Indian J. Pl. Genet. Resources 12(2): 148-162, 1999

THE CONVENTION ON BIOLOGICAL DIVERSITY : ITS IMPLICATIONS FOR CONSERVING AGRO-BIOLOGICAL DIVERSITY IN INDIA*

K. P. S. CHAUHAN, Ministry of Environment and Forests, Government of India, Paryavaran Bhawan, CGO Complex, Lodi Road, New Delhi 110 003

The most significant development during the historic United Nations Conference for the Environment and Development (UNCED) held in 1992 at Rio de Janeiro, Brazil was that 171 countries adopted the Convention on Biological Diversity (CBD) and the Agenda 21. The CBD which came into force in December 1993 is legally-binding, (although Agenda 21 is not). The basic objectives of the CBD (Art. 1) are 'the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilisation of genetic resources, including by appropriate access to genetic resources and by appropriate transfer of relevant technologies, taking into account all rights over those resources and to technologies, and by appropriate funding'. The Conference of Parties have been involved in initiating action to realise these objectives. This paper elucidates the most relevant provisions of the CBD and their implications with regard to conservation and sustainable use of agro-biological diversity. Taking these provisions into account, it identifies causes for the loss of agro-biological diversity, and further discuss the principles, the essential elements and action points required for developing a functional strategy for the conservation of agro-biological diversity - a basic foundation and the crucial elements required for 'environmentally sound post - green agriculture'.

Key words: CBD, agro-biological diversity, conservation, access, legal implications

The 23 preambular paragraphs of the CBD recognise and reaffirm the intrinsic value of biological diversity; the sovereign rights of States over their biological resources, the fundamental requirements of *in situ* conservation of eco-systems and natural habitats; the supporting role of *ex situ* conservation; the vital role of local communities and women in the conservation and sustainable use of biological diversity; the desirability of equitably sharing the benefits arising from the use of traditional knowledge, skills, innovations and practices; the importance of and need to promote regional and global cooperation for conservation; and the need for substantial investments to conserve biological diversity. Recognition and reaffirmation of these elements crystallize the aims of the CBD - the conservation of biological diversity, sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilisation of the genetic resources.

The CBD contains 42 Articles dealing with recognition to sovereign rights of the nations over their biological resources (Art 3); calling Contracting Parties for taking general measures for conservation and sustainable use (Art 6); identification and monitoring (Art 7); *in situ* and *ex situ* conservation (Art 8 and 9); sustainable

*The views expressed in this paper are those of the author and not necessarily that of Government of India

Table 1. Details of action points arising from Convention on Biological Diversity and Agenda 21 (Chapters 15 &16)

	Action points	Article References	Existing activity to be continued/ strengthened	New activity to be initiated
I.	**General**			
-	Develop National Bio-diversity Conservation Strategy/Programmes- Carry out country study	Art. 6 Agenda 21	+	+
-	Integrate Conservation and Sustainable use of biodiversity into sectoral/cross-sectoral plans, programmes & policies	Art. 6 Art. 10	+	
-	Promote awareness/understanding of Biodiversity Conservation and use - Inclusion in educational programmes	Art. 13	+	
-	Adopt economic and social incentives for biodiversity conservation and sustainable use of its components	Art. 11		+
-	Exchange information with other countries relevant to conservation/sustainable use of biodiversity	Art. 17	+	
-	Reporting on implementation of Convention and effectiveness of measures taken nationally	Art. 26		+
-	Ratify the Convention	Art. 34		+
II.	**Survey, Identification & Monitoring**			
-	Identify/monitor components of biodiversity for conservation and sustainable use	Art. 7	+	
-	Identify/monitor processes and activities causing adverse effects on biodiversity	Art. 7		+
-	Maintain/organise data derived from survey,identification & monitoring	Art. 7		+
III.	**Conservation Measures**			
	(A) ***In-situ* Conservation**			
-	Establish a system of Protected Areas	Art. 8	+	
-	Develop guidelines for selection,establishment and management of Protected Areas	Art. 8	+	
-	Regulate/manage biological resources within or outside Protected Areas to ensure their conservation and sustainable use	Art. 8	+	
-	Protection of eco-systems/habitats for maintenance of viable population of species	Art. 8	+	
-	Promote environmentally sound and sustainable development (eco-development) in areas adjacent to Protected Areas	Art. 8	+	
-	Encourage biodiversity conservation and sustainable use of biological resources on private lands	Agenda 21	+	
-	Promote international co-operation for conservation of migratory species; establishment of Protected Areas in trans- boundary locations	Agenda 21	+	
-	Rehabilitate/restore degraded ecosystems and promote recovery of threatened species	Art. 8	+	
-	Prevent introduction of & control/eradicate alien species threatening ecosystems/ habitats/species	Art. 8		+
-	Respect/uphold relevant knowledge innovations and practices of local communities; promote wider applications	Art. 8	+	

