countries, have submitted applications for the START Fellowship/Visiting Scientist Programme and the START Visiting Lectureship Programme. In three rounds of awards, START has made Fellowship/Visiting Scientist Awards to 10 scientists from Africa, seven from Asia and one from the Mediterranean region, for study and research at institutions in Canada, Denmark, France, the Netherlands, South Africa, and the USA. Eight senior scientists received Guest Lectureship Awards to share their expertise with institutions in China (Beijing), Indonesia, Kenya, Malawi, Malaysia, Mozambique, Singapore, the Philippines, Taiwan, Thailand, Vietnam, and Zimbabwe.

A List of Fellowship/Visiting Scientist Awards

Dr. Kodjo Amegee, Universite du Benin, TOGO and Scientific Coordinator, START Northern Africa Secretariat, GHANA

Dr. Amegee undertook research on modelling global change impacts on water resources while at the International Institute of Water Resources, Delft, The Netherlands.

Dr. K.V.S. Badarinath, National Remote Sensing Agency, INDIA

An active participant in IGBP-related activities in India, Dr. Badarinath studied the modelling of land use changes in India during his stay at the National Research and Ecology Laboratory (NREL) in Fort Collins, Colorado, USA.

Dr. Abdelkader Dodo, University of Niamey, NIGER

Dr. Dodo lead a group working on groundwater studies of the Afro-European Transect Project (PAGES-PEP III). Host institutions were Orsay University in Paris and the MEDIAS Office in Toulouse, France.

Ms. Regina Folorunsho, Nigerian Institute for Oceanography and Marine Research, NIGERIA

Ms. Folorunsho was based at the LOICZ IPO in the Netherlands. She worked with LOICZ staff to integrate Geographic Information System (GIS) data for West African coasts and obtained training in the modelling of coastal processes.

Prof. Fu Congbin, Regional Research Centre for TEA, CHINA (Beijing)

Prof. Fu developed a proposal on regional modelling for climate change over East Asia. The National Center for Atmospheric Research (NCAR) at Boulder, Colorado in the USA hosted Prof. Fu.

Mr. Charles K. Gatebe, University of Nairobi, KENYA

While at the University of the Witwatersrand in South Africa, Mr. Gatebe analyzed data collected at Mt. Kenya and carried out air trajectories for eastern Africa.

Dr. Christopher Gordon, Volta Basin Research Project, GHANA

Dr. Gordon developed three categories of models from observations of coastal lagoons in Ghana, following procedures defined by the LOICZ Science Plan. NIOZ in the Netherlands hosted his visit.

Dr. Daji Huang, Second Institute of Oceanography, CHINA (Beijing)

Dr. Huang studied numerical techniques for ecosystem dynamical modelling at the Ecological Modelling Centre in Denmark.

Dr. J.I. Kinyamario, University of Nairobi, KENYA

During his stay at NREL, Colorado State University, USA, Dr. Kinyamario used the Century Model to simulate data obtained from the Nairobi National Park grassland site.

Mr. Haiyuan Liu, Institute of Geography, Chinese Academy of Sciences, CHINA (Beijing)

Mr. Liu was hosted by NREL, Colorado State University, USA. During his visit, he worked on the NREL-TEACOM joint project on land use change.

Mr. Collins Mweene, University of Zambia, ZAMBIA

Mr. Mweene studied greenhouse gas effects and climate change. He was being hosted by the Climatology Research Group at the University of the Witwatersrand in South Africa.

Mr. Ben Kisila Odhiambo, University of Nairobi, KENYA

A graduate student at the University of Nairobi, Mr. Odhiambo was engaged in special studies linked to the International Decade for the East African Lakes (IDEAL/PAGES) research. While at the University of Minnesota, USA, he studied climate dynamics during human evolution in East Africa, using lake sediments collected by an IDEAL expedition.

Prof. Wandera Ogana, University of Nairobi, KENYA

Prof. Ogana served as the co-organiser of the GAIM Africa '97 workshop. The University of New Hampshire and the NCAR in Boulder, Colorado, USA, hosted his visit, during which he gained familiarity with the models and equipment to be used at the 1997 workshop.

Mr. Almeida Siteo, Universidade Eduardo Mondlane, MOZAMBIQUE

Mr. Siteo worked directly with one of the leaders of the inter-core Miombo transect project at Michigan Technological University, USA. His research focused on acquiring Landsat TM data for the Mozambique Miombo region.

Ms. Djamila Tellia, Ministry of Interior and Environment, ALGERIA

Ms. Tellia developed a research plan in the area of carbon cycle modelling and application of remote sensing techniques. She was hosted by the Laboratory of Terrestrial Ecology in Toulouse, France and visited a number of other laboratories in that region.

Dr. D.C. Uprety, Indian Agricultural Institute, INDIA

Dr. Uprety studied issues involved in implementing Free Air CO₂ Enrichment (FACE/GCTE) technology during his stay at the US Water Conservation Laboratory, Agricultural Research Service, US Department of Agriculture in Arizona, USA.

Dr. Kanthi Yapa, University of Ruhuna, SRI LANKA

Dr. Yapa's research focussed on the effects of ocean waves, currents and tides on migrating fish and fish production in southern Sri Lanka. She was hosted by Canada's Bedford Institute of Oceanography.

Dr. Yun Qian, START RRC for Temperate East Asia, CHINA (Beijing)

As follow-up to a recent START/APN workshop on regional climate modelling, Dr. Qian visited NCAR in Boulder, Colorado, USA. He prepared training courses as part of the START/APN workshop during the autumn of 1997.

Visiting Lectureship Awards

Dr. Paul Desanker, Michigan Technological University, USA

Dr. Desanker, a leader of the inter-core transect project on Miombo woodlands, is hosted by the University of Zimbabwe. He gave lectures at institutions in Cameroon.

Dr. Liping Di, Earth Observing System (EOS/DIS), USA

Dr. Di worked with the TEA-START to develop a regional data and information system at the RRC for TEA.

Prof. Dean Hegg, University of Washington, USA

Prof. Hegg lectured on aerosol science and heterogeneous cloud chemistry, while being hosted by Beijing University, China.

Dr. Chris Justice, National Aeronautics and Space Administration (NASA), USA

Dr. Justice participated in a IGBP-DIS workshop held at the Southeast Asia START RRC in January 1997. He also provided assistance to the regional center in identifying regional data needs, existing data sets and gaps in availability.

Prof. David Karoly, Monash University, AUSTRALIA

Prof. Karoly's lectures focussed on greenhouse gases and climate change, during his stay at the START TEA RRC in Beijing, China.

Dr. John Pernetta, LOICZ IPO, THE NETHERLANDS

Dr. Pernetta was hosted by SEA-START. During his stay, he participated at various coastal zone management meetings, made presentations at seminars and assisted in the development of project proposals for national research related to LOICZ.

Prof. Herman H. Shugart, University of Virginia, USA

Prof. Shugart was hosted by the START SEA RRC in Bangkok, Thailand, and the GCTE Impacts Centre in Bogor, Indonesia. He gave lectures on global change and forest ecosystems at institutions in Thailand, Indonesia, and the Philippines.

Dr. Will Steffen, GCTE IPO, AUSTRALIA

During his visit to southern Africa, Dr. Steffen introduced the GCTE Impacts Centre project to relevant institutions and agencies, as the initial steps toward establishing such a centre in the region.

