

**REPORT of the
INTERNATIONAL EXPERT ADVISORY PANEL for the
STUDY OF GEF'S OVERALL PERFORMANCE**

October 1997

The Senior Monitoring and Evaluation Coordinator in the GEF Secretariat formed an International Expert Advisory Panel to provide guidance to the Study of GEF's Overall Performance and to assure that the study is complete in coverage and a fully independent review. The Panel met on June 27, 1997, to review the Terms of Reference and Inception Report for the study. The composition of the Panel is in Annexure. Prof. M. S. Swaminathan of India was elected Chair of the Panel.

The Panel held its second meeting in Washington, D.C. from October 27-29, 1997, to review the first draft of the report prepared by the study team. Although all sections of the report were not yet drafted, the Panel reviewed and discussed in depth with the study team the portions of the report that were made available to it. The Panel provided detailed reactions, comments and guidance to the GEF Senior Monitoring and Evaluation Coordinator and to the study team to assist it in completing the report of the study. The Panel's discussions will be summarized in minutes of its meeting, which will be provided to the Senior Monitoring and Evaluation Coordinator and the study team separately from this report. The Panel's comments will be taken into account in a second draft of the report to be prepared by the study team, which will be shared with representatives of the GEF implementing agencies and other stakeholders for the next round of comments. The final draft of the team's report will be shared with the Panel for further review and comment prior to the completion of the study.

In addition to its comments on the draft study report itself, the Advisory Panel agreed on a number of conclusions and recommendations to the GEF Council on the topics examined by the Overall Performance Study. These are presented in this report.

Mobilization of Resources for the Global Environment

- Based on the information analyzed for the study, it appears that there has been a gradual overall increase in investments for the environment over the last five years. Levels of official development assistance (ODA) may have decreased, but overall--including investments by developing countries themselves and the private sector--there has been an increase. This increase, however, has been very uneven among countries. Nevertheless, levels of funding for the environment, and to address global environmental problems in particular, are still inadequate in relation to the threats and problems. New and additional resources are urgently needed, based on common but differentiated responsibilities among nations.
- There would be considerable benefit in establishing more coordinated strategies at the country level to address environmental problems. **In this regard, the Panel**

supports the recommendation of the study team that GEF implementing agencies, in association with national governments, initiate Environmental Consultative Group meetings at the country level. Such groups would be made up of all donors providing climate, biodiversity and other GEF mandate-related assistance to the country, as well as a range of government agencies and other organizations, including the private sector, interested in environmental issues. The objective of these consultative groups would be to advise on the reduction of duplication, identification of gaps where additional efforts are needed, ways to make optimum use of resources to address global environmental problems, and how to assure the continuation and sustainability of activities initiated with support from the GEF.

- The Panel believes that it is important to emphasize the international public good nature of the GEF and the need to sustain funding for global environmental investments over time.
- The GEF should explore additional ideas and mechanisms to expand the involvement of the private sector in addressing global environmental issues. This would include not only private businesses, but also the major international philanthropic foundations and environmental organizations. **The Panel recommends that the GEF consider organizing a workshop with the World Business Council for Sustainable Development to suggest opportunities for greater involvement of the private sector. Such a workshop might be held in conjunction with the upcoming GEF Assembly meeting in India next April.**
- Similarly, the GEF should initiate further steps to identify mechanisms for the expanded involvement of the international scientific and academic communities in the effective implementation of its mandate.
- There is a need for greater public awareness and understanding of global environmental issues and the role the GEF is playing to address them. Some of this effort could be carried out by the GEF directly. **In addition, national committees for GEF, which should include government, NGO, business, scientific and other representatives, could be formed to play a role in this regard.** There may also be opportunities to work with regional groupings in this area, as well. At the country level, the implementing agencies should make greater efforts to identify GEF-funded activities with the GEF rather than the agencies themselves.

Institutional Roles and Relationships

- The Panel noted the study team's conclusion that mainstreaming of global environmental concerns into the regular (non-GEF) strategies and programs of the World Bank and UNDP appear to be limited to date. However, it also noted that, to be effective, this kind of mainstreaming has to be built on partnerships between these implementing agencies and governments in recipient countries. Overall

country strategies and programs are not the product of the World Bank and UNDP alone. National and donor priorities are focused on poverty alleviation, sustainable livelihoods, and elimination of gender inequity. However, the linkages between these priorities and environmental issues, including global environmental issues, are clear and important. The World Bank and UNDP should make greater efforts at the country level to raise awareness of these linkages and of the importance of addressing environmental issues, and in this way increasingly mainstream them in their country assistance strategies and programs. The proposed national committees for GEF could also help in this regard.

- The general roles of the three implementing agencies within the GEF should, in the near term, remain basically as they are evolving. The Panel expects that this would mean that the World Bank would likely be the major financing channel for disbursing GEF resources. **However, in the future a fourth “partner” might be the private sector, including foundations--not necessarily as implementing agencies, but as a fuller partner within the GEF, for example, for technology transfer. The recommended workshop with the World Business Council for Sustainable Development might explore ways this partnership could be developed and institutionalized.**
- The Panel believes that the GEF should devote continued efforts to streamline the procedures for designing, approving and implementing projects, and to make these procedures simpler and more nationally-driven. The UNDP-managed Small Grants Programme has, by all reports, been very successful in this regard, and the new expedited medium-sized project procedures also have potential to make significant strides in this direction. **In view of this, the Panel suggests that the GEF consider raising the ceilings for maximum project size under the Small Grants Programme and under the medium-sized projects procedures with a view to increasing the percentage of the projects funded by the GEF that benefit from expedited procedures. In addition, as a step toward expediting project approval procedures, the Panel concurs with the study team’s recommendation that the GEF Council seriously consider delegating its second review of project proposals to the Secretariat.**
- The Panel noted the discussion in the draft study report of the merits of expanding the number of GEF implementing agencies from the existing three. This is not a new issue, and has been the subject of a number of NGO letters to the Chairman of the Panel. Upon consideration of the arguments on both sides of this issue, **the Panel believes that, for the moment, the GEF should focus on consolidating its strengths and streamlining procedures and should not, at least for the near future, expand the number of implementing agencies.** However, the Panel encourages the three existing implementing agencies to look for increased opportunities to involve regional development banks and other suitable organizations in GEF programs implemented through them. In addition, the Panel recommends that the GEF undertake a study to examine the potential for

leveraging additional resources for the global environment by including other organizations as GEF implementing agencies.

- The Panel believes that is essential for the effective operation of the GEF that there be a Secretariat that plays a strong coordinating and catalytic role within the GEF family. Its focus should be on strategic and policy issues, aimed at creating common systems and approaches for the GEF as a whole. **It should promote strategic alliances within the GEF family and, for example, with the climate change and biological diversity convention secretariats.** The GEF secretariat's role should not include micro-management or detailed review of project designs presented by the implementing agencies for GEF approval. The Panel stressed that, in fact, neither should it be the role of the implementing agencies to micro-manage projects, since recipient countries should have the principal project management responsibility.
- The Panel noted the valuable and important work performed by the STAP since the creation of the GEF. However, it noted that during the past five years, a number of other strong, government-approved scientific bodies have been created, including the subsidiary bodies of the two conventions for which the GEF is the interim financial mechanism. **The Panel recommends that the Council review the future mandate, scope and role of the STAP taking into consideration the existence of these other bodies.**

Country-Level Issues

- The Panel believes it is helpful to identify three dimensions of the question of the extent to which GEF-funded projects are country-driven and reflect country ownership and commitment: (1) how projects are identified and initiated, (2) how projects are managed, and (3) the long-term sustainability of activities supported by GEF projects. With respect to the first, while it is important that there is a correspondence between the project idea and country interests, priorities and policies, it is not a prerequisite that the idea always originate in the country, since the benefits of GEF projects are designed to transcend national priorities. **However, project management should be "driven" by national organizations and individuals. Finally, ownership is closely related to, and reflected in, the long-term sustainability of project activities. Thus, even though an idea for a GEF-funded project may initially come from outside the country, it is essential that management responsibility be with the country and that the country commitment to and ownership of the activity be such that it will be sustained following the completion of the GEF project.**
- The Panel believes that the study team brought out a number of good points on the issue of the use of foreign consultants in GEF projects, and the impact this can have on country ownership. The Panel recognizes that in areas related to the global environment there is sometimes a need for expertise from outside developing countries. **However, the Panel believes that the need for foreign**

consultants is likely more often to be the exception rather than the rule, and that GEF's implementing agencies should give a strong emphasis to involving local and regional expertise in the design, analysis and implementation of GEF projects, including PDF activities.

- The Panel believes that the GEF should be given credit for encouraging substantial involvement of stakeholders in the design and implementation of its projects. One of the clearest lessons from GEF experience to date is that a high degree of stakeholder involvement is an important factor in project success. The GEF's emphasis on stakeholder participation has led a number of countries to recognize the positive contributions that NGOs and other stakeholders can make to the solution of global environment and national development problems. **The Panel encourages the GEF to continue its emphasis on stakeholder participation and to look for ways to do more in this area, especially in the area of monitoring and evaluation. The creation of national committees for GEF involving a wide range of organizations and interests, as suggested earlier, might help identify the ways this could be done.**
- The GEF has a key role to play in raising awareness of global environmental issues in the countries where it works, and in this way helping assure that these considerations are increasingly reflected in country policies, regulations and priorities. In particular, the Panel recognizes the contributions of the Small Grants Programme to mainstreaming environmental concerns more broadly in the countries where it has functioned. The GEF can also usefully stimulate public policy debates on important issues related to the projects it funds and the global environment within its focal areas. The Panel recognizes that the GEF cannot be looked at in isolation from the increasing number of other actors involved in these issues. For example, in the area of biological diversity, most countries are signatories to the biological diversity convention and several now have national legislation that resulted from public examination and debate. The Panel encourages the Council to look for additional mechanisms through which the GEF, working with its implementing agencies, the climate and biological diversity conventions and others, can help create a broader public understanding of global environmental issues in developing countries. **One such mechanism might be for GEF to provide support to media resource centers in some countries.**

Project Issues

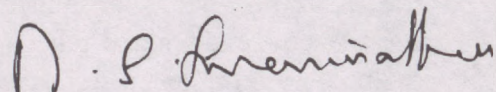
- The Panel recommends that all GEF projects incorporate a specific withdrawal strategy in their design. Such a strategy would address how the activities supported by the project would be sustained over the long term following completion of GEF funding. While the specific approaches will vary project by project, the Panel believes it is very important to focus on long term sustainability at the beginning of project support. The Panel believes that the analysis conducted for the design of each GEF project should identify the costs of long-

term sustainability. The sources of such future support clearly would need to be identified over time, but it is useful to identify likely future requirements at the outset so that proactive measures can be taken to assure continuity.

- In order to ensure greater clarity in the criteria for calculating and negotiating the incremental costs on which GEF-funded projects are based, the Panel endorses the recommendation of the study team that a working group of representatives from the GEF and convention secretariats and implementing agencies be formed to explore ways to make the process of determining incremental costs more reflective and appreciative of the contributions of recipient countries for a better common future for humankind.

Final Comments

- The Panel believes that the world requires a well-run multilateral mechanism for worldwide "ecological security". Global environmental issues cannot be left exclusively to the multitude of bilateral negotiations and efforts underway. In GEF, we have the needed multilateral funding mechanism. The GEF should not only be continued but should be strengthened further.
- Based on its review of the Overall Performance study and the draft report, the Panel believes the study team has conducted an honest and independent assessment of the GEF. The Panel compliments the team on its work. It also compliments GEF's Senior Monitoring and Evaluation Coordinator on the procedures followed in designing and carrying out the study, which have contributed greatly to the quality and objectivity of the assessment. The Panel believes that the study will be very useful to the GEF family and others interested in the GEF, and recommends that comprehensive assessments of the accomplishments of the GEF be conducted at appropriate intervals in the future when there will be additional basis for determining the impacts and effectiveness of GEF-funded activities.

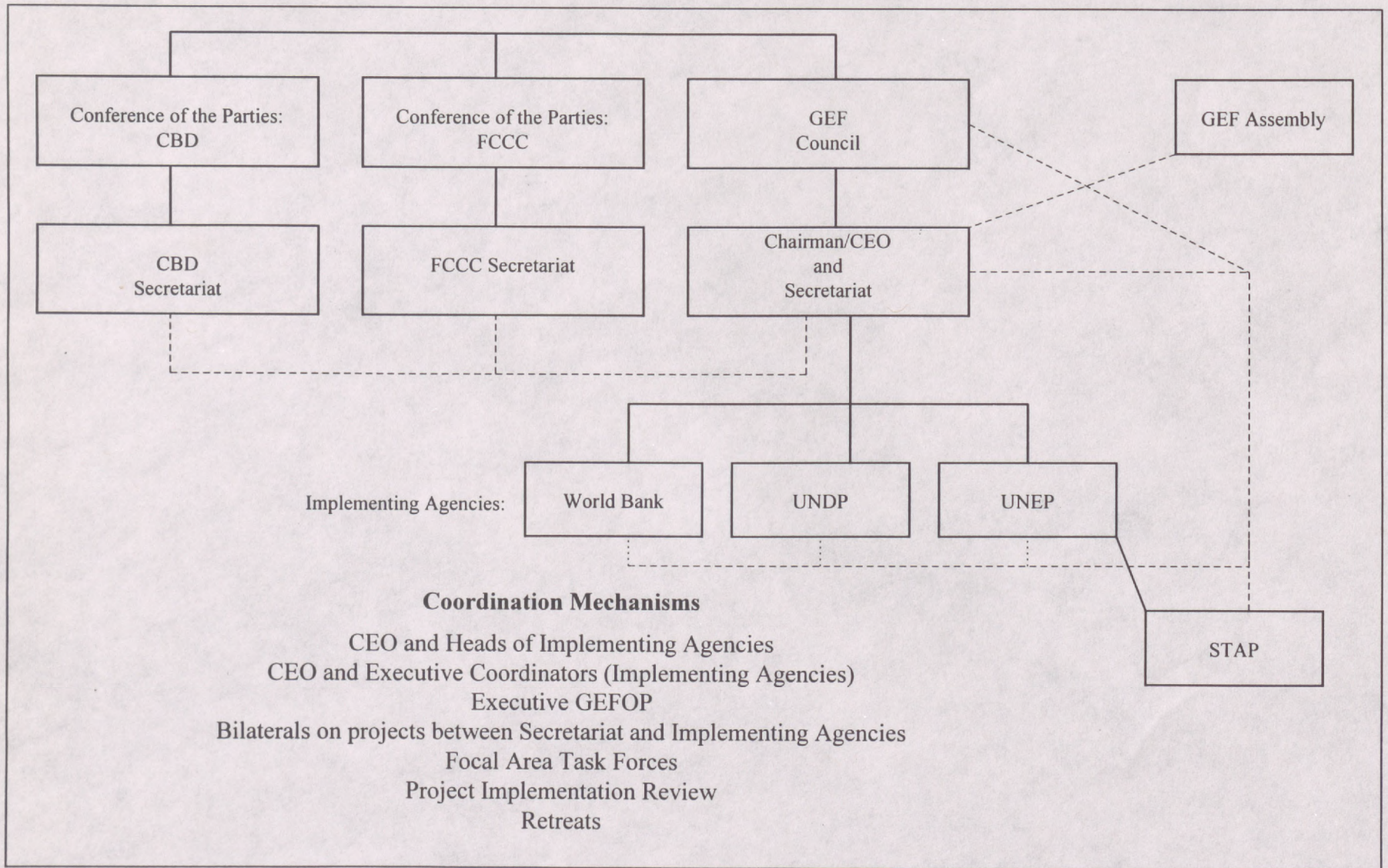


M.S. Swaminathan
Chair
International Expert Advisory Panel

List of Panel Members

- Dr. M. S. Swaminathan, M. S. Swaminathan Research Foundation, Madras - India
- Dr. Edward S. Ayensu, Edward S. Ayensu Associates Limited, Science, Technology and Economic Consultants, Accra - Ghana
- Dr. Richard Bissel, McLean VA - USA
- Dr. Rudolf Dolzer, University of Bonn - Germany
- Dr. Wakako Hironaka, House of Councillors, Tokyo - Japan
- Dr. Hisham Khatib, World Energy Council, Amman - Jordan
- Dr. Brice Lalonde, Association for Colloguia on the Environment, Paris - France
- Dr. Maria Tereza Jorge Padua, Funatura Fundação Pró-Natureza, Foundation for Nature, Brasilia - Brazil

GLOBAL ENVIRONMENT FACILITY: POLICY AND IMPLEMENTATION STRUCTURE



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THE BIOLOGICAL DIVERSITY BILL, 2000

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THE BIOLOGICAL DIVERSITY BILL, 2000

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BILL

to provide for conservation of Biological Diversity, sustainable use of its components and equitable sharing of the benefits arising out of the use of biological resources and for matters connected therewith or incidental thereto.