	Action Points	Article References	Existing activity to be continued/ strengthened	New activity to be initiated
	(B) *Ex-situ* Conservation			
	Adopt measures/establish facilities for ex-situ conservation and research on components of biological diversity.	Art. 9	+	+
-	Adopt measures for recovery and rehabilitation of threatened species (including re-introduction where appropriate)	Art. 9	+	+
-	Regulate/manage collection of biological resources from natural habitats	Art. 9	+	
IV.	**Sustainable Use**			
-	Adopt measures relating to use of biological resources toavoid/minimise adverse impacts	Art. 10	+	
-	Encourage customary use of biological resources in accordance with traditional cultural practices compatible with conservation/sustainable use	Art. 10	+	
-	Support "remedial action" in degraded areas by local populations	Art. 10	+	+
-	Encourage Govt. - Private Sector (industry) cooperation on sustainable resources-use methodology	Art. 10		
V.	**Scientific Research, Training and Cooperation**			
-	Establish and support biodiversity research and training programmes	Art. 12	+	
-	Promote and cooperate in use of scientific advances in biodiversity research with other countries	Art. 12		+
-	Identify institutions for R & D activities pursuant to Article 15(6) on genetic resources and Article 19 (1) on biotechnology	Art. 12 Art. 19		+
-	Take measures for capacity building for research.	Art. 18	+	
-	Promote technical and scientific cooperation	Art. 18		+
VI.	**Legal/Regulatory Measures**			
	(A) Protection & Conservation			
-	Examine the need for Constitutional Amendment	Entire Convention		+
-	Review existing legislations	Art. 15		+
-	Enact new legislation/regulations for *in-situ/ex-situ* purposes (public & private)	Art. 15		+
-	Develop/maintain necessary legislation or other regulatory provisions for protection of threatened species/populations	Art. 8	+	
-	Strengthen environmental impact assessment procedures to minimise adverse impacts of projects-allow public participation	Art. 14	+	
-	Develop procedure/mechanism for notification information exchange and emergency response relating to activities affecting biodiversity beyond national jurisdiction	Art. 14	+	
	(B) Access to and transfer of genetic resources			
-	Enact legislation to establish State authority/control on genetic resources	Art. 15		+
-	Work out modalities including model agreements for providing access	Art. 15		+
-	Identify components on which "prior informed consent" will be based	Art. 15		+

	Action Points	Article References	Existing activity to be continued/ strengthened	New activity to be initiated
	(C) Access to and transfer of technology			
-	Develop modalities for access to and transfer of technology to identified institutions in return for access to genetic resources	Art. 16		+
-	Take measures for receiving such technologies from other countries and utilising them.	Art. 16		+
-	Formulate policy and implementation modalities for international cooperation on patents and other IPRs compatible with Convention	Art. 16		+
	(D) Biotechnology			
-	Develop modalities for priority access to biotechnological results and benefits on mutually agreed terms	Art. 19	+	
-	Formulate procedures for "advance informed agreement" on safe transfer of living modified organisms (LMOs) beyond national jurisdiction	Art. 19	+	
-	Take measures to control risks and provide information associated with use/release of LMOs resulting from biotechnology	Art. 8	+	
VII.	**Financial Resources/Mechanism**			
-	Participate in negotiations concerning financial mechanism under the Convention	Art. 21		+
-	prepare and pose projects to utilise financial mechanism under the convention	Art. 21		+
-	Work out modalities to provide financial support/incentives pursuant to Convention's objectives	Art. 20	+	

use of the components of biological diversity (Art 10); providing incentive measures (Art 11); research and training (Art 12); public education and awareness (Art 13); and impact assessment and minimising adverse impacts (Art 14). In addition, it facilitates access to genetic resources on "mutually agreed terms" and with the "prior informed consent" of the country providing the resources, with the recipient country being committed to share the accruing benefits (Art 15). It also makes provision for the access to and transfer of technologies, including biotechnologies, on "fair and most favourable" terms, from the developed to developing countries, which are the main providers of genetic resources (Art 16). Moreover, the CBD calls on the private sector to facilitate access to and transfer of such technologies developed by them (Art 16.4). The Contracting Parties are to cooperate in this regard to ensure that patents and other 'Intellectual Property Rights (IPRs)' are supportive of, and do not run counter to, the objectives of the CBD (Art 16.5). The Parties are also to take measures to facilitate access on a 'fair and equitable' basis, and on 'mutually agreed terms', to the results and benefits arising from biotechnologies (Art 19.2). It commits the Parties to consider the need for, and modalities of, a protocol in the field of safe transfer, handling and use of any living modified organisms resulting from biotechnologies (Art 19.3). The developed Country Parties are committed to contribute to a fund to enable developing Country Parties to meet the 'agreed full incremental cost' for implementing the provisions of the CBD (Art 20.2). This financial mechanism is to 'operate within a democratic and transparent system of governance' and 'function under the authority' of the Conference of Parties (CoP) as per the Article 21 (Chauhan, 1996a).

Based on an analysis of the provisions of the CBD, Agenda 21 and the conservation measures adopted so far by India, 50 action points have been identified and are summarised in Table 1. These action points together with causes for the loss biological diversity need to be considered, so as to outline the principles, identify priority areas and set out a policy framework for a comprehensive strategy for the conservation of agro-biological diversity.

I. Causes for the loss of agro-biological diversity

India is one of the centres of mega biological diversity, with 10 biogeographical centres including 20 broad agro-ecological zones and 16 major forests types consisting of 221 minor types. The Indian region is also one of the eight centres of origin and diversity in cultivated crop plants as identified by the Russian scientist N. I. Vavilov. It is estimated that 166 food crop species and 324 wild relatives of crops have originated in this region (Chandel, 1996). India also has a rich diversity of domesticated animals including 26 breeds of cattle, 40 of sheep, 20 of goat, 27 of donkey, 8 of camel, 6 of horse and 18 of poultry. The estimates of genetic diversity in cultivated crops, domesticated animals and birds are given in Table 2.