Additional scientists have been nominated to participate in a short-term fellowship programme for Central African, South American, and Southeast Asian scientists. Dr. Chris Justice of NASA's Goddard Space Flight Center, USA, will coordinate a training programme for Central African scientists, while Prof. Herman Shugart of the University of Virginia, USA, will develop the Southeast Asian programme. Candidates from South America will be selected in cooperation with the IAI.

Central Africa

M. Bizenga, CERGEC Brazzaville, Congo

Zasy Ngisako, Inventaire Forestier, SPAF, Republic of Congo (Formally Zaire)

Jean-Bruno Vickos, Centre ORSTOM de Bangui, Central African Republic.

Southeast Asia

Damasa M. Macandog, University of the Philippines, Los Banos, the Philippines

Mastura Mahmud, University Kebangsaan Malaysia, Malaysia

Budi Suharjo, Bogor Agricultural University, Bogor, Indonesia

Desi Ariyadhi Suyamto, Southeast Asian Impacts Centre, Bogor, Indonesia

Upik Rosalina Wasrin, Southeast Asian Regional Centre for Tropical Biology, Bogor, Indonesia.

Appendix III

START Activities: Research Workshops and Training Courses Sponsored/ Co-Sponsored by START

- Africa and Global Change; Niger — 23-27 November 1992
- SARCS Greenhouse Gas Inventories, 21-25 March 1993
- African Savannas, Land Use and Global Change; Zimbabwe — 2-5 June 1993
- START/PAGES Workshop on Past Global Changes in Africa; Kenya — 16-17 December 1993
- IGBP/SARCS Workshop on Methodology for Land Use/Land Cover Change; Thailand — 21-25 March 1994
- SARCS Regional Tutorial on Climate Change and General Circulation Modelling; Australia — 2-13 May 1994
- SARCS/LIPI/WOTRO Workshop on Coastal Zone Research in Southeast Asia; Indonesia — 9-11 May 1994
- SARCS/GCTE/CSIRO Course on Modelling Ecosystem Response; Malaysia — 15-20 August 1994
- SARCS Regional Training Course on Flux Measurements; the Philippines — 16-27 November 1994
- SARCS Training Course on Land Use and Land Cover Change; Thailand — October - December 1994
- SARCS Regional Training Course on Flux Measurements; the Philippines — 16-18 November 1994
- IGAC-DEBITS/START Measurement of Trace Chemical Fluxes; Cote d'Ivoire — 5-8 December 1994

- SARCS /HDP Regional Workshop on Socio-Economic Research Agenda for Global Change; Thailand — 9-11 December 1994
- SASCOM/WCRP/IGBP Workshop on Climate Variability and its Implications; India — 6-9 February 1995
- SARCS Workshop to Develop Appropriate Methodologies for Assessing GHGs; the Philippines — 11-15 April 1994
- SARCS/WOTRO/LOICZ Workshop on Economic Methods for Coastal Zone Research; the Philippines — 20-22 April 1995
- START Southern Africa Workshop: Global Climate Change Scenarios; South Africa — July 1995
- START/GAIM Workshop in conjunction with GAIM First Open Science Conference; Germany — 24-29 September 1995
- START/IGAC Workshop in conjunction with IGAC's Conference on Measurement and Assessment of Atmospheric Composition Change; China-Beijing — 9-14 October 1995
- SARCS Second Regional Training Course on Flux Measurements; Australia — 15-25 October 1995
- START/SAS Workshop on Cyclones and Related Phenomena; Bangladesh — 18-20 November 1995
- GAW-WMO/IGAC/AGU/START/IAI Training Course on Trace Gas Instrumentation and Measurement; Argentina — 30 October-1 November 1995
- SARCS/WOTRO/LOICZ Workshop on Biophysical Modeling; Malaysia — 4-8 December 1995
- GCTE/LUCC/IGBP-DIS Workshop on Miombo Ecosystems Processes and Mechanisms; Malawi — 4-8 December 1995
- START/SARCS/APN Global Change Science and Policy Forum, Thailand — 27-28 March 1996
- TEACOM/APN Land Use Working Group Meeting, China-Beijing — 8-9 May 1996
- BAHG/GCTE/SASCOM Workshop on Global Change and Mountain Hydrology and Ecology; Nepal — 30 March - 2 April, 1996
- Workshop on Land Use Change in the Humid Tropics: An Integrated SARCS/IGBP/IHDP Southeast Asia Study, Thailand — 27-30 May 1996
- START/GCTE Workshop on Global Change Impacts on African Grasslands and Rangelands; Botswana — 10-14 June 1996
- Living with Global Change: Linking Science and Policy in Southeast Asia, Bogor, Indonesia — 12-15 August 1996
- SARCS: Advanced Training Workshop on Regional Remote Sensing and LUCC Modeling, New Hampshire, USA — 7-18 September 1996

- TEACOM/ APN Workshop on Regional Climate Modeling, Boulder, Colorado, USA — 16-17 September 1996
- START/ENRICH International Workshop on Global Change in the Mediterranean Region, Spain — 25-28 September 1996
- START/NOAA/WCRP Workshop on Reducing Climate-Related Vulnerability in Southern Africa, Zimbabwe — 1-4 October 1996
- SARCS/WOTRO/LOICZ Principal Investigators meeting, Vietnam — 26-30 October 1996
- TEACOM/ APN Workshop on Land Use in East Asia, Japan — 8-9 November 1996
- SASCOM/SAIPO Workshop on Aerosol, Biomass Burning and Acid Rain, Reduit, Mauritius — 8-10 January 1996
- START/APN/IHDP/GCTE Workshop on Human Dimensions of Global Environmental Change in Asia, India — 20-23 January 1997
- SARCS Regional Database Workshop, Bangkok, Thailand - 27-31 January 1997
- START/WCRP/IGBP-GCTE Workshop on Climate Variability/ Agricultural Production and Food Security in the Asian Monsoon Region, Bogor, Indonesia — 19-22 February 1997
- NOAA-OGP/START-APN Preparatory meeting for Asia/Pacific Regional ENSO Pilot Activities, Bali, Indonesia — 25-26 February 1997
- GAIM/START Tutorial Workshop on Terrestrial Modeling, Kenya — March 1997
- IPCC/START Integrated Assessment Modeling Training Program, Core Group Planning Meeting, Japan — 9 and 13 March 1997
- SARCS-LUCC Synthesis Workshop, Pattaya, Thailand — 12-14 May 1997
- SASCOM-GCTE: FACE Planning Meeting, New Delhi — 23-26 June 1997
- SASCOM and others: Dynamics of Land Use/Cover Change in the Hindu Kush-Himalayas, Kathmandu, Nepal — 21-24 April 1997
- SASCOM-LUCC Land Use/Cover Change in the Indo-Gangetic Plain — 30 April - 1 May 1997
- START/WCRP/ICSU-SCOWAR/ORSTOM Workshop on Climate Variability Prediction, Water Resources and Agricultural Production: Food Security Issues in Sub-Saharan Africa, Cotonou, Benin — 22-25 July 1997
- Workshop on Land Uses and Land-Cover Change in Miombo Ecosystems, Lusaka, Zambia — 28-31 October 1997
- TEACOM Workshop on Regional Modelling of General Monsoon System in Asia, China - Beijing — 20-23 October 1997
- START/NAFCOM/CARPE Workshop on Land Use and Land Cover Change in West and Central Africa, Accra, Ghana — 3-5 November 1997

- SARCS/IGAC/LUCC/IGBP National Committee of Academia Sinica, China-Taipei Synthesis Workshop on Greenhouse Gas Emission, Aerosols and Land Use/Cover Change in Southeast Asia, Chungli, China-Taipei — 15-18 November 1997.