5 WHEREAS India is rich in biological diversity and associated traditional and contemporary knowledge system relating thereto;

AND WHEREAS India is a party to the United Nations Convention on Biological Diversity signed at Rio de Janeiro on the 5th day of June, 1992;

AND WHEREAS the said Convention came into force on the 29th December, 1993;

10 AND WHEREAS the said Convention reaffirms the sovereign rights of the States over their biological resources;

AND WHEREAS the said Convention has the main objective of conservation of biological diversity, sustainable use of its components and fair and equitable sharing of the benefits arising out of utilisation of genetic resources;

15 AND WHEREAS it is considered necessary to provide for conservation, sustainable utilisation and equitable sharing of benefits arising out of utilisation of genetic resources and also to give effect to the said Convention;

BE it enacted by Parliament in the Fifty-first Year of the Republic of India as follows:—

CHAPTER I

PRELIMINARY

Short title, extent and commencement

1. (1) This Act may be called the Biological Diversity Act, 2000.

(2) It extends to the whole of India.

(3) It shall come into force on such date as the Central Government may, by notification in the Official Gazette, appoint:

Provided that different dates may be appointed for different provisions of this Act and any reference in any such provision to the commencement of this Act shall be construed as a reference to the coming into force of that provision.

Definitions.

2. In this Act, unless the context otherwise requires,—

(a) "benefit claimers" means the conservers of biological resources, their by-products, creators and holders of knowledge and information relating to the use of such biological resources, innovations and practices associated with such use and application;

(b) "biological diversity" means the variability among living organisms from all sources and the ecological complexes of which they are part and includes diversity within species or between species and of eco-systems;

(c) "biological resources" means plants, animals and micro organisms or parts thereof, their genetic material and by-products with actual or potential use or value but does not include human genetic material;

(d) "bio-survey and bio-utilisation" means survey or collection of species, subspecies, genes, components and extracts of biological resource for any purpose and includes characterisation, inventorisation and bioassay;

(e) "Chairperson" means the Chairperson of the National Biodiversity Authority or, as the case may be, of the State Biodiversity Board;

(f) "equitable benefit sharing" means sharing of benefits as determined by the National Biodiversity Authority under section 21;

(g) "local bodies" means Panchayats and Municipalities, by whatever name called, within the meaning of clause (1) of article 243B and clause (1) of article 243Q of the Constitution and in the absence of any Panchayats or Municipalities, institutions of self-government constituted under any Central Act or State Act;

(h) "member" means member of the National Biodiversity Authority or a State Biodiversity Board and includes the Chairperson;

(i) "National Biodiversity Authority" means the National Biodiversity Authority established under section 8;

(j) "prescribed" means prescribed by rules made under this Act;

(k) "regulations" means regulations made under this Act;

(l) "research" means study or systematic investigation of any biological resource or technological application, that uses biological systems, living organisms or derivatives thereof to make or modify products or processes for any use;

(m) "State Biodiversity Board" means the State Biodiversity Board established under section 22;

(n) "sustainable use" means the use of components of biological diversity in such manner and at such rate that does not lead to the long-term decline of the biological diversity thereby maintaining its potential to meet the needs and aspirations of present and future generations.

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No human genetic material

Working with the...

CHAPTER II

REGULATION OF BIOLOGICAL DIVERSITY

3. (1) No person referred to in sub-section (2) shall without previous approval of the National Biodiversity Authority obtain any biological resource occurring in India or knowledge associated thereto for research or for commercial utilisation or for bio-survey and bio-utilisation.

Certain persons not to undertake Biodiversity related activities without approval of National Biodiversity Authority.

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(2) The persons who shall be required to take the approval of the National Biodiversity Authority under sub-section (1) are the following, namely:—

(a) a person who is not a citizen of India;

(b) a citizen of India, who is a non-resident as defined in clause (30) of section 2 of the Income-tax Act, 1961;

43 of 1961.

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(c) a body corporate, association or organisation—

(i) not incorporated or registered in India; or

(ii) incorporated or registered in India under any law for the time being in force which has any non-Indian participation in its share capital or management.

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4. No person shall without the previous approval of the National Biodiversity Authority, transfer the results of any research relating to any biological resources occurring or obtained from India for monetary consideration or otherwise to any person who is not a citizen of India or a body corporate or organisation which is not registered or incorporated in India or which has any non-Indian participation in its share capital or management.

Results of research not to be transferred to certain persons without approval of National Biodiversity Authority.

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Explanation.—For the purposes of this section, "transfer" does not include publication of research papers or dissemination of knowledge in any seminar or workshop, if such publication is as per the guidelines issued by the Central Government.

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5. (1) The provisions of sections 3 and 4 shall not apply to collaborative research projects involving transfer or exchange of biological resources or information relating thereto between institutions, including Government sponsored institutions of India, and such institutions in other countries, if such collaborative research projects satisfy the conditions specified in sub-section (3).

Sections 3 and 4 not to apply to certain collaborative research projects.

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(2) All collaborative research projects, other than those referred to in sub-section (1) which are based on agreements concluded before the commencement of this Act and in force shall, to the extent the provisions of agreement are inconsistent with the provisions of this Act or any guidelines issued under clause (a) of sub-section (3), be void.

under Agmt void if inconsistent

(3) For the purposes of sub-section (1) collaborative research projects shall,—

(a) conform to the policy guidelines issued by the Central Government in this behalf;

(b) be approved by the Central Government.

No fee before NBSA approval -

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6. (1) No person shall apply for any intellectual property right by whatever name called in or outside India for any invention based on any research or information on a biological resource obtained from India without obtaining the previous approval of the National Biodiversity Authority before making such application:

Application for intellectual property rights not to be made without approval of National Biodiversity Authority.

Provided that if a person applies for a patent, permission of the National Biodiversity Authority may be obtained after the acceptance of the patent but before the sealing of the patent by the patent authority concerned.

Loyalty, fee Bstc

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(2) The National Biodiversity Authority may, while granting the approval under this section, impose benefit sharing fee or royalty or both or impose conditions including the sharing of financial benefits arising out of the commercial utilisation of such rights.

(3) The provisions of this section shall not apply to any person making an application for any rights under any law relating to protection of plant varieties enacted by Parliament.

(4) Where any right is granted under sub-section (3), the concerned authority granting such right shall endorse a copy of such document granting the right to the National Biodiversity Authority. 5

7. No person who is a citizen of India or a body corporate, association or organisation which is registered in India shall obtain any biological resource for commercial utilisation or bio-survey and bio-utilisation except after giving prior intimation to the State Biodiversity Board concerned:

Provided that the provisions of this section shall not apply to the local people and communities of the area, including *vaid*s and *hakims*, who have been practising indigenous medicine. 10

CHAPTER III

NATIONAL BIODIVERSITY AUTHORITY

8. (1) With effect from such date as the Central Government may, by notification in the Official Gazette, appoint, there shall be established for the purposes of this Act, a body to be called the National Biodiversity Authority. 15

(2) The National Biodiversity Authority shall be a body corporate by the name aforesaid, having perpetual succession and a common seal, with power to acquire, hold and dispose of property, both movable and immovable, and to contract, and shall by the said name sue and be sued. 20

(3) The head office of the National Biodiversity Authority shall be at Chennai and the National Biodiversity Authority may, with the previous approval of the Central Government, establish offices at other places in India.

(4) The National Biodiversity Authority shall consist of the following Members, namely:— 25

(a) A Chairperson, who shall be an eminent person having adequate knowledge and experience in the conservation and sustainable use of biological diversity and in matters relating to equitable sharing of benefits, to be appointed by the Central Government; 30

(b) three members *ex officio* to be appointed by the Central Government, one representing the Ministry of Tribal Affairs and two representing the Ministry of Environment and Forests of whom one shall be the Additional Inspector General of Forests or the Inspector General of Forests;

(c) five members *ex officio* to be appointed by the Central Government to represent respectively the Ministries of the Central Government dealing with— 35

(i) Agricultural Research and Education;

(ii) Biotechnology;

(iii) Ocean Development;

(iv) Agriculture and Cooperation; 40

(v) Indian Systems of Medicine and Homoeopathy;

(d) five non-official members to be appointed from amongst specialists and scientists having special knowledge of, or experience in, matters relating to conservation of biological diversity, sustainable use of biological resources and equitable sharing of benefits arising out of the use of biological resources, representatives of industry, conservers, creators and knowledge holders of biological resources. 45

Prior intimation to State Biodiversity Board for obtaining biological resource for certain purposes.

Establishment of National Biodiversity Authority.

Chennai

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9. The term of office and conditions of service of the Chairperson and the other members other than *ex officio* members shall be such as may be prescribed by the Central Government.

Conditions of service of Chairperson and Members.

5 10. The Chairperson shall be the Chief Executive of the National Biodiversity Authority and shall exercise such powers and perform such duties, as may be prescribed.

Chairperson to be Chief Executive of National Biodiversity Authority.

11. The Central Government may remove from the National Biodiversity Authority any member who, in its opinion has,—

Removal of members.

(a) been adjudged as an insolvent; or

(b) been convicted of an offence which involves moral turpitude; or

10 (c) become physically or mentally incapable of acting as a member; or

(d) so abused his position as to render his continuance in office detrimental to the public interest; or

(e) acquired such financial or other interest as is likely to affect prejudicially his functions as a member.

15 12. (1) The National Biodiversity Authority shall meet at such time and place and shall observe such rules of procedure in regard to the transaction of business at its meetings (including the quorum at its meetings) as may be prescribed.

Meetings of National Biodiversity Authority.

(2) The Chairperson of the National Biodiversity Authority shall preside at the meetings of the National Biodiversity Authority.

20 (3) If for any reason the Chairperson is unable to attend any meeting of the National Biodiversity Authority, any member of the National Biodiversity Authority chosen by the members present at the meeting shall preside at the meeting.

25 (4) All questions which come before any meeting of the National Biodiversity Authority shall be decided by a majority of the votes of the members present and voting and in the event of equality of votes, the Chairperson or, in his absence, the person presiding, shall have and exercise a second or casting vote.

30 (5) Every member who is in any way, whether directly, indirectly or personally, concerned or interested in a matter to be decided at the meeting shall disclose the nature of his concern or interest and after such disclosure, the member concerned or interested shall not attend that meeting.

(6) No act or proceeding of the National Biodiversity Authority shall be invalidated merely by reason of—

(a) any vacancy in, or any defect in the constitution of the National Biodiversity Authority; or

(b) any defect in the appointment of a person acting as a member; or

(c) any irregularity in the procedure of the National Biodiversity Authority not affecting the merits of the case.

40 13. (1) The National Biodiversity Authority may constitute a committee to deal with agro-biodiversity.

Committees of National Biodiversity Authority.

Explanation.—For the purposes of this sub-section "agro-biodiversity" means biological diversity of agriculture related species and their wild relatives.

(2) Without prejudice to the provisions of sub-section (1), the National Biodiversity Authority may constitute such number of committees as it deems fit for the efficient discharge of its duties and performance of its functions under this Act.

(3) A committee constituted under this section, shall co-opt such number of persons, who are not members of the National Biodiversity Authority, as it may think fit and the persons so co-opted shall have the right to attend the meetings of the committee and take part in its proceedings but shall not have the right to vote.

(4) The persons appointed as members of the committee under sub-section (2) shall be entitled to receive such allowances or fees for attending the meetings of the committee as may be fixed by the Central Government.

Officers and employees of National Biodiversity Authority.

14. (1) The National Biodiversity Authority may appoint such officers and other employees as it considers necessary for the efficient discharge of its functions under this Act.

(2) The terms and conditions of service of such officers and other employees of the National Biodiversity Authority shall be such as may be specified by regulations.

Authentication of orders and decisions of National Biodiversity Authority.

15. All orders and decisions of the National Biodiversity Authority shall be authenticated by the signature of the Chairperson or any other member authorised by the National Biodiversity Authority in this behalf and all other instruments executed by the National Biodiversity Authority shall be authenticated by the signature of an officer of the National Biodiversity Authority authorised by it in this behalf.

Delegation of powers.

16. The National Biodiversity Authority may, by general or special order in writing, delegate to any member, officer of the National Biodiversity Authority or any other person subject to such conditions, if any, as may be specified in the order, such of the powers and functions under the Act (except the power to settle disputes under section 50 and the power to make regulations under section 62) as it may deem necessary.

Expenses of National Biodiversity Authority to be defrayed out of the Consolidated Fund of India.

17. The salaries and allowances payable to the members and the administrative expenses of the National Biodiversity Authority including salaries, allowances and pension payable to, or in respect of, the officers and other employees of the National Biodiversity Authority shall be defrayed out of the Consolidated Fund of India.

CHAPTER IV

FUNCTIONS AND POWERS OF THE NATIONAL BIODIVERSITY AUTHORITY

Functions of National Biodiversity Authority.

18. (1) It shall be the duty of the National Biodiversity Authority to regulate activities referred to in sections 3, 4 and 6 and by regulations issue guidelines for access to and equitable benefit sharing.

(2) The National Biodiversity Authority may grant approval for undertaking any activity referred to in sections 3, 4 and 6.

(3) The National Biodiversity Authority may—

(a) advise the Central Government on matters relating to the conservation of biodiversity, sustainable use of its components and equitable sharing of benefits arising out of the utilisation of biological resources;

(b) advise the State Governments in the selection of areas of biodiversity importance to be notified as heritage sites and measures for the management of such heritage sites;

(c) perform such other functions as may be necessary to carry out the provisions of this Act.

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(4) The National Biodiversity Authority may, on behalf of the Central Government, take any measures necessary to oppose the grant of intellectual property rights in any country outside India on any biological resource obtained from India or knowledge associated with such biological resource which is derived from India. *

CHAPTER V

APPROVALS BY THE NATIONAL BIODIVERSITY AUTHORITY

5 19. (1) Any person referred to in sub-section (2) of section 3 who intends to obtain any biological resource occurring in India or knowledge associated thereto for research or for commercial utilisation or for bio-survey and bio-utilisation or transfer the results of any research relating to biological resources occurring in, or obtained from, India, shall make application in such form and payment of such fees as may be prescribed, to the National Biodiversity Authority. Approval by National Biodiversity Authority for undertaking certain activities.

(2) Any person who intends to apply for a patent or any other form of intellectual property protection whether in India or outside India may make an application in such form and in such manner as may be prescribed to the National Biodiversity Authority.

15 (3) On receipt of an application under sub-section (1) or sub-section (2), the National Biodiversity Authority may, after making such enquiries as it may deem fit and if necessary after consulting an expert committee constituted for this purpose, by order, grant approval subject to any regulations made in this behalf and subject to such terms and conditions as it may deem fit, including the imposition of charges by way of royalty or for reasons to be recorded in writing reject the application:

20 Provided that no such order for rejection shall be made without giving an opportunity of being heard to the person affected.

(4) The National Biodiversity Authority shall give public notice of every approval granted by it under this section.

25 20. (1) No person who has been granted approval under section 19 shall transfer any biological resource or knowledge associated thereto which is the subject matter of the said approval except with the permission of the National Biodiversity Authority. Transfer of biological resource or knowledge.

(2) Any person who intends to transfer any biological resource or knowledge associated thereto referred to in sub-section (1) shall make an application in such form and in such manner as may be prescribed to the National Biodiversity Authority.

30 (3) On receipt of an application under sub-section (2), the National Biodiversity Authority may, after making such enquires as deemed fit and if necessary after consulting an expert committee constituted for this purpose, by order, grant approval subject to such terms and conditions as it may deem fit, including the imposition of charges by way of royalty or for reasons to be recorded in writing reject the application:

35 Provided that no such order for rejection shall be made without giving an opportunity of being heard to the person affected.

(4) The National Biodiversity Authority shall give public notice of every approval granted by it under this section.

40 21. (1) The National Biodiversity Authority shall while granting approvals under section 19 or section 20 ensure that the terms and conditions subject to which approval is granted secures equitable sharing of benefits arising out of the use of accessed biological resources, their by-products, innovations and practices associated with their use and applications and knowledge relating thereto in accordance with mutually agreed terms and conditions between the person applying for such approval, local bodies concerned and the benefit claimers. Determination of equitable benefit sharing, by National Biodiversity Authority.

45 (2) The National Biodiversity Authority shall subject to any regulations made in this behalf determine the benefit sharing which shall be given effect in all or any of the following manner, namely:—

(a) grant of joint ownership of intellectual property rights to the National Biodiversity Authority, or where benefit claimers are identified, to such benefit claimers;

(b) transfer of technology;

(c) location of production, research and development units in such areas which will facilitate better living standards to the benefit claimers;

(d) association of Indian scientists, benefit claimers and the local people with research and development in biological resources and bio-survey and bio-utilisation;

(e) setting up of venture capital fund for aiding the cause of benefit claimers;

(f) payment of monetary compensation and other non-monetary benefits to the benefit claimers as the National Biodiversity Authority may deem fit.