Table 2. Genetic diversity in plant and animal genetic resources of India

(a) Cultivated Plant Genetic Resources			
Potato	16	Cardamom	226
Rice	50,000-60,000	Ginger	1?4
Cotton	1975	Turmeric	184
Sorghum	5160	Clove	150
Cassava	701	Nutmeg	301
Sweet potato	495	Cinnamon	4
Yams	305	Tea	1607
Aroids	350	Rubber	103
Minor tuber crops	78	Arid & Semi-arid fruits	380
Coconut	42	Mango	>1000
Arecanut	45	Sugar cane	48
Pepper	500	Ground nut	80
(b) Domesticated Animal Genetic Resources			
Sheep	40	Horses & Ponies	6
Camel	4	Buffalo	8
Yak	1?	Cattle	26
Pig	2	Poultry	20
Goat	20	Ducks	4
Donkey	27		

Adapted from Kothari (1997 a)

The All India Coordinated Project on Ethnobiology undertaken by the Ministry of Environment and Forests has so far revealed that local communities including tribals use about 9500 species for different purposes - medicines (7,500), food (3,900), material and cultural requirements (700), fiber and cordage (525), fodder (400), pesticides and piscicides (300). Besides, there is also repository of cultural and ethnic diversity which is represented by 500 tribal communities and 227 ethnic groups. There would probably be many more species and uses identified by the time the final phase of this project is over (Anonymous, 1994). The 'Hot Spots' of endemic plants of India, Nepal and Bhutan amply demonstrate the significant level of the endemism (33.5 per cent of 17,000 species of flowering plants) in the plant genetic resources distributed in the three 'Mega Endemic Centres' and 25 'Micro Endmic Centres'. (Nayar, 1996); some of the prominent ones are given in Table 3. Besides, there is also a repository of cultural and ethnic diversity which is represented by 500 tribal communities and 227 ethnic groups. There would probably be many more species and uses identified by the time the final phase of this project is over (MoEF, 1994). The 'Hot Spots' of endemic plants of India, Nepal and Bhutan amply demonstrate the significant level of the endemism (33.5 per cent of 17,000 species of flowering plants) in the

plant genetic resources distributed in the three 'Mega Endemic Centres' and 25 'Micro Endemic Centres'. (Nayar, 1996); some of the prominent ones are given in Table 3.

Table 3. Some endemic plant genetic resources of India

Sl. No.	Name	Locality
1.	*Arenria holosteoides*	Ladakh
2.	*Avena steriles* L. ssp. *indoviciana*	North west India
3.	*Cajanus mollis*	Foothills of Himalaya
4.	*Coptis teeta*	Mishmi hills
5.	*Curcuma cannorensis*	Kerala
6.	*Curcuma escalcarata*	Kerala
7.	*Flemingia procumbens*	Garhwal Himalaya to Bhutan
8.	*Musa sikkimensis*	Sikkim, East Himalaya
9.	*Oryza jeyporensis*	Orissa
10.	*Oryza officinalis* Ssp. *malampuzhaensis*	Kerala, Tamil Nadu and Andhra Pradesh
11.	*Piper hapinum*	Kerala
12.	*Piper muneyporeuse*	Manipur
13.	*Pueraria bella*	Mishmi Hills
14.	*Vigna khandalensis*	Maharashtra
15.	*Vigna trilobata*	Maharashtra

Based on Nayar (1996)

Due to the fragmentation, both at the macro and micro levels, of most of the agro-ecological zones and the significant level of soil erosion due to faulty land use, soil and water pollution etc., tremendous pressure has been put on the basic physical foundations of ecosystem functions, which has resulted in confining cultivation to a narrow genetic base of major crops such as rice, wheat, cotton, minor millets, and pulses. There has also been serious threat to livestock diversity. According to one estimate, 10 breeds of goat (i.e. 50 per cent of the total breeds), five breeds of cattle (almost 20 per cent), 12 breeds of sheep (30 per cent), and all the 18 breeds of poultry, are threatened, today (Kothari, 1997). Chauhan (1997b) has described different reasons for the erosion of the agriculturally related genetic resources, including changes in agricultural systems and the abandonment of traditional crops/livestock in favour of the new ones; over-grazing and excessive harvesting; deforestation and alteration in the land use for various developmental activities; loss of the nutritional balance of the soil, and excessive use of agrochemicals; inequity in ownership and access to genetic resources, including benefits from use and conservation of biological resources; population pressure and urbanisation; adverse environmental conditions, such as drought and flooding; and policies and planning resulting in unsustainable consumption.

II. Functional strategy for conservation of agro-biological diversity

Clear principles for the achieving the objectives of conservation are necessary for setting the priorities and establishing a framework for the conservation of agro-biological diversity. The main principles are: replicable and transparent processes at national, regional and local levels; regular evaluation of advantages and disadvantages of selected priorities; full utilisation of relevant and available information; involvement of local communities and others responsible for implementing conservation action in the process of setting priorities, together with the scope of reassessment and revision of priorities; and their integration into the institutional and policy making process. These principles would form the basis for an integrative approach that relates ecosystems, species and genes, links agro-biological diversity with other natural resources, and also takes into account economic, social and political factors (Chauhan, 1997b).