START has Provided Partial Support for Key Global Change Scientific Meetings

- IGAC Workshop; Israel — April 1993
- IAI Workshop on Comparative Studies of Oceanic, Coastal and Estuarine Processes; Uruguay — 2-6 August 1993
- LUCC Workshop on Global Land Use and Cover Change; UK — 16-19 November 1993
- IGBP SAC III/ICSU Global Change Forum; Mexico — January 1994
- IGBP National Committee Chairs; Germany — March 1994
- First GCTE Science Conference; USA — May 1994
- TSBF/IGBP: Response of Multi-Societal Agricultural System to Global Change; Kenya — 9-13 May 1994
- MEDIAS International Winter School on Subtropical Climates; Niger — 16-17 December 1994
- JGOFS Workshop on Applications of Remotely Sensed Data on Ocean Colour — March 1995
- GEWEX-GAME Meeting; Thailand — 5-8 March 1995
- USCSP Workshop on GHG Mitigation Assessment; USA — 19-28 April 1995
- LOICZ Open Science Meeting; the Philippines — 23, 28-30 April 1995
- IGBP Regional Conference on Global Environmental Change; South Africa — 24-25 April 1995
- IHDP Third Scientific Symposium; Switzerland — 20-22 September 1995
- IGBP SAC IV/ICSU Global Change Forum; China- Beijing — 22-27 October 1995
- First Open Science Meeting of Land Use and Cover Change (LUCC); Netherlands — 29 January - 1 February, 1996
- First APN Intergovernmental Meeting, Thailand — 25-27 March 1996
- Integrated IGBP/IHDP/WCRP Study on Land Use/Change in Southeast Asia; Thailand — 27-30 May, 1996
- LOICZ Open Science Meeting; Nigeria — 30 September-3 October 1996
- Open IGBP/BAHC-LUCC Joint Inter-Core Projects Symposium on Interactions between the Hydrological Cycle and Land Use/Cover Change; Japan — 4-7 November 1996

- COSTED Land Use Workshop; India — 2-6 December, 1996
- GCTE Complex Agroecosystems Workshop, Bogor, Indonesia — 18-20 March 1997
- APN Scientific Planning Group Meeting and Second APN Intergovernmental Meeting, Tokyo, Japan — 24-28 March 1997.

Ongoing Research Programmes:

- SARCS/LOICZ Integrated Assessments of Coastal Zones
- SARCS/GCTE Ecosystem Impacts Analysis
- SARCS Land Use and Land Cover Change Case Studies and GIS Mapping.

In planning phases, various programs for Africa and Asia, including:

- Land use/cover change and its ecosystem impacts
- Climate variability and change and food security.

START International Summer /Winter Schools

- TEACOM International School on Frontiers of Global Change; China - Beijing — 6-12 August 1994
- International Winter School on Subtropical Climates Niger — 16-17 December 1994
- START/IGBP-DIS Summer School on Information Technology; USA — July-August 1995.

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- Kenya Academy of Sciences , University of Nairobi, Kenya
- MEDIAS Secretariat, France
- IGBP National Committees of Mongolia, China-Taipei, Korea, and Japan.

International Global Change Research Programmes and their Programme Elements

ICSU The International Council of Scientific Unions

Created in 1931, ICSU is a non-governmental organization comprising international disciplinary and national multidisciplinary member organizations. ICSU's mandate is to promote and protect scientific cooperation across national, ideological, ethnic, age, sex, or language boundaries. Following a successful International Geophysical Year (IGU) in 1958, ICSU established major international interdisciplinary research programmes such as the 1967-1974 International Biological Programme (IBP) and the more recent IGBP. In addition, ICSU maintains bodies which oversee issues of interest to the scientific community as a whole, such as capacity building and scientific ethics, and is involved in other interdisciplinary programmes including Antarctic, oceanic, and genetic experimentation. Finally, the Council acts as a forum for ideas and scientific information, as a developer of scientific standards, and increasingly as an advisor to policy-makers and as a speaker for the world scientific community. ICSU has close ties with the UN system.

IHDP International Human Dimensions Programme on Global Environmental Change

The IHDP seeks to describe, analyse and understand the interactions between human beings and the planetary system of which they are a part: (i) the way in which human activities contribute to global environmental change; and (ii) the consequences of global change for humankind, and possible human responses to mitigate and adapt to global change. Since 1996, the IHDP has been jointly sponsored by the ISSC and ICSU and this has enhanced opportunities for co-ordination and collaboration with the other major global environmental change programmes, IGBP and WCRP. The IHDP is devoting priority to the following IHDP Scientific Projects: LUCC which is jointly sponsored by IGBP and IHDP; the Institutional Dimensions of Global Environment Change (IDGC); Industrial Transformation (IT); and Global Environmental Change and Human Security (GECHS). In addition, the IHDP is giving special attention to facilitating the strengthening of existing and the development of new national human dimension committees and programmes with a view to promoting the development of national, regional and international networking and co-ordination activities in this field and to providing a vigorous "bottom-up" support mechanism for the IHDP.

Programme Elements of the IHDP

GECHS Global Environmental Change and Human Security

The overall goal of GECHS is to promote international co-operation in research on environmental security, by assisting in: linking researchers, policy-makers, and stakeholders; identifying research needs and priorities; providing a focus for interdisciplinary research; and facilitating the dissemination of research results. In the first two-year cycle, priority is expected to be given to the relationship between three critical factors: environmental degradation, population displacement and human security.

IDGC Institutional Dimensions of Global Change

The basic objectives of the IDGC project are to determine the roles that institutions play as drivers of global environmental changes as well as to explore institutional responses to changes in biophysical systems. Research foci are the role of institutions as driving social forces, the interactions among institutions, ideas, and material conditions, and the effectiveness and (re)formation of environmental and natural resource regimes. Particular priority is expected to be given to institutional issues related to LUCC and LOICZ research priorities and to activities in South East Asia and the Arctic or Circumpolar North.

LUCC Land-Use/Cover Change
(See text as IGBP programme element).

IT Industrial Transformation

The Industrial Transformation research agenda is about understanding the human drivers and mechanisms that could enable a transformation of the industrial system towards sustainability, and in physical terms to decouple industrial activities from their environmental impacts. Three related fields are to be considered: (i) System-Analytical perspectives such as the Kuznets Curve, International mass balance research, Eco-structuring and developed-developing country interactions; (ii) Industrial ecology including industrial networks, eco-efficiency, Life-Cycle Analysis, greening of industry and organizational issues; and (iii) Consumers, including consumer choice issues and the role of consumers in decision making.

WCRP World Climate Research Programme

The WCRP works toward a predictive local- and global-scale understanding of climate, including human influence on climate. Established in 1980 as a joint project of WMO and ICSU, and since 1993 also co-sponsored by the IOC, the WCRP manages its research mandate through a set of projects: GEWEX, The Global Energy and Water Cycle Experiment; CLIVAR, the Climate Variability and Predictability Study; WOCE, the World Ocean Circulation Experiment; ACSYS, the Arctic Climate System Study; SPARC, the study for Stratospheric Processes and their Role in Climate; and WGNE, the Working Group on Numerical Experimentation. These projects work together to provide predictive models of the interaction between atmosphere, ocean, land, and the biosphere.

