CHAPTER 2

Biological Diversity and Genetic Resources Programme

2.1 Background

The genesis of the Commonwealth Science Council's Biodiversity and Genetic Resources (BDGR) programme can be found in the project on under-exploited plant species 'the chenopods', part of the All India Co-ordinated Project on Under-exploited Plants of the Indian Council of Agricultural Research. These plants are of great importance because of their socio-economic and survival value to the fragile ecosystems of the Himalayas and the Andean mountains. The work on the *Chenopodium* species was carried out within the project on 'Population dynamics of wild and cultivated biotypes of *Chenopodium album*' undertaken at the Bio-science department of Himachal Pradesh University, Simla, India. Recognising the importance of the role these plants played in maintaining the environmental integrity, it was agreed that the project needed to be extended to include similar indigenous under-exploited plants.

A similar idea was mooted in the Kendrew report of 1984, *Science for Technology for Development*, which stated that biological diversity is crucial both for enhancing genetic resources and for the discovery of new resources. It said: "In agriculture, the productivity of major crops cannot be maintained, let alone expanded, without a constant infusion of fresh genetic variability." It further noted that "wild species offer considerable potential for entirely new foods.... In industry, plants are used across a wide spectrum, from the production of paper to thickening of dessert food, fire hoses, detergents, cosmetics, paints and varnishes, shoes, golf balls and drilling muds. The chemical industry in particular may, in the future, find phytochemicals more cost effective than petrochemicals. Scientists have only conducted a cursory screening of one plant species in ten, and an intensive screening of one in a hundred. Thus an analysis of all 250,000 plant species would reveal many new materials of benefit to mankind." The report went on to recommend: *"The Council should, therefore, urgently consider undertaking the study of biological diversity because of its pressing relevance to genetic resources for mankind."* The report thus highlighted the need to develop a Commonwealth-wide programme on under-exploited species. The Government of New Zealand provided the catalytic support by outlining a project concept initially in 1984 for South Pacific countries for the *"study of the genetic diversity of perennial plants which are (i) poorly known, (ii) not studied by other organisations, and (iii) of potential value for the production of food, fibre, and pharmaceuticals, etc."*

Subsequently in 1984 it was decided at the CSC's biennial meeting in Canada to take steps to launch a Biological Diversity and Genetic Resources project in the Commonwealth. A professional ecologist with practical experience of work in the conservation and use of under-exploited plant species was appointed in September 1985 to design and develop a pan-Commonwealth project in this area.

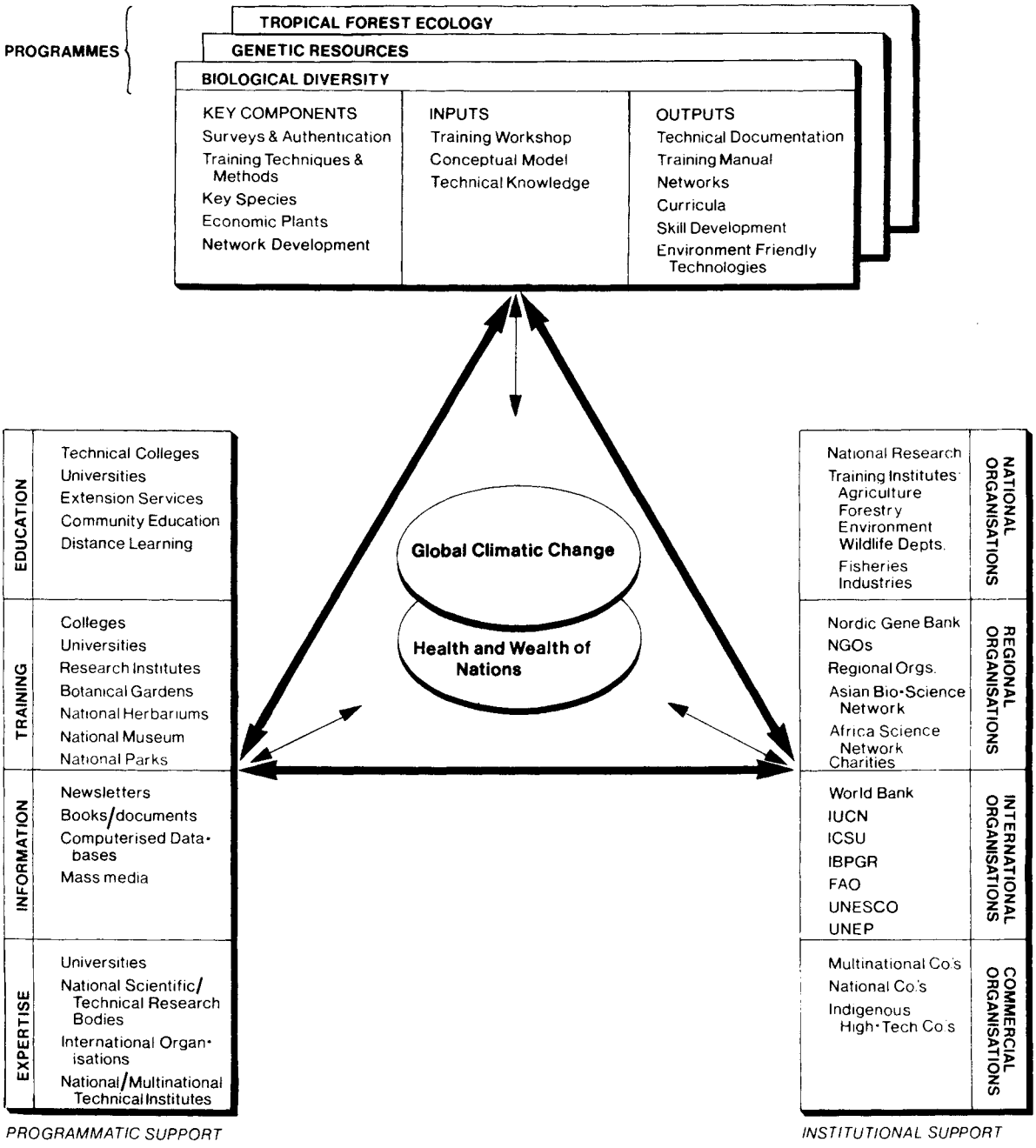

Figure 2.