III. Priority areas

In order to ensure that India fulfills its obligation as one of the Contracting Parties, the national priorities would have to consider the action points identified as per the provisions of the CBD and Agenda 21 (Table 1), together with the elements identified in the FAO's (1996) Global Plan of Action. Therefore, the following areas need particular attention:

(i) Survey, inventory and monitoring

Article 7 emphasizes that the Parties must undertake an exercise to identify and monitor components of biological diversity. Maintenance and analysis of the data derived from survey, identification and monitoring is necessary for finalizing the conservation and utilisation plan for agro-biological diversity of ecosystems, species and genes. Inadequacy at any one of these levels would impair the overall outcome. In addition, monitoring processes need to be brought into sharp focus to identify and qualify the processes and activities causing adverse effects on agro-biological diversity and its components. It may be pointed out that India already has a strong base in the various Surveys of India, for botanical, zoological, forest and fish resources. Besides, agricultural genetic diversity is also being collected and evaluated by the three bureaus, namely, plant genetic, animal genetic and fish genetic resources under the aegis of the Indian Council of Agricultural Research. However, following areas as identified earlier (Chauhan, 1997b) need attention. a) development of effective databases and networking including Geographic Information System among various concerned institutions, and links with regional and CGIAR and the FAO Commission; b) focused surveys and documentation of rare, endangered and threatened genetic resources; c) studies on endemism in agri-horticultural plants and animal breeds; d) coverage of micro-organisms, and lower groups of plants and animals used in agriculture; and e) effective monitoring mechanisms to assess the processes and activities causing adverse effects.

These activities need to be integrated into the existing Five Year Plan process and completed within a specified time frame. Accordingly the mandate of these institutions would have to be expanded.

(ii) *In situ* conservation

Both article 8 and Agenda 21 identify activities for *in situ* conservation (Table 1). These activities are primarily intended to establish protected areas; develop guidelines for their selection, establishment and management, regulate the extraction of biological resources for sustainable use; protect and manage the habitats and viable populations of the species within and outside protected areas; to promote eco-development including on private lands; restore degraded ecosystems and promote the recovery of rare, endangered, threatened and endemic species; control the risks associated with the use and release of living modified organisms and the introduction and spread of alien species threatening ecosystems, habitats and species; regulate and manage adverse impacts; and uphold the traditional knowledge, innovations and practices of local communities and promote their wider applications. The focus of the conservation measures is to sustain the ecological foundations in biologically rich ecosystems and habitats. This is regarded as the most cost effective means of sustaining evolutionary processes, and maintaining a viable size of populations. Chauhan (1993) has elucidated various options. India has already adopted for *in situ* conservation through various management systems such as National Parks (85), Sanctuaries (448), Tiger Reserves (23), Biosphere Reserves (7), World Heritage Sites (5), Wetlands (16 including 6 RAMSAR sites), Mangroves (15), and Coral Reefs (4), and other areas such as Sacred Groves, Natural Monuments and Ethno-biological Reserves etc. An estimated geographical area of

more than four per cent is under formal management (MoEF, 1997). However, as yet, on-farm conservation of agro-biological diversity, particularly in traditional farming systems has not been adequately addressed except in an informal basis by tribal and rural families. This will soon have to be addressed.

Several other activities also need urgent implementation (Chauhan 1997b), for example: development of models for monitoring and forecasting changes in key areas of agro-biological diversity; sustainable management of traditional farming systems, range lands, hot spots, sacred groves, endemic (Nayar, 1996) and other diversity rich areas representing agro-biological diversity; promotion of *in situ* conservation of wild relatives, land races, and lesser known plants and animal genetic resources; encouragement and assistance to farming communities in disaster situations to restore affected agro-ecological zones; development of interfaces between *in situ* and *ex situ* conservation mechanisms; and setting up compatible mechanisms to integrate *in situ* conservation in the national strategy for conserving biological diversity.

(iii) *Ex situ* Conservation

Article 9 addresses the problem of *ex situ* conservation, calling upon the Contracting Parties to establish and strengthen *ex situ* capabilities, especially in the country of origin of biotic components; recover and reintroduce threatened species; regulate and manage collection of biological resources from natural habitats to avoid the adverse impact on natural populations; and to establish cooperative mechanisms among developing countries in this regard. As already mentioned, the mandate for undertaking *ex situ* conservation of the genetic resources of plants, animals and fish is with the three bureaus of the ICAR. There is also a proposal to establish a National Bureau of Agriculturally Important Micro-organisms which is likely to be implemented in the 9th Five Year Plan. The ongoing activities and achievements have been highlighted in their annual reports. Also engaged in *ex situ* conservation of plant genetic resources are the 68 botanic gardens, dispersed through all the major biogeographical regions. These have tremendous potential, provided that their activities are effectively linked and are directed towards conserving rare, threatened and endemic plants of economic value.

Apart from these activities, other initiatives are also urgently required. These include: a) creation of new storage facilities and further strengthening of the existing facilities in all terms of storage, cryopreservation, *in vivo* and *in vitro* etc.; b) collection and sustaining the germplasm of prioritised agro-biological diversity, with special emphasis on endemic, rare, and endangered genetic resources; c) optimal utilisation of the storage facility, by reducing duplicate material; d) development of regenerative methodologies/ protocols for genetic resources maintained in the *ex situ* conditions; and d) acquisition of modern methodologies to optimise the efficiency of existing *ex situ* facilities; and development of low cost technologies and methodologies.