Programme Elements of the WCRP

ACSYS The Arctic Climate System Study

The Joint Scientific Committee for WCRP established ACSYS in 1992 as a response to the increasing awareness of the Arctic's significant role in the earth's climate system. ACSYS is developing representations, based on observational evidence, of Arctic processes in global climate models; establishing long-term Arctic climate observation networks; and studying the interactions between Arctic Ocean circulation, the ice cover, and the hydrologic cycle.

CLIVAR The Climate Variability and Predictability Study

CLIVAR succeeds the Tropical Ocean/Global Atmosphere Programme (TOGA) in the WCRP's push toward increasingly accurate numerical models of the coupled atmosphere-ocean-ice-land system. Drawing on a broad involvement of oceanographers and climatologists, CLIVAR is assembling a base of quantitative observational records and is developing coupled ocean-atmosphere-land models for scales up to centuries in order to predict climate to the extent possible.

GEWEX Global Energy and Water Cycle Experiment

Created in 1988, GEWEX observes and models the hydrologic cycle and energy fluxes in the atmosphere, at the land surface. GEWEX objectives include global-scale measurements of the hydrologic cycle and energy fluxes; models of the global hydrologic cycle and assessments of that cycle's impacts on atmosphere, ocean, and land surfaces; the ability to predict variations in global and regional hydrologic processes and water resources as well as their responses to environmental change; and advanced observation techniques, data management, and assimilation systems to improve weather, hydrology, and climate change predictions.

SPARC Stratospheric Processes and their Role in Climate

SPARC is dedicated since 1992 to understanding the impact of stratospheric chemical, dynamical and radiative processes on global climate. It includes studies on chemical and aerosol processes, transport of chemical constituents, radiative-dynamical-chemical interactions in general circulation models, long-term trends in the stratosphere, stratosphere/troposphere interactions, and modelling of UV penetration.

WOCE The World Ocean Circulation Experiment

Predictive understanding of both natural and anthropogenic climate change is impossible without a quantitative description of the ocean's role for the climate system. Established in 1988, WOCE's international Scientific Steering Committee plans, implements and coordinates global fieldwork and modelling studies in a coordinated effort to provide tested three-dimensional circulation models of the ocean.

IGBP

The International Geosphere-Biosphere Programme

The IGBP, an ICSU programme, was established in 1986 to promote the interdisciplinary and international cooperation required for effective whole-Earth-system research. The mission of the IGBP is “to describe the interactive physical, chemical and biological processes that regulate...the unique environment that (the total earth system) provides for life, the changes that are occurring in this system, and the manner in which they are influenced by human actions.”

Programme Elements of the IGBP

BAHC

Biospheric Aspects of the Hydrological Cycle

The BAHC Core Project studies the role of vegetation in the hydrological interactions between land surfaces and the atmosphere on physical scales ranging from patches to 10^5 - 10^6 km² and time scales from minutes to millennia. Due to this immense range of spatial and temporal scales, experiments are managed collaboratively. BAHC cooperates with WCRP on experiment design and with IGAC, GCTE, and GEWEX-ISLSCP on implementation; large-scale guidance comes from the joint IGBP/WCRP Working Group on Land-Surface Experiments.

IGBP-DIS

Data and Information System

While the various programme elements of the IGBP generate their own data, there remains a need for data from outside sources such as satellite observations and other spatially-referenced datasets. Much of this data requires considerable assembly and processing before it can be used. IGBP-DIS has the responsibility of developing and maintaining data-acquisition pipelines, processing and standardizing datasets, and disseminating information, as well as establishing consistent data management policy and facilitating information transfer between the Core Projects.

GAIM

Global Analysis, Interpretation, and Modelling

GAIM's mandate is to produce, evaluate, and implement a family of models and datasets on varying scales with which to approach specific problems relating to the Global Biogeochemical Subsystem. There is already significant development relating to the Physical-Climate Subsystem in Global Circulation Models (GCM's); in a broad conceptual framework which divides the whole-earth system into these two Subsystems, GAIM works to provide the other half of the picture in a suite of models which corresponds to GCM's already in place.

GCTE

Global Change and Terrestrial Ecosystems

The GCTE Project tracks on a global scale the complex structural and functional relationships between terrestrial ecosystems and changes in atmospheric composition, climate, human impacts and other environmental factors in order to predict changes in agriculture, forestry, soils and ecological complexity.

GLOBEC

Global Ocean Ecosystem Dynamics

GLOBEC's goal is to advance human understanding of the structure and functioning of the global ocean ecosystem, its major subsystems, and its response to physical forcing so that a capability can be developed to forecast the responses of the marine ecosystem to global change. GLOBEC uses models to analyze ecosystems interactions rather than the environment-independent population dynamics approach, classically employed as the basis for fisheries studies. GLOBEC is co-sponsored by SCOR and IOC.

IGAC

International Global Atmospheric Chemistry Project

The goal of the IGAC programme is to develop an understanding both of the base processes of atmospheric composition and of the effects of terrestrial and marine biospheric processes and human impacts on it. IGAC's goal is to be able to predict on a global scale the effects of natural and anthropogenic influences on atmospheric chemistry. IGAC is jointly sponsored by the IGBP and the Commission on Atmospheric Chemistry and Global Pollution (CACGP) of the International Association of Meteorology and Atmospheric Sciences (IAMAS).

JGOFS

Joint Global Ocean Flux Study

Jointly sponsored by IGBP and SCOR, JGOFS focuses on understanding carbon exchange, both within the ocean and across its boundaries, which take into account ocean biology and chemistry, ocean circulation and associated physical factors, and anthropogenic impacts. The goal is to develop a predictive understanding of the relationships among climate change, its causal factors, and regional-to-global and seasonal-to-interannual shifts in carbon between the atmosphere, the ocean surface and the ocean interior.

LOICZ

Land-Ocean Interactions in the Coastal Zone

LOICZ efforts aim at simulating and predicting coastal-zone responses to global climate change at a decadal time scale. LOICZ's goal is to provide intelligent guidelines for long-term sustainable-development, economic and social policy in coastal regions. Research foci span ecological, biogeochemical, and biogeomorphological processes, the factors which determine patterns of human resource exploitation, and the relationships between human uses and natural responses.

LUCC

Land-Use/Cover Change

LUCC's project begins by establishing an understanding of the fundamental human and biophysical patterns of land use and proceeds with investigations into the effects of changes in land use on land cover. Using a set of systematic and integrated case studies, LUCC is developing regionally-sensitive global models with which to predict future patterns of land-use/land-cover change. LUCC is also helping to develop a global land-use classification scheme. These interests connect directly with those of the IGBP and the IHDP, both of which co-sponsor the LUCC project.

PAGES

Past Global Changes

PAGES is the touchstone project: through the coordinated effort of national and international scientific projects, PAGES obtains, integrates, compares, and interprets ice, ocean and terrestrial paleorecords. Its goal is to define an envelope of natural environmental variability against which predictive models can be tested and human effects discerned from natural. PAGES also encourages the development and use of consistent analytical and database methodologies in the palaeosciences.

START

A Global Change SysTem for Analysis, Research, and Training

Jointly co-sponsored by IGBP, IHDP, and WCRP, START comprises a system of regional networks whose goal is to promote interdisciplinary and multisectoral research on global change issues at the regional level and to encourage regionally-focused impact assessments for use by policy-makers. The START mandate is to mobilize the resources necessary to augment indigenous scientific capabilities in developing countries to support those countries' participation in the various global change research programmes.