(3) Where any amount of money is ordered by way of benefit sharing, the National Biodiversity Authority may direct the amount to be deposited in the National Biodiversity Fund:

Provided that where biological resource or knowledge was a result of access from specific individual or group of individuals or organisations, the National Biodiversity Authority may direct that the amount shall be paid directly to such individuals or group of individuals or organizations in accordance with the terms of any agreement and in such manner as it deems fit.

(4) For the purposes of this section, the National Biodiversity Authority shall, in consultation with the Central Government, by regulations, frame guidelines.

CHAPTER VI

STATE BIODIVERSITY BOARD

Establishment
of State
Biodiversity
Board.

22. (1) With effect from such date as the State Government may, by notification in the Official Gazette, appoint in this behalf, there shall be established for the purposes of this Act, a Board for the State to be known as the _____ (name of the State) Biodiversity Board.

(2) Notwithstanding anything contained in this section, no State Biodiversity Board shall be constituted for a Union territory and in relation to a Union territory, the National Biodiversity Authority shall exercise the powers and perform the functions of a State Biodiversity Board for that Union territory:

Provided that in relation to any Union territory, the National Biodiversity Authority may delegate all or any of its powers or functions under this sub-section to such person or group of persons as the Central Government may specify.

(3) The Board shall be a body corporate by the name aforesaid, having perpetual succession and a common seal, with power to acquire, hold and dispose of property, both movable and immovable, and to contract, and shall by the said name sue and be sued.

(4) The Board shall consist of the following members, namely:—

(a) a Chairperson who shall be an eminent person having adequate knowledge and experience in the conservation and sustainable use of biological diversity and in matters relating to equitable sharing of benefits, to be appointed by the State Government;

(b) not more than five *ex officio* members to be appointed by the State Government to represent the Departments of the State Government;

(c) not more than five members to be appointed from amongst experts in matters relating to conservation of biological diversity, sustainable use of biological resources and equitable sharing of benefits arising out of the use of biological resources.

(5) The head office of the State Biodiversity Board shall be at such place as the State Government may, by notification in the Official Gazette, specify.

23. The functions of the State Biodiversity Board shall be to,—

Functions of State Biodiversity Board.

5 (a) advise the State Government, subject to any guidelines issued by the Central Government, on matters relating to the conservation of biodiversity, sustainable use of its components and equitable sharing of the benefits arising out of the utilisation of biological resources;

(b) regulate by granting of approvals or otherwise requests for commercial utilization or bio-survey and bio-utilisation of any biological resource by Indians;

10 (c) perform such other functions as may be necessary to carry out the provisions of this Act or as may be prescribed by the State Government.

24. (1) Any citizen of India or a body corporate, organisation or association registered in India intending to undertake any activity referred to in section 7 shall give prior intimation in such form as may be prescribed by the State Government to the State Biodiversity Board.

Power of State Biodiversity Board to restrict certain activities violating the objectives of conservation, etc.

15 (2) On receipt of an intimation under sub-section (1), the State Biodiversity Board may, in consultation with the local bodies concerned and after making such enquires as it may deem fit by order, prohibit or restrict any such activity if it is of opinion that such activity is detrimental or contrary to the objectives of conservation and sustainable use of biodiversity or equitable sharing of benefits arising out of such activity:

20 Provided that no such order shall be made without giving an opportunity of being heard to the person affected.

25. The provisions of sections 9 to 17 shall apply to a State Biodiversity Board and shall have effect subject to the following modifications, namely:—

Provisions of sections 9 to 17 to apply with modifications to State Biodiversity Board.

25 (a) references to the Central Government shall be construed as references to the State Government;

(b) references to the National Biodiversity Authority shall be construed as references to the Board;

(c) reference to the Consolidated Fund of India shall be construed as reference to the Consolidated Fund of the State.

CHAPTER VII

FINANCE, ACCOUNTS AND AUDIT OF NATIONAL BIODIVERSITY AUTHORITY

30 26. The Central Government may, after due appropriation made by Parliament by law in this behalf, pay to the National Biodiversity Authority by way of grants or loans such sums of money as the Central Government may think fit for being utilised for the purposes of this Act.

National Biodiversity Fund.

35 27. (1) There shall be constituted a Fund to be called the National Biodiversity Fund and there shall be credited thereto—

Application of National Biodiversity Fund.

(a) any grants and loans made to the National Biodiversity Authority under section 26;

(b) all charges and royalties received by the National Biodiversity Authority under this Act; and

(c) all sums received by the National Biodiversity Authority from such other sources as may be decided upon by the Central Government.

(2) The Fund shall be applied for—

(a) channeling benefits to the benefit claimers;

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(b) conservation of biological resources and development of areas from where such biological resources or knowledge associated thereto has been accessed;

(c) socio economic development of areas referred to in clause (b) in consultation with the local bodies concerned.

Annual report of National Biodiversity Authority.

28. The National Biodiversity Authority shall prepare, in such form and at such time each financial year as may be prescribed, its annual report, giving a full account of its activities during the previous financial year and furnish, to the Central Government, before such date as may be prescribed, its audited copy of accounts together with auditors' report thereon. 5

Budget, accounts and audit.

29. (1) The National Biodiversity Authority shall prepare a budget, maintain proper accounts and other relevant records (including the accounts and other relevant records of the National Biodiversity Fund) and prepare an annual statement of account in such form as may be prescribed by the Central Government in consultation with the Comptroller and Auditor-General of India. 10

(2) The accounts of the National Biodiversity Authority shall be audited by the Comptroller and Auditor-General of India at such intervals as may be specified by him and any expenditure incurred in connection with such audit shall be payable by the National Biodiversity Authority to the Comptroller and Auditor-General of India. 15

(3) The Comptroller and Auditor-General of India and any other person appointed by him in connection with the audit of the accounts of the National Biodiversity Authority shall have the same rights and privileges and authority in connection with such audit as the Comptroller and Auditor-General generally has in connection with the audit of the Government accounts and, in particular, shall have the right to demand the production of books, accounts, connected vouchers and other documents and papers and to inspect any of the offices of the National Biodiversity Authority. 20

(4) The accounts of the National Biodiversity Authority as certified by the Comptroller and Auditor-General of India or any other person appointed by him in this behalf together with the audit report thereon shall be forwarded annually to the Central Government. 25

Annual report to be laid before Parliament.

30. The Central Government shall cause the annual report and auditor's report to be laid, as soon as may be after they are received, before each House of Parliament. 30

CHAPTER VIII

FINANCE, ACCOUNTS AND AUDIT OF STATE BIODIVERSITY BOARD

Grant of money by State Government to State Biodiversity Board. State Biodiversity Fund.

31. The State Government may, after due appropriation made by the State Legislature by law in this behalf, pay to the State Biodiversity Board by way of grants or loans such sums of money as the State Government may think fit for being utilized for the purposes of this Act. 35

32. (1) There shall be constituted a Fund to be called the State Biodiversity Fund and there shall be credited thereto—

(a) any grants and loans made to the State Biodiversity Board under section 31;

(b) any grants or loans made by the National Biodiversity Authority;

(c) all sums received by the State Biodiversity Board from such other sources as may be decided upon by the State Government. 40

(2) The State Biodiversity Fund shall be applied for—

(a) the management and conservation of heritage sites;

(b) compensating or rehabilitating any section of the people economically affected by restriction imposed under section 37; (Kno.) heritage sites) 45

(c) conservation of biological resources;

(d) socio-economic development of areas from where such biological resources or knowledge associated thereto has been accessed subject to any approval granted under section 24, in consultation with the local bodies concerned;

Power of Central Government to notify threatened species.

38. Without prejudice to the provisions of any other law for the time being in force, the Central Government may from time to time notify, any species which is on the verge of extinction or likely to become extinct in the near future as a threatened species and prohibit or regulate collection thereof for any purpose and take appropriate steps to rehabilitate and preserve those species.

Threatened species
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Power of Central Government to designate repositories.

39. (1) The Central Government may in consultation with the National Biodiversity Authority, designate institutions as repositories under this Act for different categories of biological resources.

(2) The repositories shall keep in safe custody the biological material including voucher specimens deposited with them.

(3) Any new taxon discovered shall be notified to the repositories or any institution designated for this purpose and deposit the voucher specimens with such repository or institution.

Repository
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Power of Central Government to exempt certain biological resources.

40. Notwithstanding anything contained in this Act, the Central Government may in consultation with the National Biodiversity Authority, by notification in the Official Gazette, declare that the provisions of this Act shall not apply to any items, including biological resources normally traded as commodities.

5 Exempt for Act

CHAPTER X

BIODIVERSITY MANAGEMENT COMMITTEES

Constitution of Biodiversity Management Committees.

41. (1) Every local body shall constitute a Biodiversity Management Committee within its area for the purpose of promoting conservation, sustainable use and documentation of biological diversity including preservation of habitats, conservation of land races, folk varieties and cultivars, domesticated stocks and breeds of animals and micro organisms and chronicling of knowledge relating to biological diversity.

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(2) The National Biodiversity Authority and the State Biodiversity Boards shall consult the Biodiversity Management Committees while taking any decision relating to the use of biological resources and knowledge associated with such resources occurring within the territorial jurisdiction of the Biodiversity Management Committee.

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(3) The Biodiversity Management Committees may levy charges by way of collection fee from any person for accessing or collecting any biological resource from areas falling within its territorial jurisdiction.

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CHAPTER XI

LOCAL BIODIVERSITY FUND

Grants to Local Biodiversity Fund.

42. The State Government may, after due appropriation made by State Legislature by law in this behalf, pay to the Local Biodiversity Funds by way of grants or loans such sums of money as the State Government may think fit for being utilised for the purposes of this Act.

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Constitution of Local Biodiversity Fund.

43. (1) There shall be constituted a Fund to be called the Local Biodiversity Fund at every area notified by the State Government where any institution of self-government is functioning and there shall be credited thereto—

(a) any grants and loans made under section 42;

(b) any grants or loans made by the National Biodiversity Authority;

(c) any grants or loans made by the State Biodiversity Boards;

(d) fee referred to in sub-section (3) of section 41 received by the Biodiversity Management Committee;

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(e) all sums received by the Local Biodiversity Fund from such other sources as may be decided upon by the State Government.

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44. (1) Subject to the provisions of sub-section (2), the management and the custody of the Local Biodiversity Fund and the purposes for which such Fund shall be applied as may be prescribed by the State Government.

Application of Local Biodiversity Fund.

5 (2) The Fund shall be used for conservation of biodiversity in the areas falling within the jurisdiction of the concerned local body and for the benefit of the community in so far as such use is consistent with conservation of biodiversity.

10 45. The person holding the custody of the Local Biodiversity Fund shall prepare, in such form and during each financial year at such time as may be prescribed, its annual report, giving a full account of its activities during the previous financial year, and submit a copy thereof to the State Government.

Annual report of Biodiversity Management Committees.

15 46. The accounts of the Local Biodiversity Fund shall be maintained and audited in such manner as may, in consultation with the Accountant-General of the State, be prescribed and the person holding the custody of the Local Biodiversity Fund shall furnish, to the State Government, before such date as may be prescribed, its audited copy of accounts together with auditors' report thereon.

Audit of accounts of Biodiversity Management Committees.

47. The State Government shall cause the annual report and auditors' report to be laid, as soon as may be after they are received, before the House of State Legislature.

Annual report of Biodiversity Management Committee to be laid before State Legislature.

CHAPTER XII
MISCELLANEOUS

20 48. (1) Without prejudice to the foregoing provisions of this Act, the National Biodiversity Authority shall, in the discharge of its functions and duties under this Act, be bound by such directions on questions of policy as the Central Government may give in writing to it from time to time:

National Biodiversity Authority to be bound by the directions given by Central Government.

25 Provided that the National Biodiversity Authority shall, as far as practicable, be given opportunity to express its views before any direction is given under this sub-section.

30 (2) The decision of the Central Government whether a question is one of policy or not shall be final.

35 49. (1) Without prejudice to the foregoing provisions of this Act, the State Biodiversity Board shall, in the discharge of its functions and duties under this Act, be bound by such directions on questions of policy as the State Government, may give in writing to it from time to time:

Power of State Government to give directions.

40 Provided that the State Biodiversity Board shall, as far as practicable, be given an opportunity to express its views before any direction is given under this sub-section.

(2) The decision of the State Government whether a question is one of policy or not shall be final.

45 50. (1) If a dispute arises between the National Biodiversity Authority and a State Biodiversity Board, the said Authority or the Board, as the case may be, may prefer an appeal to the Central Government within such time as may be prescribed.

Settlement of disputes between State Biodiversity Boards.

(2) Every appeal made under sub-section (1) shall be in such form as may be prescribed by the Central Government.

50 (3) The procedure for disposing of an appeal shall be such as may be prescribed by the Central Government:

55 Provided that before disposing of an appeal, the appellant shall be given a reasonable opportunity of being heard.

(4) If a dispute arises between the State Biodiversity Boards, the Central Government shall refer the same to the National Biodiversity Authority.

60 (5) While adjudicating any dispute under sub-section (4), the National Biodiversity Authority shall be guided by the principles of natural justice and shall follow such procedure as may be prescribed by the Central Government.

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Appeals

(6) The National Biodiversity Authority shall have, for the purposes of discharging its functions under this section, the same powers as are vested in a civil court under the Code of Civil Procedure, 1908 in respect of the following matters, namely:—

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(a) summoning and enforcing the attendance of any person and examining him on oath;

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(b) requiring the discovery and production of documents;

(c) receiving evidence on affidavits;

(d) issuing commissions for the examination of witnesses or documents;

(e) reviewing its decisions;

(f) dismissing an application for default or deciding it *ex parte*;

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(g) setting aside any order of dismissal of any application for default or any order passed by it *ex parte*;

(h) any other matter which may be prescribed.

(7) Every proceeding before the National Biodiversity Authority shall be deemed to be a judicial proceeding within the meaning of sections 193 and 228 and for the purpose of section 196 of the Indian Penal Code and the National Biodiversity Authority shall be deemed to be a civil court for all the purposes of section 195 and Chapter XXVI of the Code of Criminal Procedure, 1973.

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51. All members, officers and other employees of the National Biodiversity Authority or the State Biodiversity Board shall be deemed, when acting or purporting to act in pursuance of any of the provisions of this Act, to be public servants within the meaning of section 21 of the Indian Penal Code.

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45 of 1860.

Members, officers, etc., of National Biodiversity Authority and State Biodiversity Board deemed to be public servants.

Protection of action taken in good faith.

52. No suit, prosecution or other legal proceedings shall lie against the Central Government or the State Government or any officer of the Central Government or the State Government or any member, officer or employee of the National Biodiversity Authority or the State Biodiversity Board for anything which is in good faith done or intended to be done under this Act or the rules or regulations made thereunder.

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Penalties.

53. (1) Whoever contravenes or attempts to contravene or abets the contravention of the provisions of section 3, section 4 or section 6 shall be punishable with imprisonment for a term which may extend to five years, or with fine which may extend to ten lakh rupees, or with both.

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(2) Whoever contravenes or attempts to contravene or abets the contravention of the provisions of section 7 or any order made under sub-section (1) of section 24 shall be punishable with imprisonment for a term which may extend to three years, or with fine which may extend to five lakh rupees, or with both.

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54. If a person contravenes any direction given or order made by the Central Government, the State Government, the National Biodiversity Authority or the State Biodiversity Board for which no punishment has been separately provided under this Act, he shall be punished with a fine which may extend to one lakh rupees and in case of a second or subsequent offence, with fine which may extend to two lakh rupees and in the case of continuous contravention with additional fine which may extend to two lakh rupees everyday during which the default continues.

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Penalty for contravention of directions or orders of Central Government, State Government, National Biodiversity Authority and State Biodiversity Boards.

NBA Civil Court

Punishment

55. (1) Where an offence or contravention under this Act has been committed by a company, every person who at the time the offence or contravention was committed was in charge of, and was responsible to the company for the conduct of the business of the company, as well as the company, shall be deemed to be guilty of the offence or contravention and shall be liable to be proceeded against and punished accordingly:

Offences by companies.

Provided that nothing contained in this sub-section shall render any such person liable to any punishment provided in this Act, if he proves that the offence or contravention was committed without his knowledge or that he had exercised all due diligence to prevent the commission of such offence or contravention.

(2) Notwithstanding anything contained in sub-section (1), where an offence or contravention under this Act has been committed by a company and it is proved that the offence or contravention has been committed with the consent or connivance of, or is attributable to any neglect on the part of any director, manager, secretary or other officer of the company, such director, manager, secretary or other officer shall also be deemed to be guilty of the offence or contravention and shall be liable to be proceeded against and punished accordingly.