Setting up *ex situ* conservation facilities is capital- intensive and requires high energy consumption. So, this has to be done in a phased manner, taking into account the specific requirements of the regions. The process should not take more than 15 years, provided funds are sufficiently augmented. Once developed, these facilities would not only complement the *in situ* conservation but would also play a pivotal role in achieving the objectives of the CBD (Chauhan, 1997b)

(iv) Sustainable use of components of biological diversity

Five paragraphs of Article 10 contain provisions for integrating biological diversity considerations into national planning and policy

making procedures; reformatting and managing biological resources and their use of minimise adverse impacts; protecting and encouraging the customary use of biological resources in accordance with traditional cultural practices compatible with conservation and sustainable use; undertaking remedial action for restoration of degraded areas with the support of local populations; and encouraging government and private sector cooperation on sustainable and pests and better adaptability, and to enhance both productivity and diversification of agriculture, in cultivated varieties and breeds.

To sharpen the focus on national conservation policy, and to minimise the adverse impacts on variability, the sustained availability of the vast range of genetic variability from ecosystems and habitats needs to be borne in mind, and the active support of tribal and rural communities is essential. For this purpose relevant 'Environment Impact Assessment' procedures addressing biological diversity need to be developed and integrated in the relevant legal instruments (Article 14a). It may also be pointed out that issues relating to the gender dimensions of management and sustainable use of biological diversity have not been adequately understood. This needs to be recognised, and studied so that gender concerns are integrated into the action plans for conservation of agro-biological diversity (MSSRF, 1997). Moreover, traditional cultural practices both for conservation and sustainable use need to be blended with modern methods, such as biotechnologies, to improve the health of the physical components of the ecosystems such as soil and water on the one hand, and achieve the expected goals of 'environmentally sound post-green agriculture' on the other.

At present, the activities of the public and private sectors engaged in the use of biological resources are completely disorganised and are sometimes contradictory to the objectives of the conservation of biological diversity. The user-agencies are multi-layered, without any organic interlinkages, and are indifferent to conservation. For example, none of the private pharmaceutical agencies manufacturing ayurvedic, unani and siddha medicines and herbal products are contributing financially to the maintenance of the wild habitats from where they are extracting raw material. Similarly, no financial provisions are allocated by seed development agencies to support traditional farming systems or the on-farm conservation of genetic resources. This practice is unsustainable and requires immediate correction. The objectives of the "sustainable utilisation of genetic resources of indigenous systems" can be achieved through implementing the effective and viable tools of cooperation among local communities, scientific institutions, non-government organisations, private and government sectors (Chauhan, 1997b). In addition, India would have to evolve and implement various incentives (both monetary and non-monetary and mechanisms for farming communities, nomadic pastoralists and shifting cultivators, in accordance with Article 11 of the CBD.

(v) Research, training, public awareness and education

Sustained research, training, public awareness and educational activities are very vital for the success of any major programme of both national and international importance. Therefore, the Articles 12 and 13 have identified elements such as encouragement of research, application of scientific and technological advances and establishment of education and training programmes in the field of conservation and sustainable use of biological resources. The optimum utilisation of our vast wealth of biological resources would largely depend on streamlining activities for a wide range of applications. This requires rapid characterisation and evaluation of the genetic potential, enhancing genetic variability

through appropriate interventions, exploring the potential of lesser known and under-utilised species, and developing new market strategies for local varieties and diversified food crops. Moreover, strengthening the Research and Development (R & D) efforts in integrated pest management, recycling of organic matter, blending tradition and frontier technologies and tapping indigenous knowledge are needed on a priority basis. (Chauhan, 1997 b). This will further reinforce the goal of conservation and utilisation of agro-biological diversity.

In this context, unlike other developing countries, India has a strong institutional base. However, a special focus has to be provided to certain activities relating to conservation and use of genetic resources. Similarly, two way processes have to be adopted for generating public awareness, and the ICAR institutions will need to develop a strategy on the lines of the 'Lab to Land Programme' which was one of the most successful extension programmes. The existing syllabus at the school, college and university levels also requires to be refined keeping in view the goals of conservation and use of biological resources. The informal sector of education needs special attention for which ICAR is ably equipped. The non-government organisations such as the Centre of Environmental Education, Ahmedabad, World Wide Fund for Nature (WWF), National and Regional Natural History Museums, M. S Swaminathan Research Foundation (MSSRF), Madras and all relevant National Science Academies and Science Societies could be involved to generate education and awareness material.

(vi) Legal measures

In setting out the objectives to conserve biological diversity, sustainably use its components and equitably share the benefits of the use of genetic resources, the CBD has posed a major challenge to the Contracting Parties to undertake a massive evaluation exercise of all existing policies and legal instruments, guidelines, and national, state and local levels action plans. In fact, the provisions of the Articles 6, 8, 10, 11, 13, 14, 15, 16, 17, 19 and 26 call for refinements or developing new legal and regulatory mechanisms in accordance with the objectives outlined in Article 1. In this context, the gaps have been identified and highlighted in Table 1.

The essential elements that need to be given priority attention for the conservation of biological resources, and agro- biodiversity in particular are: a) examination of the need for constitutional amendments, and review of the existing relevant legislations; b) enacting new legal instruments for *ex situ* and *in situ* conservation with special reference to endemic, rare and threatened species; c) strengthening environmental assessment procedures to minimise the adverse impact of developmental projects; d) establishing procedures for notification, information exchange and emergency responses relating to activities affecting biological diversity beyond national jurisdictions. The review of about 40 central acts carried out by Kothari and Singh (1994) revealed that they covered only the protection, use and trade related aspects of biological resources. Chauhan (1996b) has discussed in detail the need of a Biological Diversity (Conservation) Act and also identified the essential elements for specific legal provisions in the area such as collection, characterisation, including identification, *ex situ* and *in situ* conservation, access to genetic resources, IPRs, benefit-sharing mechanisms, penalties and incentives, and biosafety aspects in application of biotechnologies. Some of these elements are discussed below, with special emphasis on agro-biological diversity.