List of Acronyms

ACSYS	Arctic Climate System Study (WCRP)
AGU	American Geophysical Union
AMCEN	African Ministerial Conference on the Environment
ANT	Antarctic (Region) (START)
APN	Asia-Pacific Network for Global Change Research (START)
ARC	Arctic (Region) (START)
AusAID	Australian Agency for International Development
BAHC	Biospheric Aspects of the Hydrological Cycle (IGBP)
CACGP	Commission on Atmospheric Chemistry and Global Pollution (IAMAS)
CEES	Central and Eastern European States
CIDA	Canadian International Development Agency
CLIVAR	Climate Variability and Predictability Research Programme (WCRP)
CSIRO	Commonwealth Scientific and Industrial Research Organization
DDA	Development Assistance Agencies
DEBITS	Deposition of Biogeochemically Important Trace Species (IGAC)
DIS	Data and Information Systems (IGBP)
EC	European Commission
ECOWAS	Economic Community of West African States
ENRICH	European Network for Research in Global Change (EU)
EOS	Earth Observing System (NASA USA)
FACE	Free Air CO ₂ Enrichment (GCTE)
FCCC	Framework Convention on Climate Change (UN)

GAIM	Global Analysis, Interpretation and Modelling (IGBP)
GAME	GEWEX Asia Monsoon Experiment
GAW	Global Atmosphere Watch (WMO)
GCTE	Global Change and Terrestrial Ecosystems (IGBP)
GECHS	Global Environmental Change and Human Security (IHDP)
GEF	Global Environment Facility
GEWEX	Global Energy and Water Cycle Experiment (WCRP)
GHG	Green House Gases
GIS	Geographic Information System
GLOBEC	Global Ocean Ecosystem Dynamics (SCOR)
IAI	Inter-American Institute for Global Change Research
IAM	Integrated Assessment Modelling
IAMAS	International Association of Meteorology and Atmospheric Sciences
IASC	International Arctic Science Committee
IBP	International Biological Programme (ICSU)
ICSU	International Council of Scientific Unions
IDEAL	International Decade for the East African Lakes (PAGES)
IDGC	Institutional Dimensions of Global Change (IHDP)
IGAC	International Global Atmospheric Chemistry (IGBP/CACGP)
IGBP	International Geosphere-Biosphere Programme (ICSU)
IGU	International Geophysical Union
IHDP	International Human Dimensions Programme of Global Environmental Change
INDOEX	Indian Ocean Experiment
IOC	Intergovernmental Oceanographic Commission (UNESCO)
IPCC	Intergovernmental Panel on Climate Change (UN)
IPO	International Project Office (IGBP)
IRI	International Research Institute for Climate Protection
ISSC	International Social Science Council
IT	Industrial Transformation (IHDP)
JGOFS	Joint Global Ocean Flux Study (IGBP/SCOR)
KNAS	Kenya National Academy of Sciences
LIPI	The Indonesian Institute of Sciences

LOICZ	Land-Ocean Interactions in the Coastal Zones (IGBP)
LUCC	Land Use/Cover Change (IGBP/IHDP)
LUTEA	Land Use in Temperate East Asia
MED	Mediterranean (Region) (START)
MEDIAS	Regional Research Network for the Mediterranean Basin and Subtropical Africa
NAF(COM)	Northern Africa (Committee) (START)
NASA	National Aeronautics and Space Administration (USA)
NCAR	National Center for Atmospheric Research (USA)
NGO	Non-Governmental Organization
NIOZ	Netherlands Institute for Sea Research (Translation)
NIS	Newly Independent State
NOAA	National Oceanic and Atmospheric Administration
NRC	National Research Council
NREL	National Research and Ecology Laboratory
NSF	National Science Foundation (USA)
OCE	Oceania (Region) (START)
OGP	Office of Global Programs (NOAA)
PAGES	Past Global Changes (IGBP)
PEP III	The Afro-European Transect (PAGES)
RPC	Regional Policy Committee
RRC	Regional Research Centre (START)
RRN	Regional Research Network (START)
RSC	Regional START Committee (START)
SADC	Southern African Development Community
SAF(COM)	Southern, Central and Eastern Africa (Committee) (START)
SAP	Scientific Advisory Panel
SAIPO	South Asia IGAC Office (IGAC)
SARCS	Southeast Asia Regional Committee for START (START)
SAS	Southern Asian (Region) (START)
SASCOM	South Asian START Committee (START)
SCAR	Scientific Committee on Antarctic Research (ICSU)
SCOWAR	Scientific Committee on Water Research
SEA	Southeast Asia (Region) (START)

SPAF	Science Policy Advisory Forum
SPARC	Stratospheric Processes and their Role in Climate (WCRP)
SPREP	South Pacific Regional Environment Programme
SSC	Scientific Steering Committee
START	Global Change System for Analysis, Research and Training (IGBP/IHDP/WCRP)
TEA(COM)	Temperate East Asia (Regional Committee) (START)
TNH	Temperate Northern Hemisphere
TOGA	Tropical Ocean and Global Atmosphere (WCRP)
TSBF	Tropical Soil Biology and Fertility Programme
UN	United Nations
UNCED	United Nations Conference on Environment and Development (also known as the Earth Summit)
UNDP	United Nations Development Programme
UNEP	United Nations Environmental Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
USAID	United States Agency for International Development
USCSP	United States Country Studies Program
US NSF	United States National Science Foundation
WCRP	World Climate Research Programme (ICSU/WMO/IOC)
WGNE	Working Group on Numerical Experimentation (WCRP)
WMO	World Meteorological Organization (UN)
WOCE	World Ocean Circulation Experiment (WCRP)
WOTRO	The Netherlands Foundation for the Advancement of Tropical Research (Translation)
WWW	World Wide Web

List of IGBP Publications

IGBP Report Series. List with short summary

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*Report Nos. 1-11 and reports marked * are no longer available.*

*Report Nos. 45-46 marked with ** are currently under production.*

No. 12

The International Geosphere-Biosphere Programme: A Study of Global Change (IGBP).

The Initial Core Projects (1990). IGBP Secretariat, Stockholm, 330 pp.

The IGBP science plan is composed of research projects aimed at answering a number of key questions related to global change, through the establishment of Core Projects on the distinct sub-components of the Earth system, and related activities on data systems and research centres. An implementation strategy provides for its fulfilment.

No. 13

Terrestrial Biosphere Exchange with Global Atmospheric Chemistry. Terrestrial Biosphere Perspective of the IGAC Project: Companion to the Dookie Report. Report on the Recommendations from the SCOPE/IGBP Workshop on Trace-Gas Exchange in a Global Perspective. Sigtuna, Sweden, 19-23 February, 1990. Edited by P.A. Matson and D.S. Ojima (1990). IGBP Secretariat, Stockholm, 103 pp.

The Sigtuna workshop contributed to the development of a scientific action plan on terrestrial ecosystem gas exchange, complementing the International Global Atmospheric Chemistry Project (an IGBP Core Project) in areas of natural variability, boreal regions, global integration and modelling of fluxes, and trace gas fluxes in mid-latitude ecosystems.