Explanation.—For the purposes of this section,—

(a) "company" means any body corporate and includes a firm or other association of individuals; and

(b) "director", in relation to a firm, means a partner in the firm.

56. The offences under this Act shall be cognizable and non-bailable.

Offences to be cognizable and non-bailable.

57. The provisions of this Act shall have effect notwithstanding anything inconsistent therewith contained in any other law for the time being in force.

Act to have overriding effect.

58. The Central Government may give directions to any State Government as to the carrying into execution in the State of any of the provisions of this Act or of any rule or regulation or order made thereunder.

Power of Central Government to give directions to State Government.

59. No court shall take cognizance of any offence under this Act or rules and regulations made thereunder save on a complaint made by the National Biodiversity Authority or State Biodiversity Board, as the case may be.

Cognizance of offences.

60. (1) The Central Government may, by notification in the Official Gazette, make rules for carrying out the purposes of this Act.

Power of Central Government to make rules.

(2) In particular, and without prejudice to the generality of the foregoing power, such rules may provide for all or any of the following matters, namely:—

(a) terms and conditions of service of the Chairperson and member under section 9;

(b) powers and duties of the Chairperson under section 10;

(c) procedure under sub-section (1) of section 12 in regard to transaction of business at meetings;

(d) form of application and payment of fees for undertaking certain activities under sub-section (1) of section 19;

(e) form of application and the manner for transfer of biological resource or knowledge under sub-section (2) of section 20;

(f) form in which, and the time of each financial year at which, the annual report shall be prepared under section 28;

(g) form in which the annual statement of account shall be prepared under section 29;

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(h) the time within which and the form in which, an appeal may be preferred, the procedure for disposing of an appeal and the procedure for adjudication, under section 50;

(i) any other matter which is to be, or may be, prescribed, or in respect of which provision is to be made, by rules. 5

(3) Every rule made under this section and every regulation made under this Act shall be laid, as soon as may be after it is made, before each House of Parliament, while it is in session, for a total period of thirty days which may be comprised in one session or in two or more successive sessions, and if, before the expiry of the session immediately following the session or the successive sessions aforesaid, both Houses agree in making any modification in the rule or regulation or both Houses agree that the rule or regulation should not be made, the rule or regulation shall thereafter have effect only in such modified form or be of no effect, as the case may be; so, however, that any such modification or annulment shall be without prejudice to the validity of anything previously done under that rule or regulation. 10

Power of State Government to make rules.

61. (1) The State Government may, by notification in the Official Gazette, make rules for carrying out the purposes of this Act. 15

(2) In particular, and without prejudice to the generality of the foregoing power, such rules may provide for all or any of the following matters, namely:—

(a) the form in which the prior intimation shall be given under sub-section (1) of section 24; 20

(b) the form in which, and the time of each financial year at which, the annual report shall be prepared under section 33;

(c) management and conservation of national heritage sites under section 37;

(d) the purposes for which local Biodiversity Fund shall be applied under sub-section (1) of section 44; 25

(e) any other matter which is to be, or may be, specified.

(3) Every rule made by the State Government under this section shall be laid, as soon as may be after it is made, before each House of the State Legislature where it consists of two Houses, or where such Legislature consists of one House, before that House.

Power to make regulations.

62. The National Biodiversity Authority shall with the previous approval of the Central Government by notification in the Official Gazette, make regulations for carrying out the purposes of this Act. 30

Power to remove difficulties.

63. (1) If any difficulty arises in giving effect to the provisions of this Act, the Central Government may, by order, not inconsistent with the provisions of this Act, remove the difficulty: 35

Provided that no such order shall be made after the expiry of a period of two years from the commencement of this Act.

(2) Every order made under this section shall be laid, as soon as may be after it is made, before each House of Parliament.

STATEMENT OF OBJECTS AND REASONS

Biodiversity encompasses the variety of all life on earth. India is one of the 12 megabiodiversity countries of the world. With only 2.5% of the land area, India already accounts for 7-8% of the recorded species of the world. India is equally rich in traditional and indigenous knowledge, both coded and informal.

2. India is a Party to the Convention on Biological Diversity (1992). The main objectives of the Convention are:

- (i) Conservation of biological diversity;
- (ii) Sustainable use of its components;
- (iii) Fair and equitable sharing of benefits arising out of utilisation of genetic resources.

3. Recognizing the sovereign rights of States to use their own biological resources, the Convention expects the Parties to facilitate access to genetic resources by other Parties for environmentally sound purposes subject to national legislation and on mutually agreed upon terms (Articles 3 and 15). Article 8 (j) of the Convention recognizes contributions of local and indigenous communities to the conservation and sustainable utilisation of biological diversity through traditional knowledge, practices and innovations and provides for equitable sharing of benefits with such people arising from the utilisation of their knowledge, practices and innovations.

4. Biodiversity is a multi-disciplinary subject involving diverse sectoral activities and actions. The stakeholders in biological diversity include the Central Government, State Governments, institutions of local self-government, scientific and technical institutions, experts, non-governmental organisations, industry, etc. One of the major challenges before India lies in adopting an instrument which helps realise the objectives of equitable sharing of benefits enshrined in the Convention on Biological Diversity.

5. After an extensive and intensive consultation process involving the stakeholders, the Central Government has decided to bring a legislation with the following salient features:—

- (i) to regulate access to biological resources of the country with the purpose of securing equitable share in benefits arising out of the use of biological resources; and associated knowledge relating to biological resources;
- (ii) to conserve and sustainably use biological diversity;
- (iii) to respect and protect knowledge of local communities related to biodiversity;
- (iv) to secure sharing of benefits with local people as conservers of biological resources and holders of knowledge and information relating to the use of biological resources;
- (v) conservation and development of areas important from the standpoint of biological diversity by declaring them as biological diversity heritage sites;
- (vi) protection and rehabilitation of threatened species;
- (vii) involvement of institutions of self-government in the broad scheme of the implementation of the Act through constitution of committees.

6. The proposed legislation primarily addresses the issue concerning access to genetic resources and associated knowledge by foreign individuals, institutions or companies, and equitable sharing of benefits arising out of the use of these resources and knowledge to the country and the people. In order to safeguard the interests of the local people, *vaidis* and

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hakims and to allow research by Indian citizens within the country, the following exceptions are proposed:—

- (i) Free access to biological resources for use within India for any purpose other than commercial use for Indian people.
- (ii) Use of biological resources by *vaidis* and *hakims*.
- (iii) Free access to the Indian citizens to use biological resources within the country for research purposes.
- (iv) Collaborative research through government sponsored or government approved institutions subject to overall policy guidelines and approval of the Central Government.

7. It is proposed to have National Biodiversity Authority, State Biodiversity Boards and Biodiversity Management Committees.

(a) The National Biodiversity Authority will deal with matters relating to requests for access by foreign individuals, institutions or companies, and all matters relating to transfer of results of research to any foreigner; imposition of terms and conditions to secure equitable sharing of benefits and approval for seeking any form of Intellectual Property Rights (IPRs) in or outside India for an invention based on research or information pertaining to a biological resource obtained from India.

(b) State Biodiversity Boards will deal with matters relating to access by Indians for commercial purposes and restrict any activity which violates the objectives of conservation, sustainable use and equitable sharing of benefits.

(c) Biodiversity Management Committees will be set up by institutions of self-government in their respective areas for conservation, sustainable use, documentation of biodiversity and chronicling of knowledge relating to biodiversity. Biodiversity Management Committees shall be consulted by the National Biodiversity Authority and State Biodiversity Boards on matters related to use of biological resources and associated knowledge within their jurisdiction.

8. It is proposed to set up Biodiversity Funds at Central, State and local levels. The monetary benefits, fees, and royalties received as a result of approvals by National Biodiversity Authority will be deposited in National Biodiversity Fund. The Fund will be used for conservation and development of areas from where resources have been accessed.

9. Normally-traded commodities may be exempted by the Central Government, by notification, and in consultation with the National Biodiversity Authority, from the purview of the proposed legislation.

10. Traditional knowledge is proposed to be protected. It is also proposed that the State Governments notify National Heritage Sites which are important from the standpoint of biodiversity, in consultation with institutions of local self government.

11. The notes on clauses explain in detail the various provisions contained in the Bill.

12. The Bill seeks to achieve the above objectives.

NEW DELHI;
The 20th April, 2000.

T.R. BAALU.

Normally traded items may be exempted by notification.

PRESIDENT'S RECOMMENDATION UNDER ARTICLE 117 OF THE
CONSTITUTION OF INDIA

[Copy of letter No. J-22018/11/2000-CSC (BC) dated 8 May., 2000 from Shri T.R. Baalu, Minister for Environment and Forests to the Secretary-General, Lok Sabha.]

The President, having been informed of the proposed Bill to protect India's rich biodiversity and associated knowledge against their use by foreign individuals and organisations without sharing the benefits arising out of such use, has given his recommendation for introduction of the Bill under article 117(1) and for consideration of the Bill under article 117(3) of the Constitution.

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Notes on Clauses

Clause 1—This clause gives the short title of the Bill, the area of its operation and the date of commencement of the Act and its various provisions. As adequate steps have to be taken for administering the provisions of the proposed legislation, provision has been made that different dates may be appointed for the different provisions of the Act.

Clause 2—This clause contains definition of various expressions used in the Bill, such as "Benefit claimers", "Biological Diversity", "bio-survey and bio-utilisation", "Equitable benefit sharing", "National Biodiversity Authority", "State Biodiversity Board" and "Sustainable use", etc.

Clause 3—This clause specifies that certain persons such as non-Indian citizens, NRIs, body corporate associations or organisations not incorporated/registered in India or registered in India but have non-Indian citizen participation in its share capital or management cannot undertake biodiversity related activities without approval of National Biodiversity Authority.

Clause 4— This clause provides that no person who intends to transfer the results of research relating to biological resources occurring or obtained from India to non-Indian citizens; any body corporate association or organisation; any body corporate registered in India but has non-Indian participation in share capital or management, shall do so without obtaining approval of National Biodiversity Authority. Publication of research papers or dissemination of knowledge through seminars or workshops is exempted provided such publications, etc. are as per the policy guidelines of the Central Government.

Clause 5—Under this clause collaborative research projects are exempted from the provisions of clauses 3 and 4 if such collaborative research projects are approved by the Central Government and are drawn up as per the policy guidelines specified by the Central Government. Collaborative research projects based on agreements concluded before the commencement of this Act are required to make appropriate amendments to conform to the provisions of this Act.

Clause 6— This clause provides that any person seeking any kind of intellectual property right in or outside India for any invention based on any biological research or information on a biological resource obtained from India, is required to obtain prior permission of the National Biodiversity Authority. In case of persons applying for Patents, prior permission of the National Biodiversity Authority is required after the acceptance of the Patent but before sealing of the Patent by the concerned patent authority. It provides for the National Biodiversity Authority to impose for benefit sharing fee or royalty or both or impose conditions for sharing of financial benefits arising out of the commercial utilisation of such rights.

Clause 7— This clause provides that Indian citizens, body corporate, association or organisation registered in India are required to give prior intimation to the State Biodiversity Boards about obtaining biological resources for commercial utilization. However, local people and communities of the area including *vaid*s and *hakim*s who have been practising indigenous medicine are exempted from the provisions of this clause.

Clause 8—This clause provides for the establishment of an Authority to be called 'The National Biodiversity Authority'. The head office of the Authority shall be located at Chennai. The Authority shall consist of a Chairperson, eight *ex officio* members and five non-official members. The Chairperson shall be an eminent person in the field of conservation and sustainable use of biological diversity and in matters relating to equitable sharing of benefits. The *ex officio* members include representatives of the Ministries dealing with Environment and Forests, Agricultural Research and Education, Ocean Development, Agriculture & Cooperation, Indian Systems of Medicine and Homoeopathy, and Tribal

Affairs. The non-official members include specialists and scientists in the field of biological diversity, representatives of industry, conservers and knowledge holders of biological resources.

Clause 9— This clause specifies that the term of office, and service conditions of the non-official members will be laid down in the rules.

Clause 10— This clause specifies that the Chairperson of the Authority shall be the Chief Executive of the Authority. His detailed powers and functions will be laid down in the rules.

Clause 11— This clause lays down the conditions for removing the members from the National Biodiversity Authority.

Clause 12— This clause lays down detailed procedure for convening the meetings of the Authority.

Clause 13— This clause seeks to provide for the appointment of various committees by the Authority for efficient discharge of its duties. One such committee will be on agrobiodiversity.

Clause 14— This clause seeks to provide for the appointment of various officers and employees of the Authority for efficient performance of its functions. It also enables the Central Government to lay down rules governing the method of appointment, salary and other terms and conditions of the officers and employees.

Clause 15— This clause provides that all orders and decisions of the Authority shall be authenticated by the signature of the Chairperson or any member authorised by the National Biodiversity Authority.

Clause 16— This clause enables the Authority to delegate its powers (except the power to settle disputes under section 50 and the power to make regulations under clause 62) by order in writing to the Chairperson or any member or officer of the National Biodiversity Authority subject to such conditions or limitations.

Clause 17— This clause provides that salaries and allowances payable to members, officers and other employees of the National Biodiversity Authority shall be defrayed out of the Consolidated Fund of India.

Clause 18— This clause lays down the detailed functions of the Authority which include granting of approvals for undertaking any activity referred to in clauses 3, 4 and 6, framing guidelines for access and equitable sharing of benefits; advising the Central Government on matters relating to conservation and sustainable use of biological diversity; advise the State Governments in the selection of areas to be notified as heritage sites. This clause also provides that the National Biodiversity Authority may take necessary measures to oppose grant of Intellectual Property Rights in any country outside India on any biological material obtained from India or associated knowledge which is derived from India.

Clause 19— This clause provides for making application to the Authority for undertaking activities referred to in clauses 3, 4 and 6. This clause specifies that after receiving of application, the National Biodiversity Authority shall make an appraisal of the case and either grant approval subject to terms and conditions or reject the application giving reasons.

Clause 20— This clause stipulates that persons granted approvals under section 19 are required to obtain approval by the Authority for third party transfer.

Clause 21— This clause deals with determination of equitable sharing of benefits by the Authority while granting approvals under clauses 19 and 20. It stipulates that the Authority in consultation with local bodies impose terms and conditions for securing equitable sharing of benefits; depositing of monetary benefits into the National Biodiversity Fund except in cases where biological resources and knowledge are accessed from specific individual or group of individuals, in which case the monetary benefit will be directly made to the providers.

Clause 22— This clause provides for the establishment of Biodiversity Boards by the State Governments to be called "State Biodiversity Board". The Board shall consist of a Chairperson, five *ex officio* members representing various departments of the State Governments and five non-official members.

Clause 23— This clause specifies the general functions of the State Biodiversity Board.

Clause 24— This clause provides that the State Biodiversity Board may regulate the activities of Indian citizens, body corporate, organisation or association registered in India, related to obtaining of biological resources for commercial utilisation. Indian citizens, body corporate, association, etc., are required to give prior intimation to State Biodiversity Board about obtaining biological resources for commercial utilization. The State Biodiversity Board, in consultation with local bodies and after making enquiries, restrict such activity if it is contrary to the objectives of conservation or sustainable use of biodiversity or equitable sharing of benefits.

Clause 25— This clause provides that clauses 9 to 17 will apply to State Biodiversity Board with certain modifications.

Clause 26— This clause enables the Central Government to provide grants and loans to the National Biodiversity Authority for the implementation of the various provisions of the proposed legislation after due appropriation by Parliament.

Clause 27— This clause provides for constitution of a National Biodiversity Fund. grants and loans to the Authority, all charges and royalties received by the Authority, etc., shall be credited into this Fund. The Fund shall be utilised for channeling benefits to the benefit claimers, conservation of biological resources and development of areas from where biological resources and knowledge have been accessed.

Clause 28— This clause deals with the preparing of the Annual Report by the National Biodiversity Authority giving full account of its activities including audited statement of accounts.

Clause 29— This clause provides that the accounts of National Biodiversity Authority will be audited by the Comptroller and Auditor General of India and a copy of audited statement of accounts will be furnished to the Central Government.

Clause 30— This clause provides that the Annual Report and Auditors' Report of the National Biodiversity Authority will be laid before the Parliament.

Clause 31— This clause enables the State Governments to provide grants and loans to the State Biodiversity Boards, after due appropriation by the State Legislatures.

Clause 32— This clause provides for constitution of State Biological Diversity Fund. grants or loans to the State Biodiversity Boards, and any grants or loans made by the National Biodiversity Authority and from other sources shall be credited into the State Biodiversity Fund. The Fund shall be utilised for conservation of biological resources, management and conservation of Heritage sites, socio-economic development of areas from where biological resources and knowledge have been accessed, subject to any approval granted by the State Board under clause 24.