(a) Access to genetic resources

Provisions relating to access, contained in Article 15, were intensely negotiated by the negotiating countries to facilitate the mutually beneficial utilisation of genetic resources by the

Contracting Parties. Formerly, the technologically rich countries were able to derive optimum economical advantages due to the supportive IPRs regime and free access to genetic resources which were treated as 'common goods'. Having recognised the sovereign rights of the countries over their biological resources, the Convention has now changed the scene. The provisions of the TRIPS under GATT has further compounded issues relating to intellectual property rights over the products developed using biological resources. The implication of the provisions under UPOV of 1978 and 1991 can also not be ignored. Bearing all this in mind, access shall have to be based on "prior informed consent" and on "mutually agreed terms". Any further scientific research based on genetic resources will have to be carried out "with full participation" of the provider. At present, access to biological resources in India are freely provided except in case of endangered and threatened plant and animal species through the provisions of the Convention on International Trade on Endangered Species (CITES) and Export and Import Policy under Foreign (Trade) Act. Chauhan (1997 and 1997 a) has emphasised that these provisions require changes at the earliest and the specific legal proposals are to be finalised taking into account the relevant elements contained in the Rio Declaration, Agenda 21. CBD, TRIPS of GATT, UPOV, FAO's Concept of Farmers' Rights, Various Conventions of ILO, and Draft Declaration on the Rights of Indigenous Peoples of the United National Economic and Social Council (ECOSOC, 1990 and 1991).

In addition, the ongoing debate has also brought the issue of "ownership over biological resources" and "community rights" of the farming and tribal communities into sharp focus, as against "plant breeders' rights" and the pressure to globalise the existing IPRs. It has been advocated that the traditional knowledge, innovations, skills and practices associated with biological resources, which were part of the 'Intellectual Commons and Common Goods' and are freely available, have to be either treated as some form of IPRs or else the communities owning them have to be suitably rewarded in the form of royalties, in keeping with the concept and spirit of 'inter and intra-generational equity'. Thus, the interface between the aspects of ownership, equity and benefit sharing with the local communities, schedule castes and tribes as per the provisions of the Indian Constitution (Art. 14 and 21), the Directive Principles (Art. 39, and 46), 5th and 6th Schedules (Article 27591), 338 and 339(1), and of the CBD has to be carefully examined and integrated in the proposed Acr (Chauhan, 1997). It is expected that the draft Plant Varieties (Protection) Act which is ready for the approval of Parliament will take into account some of these concerns thus protecting the interest of plant breeders and farming communities as part of a *sui generis* system mentioned in the TRIPs provisions (Ganesan, 1994).

(b) Access to and transfer of technology

Article 16 calls for the development of modalities for access to and transfer of technologies to identified institutions in return for access to genetic resources, and taking adequate measures for utilising them as per the conditions, so that an effective and cordial environment is created for international cooperation on patents and others IPRs compatible with the spirit of the CBD. In any case, these modalities would have to be based on specific essential elements and conditions as a part of 'Prior Informed Consent' and 'Material Transfer Agreements' (Chauhan, 1997b).

(c) Handling of biotechnology and Distribution of its benefits

According to Article 19(2), each Contracting Party shall develop fair and equitable modalities for 'advance priority access' to the 'results and benefits arising from biotechnologies' based upon

utilisation of the genetic resources and 'such access shall be on mutually agreed terms'. For this purpose, specific provisions have to be drawn up and integrated in the 'Material Transfer Agreements' as a part of the proposed Biodiversity (Conservation) Act. In addition, legal procedures have also to be formulated for the preparation of 'advance informed agreement' on safe transfer, handling and use of the living modified organisms (LMOs) resulting from biotechnologies that may have adverse effects on the conservation and sustainable use of biological diversity (Art. 19(3)). Such procedures would also have to regulate the environmental and human and animal health risks associated with the use and release of LMOs (Art. 8(g)). The Contracting Parties in the second meeting took a decision to constitute an open-ended Ad Hoc Working Group to develop a 'Protocol on Biosafety' and has already begun its deliberations (Chauhan, 1996). The non-legally binding 'International Guidelines for safety in Biotechnology' finalised in 1995 under the aegis of the UNEP could form the basis of formulating the proposed 'Protocol' (UNEP 1995). In India at present, the Rules on Biosafety (notified in 1989) and the revised guidelines (1990) under the Environment (Protection) Act govern the risk assessment and biosafety of hazardous micro-organisms/genetically modified organisms or cells. However, these are inadequate in terms of the provisions of the Article 19 and 8, as mentioned above, and also with respect to compensation and liability in the case of any major disaster. This has been discussed in detail by Chauhan (1996a) elsewhere.

To effectively implement the aforesaid legal provisions under the proposed Biological Diversity (Conservation) Act, a 'National Authority' shall be required to be created. The other entities such as 'National Register', 'National Monitoring Centre' and 'National Biological Diversity Fund' could operate under this 'Authority' with well laid out guidelines (Chauhan 1998).