No. 14

Coastal Ocean Fluxes and Resources. Report of a CP2 Ad Hoc Workshop, Tokyo, Japan, 19-22 September 1989. Edited by P. Holligan (1990). IGBP Secretariat, Stockholm, 53 pp.

The focus of IGBP Coordinating Panel 2 on Marine Biosphere-Atmosphere Interactions is the elucidation and prediction of the feedback loops between climate and ocean biogeochemistry under conditions of significant anthropogenic changes to the trace gas composition of the atmosphere. The workshop concentrated on global change and the coastal oceans.

No. 15

Global Change System for Analysis, Research and Training (START). Report of a Meeting at Bellagio, December 3-7, 1990. Edited by J.A. Eddy, T.F. Malone, J.J. McCarthy and T. Rosswall (1991). IGBP Secretariat, Stockholm, 40 pp. Also available in Spanish and French.

START is a plan for the development of an international network of regional research centres and sites to gather data and study global change problems in their regional contexts. These regions are identified. Issues to be addressed are: How changes in land use and industrial practices alter the water cycles, atmospheric chemistry and ecosystems dynamics; how regional changes affect global biogeochemical cycles and climate; and how global change leads to further regional change in the biospheric life support system.

No. 16

Report from the IGBP Regional Meeting for South America. São José dos Campos, SP, Brazil, 5-9 March 1990 (1991). IGBP Secretariat, Stockholm, 58 pp.

The workshop discussed, in a South American context, past global changes, the effects of climate change on terrestrial ecosystems, the role of ocean processes in global change, land transformation and global change processes, the importance of the Andes for general circulation models, and regional research centres. Recommendations promote the role of South American science in global change research.

No. 17

Plant-Water Interactions in Large-Scale Hydrological Modelling. Report of a Workshop, Vadstena, Sweden, 5-8 June 1990 (1991). IGBP Secretariat, Stockholm, 44 pp.

The workshop addressed plant-water interrelationships at landscape to continental scales: the spatial pattern at landscape level of the dynamics of water flows and waterborne fluxes of dissolved and suspended matter; plant/vegetation characteristics and properties affecting return flow to the atmosphere; methodological issues of large-scale modelling; research in humid tropical, semi-arid and temperate zones.

No. 18:1

The Recommendations of the Asian Workshop, New Delhi, India, February 11-15, 1991. Edited by R.R. Daniel (1991). IGBP Secretariat, Stockholm, 36 pp.

Recommendations of the Workshop address issues of prime concern to Asian countries, with reports and recommendations from Working Groups on IGBP Core Projects and key activities.

No. 18:2

Proceedings of the Asian Workshop, New Delhi, India, 11-15 February 1991. Edited by R.R. Daniel and B. Babuji.

Madras, Committee on Science and Technology in Developing Countries (COSTED) and the Indian National Committee for the IGBP (1992). Madras, COSTED, Asia Regional Office, 152 pp.

The Proceedings include 19 papers on Earth system research and global environmental change in Asia, and national reports on global change programmes.

No. 19*

PAGES Past Global Changes Project: Proposed Implementation Plans for Research Activities. Edited by J.A. Eddy (1992). IGBP Secretariat, Stockholm, 112 pp.

The Past Global Changes (PAGES) project will secure better understanding of the natural and human-induced variations of the Earth system in the past, through studies of both natural and written records. Focus is on changes within two temporal streams: global changes for the period 2000 BP, and changes through a full glacial cycle. Implementation plans address: solar and orbital forcing and response, Earth system processes, rapid and abrupt global changes, multi-proxy mapping, palaeoclimatic and palaeoenvironmental modelling, advances in technology, management of palaeodata, and improved chronologies for palaeoenvironmental research.

No. 20*

Improved Global Data for Land Applications: A Proposal for a New High Resolution Data Set, Report of the Land Cover Working Group of IGBP-DIS. Edited by J.R. Townshend (1992). IGBP Secretariat, Stockholm, 75 pp.

This report outlines a proposal to produce a global data set at a spatial resolution of 1 km derived from the Advanced Very High Resolution Radiometer primarily for land applications. It defines the characteristics of the data set to meet a number of requirements of IGBP's science plan and outlines how it could be created. It presents the scientific requirements for a 1 km data set, the types and uses of AVHRR data, characteristics of a global 1 km data set, procedures, availability of current AVHRR 1 km data, and the management needs.

No. 21*

Global Change and Terrestrial Ecosystems: The Operational Plan. Edited by W.L. Steffen, B.H. Walker, J.I. Ingram and G.W. Koch (1992). IGBP Secretariat, Stockholm, 97 pp.

The objectives of GCTE are: to predict the effects of changes in climate, atmospheric composition, and land use on terrestrial ecosystems, including agricultural and production forest systems, and to determine how these effects lead to feedbacks to the atmosphere and the physical climate system. The research plan is divided into four foci: ecosystem physiology, change in ecosystem structure, global change impact on agriculture and forestry, and global change and ecological complexity. Research strategies are presented.

No. 22

Report from the START Regional Meeting for Southeast Asia. Arranged by The International Geosphere-Biosphere Programme: A Study of Global Change (IGBP), in collaboration with Human Dimensions of Global Environmental Change (HDGEC) Programme (1992). IGBP Secretariat, Stockholm, 114 pp.

The report presents general recommendations on global change research in the region, thematic studies relating to IGBP Core Project science programmes, global change research in studies of eight countries in the area, and conclusions from working groups on the participation of the region in research under the five established IGBP Core Projects and the related HDGEC programme.

No. 23

Joint Global Ocean Flux Study: Implementation Plan. Jointly published with the Scientific Committee on Oceanic Research (SCOR) (1992). IGBP Secretariat, Stockholm, 78 pp. (JGOFS Report No. 9)

The Report describes how the aims of JGOFS are being, and will be, achieved through global synthesis, large scale surveys, process studies, time series studies, investigations of the sedimentary record and continental margin boundary fluxes, and the JGOFS data management system.

No. 24

Relating Land use and Global Land-Cover Change: A Proposal for an IGBP-HDP Core Project. A report from the IGBP/HDP Working Group on Land-Use/Land-Cover Change. Edited by B.L. Turner, R. H. Moss, and D.L. Skole (1993). IGBP Secretariat, Stockholm, 65 pp. (Human Dimensions of Global Environmental Change Programme, HDP Report No. 5).

The report presents the main findings of the joint Working Group of the IGBP and the International Social Science Council on Land-Use/Land-Cover Change; it describes the research questions defined by the group and identifies the next steps needed to address the human causes of global land-cover change and to understand its overall importance. It calls for the development of a system to classify land-cover changes according to the socioeconomic driving forces. The knowledge gained will be used to develop a global land-use and land-cover change model that can be linked to other global environmental models.

No. 25

Land-Ocean Interactions in the Coastal Zone (LOICZ) Science Plan. Edited by P.M. Holligan and H. de Boois, with the assistance of members of the LOICZ Core Project Planning Committee (1993). IGBP Secretariat, Stockholm, 50 pp.

The report describes the new IGBP Core Project, giving the scientific background and objectives, and the four research foci. These are: the effects of global change (land and freshwater use, climate) on fluxes of materials in the coastal zone; coastal biogeomorphology and sea-level rise; carbon fluxes and trace gas emissions on the coastal zone; economic and social impacts of global change on coastal systems. The LOICZ project framework includes data synthesis and modelling, and implementation plans cover research priorities and the establishment of a Core Project office in the Netherlands.