Clause 33— This clause deals with the preparing of the Annual Report by the State Biodiversity Boards.

Clause 34— This clause provides that the accounts of the State Biodiversity Board will be audited by the Accountant General of the State and a copy of the audited statement will be furnished to the State Government.

Clause 35— This clause provides that the Annual Report and Auditors' Report of the State Biodiversity Board will be laid before the State Legislature.

Clause 36— Under this clause the Central Government shall develop national strategies, plans and programmes for conservation and sustainable use of biodiversity; as far as

practicable and wherever appropriate integrate the conservation and sustainable use of biodiversity into relevant sectoral or cross-sectoral plans, programmes and policies; take measures— (i) for assessment of environmental impact of projects, wherever necessary, and with public participation where appropriate; and (ii) to regulate, manage or control the risks associated with the use and release of living modified organisms resulting from biotechnology and endeavour to respect and protect knowledge of local people relating to biodiversity through measures such as registration and *sui generis* system as per the recommendations of the National Biodiversity Authority.

Clause 37— This clause provides that the State Government may, in consultation with the local bodies, notify areas of biodiversity importance as biodiversity heritage sites under this Act; in consultation with the Central Government frame rules for the management and conservation of heritage sites; and framing of schemes for compensating or rehabilitating people economically affected by such notification.

Clause 38— This clause empowers the Central Government to notify threatened species, prohibit or regulate their collection, and take steps to rehabilitate and preserve these species.

Clause 39— This clause provides that the Central Government in consultation with the National Biodiversity Authority may designate institutions as Repositories under this Act for different categories of biological resources; the Repositories to keep in safe custody the biological materials including voucher specimens deposited with them; and that any new taxon discovered shall be notified to the Repositories or any other institution designated for this purpose and its voucher specimen deposited with such Repository or institution.

Clause 40— This clause provides that the Central Government may in consultation with the National Biodiversity Authority exempt, by notification biological resources normally traded as commodities from the provisions of this Act.

Clause 41— This clause stipulates that every local body shall constitute a Biodiversity Management Committee for conservation, sustainable use and documentation of biodiversity; the National Biodiversity Authority and the State Boards will consult the Biodiversity Management Committees while taking any decision relating to the use of biological resources and associated knowledge occurring within their jurisdiction; and the Biodiversity Management Committee may impose collection fees for collecting biological resources from their territory.

Clause 42— This clause enables the State Government to provide grants or loans to Local Biodiversity Funds after due appropriation by the State Legislature.

Clause 43— This clause provides for constitution of a Local Biodiversity Fund in areas where institutions of self-government are functioning. Grants or loans made by the National Authority, any grants or loans made by the State Biodiversity Boards, collection fees received by the Biodiversity Management Committee, and other sources shall be credited into such Fund.

Clause 44— This clause provides that the Local Biodiversity Fund shall be used for conservation of biodiversity in the jurisdiction of the local self-governments.

Clause 45— This clause provides for preparing the Annual Report of the Biodiversity Management Committee and accounts for submission to the State Governments.

Clause 46— This clause provides that the accounts of the Local Biodiversity Fund shall be maintained and audited in consultation with the Accountant General of the State.

Clause 47— This clause provides that the Annual Report and the Auditors' Report of the Local Biodiversity fund will be laid before the State Legislature.

Clause 48— This clause stipulates that the National Biodiversity Authority in discharge of its functions and duties shall be bound by the directions of the Central Government.

Clause 49 — This clause stipulates that the State Biodiversity Board in discharge of its functions and duties shall be bound by the directions of the State Government.

Clause 50 — This clause sets out the detailed procedure for settlement of disputes between State Biodiversity Boards; proceedings before the National Authority shall be deemed to be a judicial proceeding for the purpose of section 196 of the Indian Penal Code and the National Authority shall be deemed to be a Civil Court for the purposes of section 195 and Chapter XXVI of the Code of Criminal Procedure, 1973.

Clause 51 — This clause states that the members, officers and other employees of the National Authority or State Biodiversity Boards shall be deemed to be public servants.

Clause 52 — This clause provides for protection of action taken in good faith by the Central Government or the State Government, officers and employees of the said governments, members, officers or employees of the National Biodiversity Authority or the State Biodiversity Board, from any suit, prosecution or other legal proceedings.

Clause 53 — This clause provides for penalties for contravening clauses 3, 4 and 6. The penalty will be imprisonment for a term which may extend to 5 years or fine which may extend to Rs. 10 lakhs or both; and that penalty for contravention of the provisions of clause (7) and sub-clause (1) of clause 24 shall be imprisonment for a term which may extend to three years or fine which may extend to Rs. 5 lakhs or both.

Clause 54 — This clause provides for penalty for contravention of directions or orders of the Central Government, the State Government, the National Biodiversity Authority and the State Biodiversity Boards.

Clause 55 — This clause contains provisions for offences by companies. This clause seeks to provide that where a person committing offence is a company, every person responsible in the company for the conduct of its business will be liable; where a person accused proves that the offence was committed without his knowledge he will not be liable. However, where it is proved that an offence has been committed with the consent or connivance or is attributable to the neglect of any director, manager, secretary or any other officer of the company, he shall be deemed to be guilty of the offence.

Clause 56 — This clause provides that the offences under this Act shall be cognizable and non-bailable.

Clause 57 — This clause states that the provisions of the proposed legislation shall have overriding effect on all other laws for the time being in force or anything inconsistent with the proposed legislation contained in any instrument.

Clause 58 — This clause stipulates that the Central Government may give directions to the State Governments for execution any of the provisions of this Act.

Clause 59 — This clause provides that no court shall take cognizance of any offence under this Act or rules/regulations made thereunder except for complaints made by National Biodiversity Authority or State Biodiversity Boards.

Clause 60 — This clause empowers the Central Government to make rules to carry out the provisions of the proposed legislation; enumerates the various matters in respect of which such rules may be made; and seeks to provide that every rule made shall be laid before Parliament.

Clause 61 — This clause empowers the State Governments to make rules to carry out the provisions of the proposed legislation, enumerates the various matters in respect of which such rules may be made, and seeks to provide that every rule made shall be laid before the State Legislature.

Clause 62 — This clause empowers the National Biodiversity Authority to make regulations consistent with the provisions of the proposed legislation and the rules made

thereunder. Such regulations are required to be made with the previous approval of the Central Government and by notification in the Official Gazette.

Clause 63 — This clause empowers the Central Government to remove difficulties which may arise in giving effect to the provisions of the proposed legislation by order published in the Official Gazette. Such order shall not be inconsistent with the provisions of the proposed legislation. This power can be exercised only within two years from the commencement of the proposed legislation. Every such order shall be required to be laid before Parliament.

FINANCIAL MEMORANDUM

Clause 8 provides for setting up of a Statutory Authority to be known as the National Biodiversity Authority at Chennai. The Authority may decide in the future to establish offices in other places in India as envisaged under clause 8(3) of the Bill. The recurring expenditure towards salary, allowances and other expenditure relating to Chairperson, members and other officers and employees of the Authority appointed under Clause 14 will be of the order of Rs. 10 lakhs per annum. The other recurring expenditure by way of rent, maintenance, meetings, office expenses and contingency, etc. will be of the order of Rs. 80 lakhs per annum. Non-recurring expenditure on establishment, office equipment, vehicles, etc. will be approximately of the order of Rs. 50 lakhs.

MEMORANDUM REGARDING DELEGATED LEGISLATION

Clause 60 of the Bill empowers the Central Government to make rules by notification in the official Gazette for carrying out the purposes of the proposed legislation. Sub-clause (2) of that clause enumerates the matters with respect to which rules may be made under the proposed legislation. These matters *inter alia* relate to the terms of office; the salary and allowances and conditions of the Chairperson and members of the National Biodiversity Authority; powers and duties of Chairperson, transaction of business of the National Biodiversity Authority; form of application and payment of fees for undertaking certain activities; the procedure for adjudication, etc.

2. Clause 61 of the Bill empowers the State Governments to make rules by notification in the official Gazette for carrying out purposes of this proposed legislation. Sub-clause (2) of that clause enumerates the various matters with respect to which rules may be made under this legislation. These matters *inter alia* relate to the form in which the prior intimation shall be given; rules for the management and conservation of heritage sites; management of the Local Biodiversity Fund, etc.

3. Clause 62 of the Bill empowers the National Biodiversity Authority to make regulations with the previous approval of the Central Government by notification in the Official Gazette.

4. The rules and regulations made under the proposed legislation shall be required to be laid before Parliament.

5. The aforesaid matters in respect of which rules, regulations may be made or framed relate to matters of procedure or administrative detail and it is not practicable to provide for them in the Bill itself. The delegation of legislative power is, therefore, of a normal character.

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to provide for conservation of Biological Diversity, sustainable use of its components and equitable sharing of the benefits arising out of the use of biological resources and for matters connected therewith or incidental thereto.

(Shri T.R. Baalu Minister for Environment and Forests)

International Conference on the Threshold
The United Nations and Global Governance in the New Millennium
The United Nations University, Tokyo, Japan
19-21, January 2000

Global Food Security for Tomorrow
M S Swaminathan
UNESCO Chair in Ecotechnology,
M S Swaminathan Research Foundation, Chennai, India

I. Introduction:

The concept of Food Security has evolved during the last 3 decades to include not only food availability, but also economic access to food and the biological absorption of food in the body. Adequate per capita availability of food is a function of the balance between food production on the one hand, and growth in population and purchasing power, on the other. Urbanisation enhances the consumption of animal products and thereby increases the demand for feed grains and fodder. The "green revolution" of the sixties and seventies helped developing countries to gain a breathing spell during which they could attempt to achieve a balance between population growth and the population supporting capacity of the ecosystems. In spite of the success of the population stabilising efforts in many developing countries, the UN projections indicate that the global population may range from 8 to 10 billion by 2050. I would like to discuss in this paper the challenge of achieving sustainable advances in farm productivity, leading to an "ever-green revolution" in the fields of farm families with small holdings.

II. The Challenge of Sustainable Agriculture:

On the eve of the UN Conference on Environment and Development held at Rio de Janeiro in June 1992, the Union of Concerned Scientists published an open letter titled, World Scientists' Warning to Humanity, which stated that "human beings and the natural world are on a collision course". The letter stated further, "if not checked, many of our current practices put at serious risk the future that we wish for human society and the plant and animal kingdoms, and may so alter the living world that it will be unable to sustain life in the manner that we know". This warning was signed by over 1600 scientists from leading scientific academies in 70 countries. The list included 104 Nobel Laureates.

Colborn, Dumanaski and Myers (1996) in their book "Our Stolen Future" and James Morgan (1999) in his book "The Last Generation" also provide a picture of the grim future that awaits the generations yet to be born, if we lose further time in restoring harmony between humankind and nature.

It is now widely realised that the genes, species, ecosystems and traditional knowledge and wisdom that are being lost at an increasingly accelerated pace limit our options for adapting to local and global change, including potential changes in climate and sea level. The Hadley Centre of the UK Meteorological office has recently predicted that even if

Governments cut green house gas emissions, sea levels may rise by at least 2 meters over the next few hundred years. If the global community can limit emissions upto 550 ppm, which is twice the preindustrial levels and 50% above today's, about 2 billion persons can be saved from water shortages, low crop yields and increased coastal flooding, especially in India and Africa (New Scientist, 30 October 1999)

The Global Biodiversity Assessment published in 1995 by the United Nations Environment Programme (Cambridge University Press) estimates that about 13 to 14 million species may exist on our planet. Of this, less than 2 million species have so far been scientifically described. Invertebrates and microorganisms are yet to be studied in detail. In particular, our knowledge of soil microorganisms is still poor. Also, biosystematics as a scientific discipline is tending to attract very few scholars among the younger generation.

Another important paradigm shift witnessed in recent decades in the area of management of natural resources is a change in the concept of "common heritage". In the past, the atmosphere, oceans and biodiversity used to be referred to as the common heritage of humankind. However, recent global conventions have led to an alteration in this concept in legal terms. Biodiversity is now the sovereign property of the nation in whose political frontiers it occurs. Further, the Trade Related Intellectual Property Rights (TRIPS) provisions of the World Trade Agreement have made it mandatory to cover products of genetic improvement with either patents and *sui generis* methods of intellectual property rights protection. Under the UN Convention on the Law of the Sea, nations with coastal areas have access to a 200 mile Exclusive Economic Zone (EEZ). The Climate Convention and the Kyoto protocol provide for both common and differentiated responsibilities to countries. Thus, the global commons can be managed in a sustainable and equitable manner only through committed individual and collective action among nations. In the Asia-Pacific Region, Australia can play a catalytic role in fostering cooperation in both avoiding and mitigating the adverse impact of climate change.

A Chinese proverb warns, "if you do not change direction, you will end up where you are headed". Since we do not want to reach where we are presently headed, what change of course should we bring about in the field of agriculture?

III. Ecstasy and Agony

As we say good bye to this century we can look back with pride and satisfaction on the revolution which the farm men and women of the Asia / Pacific region have brought about in contemporary agricultural history. While we can and should rejoice about the past achievements of our farmers, scientists, extension workers and policy makers, there is no room for complacency. We will face several new problems, such as the following:

- First, increasing population leads to increased demand for food and reduced per capita availability of arable land and irrigation water.
- Second, improved purchasing power and increased urbanisation lead to higher per capita food grain requirements due to an increased consumption of animal products.

- Third, marine fish production is tending to become stagnant and coastal aquaculture is facing environmental problems.
- Four, there is increasing damage to the ecological foundations of agriculture, such as land, water, forests, biodiversity and the atmosphere and there are distinct possibilities for adverse changes in climate and sea level.
- Finally while dramatic new technological developments are taking place, particularly in the field of biotechnology, their environmental, health and social implications are yet to be fully understood.

Since land and water are shrinking resources for agriculture, there is no option except to produce more food and other agricultural commodities from less per capita arable land and irrigation water. In other words, the need for more food has to be met through higher yields per units of land, water, energy and time. It would therefore be useful to examine how science can be mobilised for raising further the ceiling to biological productivity without associated ecological harm. It will be appropriate to refer to the emerging scientific progress on the farms as an "*ever-green revolution*", to emphasise that the productivity advance is sustainable overtime since it is rooted in the principles of ecology, economics, social and gender equity and employment generation.

The green revolution has so far helped to keep the rate of growth in food production above population growth rate. The green revolution, was however, the result of public good research, supported by public funds. The technologies of the emerging gene revolution in contrast, are spearheaded by proprietary science and can come under monopolistic control. How then can we harness the power of frontier science to promote an ever-green revolution in our farms?

The 20th century began with the rediscovery of Mendel's laws of inheritance. It ends with moving specific genes across sexual barriers with the help of molecular mapping and recombinant DNA technology. The impact of science and technology in every field of crop and animal husbandry, inland and marine fisheries and forestry has been profound. Let me illustrate this, taking the improvement of wheat production in India as an example.

Wheat cultivation started in the Indian subcontinent over 4000 years ago. Wheat kernels have been found in the Mohenjodaro excavations dated 2000 BC. From that period up to August 1947, when the colonial rule ended, Indian farm men and women developed the capacity to produce 7 million tonnes of wheat per year. Between 1964 and 1968, when semi-dwarf strains containing the Norin 10 genes for dwarfing were introduced in irrigated areas, wheat production rose from 10 to 17 million tonnes per year. In other words 4000 years of progress was repeated in 4 years (Swaminathan, 1993). During 1998-99, wheat production in India exceeded 70 million tonnes, i.e. a ten- fold increase in about 50 years.

Similar progress has been made in improving the production and productivity of rice, maize, soybean, potato and several other crops as well as in farm animals in many developing countries around the world. **New technologies supported by appropriate services and public policies as well as international scientific cooperation have helped to prove doomsday predictions wrong and have led to the agricultural revolution (the green revolution) becoming one of the most significant of the scientific and socially meaningful revolutions of this century.** A world without hunger is now within our reach. A hunger free world will be possible if every nation pays concurrent attention to improving food **availability** through ecologically sustainable methods of production, to enhancing economic **access** to food by promoting a job-led economic growth strategy, and to ensuring the biological **absorption** of food in the body through the availability of safe drinking water and environmental hygiene. Steps should also be taken to enlarge the base of the food security basket by revitalising the earlier tradition of cultivating a wide range of food crops (See MSSRF, 1999).

Emerging farming technologies will be based on precision farming methods leading to plant scale rather than field scale husbandry. Farming will be knowledge intensive, using information from remote sensing, Geographical Information System (GIS), Global Positioning Systems (GPS), and information and computer technologies. Farmers in industrialised countries are already using satellite imagery and GPS for early detection of diseases and pests, and to target the application of pesticides, fertilizer and water to those parts of their fields that need them urgently. Among other recent tools, the GIS methodology is an effective one for solving complex planning, management and priority setting problems. Similarly, remote sensing technology can be mobilised in programmes designed to ensure drinking water security.