(vii) Technical and Scientific Cooperation

Article 18 of the CBD provides for the Contracting Parties to promote international technical and scientific cooperation in the field of conservation and sustainable use of biological diversity, particularly through the development and strengthening of national capabilities. In this context, cooperation among the nations of the Asia region is very critical, as there are significant common elements of agro-biological diversity and patterns of use in all the countries. Realising this, MoEF had organised a regional workshop of all the countries belonging to SAARC and ASEAN regions. There was consensus on having a 'Regional Platform' to establish a strong and close cooperative mechanism to evolve common approaches on mechanisms for emergency responses; access to and transfer of genetic material including benefit sharing mechanisms; common systems of royalty payments, transfer and development of technologies under 'prior informed consent'; a common policy for all *ex situ* collections denoted earlier to CGIAR, FAO and other organisations; broad principles of IPRs including farmers rights; trade in living and genetically modified biological material; and the biosafety aspects of using transgenics. This needs to be pursued vigorously with all countries of the SAARC and ASEAN region (Chauhan, 1997b); the ICAR could take a lead in this direction.

(viii) Capacity building for human and infrastructural resources

The success of any future plan of action for conservation and sustainable utilisation of agro-biological diversity would largely depend upon building the capacity of people and of institutional structures. Chauhan (1997b) has illustrated that as many as 27 disciplines need to be covered in

terms of human resource development and deployment in this area; this requires careful planning. Therefore, the existing university system has to be sensitised to incorporate courses and curricula relevant to the contemporary situation.

The functioning of the existing infrastructure also requires to be suitably geared to the needs of agro-biological diversity. At present, these institutions are involved with their given mandates, which sometimes causes considerable conflict. This is because of few viable interlinkages between them. This is a lacuna in our planning, The flow chart (Figure 1) suggests an effective way of dealing with complex issues relating to conservation and sustainable use of agro-biological diversity. The agencies highlighted in the figure would need to ensure that they are constantly exchanging their views through modern information technology highways so that decision making processes are quick, transparent and on the basis of consensus (Chauhan, 1997b).

(ix) Financial mechanisms

Articles 20 and 21 of the CBD provides a framework for generating and utilising financial resources. As of today, the interim financial mechanism identified for this purpose is the Global Environment Facility. This mechanism is to work under the overall control of the Contracting Parties and provide financial support to those activities which have been duly approved by the COP. In fact, India should capitalise on this and submit projects for funding in the areas which requires immediate action. This is necessary as a very insignificant share of the total plan outlays are allocated to the management of our biological resources.

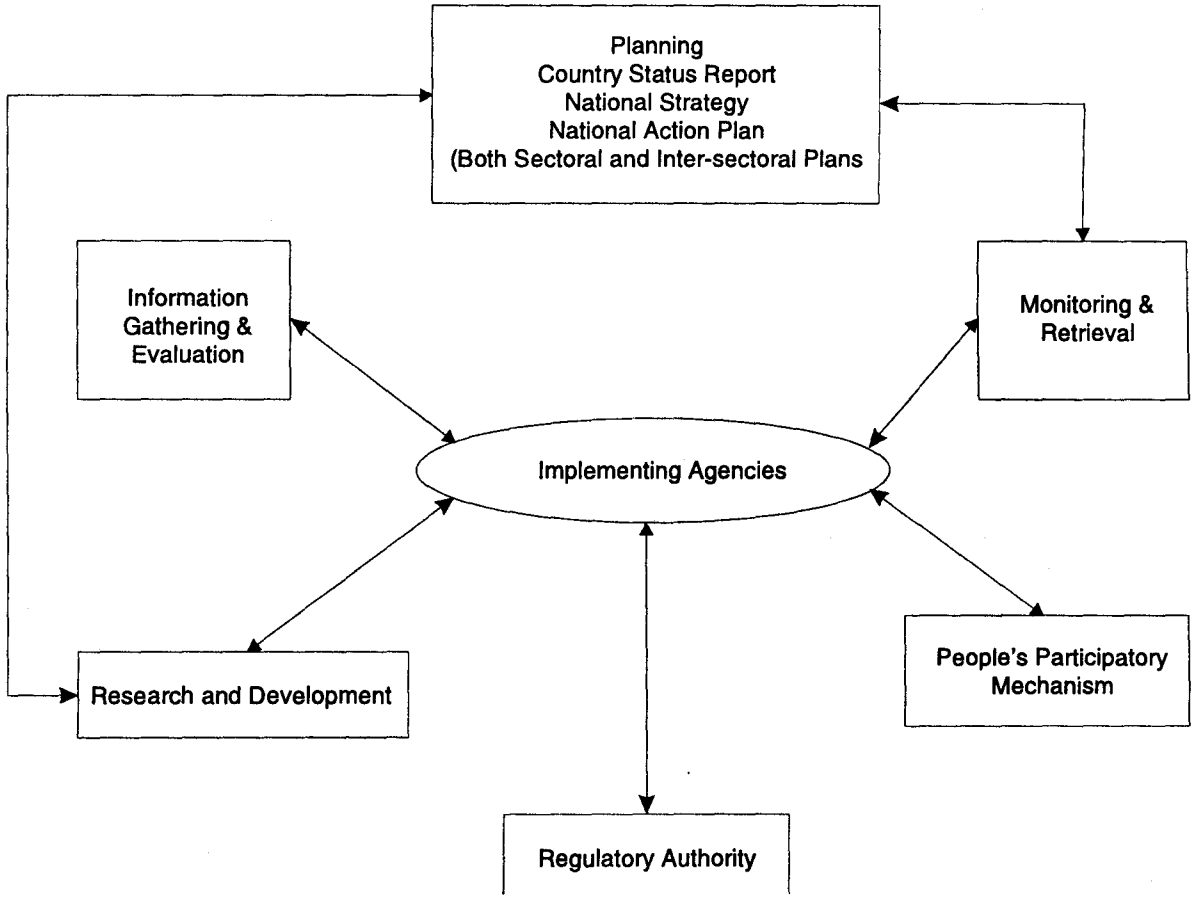

Fig. 1. A flow chart showing the infrastructure facilities and their inter-linkages

Therefore, it is pertinent to carry out an exhaustive exercise to assess both capital and recurrent assets, and project financial requirements for the coming 50 years. The additional and new financial requirements could be augmented through national and states appropriation, international bilateral/multilateral agencies and private foundations. There is also a need to explore other possibilities like public/private co-financing, community trust funds and debt swapping mechanisms as it is unlikely that government agencies alone will be able to provide 100 per cent of the required finances, particularly in the context of the new economic policies Chauhan, 1997b).