Model for Conservation of Environment and Development of Biological Resources

2.2 The BDGR Project

The Commonwealth Science Council's BDGR project was designed in 1986 to help Commonwealth member countries in formulating and implementing national, regional and intra-regional strategies for conservation and rational utilisation of BDGR. This project has been accepted by the experts working in this area as providing a paradigm for better understanding of global changes occurring in the biosphere and their implication for food and livelihood security of indigenous people. It has five components: survey and authentication; techniques and methods; key species; economic plants; and development of appropriate networks for co-ordination of activities on a pan-Commonwealth basis. The programme utilises the process of multifarious interactions among different participants responsible for conserving and using our genetic resources described in detail in Section 2.3.

2.2.1 Aim of the project

Conservation of biological resources to ensure sustainable development for survival of mankind on this Earth.

2.2.2 Higher level objective

To initiate and develop national, regional and intra-regional strategies and practical action plans for the conservation and sustainable utilisation of biological diversity and genetic resources of under-exploited species.

2.2.3 Immediate objectives

(a) Exploration and authentication of species having socio-economic value (through the survey and authentication component)

(b) To initiate, develop and provide practical training to scientists and technicians at all levels for the study and sustainable use of biological diversity and genetic resources through inexpensive techniques and methods (through the techniques and methods component)

(c) To identify key species of ecological and socio-economic importance. These may assume importance in the context of postulated changes in temperature, precipitation, carbon dioxide concentration, ultraviolet radiation and sea-level rise (through the key species component)

(d) To promote and develop regional centres for the study of plants having industrial and medicinal value (through the economic plants component)

(e) To provide information and give appropriate training to senior, middle and field level scientists and technicians (through training workshops)

(f) Access by Commonwealth member countries to advances in molecular biology and genetic engineering (through the techniques and methods component)

(g) To develop appropriate organisational structures and institutional mechanisms for storage, analysis and dissemination of information (through the network building component of the programme).

The programme's structural framework has been developed by taking into account:

(a) Current status of species diversity in the plant kingdom and their extinction

(b) Current status of techniques available for the study of biodiversity and genetic resources

(c) Use and conservation of the diversity of plant species in member countries of the Commonwealth

(d) Neglect of indigenous economic species due to preoccupation with a handful of food crops

(e) Training needs for indigenous human resource development for facilitating rational utilisation and conservation of the local germplasm

(f) Existing national conservation strategies.

2.3 Model for the BDGR Project as it has been Implemented

2.3.1 Structure

The project is based on the pillars of 'programmatic' and 'institutional' support which provide the foundation for the thematic programmes that evolved over time and were developed to meet the emerging priorities of the member states based on their scientific and technical needs. This is diagrammatically depicted in Figure 2. The model is interactive and its key components and processes take into account vital issues of importance, e.g. global climate change and the ability of nations to cope with it.

2.3.2 Thematic programmes

There are three thematic programmes with overlapping components within the project:

(a) **Biodiversity** – The aim of this programme is to initiate and develop national, regional and intra-regional strategies and action plans for the conservation and rational utilisation of biodiversity

(b) **Genetic Resources** – The aim of this programme is to assist member countries to assess and survey the indigenous genetic resources and to meet their needs for building human resource capability and capacity for the conservation and use of key plant genetic resources

(c) **Tropical Forest Ecology** – The specific aim of this programme is to determine ways and means of reducing the undesirable consequences of forest exploitation and development through training and sound economic planning in terms of timber supplies, species diversity, watershed management, preservation of ethnocultural diversity, etc., through sound ecological principles.

2.3.3 Components

The thematic programmes have the following five key components:

(a) Survey and authentication of species of socio-economic value

(b) Training and development of techniques and methods

(c) Identification of key species for conservation and development

(d) Economic plants, especially medicinal plants, and industrial species which have potential in the pharmaceutical industry

(e) Establishment of regional and national networks of scientists and technicians.

Necessary indigenous and external inputs have been provided into the programme through:

(a) Training workshops

(b) Refinement of the conceptual model

(c) Designing of appropriate programmes at regional and national levels suitable to the prevailing ecological conditions.

A number of project proposals and action plans were prepared based on exhaustive guidelines prepared in 1986 at the time of refinement of the project design. The BDGR project is interchangeably also known as the Biodiversity and Genetic Resources Programme. Each country has its own priority within the BDGR programme.

The outputs derived from the processes of the BDGR programme comprise:

(a) Preparation of technical documentation including training manuals

(b) Establishment of appropriate networks

(c) Development of curricula and courses

(d) Institutional and individual capacity building

(e) Determination of environment friendly approaches for economic development.

The two pillars of the model are 'Programmatic support' and 'Institutional support'.