No. 26*

Towards a Global Terrestrial Observing System (GTOS): Detecting and Monitoring Change in Terrestrial Ecosystems. Report of the Fontainebleau Workshop. Edited by O.W. Heal, J.-C. Menaut and W.L. Steffen (1993). Paris: MAB, 71 pp. (UNESCO Man and the Biosphere Digest 14).

The Fontainebleau Workshop, July 1992, defined a strategy to initiate a global terrestrial monitoring system for the IGBP project on Global Change and Terrestrial Ecosystems, the French Observatory for the Sahara and the Sahel, and the UNESCO Man and the Biosphere programme, in combination with other existing and planned monitoring programmes. The report reviews existing organisations and networks, and drafts an operational plan.

No. 27*

Biospheric Aspects of the Hydrological Cycle. The Operational Plan. Edited by BAHC Core Project Office, Berlin (1993). IGBP Secretariat, Stockholm, 103 pp.

A presentation of the mandate, scope, principal subjects and structure of the BAHC research plan is followed by a full description of the four BAHC Foci: 1) Development, testing and validation of 1-dimensional soil-vegetation-atmosphere transfer (SVAT) models; 2) Regional-scale studies of land-surface properties and fluxes; 3) Diversity of biosphere-hydrosphere interactions; 4) The Weather Generator Project.

No. 28*

The IGBP in Action: The Work Plan 1994-1998. 1994. IGBP Secretariat, Stockholm, 151 pp.

This Report provides an overview of the global change research to be carried out under the aegis of the International Geosphere-Biosphere Programme over the next five years. It represents a follow-up to IGBP Report No. 12 (1990) that described the basic structure of the global change research programme, the scientific rationale for its component Core Projects and proposals for their development. The IGBP Core Projects and Framework Activities present their aims and work programme in an up-to-date synthesis of their science, operational and implementation plans.

No. 29

Africa and Global Change. A Report from a Meeting at Niamey, Niger, 23-27 November, 1992. (1994). IGBP Secretariat, Stockholm. (English and French under the same cover) 55 pp.

A summary is given of the conference arranged by the Global Change System for Analysis, Research and Training (START) on behalf of the IGBP, the Human Dimensions of Global Environmental Change Programme (HDP), and the Joint Research Centre of the Commission of the European Communities (CEC) that describe the global change scientific research situation in Africa today.

No. 30

IGBP Global Modelling and Data Activities, 1994-1998. Strategy and Implementation Plans for Global Analysis, Interpretation and Modelling (GAIM) and the IGBP Data and Information System (IGBP-DIS) (1994). IGBP Secretariat, Stockholm, 86 pp. This report sets out the goals and directions for GAIM and IGBP-DIS over the next five years, expanding on the recent overview of their activities within IGBP Report 28 (1994). It describes the work within IGBP-DIS directed at the assembly of global databases of land surface characteristics, and within GAIM, directed at modelling the global carbon cycle and climate-vegetation interaction.

No. 31

African Savannas and the Global Atmosphere. Research Agenda. Report of a joint IGBP/START/IGAC/GCTE/GAIM/DIS Workshop on African Savannas, Land use and Global Change: Interactions of Climate, Productivity and Emissions, 1-5 June 1993, Victoria Falls, Zimbabwe. Edited by C. Justice, B. Scholes and P. Frost (1994). IGBP Secretariat, Stockholm, 53 pp.

The workshop focused on interactions between African savannas and the global atmosphere, specifically addressing land-atmosphere interactions, with emphasis on sources and sinks of trace gases and aerosol particles. The report discusses the ecology of African savannas, the research issues related to carbon sequestration, ongoing and proposed activities, and gives a research agenda.

No. 32

International Global Atmospheric Chemistry (IGAC) Project. The Operational Plan. 1994. IGBP Secretariat, Stockholm, 134 pp.

The goals of IGAC are to: develop a fundamental understanding of the processes that determine atmospheric composition; understand the interactions between atmospheric chemical composition and biospheric and climatic processes, and predict the impact of natural and anthropogenic forcings on the chemical composition of the atmosphere. The Operational Plan outlines the organisation of the project. The plan describes the seven Foci, their related Activities and Tasks, including for each the scientific rationale, the goals, strategies.

No. 33

Land-Ocean Interactions in the Coastal Zone. Implementation Plan. Edited by J.C. Pernetta and J.D. Milliman (1995). IGBP Secretariat, Stockholm, 215 pp. LOICZ is that component of the IGBP which focuses on the area of the Earth's surface where land, ocean and atmosphere meet and interact. The implementation plan describes the research, its activities and tasks, and the management and implementation requirements to achieve LOICZ's science goals. These are, to determine at regional and global scales: the nature of these dynamic interactions, how changes in various compartments of the Earth system are affecting coastal zones and altering their role in global cycles, to assess how future changes in these areas will affect their use by people, and to provide a sound scientific basis for future integrated management of coastal areas on a sustainable basis.

No. 34

BAHC-IGAC-GCTE Science Task Team. Report of First Meeting. Massachusetts Institute of Technology, Cambridge, Massachusetts, USA, 10-12 January, 1994 (1995). IGBP Secretariat, Stockholm, 45 pp.

The Science Task Team discussed and developed recommendations for multi-Core Project collaboration within the IGBP under three headings: process studies in terrestrial environments, integrated modelling efforts, and partnership with developing country scientists. Three interrelated themes considered under process studies are: transects and large-scale land surface experiments, fire, and wetlands. Methods for implementation and projects are identified.

No. 35

Land-Use and Land-Cover Change. Science/Research Plan. Edited by B.L. Turner II, D. Skole, S. Sanderson, G. Fischer, L. Fresco and R. Leemans (1995). IGBP Secretariat, Stockholm, HDP Secretariat, Geneva, (IGBP Report 35/HDP Report 7) 132 pp. The Science/Research Plan presents land-use and land-cover change and ties it to the overarching themes of global change. It briefly outlines what is currently known and what knowledge will be necessary to address the problem in the context of the broad agendas of IGBP and HDP. The three foci address by the plan are: (i) land-use dynamics, land-cover dynamics - comparative case study analysis, (ii) land-cover dynamics - direct observation and diagnostic models, and (iii) regional and global models - framework for integrative assessments.

No. 36

The IGBP Terrestrial Transects: Science Plan. Edited by G.W. Koch, R.J. Scholes, W.L. Steffen, P.M. Vitousek and B.H. Walker (1995). IGBP Secretariat, Stockholm, 53. pp. Also available in Chinese.

The IGBP Terrestrial Transects are a set of integrated global change studies consisting of distributed observational studies and manipulative experiments coupled with modelling and synthesis activities. The transects are organised geographically, along existing gradients of underlying global change parameters, such as temperature, precipitation, and land use. The initial transects are located in four key regions, where the proposed transects contribute to the global change studies planned in each region.

No. 37

IGBP Northern Eurasia Study: Prospectus for an Integrated Global Change Research Project. Edited by W.L. Steffen and A.Z. Shvidenko (1996). IGBP Secretariat, Stockholm, 95 pp. Also available in Russian.

This report was prepared by scientists representing BAHC, IGAC, and GCTE. It is a prospectus for an integrated hydrological, atmospheric chemical, biogeochemical and ecological global change study in the tundra/boreal region of Northern Eurasia. The unifying theme of the IGBP Northern Eurasia Study is the terrestrial carbon cycle and its controlling factors. Its most important overall objective is to determine how these will alter under the rapidly changing environmental conditions.