The implications of the 'Convention on Biological Diversity], particularly with reference to agro-biological diversity are manifold. In the light of the various provisions of the CBD, the on-going programmes have to be re-examined and appropriately modified to achieve the objective of conservation and sustainable use. The areas in which new initiatives need to be taken include, in particular, survey, identification and monitoring; the development of *ex-situ* and *in situ* conservation strategies; and methodologies for the sustainable use of genetic resources. For this both national and regional plans would need to be supported with adequate legal instruments. The essential elements covering all these aspects have been outlined and could form the basis for a detailed 'Action Plan for the next 50 Years'. The success of such a plan would depend on the establishment of effective interlinkages among all the key implementing agencies, the participation of local communities, the integration of the required scientific inputs, and realisation of the economic potential of sustainably used genetic resources. This is a major challenge. Moreover, a concerted effort would also have to be made to augment the financial resources through reappropriation of plan funding, bilateral and multilateral institutional funding, and private funding sources.

REFERENCES

Chandel, K.P.S. 1996. Hindustani centre provides India and world a trove of genetic diversity. *Diversity* 12(3): 21.

Chauhan, K.P.S. 1993. Research options and priorities for conservation of biological diversity in the Western Ghats. *In*: Frame, B., Victor, J and Joshi Y. (eds.). Biodiversity conservation: forests, wetlands and deserts. Tata Energy Research Institute and British Council, New Delhi, India.

Chauhan, K.P.S. 1996b. Implications of the convention on biological diversity : Indian approach. *Indian J. Pl. Genet. Resources* 9(1); 1-20.

Chauhan, K.P.S. 1996c. Legal requirements for fulfilling obligations under the convention on biological diversity in India. *Indian J. Pl. Genet. Resources* 9(2): 183-191.

Chauhan, K.P.S. 1997a. Intellectual property rights : Aspects of equity and benefit sharing in sustainable utilisation of biological resources by local communities. *In*: Singh, B. and Mahanti, N. (eds.). Tribal policy in India. 109-121.

Chauhan, K.P.S. 1997b. Conservation of biological diversity in Agriculture - An action plan for the future. *In*: Bajwa, M.S., Dhillon, J.S., Dilawari, V.K. and Chahal, S.S. (eds.). Proc. third agricultural science congress- Invited papers (vo. 1): 265-278, National Academy of Agricultural Sciencies, New Delhi and Punjab Agric. Univ., Ludhiana, India.

Chauhan, K.P.S., G.V. Sarat Babu and S. Arora. 1997. Rights of local communities and implications of the convention on biological diversity. *In*: Singh, B and Mahanti, N. (eds.). Intellectual property rights and the tribals, 57-66.

Chauhan, K.P.S. 1998. Biosafety concerns in biological resource management. *Indian J. Pl. Genet. Resources* 11(2); 153-163.

F.A.O. 1996. Global plan of action for the conservation and sustainable utilisation of plant genetic resources for food and agriculture. Food and Agriculture Organisation, Rome, Italy.

Ganesan, A.V. 1994. The GATT Uruguay round agreement : opportunities and challenges. RGICS paper no. 8, 1-69, Rajiv Gandhi Institute for Contemporary Studies, New Delhi, India.

Kothari, A. 1997a. Understanding biodiversity; life, sustainability and equity. Orient Longman Limited, New Delhi, India. 161p.

Kothari, A. 1997b. Conserving India's agro-biodiversity : prospects and policy implications. Gatekeept Series No. SA65: 1- 20, International Institute for Environment and

Development, London, U.K.

Kothari, A. and Singh, S. 1994. Biodiversity and Indian national law : A conceptual framework. *In*: Krattiger, A.F., McNeely, J.A., Lesser, W.H., Miller, K.R., Hill, Y. St. and Senanayake, R. (eds.). Widening perspectives on biodiversity. IUCN and International Academy of the Environment, Switzerland. p147-158.

MoEF. 1994. Ethnobiology in India; A status report. Ministry of Environment and Forests, Government of India, New Delhi, India.

MoEF. 1997. Draft national action plan for biodiversity, 1997. Ministry of Environment and Forests, Government of India, New Delhi, India.

MSSRF. 1997. Gender dimensions in biodiversity management in India. A report submitted to FAO Regional Office for Asia and the Pacific, M.S. Swaminathan Research Foundation, Chennai, India.

Nayar, M.P. 1996. Hot spots of endemic plants of India, Nepal and Bhutan. Tropical Botanic Garden and Research Institute, Pacha Palode, Thiruvananthapuram, India.

UNEP. 1992. Convention on Biological Diversity, United National Environment Programme, Nairobi, Kenya.

UNEP. 1995. International technical guidelines for safety in biotechnology. United Nations Environment Programme, Nairobi, Kenya.