Programmatic support

This support to the thematic programmes is given in the following four areas:

(a) Education – involves technical colleges, universities, extension services, community education and distance learning

(b) Training – involves training of senior, middle and field level scientists and technicians working at the colleges, universities, research institutes, botanical gardens, national herbarium, national museum and national parks

(c) Information – involves communication through newsletters, publication of books, documents, reports, computerised databases and mass media

(d) Expertise – required for undertaking work in the programmes, is taken from the local national universities, national scientific/technical research bodies, international research institutes and organisations, national and multinational technical institutes.

Institutional support

This is provided through the following four sources:

(a) **National organisations** – These are the national research and training institutes of agriculture, forestry, environment, wildlife, fisheries and industry

(b) **Regional organisations** – These are the regional networks and organisations, both governmental and non-governmental. Examples are: the Southern African regional gene bank, Nordic gene bank, the African science network and the Asian bioscience network

(c) **International organisations** – These are organisations that are actively working for the conservation and sustainable development of genetic resources especially in the tropical ecosystems and regions rich with biodiversity, e.g. the United Nations Environment Programme, United Nations Educational, Scientific and Cultural Organisation, Food and Agriculture Organisation, International Board for Plant Genetic Resources, International Council of Scientific Unions, World Bank, International Union for the Conservation of Nature and Natural Resources

(d) **Commercial organisations** – These comprise the multinational and national high-tech companies using biotechnology and needing genetic resources as a key raw material.

2.3.4 Processes

The following four processes are an integral part of the BDGR programme:

(a) **Interactive dialogue** between various scientists, institutions, funding agencies and people providing grassroots support who are critical for implementing the programme

(b) **Adaptive transfer of technology** so that the relevant scientific and technical know-how is adopted by indigenous national groups for further diffusion and use throughout member countries of the Commonwealth. This entailed setting up of national and regional networks

(c) **Negotiations** with various agencies involved in funding specific activities of the programme

(d) **Field work at national level** to obtain feedback from technicians and field level scientists for modifying the programme if necessary and for building an inventory of indigenous biological resources and scientific and technical skills.

To initiate the various processes of the project CSC prepared a background paper on Biological Diversity for Human Welfare. This paper provided the background for the CSC activities under this programme. The processes entailed in the overall programme were meant to be used appropriately by the national co-ordinators.

2.4 National Co-ordinators

The national co-ordinators were appointed by the CSC members and were identified to make the programme self sustaining. Their roles are as given below:

(a) act as contact for the country's BDGR project for CSC

(b) identify national teams of experts which would work in the project

(c) set up a national committee of scientists and institutions for each project component which would assist in developing and implementing the national project on BDGR

(d) meet members of national committee at regular intervals to review the progress of the project and identify priority areas for action

(e) interact and establish collaboration with national organisations and donor agencies who would provide financial and technical assistance

(f) interact with planners and policy makers to enable them to incorporate various components of the project into the national development plans

(g) prepare national reports on the status of the project and send it to CSC's Project Officer and Regional Co-ordinator

(h) hold national and regional workshops, seminars and training programmes on the project activities

(i) nominate relevant individuals, scientists, etc., to attend international, regional and national conferences, workshops, etc., related to the BDGR project activities.

2.5 Regional Co-ordinators

The regional co-ordinators were identified during the Kew workshop in 1986 and were entrusted with the following responsibilities:

(a) to keep active contact with national co-ordinators in the region regarding progress of work on the project

(b) to hold agreed regional activities jointly with other regional bodies and organisations. These are approved and prioritised by the national co-ordinators

(c) to assist and facilitate in establishing formal collaborations with international and regional agencies for providing financial and technical assistance.

2.6 Development of the BDGR Project

The studies carried out on the *Chenopodium* species between 1975-1985 sought to understand the complexity of: (1) species variability undertaken at intra- and inter-species level in diverse ecological conditions; (2) species distribution and abundance on a temporal and spatial scale; (3) species interactions at intra- and inter-species level; (4) ethnobotanical aspects; (5) processes of evolution affecting the species' domestication; and (6) floral biology and seed polymorphism.