No. 38

Natural Disturbances and Human Land Use in Dynamic Global Vegetation Models. A report of a workshop co-convened by the GAIM, GCTE, LUCC, and IGBP-DIS Programme Elements of the IGBP. Edited by F.I. Woodward and W.L. Steffen (1997). IGBP Secretariat, Stockholm, 49 pp.

This report summarises the findings and recommendations of an International Geosphere-Biosphere Programme (IGBP) Workshop which aimed to develop an approach to modelling landscape-scale disturbances in the context of global vegetation change.

No. 39

Modelling the Transport and Transformation of Terrestrial Materials to Freshwater and Coastal Ecosystems. A workshop report and recommendations for IGBP Inter-Programme Element Collaboration. Edited by C.J. Vörosmary, R. Wasson and J. Richey (1997). IGBP Secretariat, Stockholm, 84 pp.

This report is the major product of a three-day workshop entitled: "Modelling the Delivery of Terrestrial Materials to Freshwater and Coastal Ecosystems" held in Durham, NH, USA from 5-7 December 1994.

No. 40

Global Ocean Ecosystem Dynamics. Science Plan. Final editing by: R. Harris and the members of the GLOBEC Scientific Steering Committee (SSC) (1997). IGBP Secretariat, Stockholm, 83 pp.

Based on a draft plan written by the SCOR/IOC SSC for GLOBEC in 1994. That plan was itself based on a number of scientific reports generated by GLOBEC working groups and on discussions at the GLOBEC Strategic Planning Conference (Paris, July 1994). This document was presented to the Executive Committee of the Scientific Committee on Ocean Research (SC-SCOR) for approval (Cape Town, November 14-16 1995), and was approved by the SC-IGBP at their meeting in Beijing in October 1995. The members of the SCOR/IGBP CPPC were: B.J. Rothschild (Chair), R. Muench (Chief Editor), J. Field, B. Moore, J. Steele, J.-O. Strömberg, and T. Sugimoto.

No. 41

Causes and Consequences of Land Use and Land Cover Change in Central African Miombo Ecosystems: Strategy for an IGBP LUCC Miombo Network. Workshop Report. Edited by P.V. Desanker, P.G.H. Frost, C.O. Justice and R.J. Scholes (1997). IGBP Secretariat, Stockholm, 109 pp

This report describes a science and implementation plan for the Miombo Network Initiative, developed at an IGBP intercore-project workshop in Malawi in December 1995 and further refined during the LUCC Open Science Meeting in January, 1996.

No. 42

The Kalahari Transect: Research on Global Change and Sustainable Development in Southern Africa. Workshop Report. Edited by R.J. Scholes and D.B. Parsons with contributions from A. Kamuhiza, G. Davis, R. Ringrose, J. Gambiza, and E. Chileshe (1997). IGBP Secretariat, Stockholm, 61 pp

This report is the basis for the proposed Kalahari Transect proposed as one of the IGBPs Mega Transects.

No. 43

Predicting Global Change Impacts on Mountain Hydrology and Ecology: Integrated Catchment Hydrology/Altitudinal Gradient Studies. Workshop Report. Edited by A. Becker and H. Bugmann (1997). IGBP Secretariat, Stockholm, 61 pp.

This report is the result of a workshop on IGBP mountain research issues held in Kathmandu, Nepal, from 30 March to 2 April 1996.

No. 44

START Implementation Plan, 1997-2002. Edited by R. Fuchs, H. Virji, and C. Flemming (1998). IGBP Secretariat, Stockholm, 80 pp.

This report describes the Implementation of START (Global Change System for Analysis, Research and Training). START involves the establishment of a system of regional networks with particular emphasis on the developing regions. The primary mission of these networks is: (i) to conduct research on regional aspects of global change; (ii) to assess the impacts of the regional findings; and (iii) to provide regionally important integrated and evaluated information to policy-makers and governments. START's overall objective is to build, through regional research activities, a world-wide indigenous capacity to tackle the scientific and policy aspects of environmental changes and sustainable development.

No. 45**

Past Global Changes (PAGES): Implementation Plan. Edited by F. Oldfield (1998). IGBP Secretariat, Stockholm.

This report summarizes progress made thus far by the Past Global Changes (PAGES) programme element of the IGBP. The document also outlines the implementation plans for most of the Foci, Activities and Tasks currently within the PAGES remit. The plan first introduces the scope and rationale of PAGES science and explains how PAGES is organized structurally and scientifically to achieve its goals.

No. 46**

Global Wetland Distribution and Functional Characterization: Trace Gases and the Hydrologic Cycle. Report from the joint GAIM/IGBP-DIS/IGAC/LUCC workshop. Edited by D. Sahagian and H. Melack (1998). IGBP Secretariat, Stockholm.

The IGBP Core Projects BAHC, LUCC and IGAC, in conjunction with Framework Activities GAIM and IGBP-DIS held a joint workshop to identify data and research needs for characterizing wetlands in terms of their role in biogeochemical and hydrologic cycles.

Book of Abstracts

Book of Abstracts. Natural and Anthropogenic Changes: Impacts on Global Biogeochemical Cycles. Asian Change in the Context of Global Change. Beijing, 23-25 October, 1995. IGBP Secretariat, Stockholm, 107 pp.

This book of abstracts is a result of materials presented at the scientific symposium held in conjunction with the Fourth Scientific Advisory Council for the IGBP (SAC) held in Beijing, 23-25 October, 1995.

IGBP Booklet*

A Study of Global Change (1989). Edited by IGBP Secretariat, Stockholm, 9pp.

Global Change: Reducing Uncertainties

Prepared by P. Williamson, with editorial assistance from the Scientific Committee for the IGBP (June, 1992; reprint August 1993), IGBP Secretariat, Stockholm, 40 pp.

IGBP Directory

IGBP Directory. No. 1, February 1994. Edited by IGBP Secretariat, Stockholm

IGBP Directory. No. 2, October 1995. Edited by IGBP Secretariat, Stockholm

IGBP Directory Update: 1996, April 1996. Edited by IGBP Secretariat, Stockholm

IGBP Directory 1997, February 1997. Edited by IGBP Secretariat, Stockholm

IGBP Directory 1998, February 1998. Edited by IGBP Secretariat, Stockholm.

IGBP NewsLetter

Global Change NewsLetter. Quarterly, No. 1, 1989. Edited by IGBP Secretariat, Stockholm (latest issue No. 32, December 1997).

IGBP Science No. 1

The Terrestrial Biosphere and Global Change: Implications for Natural and Managed Ecosystems. A Synthesis of GCTE and Related Research. Edited by B. Walker and W. Steffen (1997). IGBP Secretariat, Stockholm, 31 pages.

This executive summary presents the major findings of the synthesis of the first six years of the Global Change and Terrestrial Ecosystem (GCTE) Core Project of the IGBP. It begins by identifying the major components and drivers of global change. It then outlines the important ecosystem interactions with global change, focusing on the functioning of ecosystems and the structure and composition of vegetation. The executive summary then discusses the implications of these ecosystem interactions with global change in terms of impacts in three key areas: managed production systems, biodiversity and the terrestrial carbon cycle. The full synthesis results and conclusions, with a complete reference list, are presented as a volume in the IGBP Book Series No. 4, published by Cambridge University Press (Walker *et al.* (In Press)). Here key references only are included.