Biotechnology will play an increasingly important role in strengthening food, water and health security systems. Recent widespread public concern relating to genetically modified (GM) food stresses the need for more effective and transparent mechanisms for assessing the benefits and risks associated with transgenic plants and animals. An internationally agreed Biosafety Protocol on the lines recommended in Article 19 of the Convention on Biological Diversity is an urgent necessity. Biotechnology companies should agree to the labelling of GM foods in the market. All food safety and environmental concerns should be addressed with the seriousness they deserve. Broad based **National Commissions on Genetic Modification for Sustainable Food and Health Security** could be set up, consisting of independent professionals, environmentalists, representatives of civil society, farmers' and womens' organizations, mass media and the concerned Government regulatory authorities. This will help to assure both farmers and consumers that the precautionary principle has been applied, while approving the release of GM crops.

Biodiversity-rich but biotechnology-poor countries are adversely affected by the prevailing non-adherence to the ethical and equity principles in benefit sharing contained in Articles 8 and 15 of CBD. The primary conservers, largely tribal and rural women and men, live in poverty, while those who use their knowledge and material for producing commercial products become prosperous (Swaminathan, 1999). The invaluable

contributions of tribal and rural families to genetic resources conservation and enhancement have been recognised in the Convention on Biological Diversity. Yet the political will to implement the equitable benefit sharing provisions of CBD is lacking. We need urgent steps to recognise and reward the contributions of indigenous communities to providing material of great importance to global food and health security. The following three validated findings will be adequate to stress the significance of traditional knowledge and conservation efforts to help mitigate handicaps caused by ageing in human beings.

Country	Plant	Property
India	<i>Trichopus Zeylanicus</i>	helps to remove fatigue
India	<i>Bacopa monnieri</i>	Helps to improve memory
Tropical Africa	<i>Prunus africana</i>	Treatment for benign Prostatic hyperplasia.

Article 27(b) of the TRIPS component (Trade related intellectual property rights) of the World Trade Agreement is now under review. **All nations should agree to incorporate in this clause the ethics and equity principles enshrined in articles 8(j) and 15 of CBD.** The World Intellectual Property Rights Organization (WIPO) which has launched a study of the need to recognise the intellectual property rights of the holders of traditional knowledge, should complete this study soon and help to make the principles of ethics and equity the foundation of IPR.

IV. Emerging Scientific Revolutions:

Fortunately, as we approach the new century we are experiencing three major revolutions in science and technology, which will influence agriculture and industry in a fundamental manner. It will therefore be appropriate to make a brief reference to them.

- i) *the gene revolution* - which provides a molecular understanding of the genetic basis of living organisms, as well as the ability to use this understanding to develop new processes and products for agriculture, industry, the environment, and for human and animal health.
- ii) *the ecotechnology revolution* - which promotes the blending of the best in traditional knowledge and technology with frontier technologies such as biotechnology, space and information technologies, renewable energy and new materials, and
- iii) *the information and communication revolution* - which allows a very rapid growth in the systematic assimilation and dissemination of relevant and timely information, as well as a dramatically improved ability to access the universe of knowledge and communicate through low cost electronic networks.

In principle, these three types of advances - when coupled with improvements in the management and governance - greatly increase the power of a scientific approach to

genetic improvement, the integrated management of natural resources and ecosystems, and the management of local and regional development strategies. Eco-technologies enable the adoption of ISO 9000 and ISO 14000 standards of environmental management. These scientific revolutions seem to be proceeding at an ever increasing pace, with most of the action occurring in industrialised nations. Also, new discoveries of great relevance to sustainable food and health security are coming under the purview of proprietary science, since they are covered by Intellectual Property Rights. It is the duty of organisations devoted to public good to mobilise recent advances in science and technology for meeting the basic needs of the economically and socially underprivileged sections of the human family.

i. The Gene Revolution

The past ten years have seen dramatic advances in our understanding of how biological organisms function at the molecular level, as well as in our ability to analyze, understand, and manipulate DNA molecules, the biological material from which the genes in all organisms are made. The entire process has been accelerated by the Human Genome Project, which has poured substantial resources into the development of new technologies for working with human genes. The same technologies are directly applicable to all other organisms, including plants. Thus, a new scientific discipline of genomics has arisen. This discipline has contributed to powerful new approaches in agriculture and medicine and has helped to promote the biotechnology industry.

Several large corporations in Europe and the United States have made major investments in adapting these technologies to produce new plant varieties of agricultural importance for large-scale commercial agriculture. The same technologies have equally important potential applications for addressing food security in the developing world.

The key technological developments in this area are:

- a. *genomics* : the molecular characterization of species.
- b. *bioinformatics* : data banks and data processing for genomic analysis
- c. *transformation*: introduction of individual genes conferring potentially useful traits into plants, trees, livestock and fish species.
- d. *molecular breeding* : identification and evaluation of useful traits by use of marker assisted selection, which greatly speeds up traditional breeding processes.
- e. *diagnostics* : identification of pathogens by molecular characterization
- f. *vaccine technology* : use of modern immunology to develop recombinant DNA vaccines for improved control against lethal diseases of animals and fish.

Let me cite one example from the work of MSSRF scientists to illustrate the value of the

new tools. As a part of the anticipatory research programme to meet the consequences of sea level rise arising from global climate change, genes responsible for conferring the ability to withstand sea water intrusion were identified in a few mangrove species through molecular mapping. They have been transferred to annual economic plants through recombinant DNA technology.

The sequencing of the genome of rice (*Oryza sativa* L.cv.Nipponbare) by an international consortium supported by the Rockefeller Foundation and the International Rice Research Institute will permit allele mining for all genes of rice and possibly for other cereals. Thus, altogether unforeseen opportunities for creating novel genetic combinations have been opened up.

As mentioned earlier, there are widespread public concerns about the potential adverse impact of genetically modified organisms (GMOs) on human health, biodiversity and the environment. Several of these concerns are genuine. In order to take advantage of recombinant DNA technologies without associated harm to human or ecological health, it is important that every country has in place suitable institutional structures and regulations for biosafety, bioethics and biosurveillance. At the same time, there is need for greater investment of public funds for public good research, the results of which can reach the unreached. For example, in food and agriculture, there is need to strengthen both National Agricultural Research Systems and the International Agricultural Research Centres supported by the CGIAR.

ii. The Ecotechnology revolution

Knowledge is a continuum. There is much to learn from the past in terms of the ecological and social sustainability of technologies. At the same time, new developments have opened up new opportunities for developing technologies which can lead to higher productivity without adverse impact on the natural resources base. Blending traditional and frontier technologies leads to the birth of ecotechnologies with combined strengths in economics, ecology, social and gender equity, employment generation and energy conservation.

For example, in the area of water harvesting and sustainable use, there are many lessons to be learnt from the Australian experience. There is need to conserve traditional wisdom and practices, which are often tending to become extinct (Agarwal and Narain, 1997). The decision of the World Intellectual Property Organization (WIPO) to explore the intellectual property needs, rights and expectations of holders of traditional knowledge, innovations, and culture is hence an important step in widening the concept of intellectual property. FAO has been a pioneer in the recognition of the contributions of farm families in genetic resources conservation and enhancement by promoting the concept of "Farmers Rights". Like WIPO, UPOV (Union for the Protection of New Varieties of Crops) should also undertake the task of preparing an integrated concept of breeders' and farmers' rights. UPOV itself should be restructured to become a **Union for the Protection of Farmers' and Breeders' Rights**.

iii. The information technology revolution

New communication and computing technologies are already influencing life on our planet in a profound manner.

- a. Access to the Internet will soon be universal, and it can provide unrestricted low-cost access to information, as well as highly interactive distance learning. The Internet will not only facilitate interactions among researchers, but also greatly improve their ability to communicate effectively with the potential users of their research knowledge.
- b. Computing makes it possible to process large-capacity databases (libraries, remote sensing and GIS data, gene banks) and to construct simulation models with possible applications in ecosystem modeling, preparation of contingency plans to suit different weather probabilities and market variables.
- c. The software industry is continuously providing new tools that increase research productivity and create new opportunities for understanding complex agroeco systems.
- d. Remote sensing and other space satellite outputs are providing detailed geographic information useful for land and natural resources management.

The promotion of ecotechnology development and dissemination, the effective adoption of integrated systems of gene and natural resources management and the effective harnessing of information technologies should become essential elements of the "science and technology for basic human needs" movement.

To sum up, there is no time to relax on the food production front. It is obvious that we have to produce more, but produce it in a manner that there is no adverse environmental or social impact. Water is likely to be a serious constraint in many countries. Hence, priority should be given to developing and spreading efficient water management techniques, including aquifer management, waste water recycling and conjunctive use of surface and rain water. Future agricultural production technologies should be based on the foundation of integrated natural resources management.

The world can produce enough food for a population of 10 billion by harnessing the untapped yield reservoir existing even with currently available technologies, if greater attention is given to soil health care and water management. We must **defend** the productivity gains so far made, **extend** the gains to semi-arid and marginal environments, and **work** for new gains using blends of frontier technologies and traditional ecological prudence. The problem of generating adequate purchasing power to enable families living in poverty to have economic access to food will still confront us. This is where a job-led economic growth strategy based on micro-level planning, micro-enterprises and micro-credit will be of great help. Integrated production and post-harvest technologies

and on-farm and off-farm employment strategies will be needed to provide livelihoods for all in rural areas.

With increasing globalisation of economies, it will be necessary to agree at the international level that safeguarding and strengthening the livelihood security of the poor should be a major goal of liberalised trade. The current trend of increasing rich-poor divide will have to be stopped, if social conflicts are not to increase. Thus, we are really walking a tightrope in terms of achieving sustainable solutions to the problems of population, poverty and environmental degradation. The various international conferences held during this decade starting with the Childrens' Summit held in New York in 1990 and ending with the World Conference on Science held at Budapest in 1999, have indicated possible solutions to these problems. It is now for nations to act individually and collectively so that the uncommon opportunities opened up by science and technology and democratic systems of governance for creating a food secure world are not missed. The United Nations University which has so far provided innovative leadership in developing institutional structures and pedagogic approaches designed to reach the unreached should not only continue its philosophy of working for a better common present and future for humankind, but should intensify its efforts to foster relevant partnerships and networks for launching and sustaining an ever-green revolution on the farms.

According to the Asian Development Bank, over 900 million out of the 1.3 billion persons currently living on a per capita daily income of less than 1 US dollar, are in Asia. One in three Asians is poor. Poverty is the main cause of food insecurity at the level of individuals today. Most of the new jobs or livelihood opportunities in Asia will have to come from the on-farm and rural non-farm sectors. Macro-economic policies at the national and global levels should ensure that they help to strengthen micro-enterprises supported by microcredit. Technology and trade should become allies in the movement for a more equitable world. It would be useful if UNU could organise a **Virtual College** together with WTO on the theme "Trade as an instrument for Poverty eradication". This will help to strengthen the livelihood security of the poor, so very essential for food security. Through appreciate blends of technologies and public policies we now have uncommon opportunities for achieving the human quest for a hunger-free world by the year 2020.

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V. S. Moorthy

Managing extreme natural disasters in coastal areas

BY P. C. KESAVAN* AND M. S. SWAMINATHAN

*M.S. Swaminathan Research Foundation (MSSRF), Third Cross Street,
Taramani Institutional Area, Taramani, Chennai 600 113, India*

Extreme natural hazards, particularly the hydro-meteorological disasters, are emerging as a cause of major concern in the coastal regions of India and a few other developing countries. These have become more frequent in the recent past, and are taking a heavy toll of life and livelihoods. Low level of technology development in the rural areas together with social, economic and gender inequities enhance the vulnerability of the largely illiterate, unskilled, and resource-poor fishing, farming and landless labour communities. Their resilience to bounce back to pre-disaster level of normality is highly limited. For the planet Earth at crossroads, the imminent threat, however, is from a vicious spiral among environmental degradation, poverty and climate change-related natural disasters interacting in a mutually reinforcing manner. These, in turn, retard sustainable development, and also wipe out any small gains made thereof. To counter this unacceptable trend, the M.S. Swaminathan Research Foundation has developed a biovillage paradigm and rural knowledge centres for ecotechnological and knowledge empowerment of the coastal communities at risk. Frontier science and technologies blended with traditional knowledge and ecological prudence result in ecotechnologies with *pro-nature*, *pro-poor* and *pro-women* orientation. The rural communities are given training and helped to develop capacity to adopt ecotechnologies for market-driven eco-enterprises. The modern information and communication-based rural knowledge centres largely operated by trained semi-literate young women provide *time-* and *locale-specific* information on weather, crop and animal husbandry, market trends and prices for local communities, healthcare, transport, education, etc. to the local communities. The ecotechnologies and time- and locale-specific information content development are need-based and chosen in a 'bottom-up' manner. The use of recombinant DNA technology for genetic shielding of agricultural crops for coastal regions against abiotic stress (induced by the water- and weather-related natural disasters), strengthens the foundations of sustainable agriculture undertaken by the resource-poor small farm families.

Keywords: natural disasters; developing countries; disaster management;
sustainable development; technological and knowledge empowerment;
rural communities

* Author for correspondence (pkesavan@mssrf.res.in).

One contribution of 20 to a Discussion Meeting Issue 'Extreme natural hazards'.

1. Perspectives on extreme natural disasters

Life on planet Earth is accustomed to encounters with natural disasters. An astro-physical event (i.e. impact of a meteorite on Earth) approximately 65 Myr ago is said to have wiped out dinosaurs and many other species. However, such astro-physical hazards are very rare. Geophysical hazards (i.e. earthquakes, volcanic eruptions) originate from within the Earth's interior and are common. Powerful earthquakes resulting in vertical displacement of the tectonic plates at the bottom of the sea can produce destructive tsunami waves as happened on 26 December 2004 (Bilham 2005, Mishra & Rajasekhar 2005). The hydro-meteorological hazards consist of tropical cyclones, landslides, floods and droughts. In the 1990s, more than 90% of those killed in natural disasters lost their lives in hydro-meteorological events (mainly droughts, floods and wind storms, GEO-3). While earthquakes accounted for 30% of the estimated risk, they caused just 9% of all fatalities due to natural disasters. In contrast, hunger caused by famines worldwide killed 42% of people in the affected regions, but accounted for just 4% of damage over the past decade (GEO-3; IFRC 2001). Further, the number of geophysical disasters has remained fairly steady during the past two decades (1980s and 1990s), but the number of hydro-meteorological disasters has increased substantially (GEO-3). Emerging events such as melting of ice in the Polar Regions and the Himalayas, rise in sea level and increasing intensity and frequency of floods, hurricanes and typhoons suggest that global warming is influencing climate change. Experts at the National Snow and Ice Data Center in Boulder, Colorado at the National Aeronautics and Space Administration of USA have recently announced that the floating cap of sea ice on the Arctic Ocean shrank during summer, 2005 to its smallest size in a century (Revkin 2005). Trenberth (2005) argues that higher sea surface temperatures in the Atlantic Ocean and increased water vapour in the lower atmosphere—caused by global warming—are to blame for the past decade's intense storms. Recently, there were newspaper reports associating the hurricanes 'Katrina' and 'Rita' in August and September 2005, respectively, which devastated New Orleans and neighbouring towns in Texas, USA, with global warming. Emanuel (2005) reports that global warming may lead to an upward trend in tropical destructive potential. He also points out that with an ever increasing coastal population, a substantial increase may occur in hurricane-related losses in the twenty-first century. Growing anthropogenic pressures are exacerbating the risks.

A scientific consensus on the potential impact of climate change is yet to emerge, although there is agreement that anthropogenic factors are influencing global climate systems. Against this background, the declaration by Lord May of Oxford, President of the Royal Society, UK, that 'the world leaders can no longer use uncertainty about aspects of climate change as an excuse for not taking urgent action to cut greenhouse gas emissions' is quite significant. It is indeed becoming increasingly clear that human-associated climate change is real. The Anniversary Address (2004) by the President of the Royal Society dealt in part with climate change (Sunday Herald, London, 19 June 2005).

The majority of natural disasters affect poor nations and the poor in all nations the most, since their coping capacity is limited. Climate change directly affects sensitive sectors like agriculture, forestry and fishery and thereby the livelihoods of millions of coastal communities (Sinha & Swaminathan 1991;

Swaminathan 1996). The adverse impacts of climate change, in the form of declining rainfall alternating with heavy downpours causing floods, and long dry spells leading to droughts, severely threaten livelihoods, economy and food security. To add to this, poor infrastructure facilities, weak institutional mechanisms, lack of financial resources and vast sectoral and regional disparities adversely affect the adaptive capacity of developing countries to climate change. Thus, climate change exerts additional stress on the ecological and socio-economic systems that are already facing tremendous pressure due to rapid industrialization, urbanization and globalization of economies.