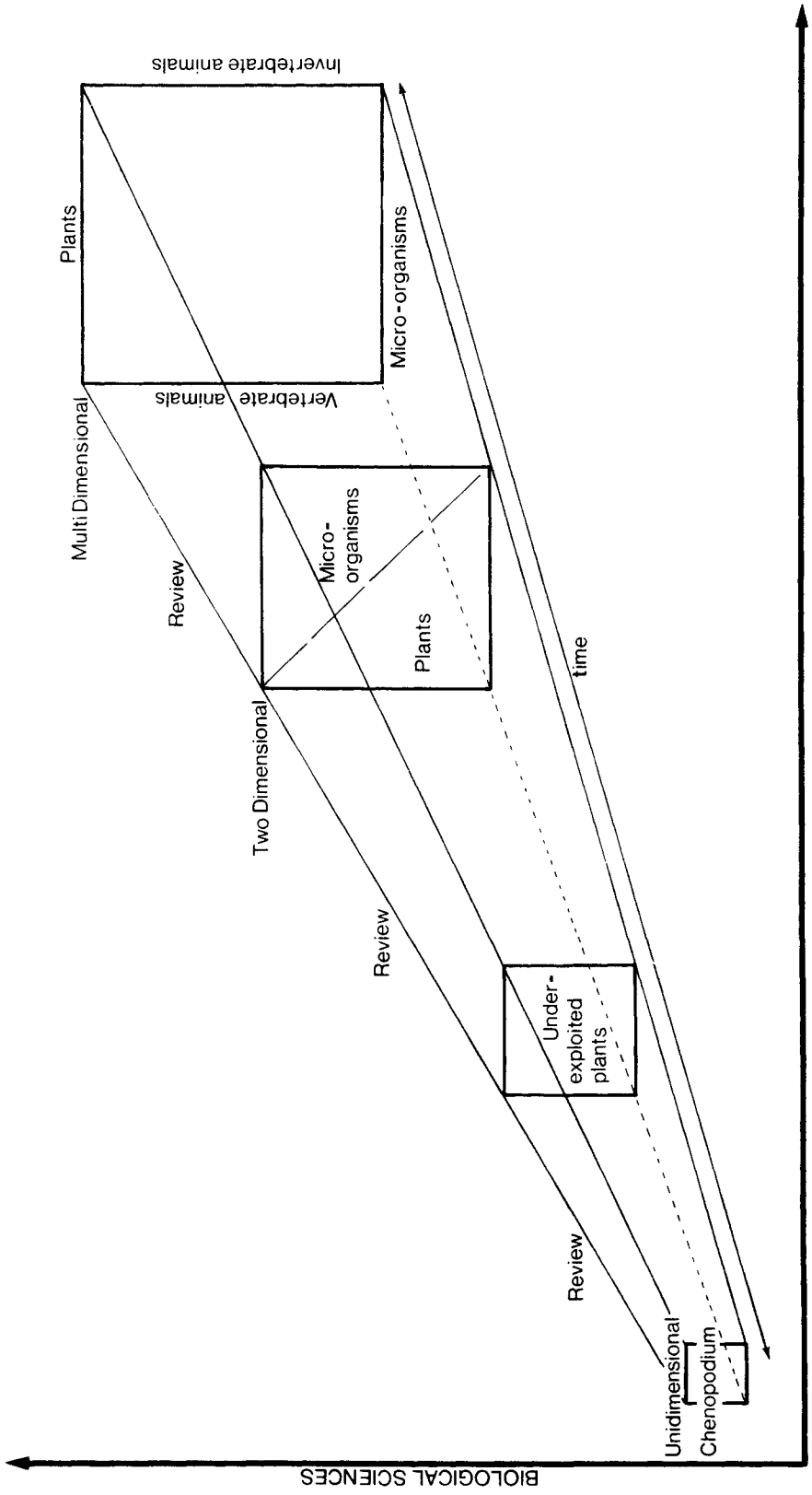

Figure 3.
Evolution of the BDGR Programme over time
Contribution of Bio-resources to sustainable development

The timely launching of the BDGR project by the CSC in 1986 allowed the use of earlier experience gained through the research and field work done on the *Chenopodium* species (chenopods) and provided a sound scientific basis for developing the CSC project. The components and activities of the project were based on a background paper prepared in 1985 which identified: (i) germplasm collection and authentication; (ii) evaluation of plants for economic value; (iii) conservation of genetic material; and (iv) bio-engineering, as key activities that needed to be undertaken under this project (Table 1). In addition the paper suggested that appropriate institutions be developed at the national and regional levels to cater to the research, service and educational needs required by member countries when undertaking these activities. The role institutions (existing or new ones to be created to meet the needs) are expected to play in this process are shown in Table 1.

The development of the BDGR project from its original unidimensional beginning to its projected multi-dimensional structure is depicted in Figure 3. In this figure the vertical axis gives the degrees to which specialisations within the biological sciences are applied to the study and use of biodiversity while the horizontal axis indicates the degree of sustainable development. The diagram thus shows that as inputs from biological sciences increase into the system being used for understanding and using biodiversity the related development becomes more sustainable.

The evolution of the BDGR project over time is depicted in this diagram. In stage I the project had a very narrow focus on only one under-exploited plant (Chenopods) and the studies conducted on it were primarily concerned with ethnobotanical, population biology and agroecological aspects. In stage II work expanded and attention was given to all "under-exploited plants in the Commonwealth member countries". This widening of the scope was based on the scientific review given by Sir John Kendrew and his expert group in 1984. The fully fledged CSC programme on BDGR was subsequently launched in 1986 using the inputs provided by: (i) Project Concept as given by the Government of New Zealand; (ii) CSC's own research during 1985-86; and (iii) the recommendations of the International workshop on Biological Diversity and Genetic Resources held in Kew, Britain, in 1986. All these helped to identify the scientific disciplines which needed to be used in the project. These disciplines spanned all the key components of the BDGR programme. With the passage of time the BDGR project developed to its current state and the need was felt to expand it to include animals and micro-organisms. This led to stage III of the project which was ratified at a review meeting held in London in 1990 as the biological systems in the widest sense of the definition have a bearing on sustainable development. The various evolutionary stages of the BDGR programme were reviewed and approved by the members of the CSC in their biennial meetings held in 1986, 1988 and 1990. Future work on the BDGR programme will rely heavily on applying the appropriate scientific disciplines to the key components of the project.

As suggested in the Kendrew Report, the project was developed in two phases. In phase I, the objective of the CSC programme was to initiate activities on under-exploited plants, especially multi-purpose species, which are useful as food, fodder, fuel, timber, medicines, biochemicals, and for soil amelioration.

The focus was on (1) identification and evaluation, (2) development, (3) harnessing/ exploitation, (4) improvement, manipulation, (5) conservation and maintenance, both *in situ* and *ex situ*.

ACTIVITIES	SCIENTIFIC TECHNIQUES		INSTITUTIONS		
			RESEARCH	SERVICE	EDUCATIONAL
I Germplasm collection & authentication	Curating		M	M	m
	Herbarium		m	M	M
	Museum		m	M	M
	Culture collection		M	m	M
	Computer-aided design*		M	m	m
	Inventory banks of bio-resources*		m	M	m
	Advanced technology/laser technology*		M	M	m
II Evaluation for economic application	Autoecology	'r' properties of growth	M	m	M
		'k' properties of growth	M	M	M
	Cultivation	agro-ecological	m	M	M
III Conservation of genetic material	Field	national protected areas *	m	M	M
		gardens, zoos, safari parks	m	M	m
	Laboratory – seed banks *in vitro*		m	M	m
IV Bio-engineering	Macro	traditional farming resource system	m	M	m
		modern farming resource system	M	M	m
	Micro	micropropagation	M	m	M
		meristem-cultivation	M	m	M
		gene fusion techniques/manipulation*	M	m	M
		cryopreservation*	M	M	m

M major role * *involves international support*
m minor role

Table 1.
Research, science and educational role of institutions in different activities for the collection, evaluation, conservation and utilisation of Biological Diversity

Preference was given to plants of the following groups: (1) legumes, (2) Palmae, (3) root crops, (4) grain crops, (5) tree species.

Specifically, the project sought to:

(a) improve nutrition and health

(b) ensure fuelwood supply

(c) ensure preservation of knowledge and the use of plants in traditional food and health care

(d) incorporate the findings of the project into agricultural diversification

(e) ensure sustained utilisation of environmental resources on a renewable basis.

In phase II, a theoretical review was added to study the importance of biodiversity of invertebrates and micro-organisms as recommended by the Kendrew Report.

The interlinked key components of the thematic programmes of tropical forest ecology, genetic resources and biodiversity remained the same. The strength of the project continues to grow with the support of, and links with, the programmatic and institutional programmes. In phase III it is envisaged that the project will evolve further, and the work will expand to include plants of other taxonomic groups, animals, both vertebrates and invertebrates, and micro-organisms. Practical work remains to be done in phase II. This will involve multifarious interactive dialogue between various scientists, institutions, fund agencies and grassroots support people who would undertake actual implementation of the programme (see Table 2).

2.7 Key Activities of the Programme

The following key activities have been instrumental in implementing the processes of the programme:

(a) Workshops

(b) Preparation of country reports

(c) Training courses and technical documentation

(d) Development of network with appropriate nodal points

(e) Project Proposals.

2.7.1 Workshops

To ensure proper involvement in the BDGR programme of appropriate scientists and technicians in member countries, 21 workshops, seminars and review symposiums and four courses were held during the period 1985-1992. A listing of these is given below.

Full recommendations of the key workshops are given in Part II of this report.

	Intergovernmental Agencies (1)	Individual Scientists (2)	Technicians (3)	Institutions (4)	Governments (5)
Intergovernmental Agencies (1)	PX	PX	X	PX	X
Individual Scientists (2)	PX	MX	MX	MX	X
Technicians (3)	X	X	MX	MX	X
Institutions (4)	PX	MX	X	X	MX
Governments (5)	PX	PX	X	MX	PX

MX Major Interaction

PX Potential Future Interaction

X Minor Interaction

Table 2.

Multifarious Interactions within the BDGR Programme

(a) **Medicinal and Aromatic Plants of the West Indies, St Christopher & Nevis, West Indies, 1985**

This workshop was held in St Christopher & Nevis, West Indies, to develop strategies and an action programme for utilisation of the natural diversity of plant species for human welfare, by harnessing plants of medicinal and economic value.

(b) **International Workshop on Micropropagation and Meristem Culture, Kuala Lumpur, Malaysia, 1986**

This workshop and symposium was organised to help promote capability in the currently available micropropagation and meristem culture techniques in the Asia-Pacific region. The workshop's objective was to evaluate the application of tissue culture techniques for scientific research and commercial purposes.

(c) **International Workshop on Biological Diversity and Genetic Resources of Under-exploited Plants, London, Britain, 1986**

The aim of the workshop was to discuss and develop action plans for survey, documentation, evaluation, cultivation, utilisation and conservation of biodiversity and genetic resources of under-exploited plants. A Commonwealth-wide project was finalised using selected species of importance which support national economies in the areas of agriculture, forestry and industry. Specific discussions for developing training programmes on conservation biology, herbarium techniques, ethnobotany and tissue culture were held. The workshop laid the foundation of the current BDGR programme of the CSC.

(d) **Pharmacognostic Authentication and Standardisation of Crude Drugs, Colombo, Sri Lanka, 1986**

The aim of the workshop was to agree guidelines for preparing technical manuals for: (1) pharmacognostic aspects; (2) botanical aspects; and (3) phytochemical aspects of drugs extracted from medicinal plants.

(e) **International Workshop on Maintenance and Evaluation of Life Support Species, New Delhi, India, 1987**

In this workshop guidelines and methodologies were developed for preparing inventories of life support species under different stress conditions. Recommendations for the evaluation of such species and their use in agriculture, forestry, fisheries, etc., were given.

(f) **Regional Workshop on Conservation Biology in SADCC member countries, Lusaka, Zambia, 1987**

The main aim of the workshop was to develop training programmes and training materials for conservation biology. At this workshop the framework of a general course in conservation biology was developed for use by senior scientists.

(g) **International Workshop on Ethnobotany held in Christchurch, New Zealand, 1988**

This workshop was organised to develop a training programme in Ethnobotany. Sixteen specific recommendations emerged from it. The need to regard the local

people as key experts for imparting knowledge on indigenous species in their region was highlighted. It was agreed that a process which respects the rights and the culture of these people was required to ensure that their knowledge is not lost. It was also determined that studies on traditional uses of plant species in the islands of the Pacific region should be undertaken.