Hydro-meteorological hazards would exert even greater hardship to the people as well as damage to the natural resources in small island state developing countries and countries with long coastlines, such as India. It is reported (UNEP 1989) that India, with a low-lying densely populated coastline extending to over 7000 km, is highly vulnerable to sea-level rise. Most of the paddy fields of coastal regions are highly vulnerable to inundation and salinization (Gupta 2005). The small island nations, such as Kiribati, Seychelles and Maldives, have more than 80% of the land area at less than a metre above the present sea level. Such low-lying islands may have to pay a heavy price in terms of loss of human lives, and property if sea level rises to the extent forecast by global climate models (UNEP/GRID; Arendal 2005). Further, migration of coastal communities to inland areas will swell the number of environmental refugees (Myers 2000, 2002). Earthquake risk is high in several parts of India (Rao 2005). There is also concern about future *large magnitude* earthquakes along the Sumatra Fault southeast of the 2005 event rupture and the adjacent region that last failed in 1833, which is likely to have accumulated substantial strain (Lay *et al.* 2005; Sieh 2006). International efforts to improve the tsunami-warning capabilities are warranted, given the inevitability of future great thrust earthquakes along the Sumatra zone. Consequently, the Indian Ocean countries are creating a framework for a region-wide warning system and girding for the next killer wave (Stone & Kerr 2005). The growing concentration of population along India's coastline will have to be prepared particularly for much higher intensity of hydro-meteorological hazards. For these reasons, small island developing countries and the countries with long coastlines need to focus on disaster management particularly in their coastal regions. Discussion of these issues with special reference to the coastal regions in the developing countries is the main thrust of this paper. The need of the hour is to promote concerted efforts for preserving natural ecosystems and diversifying coastal economies, which can enhance recovery from disasters and resilience to their effects (Adger *et al.* 2005; Allenby & Fink 2005).

2. Vulnerability

Vulnerability to disasters has social, gender, ecological and economic dimensions in addition to the well-acknowledged technological capacities of the countries. It describes the degree to which a socio-economic system or physical assets are either susceptible or resilient to the impact of natural hazards. Development practices which do not take into account the susceptibility to natural hazards result in enhancing the vulnerability. There is a close correlation among the trends of increased demographic pressure in developing countries, enhanced

environmental degradation, higher human vulnerability and the intensity of the natural disasters. For instance, both the intensity of damage and loss of human lives were more severe where the mangrove forests had been degraded at the time of the Orissa cyclone in 1999. The degradation of the environment, particularly the forest cover, is often a critical factor that transforms a natural hazard, or a climatic extreme such as heavy downpour, into a disaster (Myers 1989).

Poverty, environmental degradation and hazard vulnerability form a vicious spiral, and are mutually reinforcing. The poor are compelled to exploit environmental resources for survival and also to live dangerously close to the high tide zones, and thus become highly vulnerable to cyclones, tsunamis, etc. Furthermore, among the poor, women and children are particularly vulnerable. Apart from the physical constraints caused by pregnancy, delivery, nursing care, etc., social and economic handicaps also contribute to their enhanced vulnerability. A generally poor reproductive health care system, particularly for women in these rural areas, combined with increasing incidence of tuberculosis, malaria and HIV/AIDS substantially weaken their health status. In India, economic globalization has accelerated the pace of migration of young men from rural to urban areas, where new employment opportunities have emerged. While this trend may be good in one sense, the detrimental consequence is the 'feminization of agriculture' in the rural areas. With much of the agriculture in the rural areas remaining as 'subsistence farming', the real effect is the 'feminization of poverty'.

Already handicapped by gender-related disadvantages, the worsening of economic status makes women much more vulnerable socially. Aglionby (2005) reported that four times as many women died in the tsunami as men on 26 December 2004. In Cuddalore, Tamil Nadu, India, 391 women were killed, compared with 146 men. According to the United Nations Children's Fund (UNICEF), children account for a third of the casualty. In some districts of Tamil Nadu, the casualty among children was an overwhelming 50–60% ('UNICEF Lays Out Four Point Programme for Tsunami children', Press Trust of India, 4 January 2005). The young girls and women face the danger of being pushed into prostitution by the anti-social elements. The trafficking of young women and girls in the human trade was noted as a serious dimension of gender-specific vulnerability resulting from natural disasters. What matters in the end, however, is that both sudden and extremely violent as well as the not-so-aggressive natural hazards with considerable lead time exert their adverse effects differentially on urban and the rural environments, the rich and poor and males and females. The need is to bridge the gaps in technological, social and gender divides.

3. Vicious spiral between poverty, environmental degradation and natural disasters

The United Nations Department of Economics and Social Affairs developed a background document in February 2002 on Sustainable Development for the *World Summit on Sustainable Development* held during August 2002 in Johannesburg, South Africa. One of the background papers submitted by the United Nations relating to an International Strategy for Disaster Reduction discusses natural disasters and sustainable development. The question posed in it was whether sustainable development along with the international instruments

aiming at poverty reduction and environment protection, can be accomplished without taking into account the risk of natural hazards and their impacts. The answer was negative. Disaster reduction policies and measures should enable societies to become resilient to natural hazards while ensuring that development efforts do not increase their vulnerability to these hazards.

Way back in 1972, at the UN Conference on the 'Human Environment' held in Stockholm, Sweden, late Ms Indira Gandhi, the then Prime Minister of India, stated that without addressing the problems of poverty and deprivations, it will not be possible to establish harmony between humankind and nature. Dr Maurice Strong, then Adviser to the UN Secretary-General also drew attention to the vicious spiral between poverty and environmental degradation. Resource-poor and landless rural women and men migrate to neighbouring urban areas in order to eke out a living and end up as 'environmental refugees' (Myers 2002). The M.S. Swaminathan Research Foundation (MSSRF) that was set up in Chennai, India about 15 years ago, therefore, laid stress on linking the livelihood security of landless and resource-poor rural women and men with ecological security in a mutually reinforcing manner. MSSRF's research programmes are also designed to transform the 'Green Revolution' referred to as 'exploitative agriculture' (Swaminathan 1968) into an 'Evergreen Revolution', a term coined by Swaminathan (1996) to denote farming systems that do not cause degradation of the ecological foundation of agriculture and would, therefore, be able to enhance productivity in perpetuity. The vicious spiral between environmental degradation and ever increasing frequency and intensity of hydro-meteorological disasters has received the foundation's attention. It is now widely acknowledged that anthropogenic pressures leading to degradation of mangrove forests (FAO 2003) in the coastal regions and non-mangrove forests throughout the developing world reduce carbon dioxide absorption and generation of oxygen. Soil erosion is yet another serious problem. Degradation of forests directly and indirectly also enhances human vulnerability to natural disasters. The mutually reinforcing vicious linkages among environmental degradation, poverty, destruction by natural disasters and sustainable development are illustrated (figure 1).

The strategy to break the vicious linkages requires concurrent attention to reduction of threats to sustainable rural livelihoods, restoration, conservation and enhancement of ecosystems and arresting environmental degradation and sustainable use of natural resources. The dictum, 'good ecology is good business' (Swaminathan 1999a) should underpin all development activities. Developing countries like India, must launch vigorous family planning programmes and contain the unsustainable population explosion. In India, poor economic conditions and the craving to have a son account for a large number of children per couple in many households. Technologically advanced countries, which also have high levels of human resource development, must not only reduce their consumption of energy from fossil fuels, but also share their technologies for 'clean energy' production technologies and energy-saving strategies with the developing countries. The transboundary nature of the harmful effects of climate change leaves humankind with no other option. It is equally important to integrate disaster management with policies, programme of activities and support for sustainable development. The Brundtland Commission Report (1987) was titled 'Our Common Future' to stress that irrespective of political frontiers, the fate of humankind is ecologically intertwined.

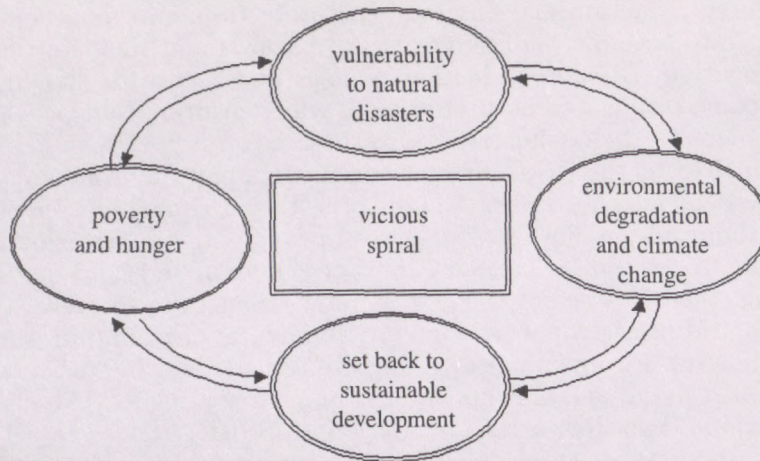


Figure 1. Feedback relationships.

4. Mainstreaming disaster management into sustainable development

(a) Bottom-up approach to sustainable use of natural resources

(i) Sustainable development

By the 1980s, humankind started facing serious ecological and social crises. The ecological problems consisted of serious damage to the basic life support systems of land, water, forests, biodiversity and atmosphere. Renewable energy sources also became a matter of great concern. The social dimension of crises arose from increasing poverty and hunger, economic, social and gender inequities, rapid growth in human population resulting in reduced *per capita* availability of arable land and irrigation water. The 'famine of employment' (i.e. livelihood) largely accounts for food insecurity at the individual household level, because of population explosion on the one hand, and rapid technological advances leading to automation and jobless economic growth, on the other. All these factors led to MSSRF defining its research agenda in terms of *sustainable development*, rooted in the principles of ecology, social and gender equity, employment (particularly rural livelihood) generation and economic viability and energy efficiency (A Social Vision for Science 2000). If technology was an important factor in the past in increasing economic and social disparities and causing ecological harm, the MSSRF's approach has been to enlist appropriate blends of traditional and frontier technologies as allies in the movement for economic and ecological well being and gender equity. A social contract between science and society (Swaminathan 1999b, 2000a) has been underpinning the programme of activities of the MSSRF. In the field of agriculture, the MSSRF's goal is to spread an Evergreen Revolution (Swaminathan 2000b). Wilson (2002) in his analytical book 'Future of life' refers to the significance of Swaminathan's concept of Evergreen Revolution in the following words: 'The problem before us is how to feed billions of new mouths over the next several decades and save the rest of life at the same time, without being trapped in a Faustian bargain that threatens freedom and security. No one knows the exact solution to this dilemma. The benefit must come from an Evergreen Revolution'.

Sustainable development as defined by the Brundtland Commission (1987) is 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs'. It is clear then that sustainable development that takes the impact of human activities on the environment into account and tries to minimize environmental damage is the key to poverty reduction, ecological security and mitigation and management of weather- and water-related natural disasters. The programme of research and development initiatives of the MSSRF provides replicable models for realizing sustainable development (Swaminathan 2005a). Focusing on the resource-poor and landless communities in the rural, and particularly in the coastal, regions is urgent, imperative for reasons of population density, work and income security, rapidly declining natural resources and high level of vulnerability to natural disasters. The Gulf of Mannar Biosphere Reserve in the State of Tamil Nadu, India, is an example of a precious biological heritage affected by the vicious spiral of poverty, degradation of natural resources, and natural disasters (M.S. Swaminathan Research Foundation, 1998). Their marine and adjacent land resources and biodiversity have started to decline rapidly because of a combination of anthropogenic pressure, pollution and hydro-meteorological disasters. Consequently, sea cows (dugong) and several kinds of marine organisms notably disappeared and these necessitated the MSSRF to initiate appropriate remedial action (Twelfth Annual Report 2001–2002, of the M.S. Swaminathan Research Foundation). This action is described below.

(ii) *Operationalizing sustainable development*

With a firm conviction that the vicious spiral of poverty and environmental degradation could be broken by technological and knowledge empowerment of the illiterate, unskilled and resource-poor rural women and men, the MSSRF initiated in 1998 a programme for fostering sustainable livelihoods in the Gulf of Mannar area with support from the Global Environment Facility and the United Nations Development Programme. Earlier, similar work had been initiated in about 20 villages in Pondicherry and great deal of experience had been gained. The thrust in these projects is the blending of frontier technologies with traditional knowledge in order to provide a *pro-nature, pro-poor, pro-women* and *pro-employment* orientation to technology development and dissemination. The resultant technologies, known as 'ecotechnologies' are readily adopted by rural families, because of their economic and ecological advantages. Local natural resources are sustainably managed. The question whether the largely illiterate and semi-literate rural women and men could develop knowledge and skills and become capable of handling eco-enterprises had already been answered in the 1970s. Swaminathan (1972) had coined the term 'techniracy' to describe the pedagogic methodology of 'learning by doing'. When learning is through work experience, the poor are able to master new technologies within a short span of time.

Groups of women and men separately or jointly organize themselves into self-help groups (SHGs) and undergo training and capacity building in one or more ecotechnologies based on the resources available in the region. Whole villages are organized into biovillages, where concurrent attention is paid to the conservation and enhancement of natural resources and to on-farm, non-farm and off-farm livelihood opportunities. In biovillages, the extreme poor (i.e. those earning one

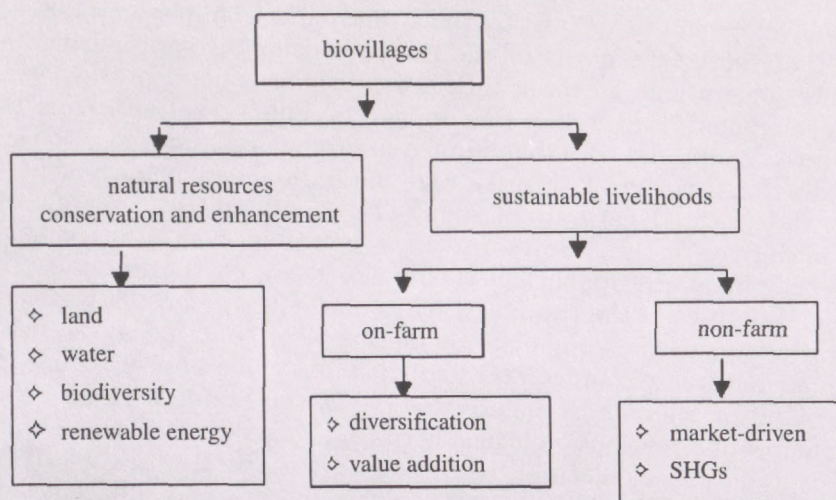


Figure 2. Biovillage paradigm.

US dollar or less per day) are enabled to take to multiple enterprises based on market demand so that the total income of the family is raised to an adequate level. The biovillage paradigm, designed to foster sustainable and equitable rural development and job-led economic growth (Swaminathan 2005a), is represented in figure 2.

Location of biovillages in three states of India, numbering 100 at present, is shown in figure 3.

In order to build the capacity of rural families to manage the various enterprises on their own, Biocentres are established as integral part of the biovillages. The organization and functions of the Biocentre are presented in figure 4. The eco-enterprises shown in figure 4 are just illustrative and not exhaustive. The aim is to provide key centralized services to promote economically viable, decentralized production, thereby combining the benefits of 'mass production' and 'production by masses' approaches to economic activity.

Demystification of technologies, especially relevant to sustainable rural development, training and capacity building of the rural communities, provision of microcredit for the microenterprises and establishing market linkages, are all integral components of a biovillage paradigm.

The five E_s of ecotechnology in the biovillage paradigm are economics, ecology, equity (gender and social), energy and employment. Without job-led economic growth, the poor and the marginalized people will not be able to come out of the poverty trap. Renewable energy is essential, particularly in the context of an ever increasing price of petroleum-based fuels.

Further, the sustainability factor would not be firmly anchored unless social and gender equities are mainstreamed into all the development activities. The actions to be taken today for sustainable development, keeping in view the need to manage climate change, are outlined by Swaminathan (2002).

The coastal communities can access both the land and marine resources for developing ecotechnologies and eco-enterprises. The coastal biovillage paradigm, therefore, takes into its account both the marine- and the land-based natural



Figure 3. Biovillages are located in states shown in green colour.

resources for developing eco-enterprises, as well as training and capacity building of the local communities. The MSSRF has prepared a toolkit describing the various ecotechnologies and how to develop these. Wherever feasible, 'aquaculture estates' are also developed. Individual fishermen can bring the catch of the day to these estates, which are equipped to process and market the fish, crabs, prawns, etc. While individual fishermen may not have time and resources to process and market their commodities, the centralized aquaculture estates are designed for this purpose. The power of scale is thus provided to the resource-poor fisher communities. A 'fish for all' movement was also launched in 2003 jointly with World Fish Centre in Penang in order to ensure integrated attention to all steps in the capture to consumption chain.