(h) Regional Training Workshop on Conservation Biology for Humid Tropics, Peradeniya, Sri Lanka, 1988

This workshop was organised to develop a specific curriculum in conservation biology for humid tropics to supplement the earlier general course developed in the Zambia Workshop held in 1987.

(i) Regional Workshop on Tropical Forest Ecology and Management for Pacific Island Nations, Lae, Papua New Guinea, 1988

This workshop was jointly organised with UNESCO in Papua New Guinea to develop a Tropical Forest Action Plan for integrated research, education and training. It covered all the key aspects of tropical forest management in the Pacific Island region with emphasis on both traditional and commercial utilisation of forests in a sustainable manner.

(j) Training Workshop on Standardised Methodology and Guidelines on Pharmacognostic and Botanical aspects of Medicinal Plants for use as Drugs in Industry, Georgetown, Guyana, June 1988

This workshop was held in Georgetown, Guyana, to provide training in the pharmacognostic aspects of medicinal plants. It was a follow-up to the workshop held in Sri Lanka in 1987. Plants which are useful or have potential use in providing cures for (a) malaria, (b) hypertension and (c) diabetes were considered. A project was developed with a view to develop (1) ethnobotanical, (2) pharmacological and (3) phytochemical screening of indigenous plants having medicinal properties and used as such by traditional healers. These plants can be used in the pharmaceutical industry if a systematic approach is developed and applied for their identification and screening.

(k) Identification of Key Species for Conservation and Socio-economic Development, Port of Spain, Trinidad and Tobago, 1989

The above workshop was jointly organised with IUCN. It examined and developed guidelines and methodologies for: (1) systematic analysis of 'key' species which have a controlling influence on biotic communities, (2) identification and development of priority action on species which have life support value for rural people, and (3) developing co-ordinated research programmes on theoretical/predictive, experimental and socio-economic aspects of key species.

(l) Workshop on Standardisation Methodologies for Survey and Documentation of Locally used Plant Genetic Resources, Ibadan, Nigeria, 1989

The aim of this workshop was to identify training needs and to develop project proposals for the survey, documentation and evaluation of locally used plant genetic resources.

(m) Regional Training Workshop on Conservation Biology for SADCC member countries, Lusaka, Zambia, 1989

At this workshop the draft edition of the general training manual on conservation biology was reviewed. Guidelines and additional curricula for regional training courses for field extension workers were prepared.

(n) Tropical Forest Ecology and Management in Asia-Pacific, Lae, Papua New Guinea, 1989

The above training workshop, organised jointly with UNESCO, covered the fundamental issues for the implementation of sustainable management of tropical forests. These are: (a) the philosophy of sustainable management, (b) research requirements for developing Sustainable Yield Management Systems (SYMS), (c) planning and logging using SYMS, (d) preparation of forest inventories, and (e) contribution of appropriate forestry management to rural development.

(o) International Workshop on Ecological Foundation for Sustainable Agriculture: Biological Diversity of Invertebrates and Micro-organisms, London, Britain, 1990

This workshop was jointly organised with CABI, CASAFA, ICSU and TWAS. It reviewed the status of biodiversity among invertebrates and micro-organisms, and assessed how agricultural and other changes were affecting it at present and how they may affect it in future. It made recommendations about action that needs to be taken by scientists and governments to improve knowledge in this area and to determine future action.

(p) International Workshop on Biological Diversity: Conserving germplasm, Botanic Gardens, London, Britain, 1990

This workshop was organised jointly with the Botanic Gardens Conservation Secretariat of the IUCN. It reviewed the ways in which the world's botanic gardens can cooperate effectively in the assessment and conservation of germplasm (genetic resources) of wild plant species and crop relatives. The workshop addressed the specific role of botanic gardens in global germplasm conservation strategy with particular reference to those wild plant species that at present are not covered by the existing agricultural genetic resources networks.

(q) Workshop on Conservation through *in vitro* methods, Kuala Lumpur, Malaysia, 1990

This workshop was planned to formulate strategies for the conservation of biodiversity and plant genetic resources in the Asia-Pacific region through *in vitro* methods. It also sought to review and standardise protocols for genetic conservation through tissue culture techniques, molecular biology, germplasm exchange, and to develop course material for future training in this area.

(r) Workshop on the Biodiversity of Traditional and Under-utilised Plants, Malta, 1991

This workshop was held to select under-utilised crops that have promising economic, industrial, nutritional and environmental uses.

(s) **International Conference on Bioresources Diversity, Ethnobiology Development and Sustainability, Hawkesbury, Australia, 1991**

This conference examined traditional usage patterns of biological resources, sustainability of such uses and their development. It examined *inter alia* use of such resources in the aboriginal context. The topics covered were: bioresources diversity for good health, clothing, shelter, and technology available for sustainable use of these resources and ethnobotany.

(t) **Workshop on Tropical Forest Ecology: Methods of Research in Social Sciences Research on Non-Timber Products in Asia, Bangkok, Thailand, May 1992**

This workshop was held to initiate studies among researchers in Asia to undertake long-term social science and natural sciences research in tropical forest management and to develop a network of such scientists to work in a long-term research project. It was jointly developed with Harvard Institute of International Development and UNESCO. The workshop's follow-up will help other Commonwealth member countries including 'The Iwokrama Rain Forest Programme' of the Commonwealth and the Government of Guyana.

(u) **Planning meeting of the CSC BDGR network, London, Britain, June 1992**

The objective of this meeting was to prepare an agenda and give recommendations for the second International Workshop on the BDGR project to be held for expanding the scope of this project. It also helped in determining new initiatives, approaches, and action plans for the 1990s for studying the interactive relationship between climate change and biological diversity in the current socio-economic context of sustainable development.

2.7.2 Preparation of Country Reports

The National Co-ordinators were requested to prepare National Status reports based on guidelines (given in Part II) provided to them by the CSC. The country report encapsulates the work done in a country under the BDGR project on its components. These reports will assist in developing a database on: (i) survey and documentation of potentially valuable plants, (ii) evaluation of growth characterisation of target species, (iii) diversity of genetic expressions of target species, (iv) training, (v) propagation and cultivation of plant material, (vi) network of contacts, and (vii) demonstration and transfer of knowledge in this area.

Eight countries have prepared detailed country reports on the status of work done on some elements of the BDGR programme according to guidelines developed by the CSC. They are Sri Lanka, Jamaica, India, Kenya, Tanzania, Papua New Guinea, New Zealand and Australia. In addition, the following seven countries have prepared reports on 'key species of ecological and socio-economic importance' on the basis of guidelines developed jointly by the Commonwealth Science Council and World Conservation Union (IUCN): Bangladesh, Grenada, New Zealand, Nigeria, Tanzania, Trinidad & Tobago, and Zambia.

2.7.3 Training Courses and Technical Documentation

(a) Training Courses

To promote, develop and provide hands-on training to scientists and technicians for the study and use of BDGR through inexpensive techniques and methods, the following two courses were designed and launched:

(i) International Diploma Course in Herbarium Techniques, Royal Botanic Gardens, Kew

The Commonwealth Science Council (CSC) has been involved in promoting the techniques and methods in the study, use and conservation of biodiversity of plant genetic resources since 1986 and has been closely involved with the training in 'Herbarium Development and Management'.

The aim of the herbarium techniques course is to give the students proficiency skills and to gain an understanding of the principles of herbarium management.

At present the course is held every year for 8-12 weeks at the Kew Herbarium in the Royal Botanic Gardens, Kew, Britain. It covers the following areas:

- Taxonomy
- Development, purpose and types of herbaria
- Herbarium building and specimen storage
- Pests and treatments
- Materials
- Label design and production

The course has two components, one formal and the other optional. The formal (and major) part of the course is concentrated in the first six weeks with practical assignments and options occurring in the last fortnight.

The formal component includes the following lectures and demonstrations:

- Herbarium management, routine and materials
- Plant collecting, preservation and related subjects
- Plant morphology, identification and curation of collections
- General interest subjects

(ii) Training Course on Conservation Biology

A training course in Conservation Biology has been developed for senior scientists. The subjects covered are:

Public Policy in Relation to Biological Conservation

- Global biodiversity strategy
- Status of national conservation strategy development

- Harmonising sustainable development with conservation of wild lands
- International legislation supporting conservation of biological diversity

Inventory of Species

- Choice of species
- Criteria for choice of species for conservation; woody plants
- Criteria for selection of conservation areas for preserving forest genetic resources
- Quantitative aspects of the collection and analysis of inventory data

Biosystematics

- Taxonomy, biosystematics and conservation
- Roles and limits of local herbaria in conservation biology
- Training in herbarium development and management

Life Cycles and Population Dynamics

- Plant population and the management of viable plant populations
- Seeds in natural population; their significance for plant conservation
- Plant–animal interactions

Breeding System of Plants

- Sexual systems, pollination mechanisms and genetic diversity in tropical forest plants

Physiology of Plants

- Physiological aspects of *ex situ* seed conservation
- Physiological consideration in conservation with special reference to propagation and growth assessment
- Biologically active natural products of plant origin

Population Maintenance and Monitoring

- The significance of competition in the maintenance and evaluation of plant accession

- Management of plant population and problems of erosion in genetic diversity
- Biological cropping systems and genetic conservation
- Biological techniques in germplasm conservation

Documentation and Data Handling

(b) Technical Documentation

The following technical documentation has been prepared for use by scientists and technicians:

(i) Training manual on conservation biology

(ii) Herbarium handbook

(iii) Training manuals on the investigation of traditional medicine for use in industry: (a) botanical aspects, (b) pharmacological aspects

(iv) Training manual on ethnobotany

(v) A guidebook to the medicinal plants of coastal Guyana

(vi) Tissue culture directory for the Asia-Pacific region

(vii) Commonwealth–Government of Guyana programme for sustainable development

Brief descriptions of these documents are given below:

(i) Training Manual on Conservation Biology

There are two manuals in this area:

Core manual of techniques used in conservation biology

A training manual on conservation biology was prepared for senior scientists. It covers the following subjects:

- Public Policy for biological conservation
- Inventory of species
- Biosystematics
- Breeding systems
- Life cycles and population dynamics
- Population and maintenance
- Documentation and data handling

International experts working in the areas of conservation, evaluation and study of biological diversity and genetic resources have contributed to the manual and 26 chapters within the above framework have been written.

A training manual for humid tropics

This manual is currently under preparation. It covers the following subjects:

- Biological diversity and conservation
- Target habitats and species
- Life cycles, population dynamics and breeding systems
- Population variability, maintenance and use
- Data handling and documentation curriculum and references

(ii) Herbarium Handbook

This book covers the following areas taught in the International Diploma Course in Herbarium Techniques and Management at the Royal Botanic Gardens, Kew, Britain:

- Taxonomy
- Development, purpose and types of herbaria
- The herbarium building, collection and materials
- Herbarium techniques and management
- Additional techniques
- Collecting
- The herbarium in a wider context

The book has been written by the Royal Botanic Gardens, Kew.

(iii) Training Manuals for the Investigation of Traditional Herbal Medicines for Use by Scientists and Technicians

Two manuals have been written based on the guidelines developed at a CSC workshop held in 1988 in Guyana to identify standardised methodologies for the use of medicinal plants in the pharmaceutical industry. The first manual deals with the botanical aspects while the second one focuses on the pharmacological aspects. These manuals give standardised methodologies of available investigative procedures which can be used to establish the therapeutic rationale of traditional medicines and help in the identification and use of medicinal plants.

Manual on the botanical aspects

This manual concentrates on the collection and recording of field data in areas

where research facilities may be poor. The investigator is encouraged to have an enquiring mind and to use his knowledge to establish links between the traditional doctor working within the indigenous and modern environment.

The manual has four chapters which describe:

- Development of botanical knowledge of medicinal plants
- Classification and nomenclature
- Plant structure as the basis of classification
- Collection of data on the plants and their uses

Emphasis is given on the training of field investigators, sampling, and collaboration with herbalists.

It also has two appendices which cover:

- Description of important families of flowering plants and give a key for their identification
- Model pro forma data sheets for undertaking surveys of medicinal plants
- Specific ethnobotanical literature
- Selected references on collecting techniques

Manual on pharmacological aspects

This manual gives emphasis to therapeutic values of the constituents of medicinal plants and the way traditional medicines are used in African and Caribbean medicine. There are six chapters: (i) general introduction, ii) use of ethnomedicine, (iii) use of botanical information, (iv) phytochemical screening, (v) pharmacological screening, and (vi) integrative evaluation. In addition, a list is given of equipment which may be procured for research and development of traditional medicines.

(iv) Training Manual on Techniques and Methods of Ethnobotany

The subject areas covered in this manual are as given below:

- The nature and the purpose of ethnobotany
- Approaches to ethnobotany
- Biodiversity
- Maintaining biodiversity *in situ*
- Maintaining biodiversity *ex situ*
- Initiating ethnobotanical study
- Field studies
- Information source and use

- Evaluation
- Communicating ethnobotany
- Training and Advocacy
- Key species: indigenous resources
- Project examples

(v) A Guide to the Medicinal Plants of Coastal Guyana

This publication gives descriptions and illustrations of plants used for healing in one of the Caribbean countries of the Commonwealth. The plants described in this book cover species of: (i) the coastal regions and the banks of great rivers; and (ii) the huge reserves of forests which cover 16.29 million hectares of interior Guyana. The text of this book has entries for 173 native and naturalised Guyanese plants as well as some cultivated species. Of these, line drawings have been given for 148 plants. Each entry relating to a plant has information pertaining to its botanical description, habitat and distribution. Medicinal and bio-dynamic uses of the plants have also been given.

(vi) Tissue Culture Directory for the Asia-Pacific Region

This gives a list of institutions in the region where work is undertaken in different aspects of tissue culture together with a directory of experts working in those areas.

(vii) Commonwealth–Government of Guyana Programme for Sustainable Tropical Forestry

This report is a result of President Hoyte of Guyana's magnanimous and imaginative offer to set aside a part of Guyana's Amazonian forest for use under the Commonwealth auspices to demonstrate methods of sustainable management of tropical forests and for conserving biological diversity for the benefit of the whole international community. The Commonwealth Secretary-General assembled a distinguished multi-disciplinary Commonwealth expert group to carry out the first phase of preparing a project proposal. The project officer in charge of the BDGR project of the CSC was appointed as member secretary.

The recommendations given in the report are concerned with ensuring conservation directly and indirectly through sustainable economic exploitation including use for recreational and educational purposes. The report proposed the establishment in Guyana of the Guyana Programme for Sustainable Tropical Forestry, which would:

- Establish and maintain a wilderness preserve at the project site
- Maintain and manage a part of the project site for yielding economic benefits to the people of Guyana

- Organise an International Centre for Research and Training for the sustain able management of tropical rainforests
- Promote environmental literacy.

2.7.4 Development of a Network of Scientists with Appropriate Nodal Points

As indicated in the conceptual model given in Chapter 2, building of capabilities at all levels is an integral part of the BDGR programme. To help achieve this, it was decided to set up a network of co-ordinators, which is given in Part II (Section III) of this report.

Member countries have appointed a national co-ordinator who works with his national committee on BDGR. The priority project areas for each country are decided by the national committee. These subject areas are given in detail in Chapter 2. The CSC network has seven regional networks:

- West Africa
- East Africa
- Southern Africa
- Asia and the Mediterranean
- South-East Asia
- Pacific
- Caribbean, Canada and Britain

A regional co-ordinator is appointed for each region. He is responsible for regional activities. The functions of the national and regional co-ordinators were agreed at various workshops and have been described earlier.

2.7.5 Project Proposals

Detailed project proposals were developed for:

(i) Biological Diversity and Genetic Resources of Under-exploited Plants

(ii) Tropical Forest Ecology

(iii) Medicinal Plants

These have been developed during international and regional workshops in the related subjects by participating scientists. The objectives were to: (i) prioritise areas that needed urgent action at national and regional levels; and (ii) have ready access to a dossier of implementable projects that could be used by the donor community. Draft project proposals are available in a separate document.