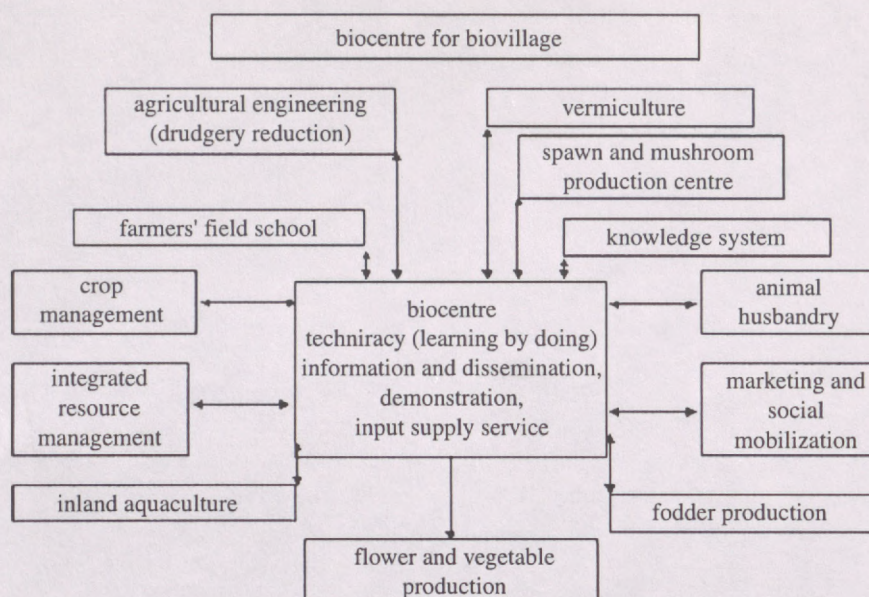


Figure 4. Biocentre for biovillage.

Marine- and land-based natural resources in the coastal areas for developing on-farm and non-farm enterprises are wide ranging. For example, the brackish water area, especially mud flats and saline-affected areas, largely remain barren or with limited biological productivity due to low soil organic content, low level of nutrients and hypersaline conditions for most part of the year. In the estuaries, mangroves provide detritus that nourish crabs, prawns and fish (Mumby *et al.* 2004). Developing an enterprise of mud crab fattening is pro-nature, pro-poor, pro-women and pro-livelihood oriented (figure 5a). Organic shrimp aquaculture is another community-centred eco-enterprise. Culturing ornamental fish is very remunerative since it has an export market and landless women are given training and initial resources to take it up. Fish pickle is also a very promising enterprise. Since many of the coastal villages do not have cold storage, the fisher women are forced to sell the fish catch of the day to the middlemen at low prices. Introduction of fish pickle technology has resulted not only in value-addition, but also in reducing the involvement of middlemen and others who exploit the fishers. Pearl culture is yet another market-driven enterprise. In the Gulf of Mannar area, the MSSRF introduced local communities to the science and art of artificial coral reefs. This has helped to revive fisheries in small areas. Coral reefs are an important ecosystem, both in terms of biodiversity and for the invaluable goods and services they provide to millions of coastal dwellers at tropical latitudes (Moberg & Folke 1999).

Paddy is a major agricultural crop in the eastern coastal areas of India. The landless women are trained to use the paddy straw as substrate to culture oyster mushrooms (figure 5b). Making paper and boards from banana waste is yet another pro-nature, pro-women and pro-poor enterprise.

The new paradigm of Evergreen Revolution envisages agriculture to be more biology- than chemistry-based. What this means is that biofertilizers and

biopesticides would replace the chemical fertilizers and chemical pesticides, respectively. SHGs of women are trained to produce vermicompost/worm compost (i.e. the process of using earthworms to digest kitchen and garden waste to create a faster than normal composting; earthworm castings contain five times more nitrogen, seven times more phosphorus and 11 times more potassium to enrich the soil (figure 5c) and biofertilizers and biopesticides such as the *Trichogramma* egg parasitoid (figure 5d). It must be emphasized that demystification of science and successful standardization of the laboratory-based technologies into ecotechnologies leads to the shifting of assetless families from unskilled to skilled work, thereby adding economic value to their time and labour.

The experience with biovillage paradigm shows that people-centric sustainable management of local land, forest and marine resources establishes mutually reinforcing linkages between development and environment. The environmental degradation ascribable to anthropogenic pressures is greatly minimized. As of now, there are 100 biovillages located in Tamil Nadu, Orissa and union territory of Pondicherry (figure 3).

(b) *Bottom-up participatory management of bioshield in the coastal regions*

During the decades preceding the 1990s, degradation of mangrove forests in India was unbridled. The current mangrove area worldwide has fallen below 15 million ha, down from 19.8 million ha in 1980 although the rate of mangrove deforestation has decreased in the 1990s from that of the 1980s (Mayaux *et al.* 2005). With substantial financial support from the India-Canada Environmental Facility (ICEF), the MSSRF took up a massive restoration of the mangrove forests in the coastal areas of West Bengal, Orissa, Andhra Pradesh and Tamil Nadu. Systematic studies on the causes of degradation whether natural or human-influenced were first carried out, and then suitable methods to ensure successful restoration were followed. A very substantial number of nursery material of different mangrove species was required. This provided an opportunity to train local women and men SHGs for raising nursery material. In doing so, they became aware of the role of mangrove trees and shrubs in providing nutrients to fish, prawns and crabs. The meaning of the traditional saying by fishermen in the Andaman sea, 'mangroves are the roots of the sea' became clear. The realization that their livelihood security was closely entwined with the security of the mangrove ecosystem was profound. Emergence of new harmony between the mangrove-dependent rural communities and the mangrove forests, prompted the MSSRF to develop a model for joint mangrove management (JMM), to be adopted and replicated by the Forest Department which manages mangrove wetlands in India. JMM aims at joint participation and sharing of experiences in mangrove management by the Forest Department, the mangrove user community (particularly the women), related government departments and non-governmental organizations in all mangrove management functions—resource mapping, planning, regeneration, protection and benefit-sharing (The Mangrove Decade and Beyond 2002).

The role of mangrove species acting as a bioshield to reduce the destructive potential of cyclones and tsunami became evident during the Orissa

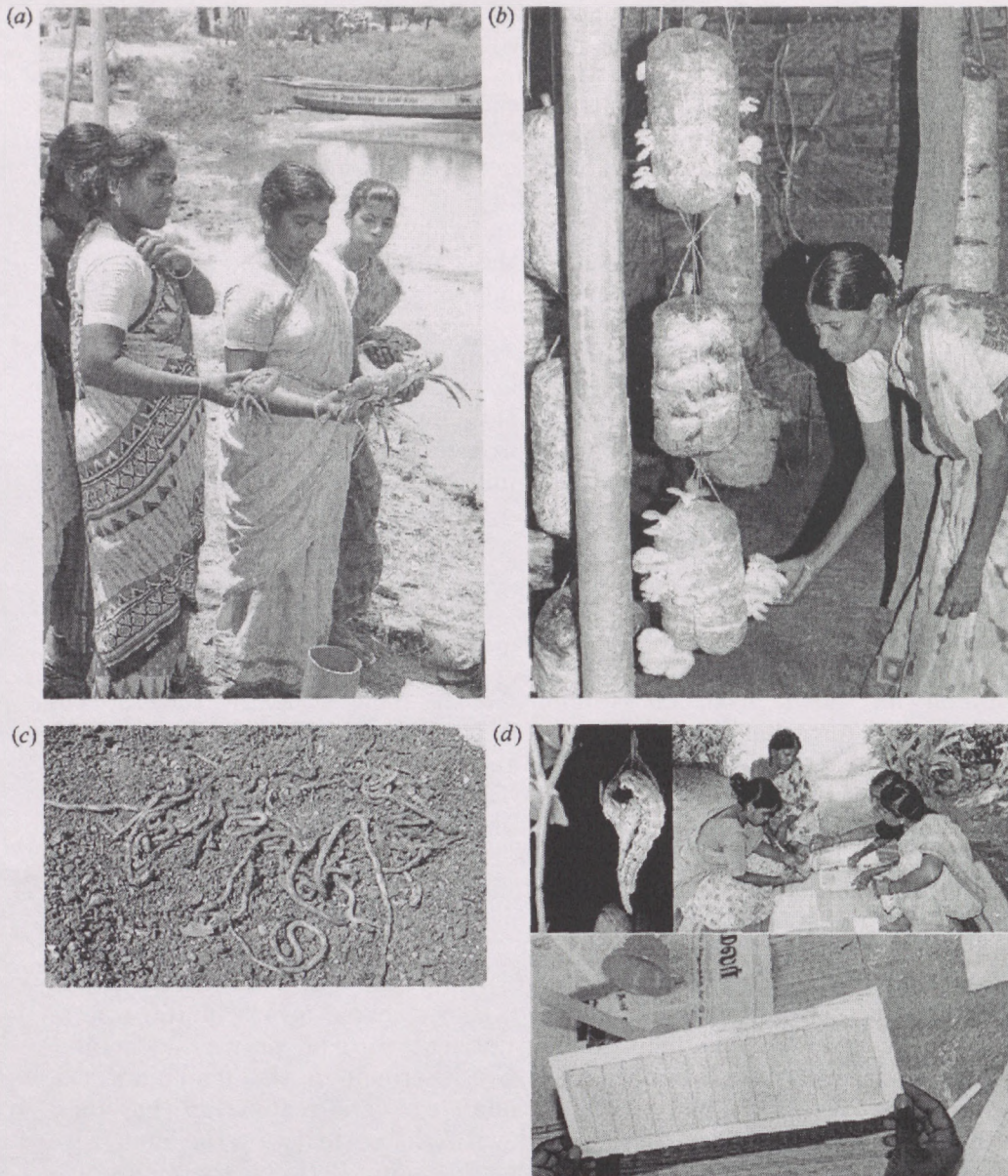


Figure 5. Eco-enterprises for sustainable livelihood: (a) mud crab production, (b) mushroom production (oyster mushroom), (c) vermicompost and (d) trichogramma egg parasitoid production.

supercyclone in October 1999 and the Indian Ocean tsunami in December 2004. In tsunami-affected Pichavaram in Tamil Nadu, the hamlets located between the sea and the mangroves were severely affected and many were destroyed, with a few deaths and substantial damage to houses, boats and fishing nets. On the other hand, the hamlets within the physical cover of the mangrove forest were largely protected, and there were no tsunami-associated deaths at all. Remote sensing (figure 6), ground-based data (Selvam *et al.*

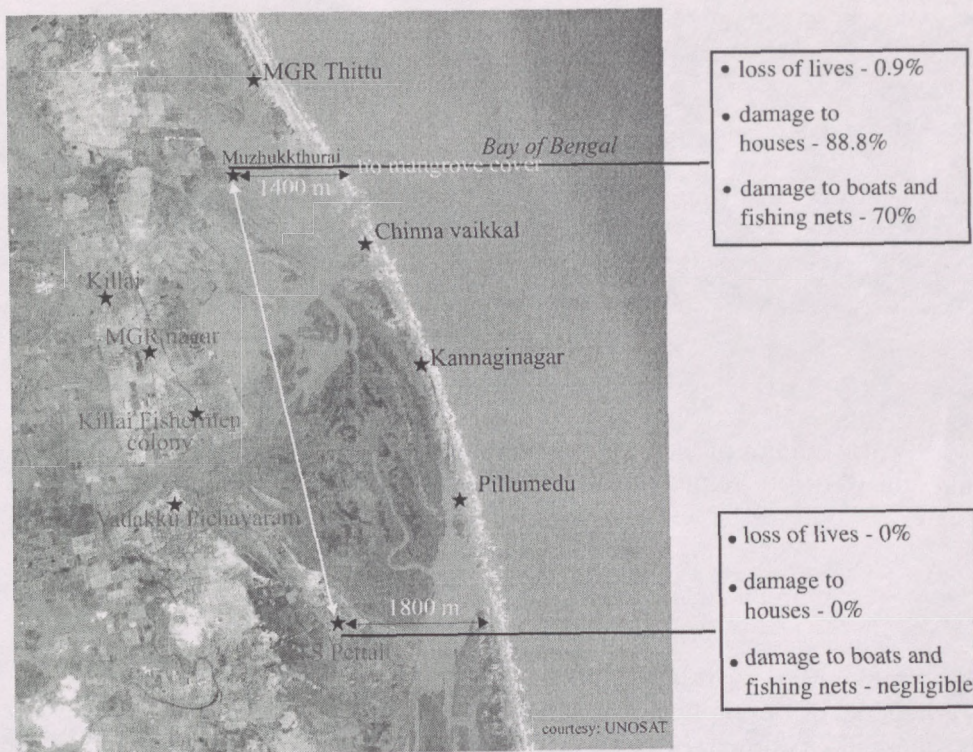


Figure 6. Protective effect of mangrove bioshield.

in press) and eyewitness accounts of the survivors of the two natural disasters have convinced the Indian government, the non-governmental organizations and coastal communities of the protective role of the mangrove forest. Wherever these have been degraded, plans are afoot for planting mangrove, *Casuarina* and other suitable species along the shore line. Danielsen *et al.* (2005) have demonstrated the protective role of the mangrove bioshield in a tsunami-affected region in Tamil Nadu. These post-tsunami observations are largely in accordance with the analytical models showing that 30 trees per 100 m² in a 100 m wide belt may reduce the maximum tsunami flow pressure by more than 90% (Hiraishi & Harada 2003). In addition, coral reefs are also as important as the bioshield. For island state countries like Maldives, which are just a metre above the sea level, coral reefs provide ecological and economic security. The corals and their ecosystem are a major tourist attraction (Moberg & Folke 1999).

In areas, where the edaphic and hydrological conditions are not favourable for putting up a mangrove bioshield, the plans are to go for non-mangrove species like *Casuarina*, followed by salt-tolerant species such as *Pandanus*, coconut, cashewnut, etc. Intercropping of these with low input and high value crops (pulses, spices, fruit crops depending upon soil, climate, etc.) would combine ecology (bioshield) and economy (livelihood). The strong and harmonious relationships among ecology, economics and development not only reduce the death and devastation by natural disasters, but also enhance the coping capacity



Figure 7. Community (a) grain and (b) water banks.

of the local rural communities. Mangrove species are an effective carbon sink and so would contribute to remedying the imbalance between carbon emissions and carbon absorption.

(c) *Community-centred cyclone/tsunami shelters, and food, fodder and water banks*

In areas highly vulnerable to cyclones, tsunamis, surge storms, etc., the MSSRF's model of Community Seed, Grain, Water Banks (figure 7*a,b*; i.e. banks with a difference) can help in enhancing the coping power of the people during a natural hazard. Often the transport and communication are severely disrupted by natural disasters, and the worse-hit areas are almost completely cut-off from rest of the world. The initial relief measures invariably consist of food packets dropped from aircrafts and helicopters. The least developed countries may not have capacity to do even this. In several hydro-meteorological disaster-prone areas, such relief measures are an annual feature. A decentralized, community-centred grain and water (food) bank would be able to provide relief almost immediately, and avoid 'transient hunger'. Built into this 'bottom-up' model is the suitable storage system.

The storage facilities could be traditional, conforming to traditional knowledge and ethos, but incorporating modern scientific inputs to withstand the impacts of natural disasters. The MSSRF facilitated putting up two multi-purpose cyclone shelters in the cyclone-prone coastal villages of Orissa. These are a safe haven during extreme natural hazards such as cyclones, windstorms and floods. These could also be linked in the neighbourhood with food and water banks, as well as first-aid facilities. Modern information and communication technology (ICT)-based village knowledge centres (VKCs) provided in these shelters will also help internet facilities for communication during emergency (§4*d*). Women, children and the infirm should be evacuated to these shelters as soon as early warning is received. The availability of first-aid, food and water would enhance the coping capacity of the communities during the disaster. The details of the community seed, grain, water and fodder banks, as well as their role in ensuring food security, are found in the book titled, 'Community Grain Bank' (2001) jointly published by the M.S. Swaminathan Research Foundation and the World Food Programme, New Delhi.

(d) *Modern ICT-based VKCs for extreme natural hazard management*

With a firm conviction and foresight that knowledge empowerment of rural women and men is crucial for sustainable development and poverty reduction, the MSSRF set up in 1997 what were then referred to as village information centres. These are now called VKCs. Wherever telephone lines are not available, connectivity is established through a wired-wireless hybrid technology. Particular attention is given to creating content that is time- and locale-specific and demand-driven. The time- and locale-specific and demand-driven information pertain to weather, crop and animal husbandry, integrated pest management, market trends and prices of local commodities, health care, immunization of children, poverty alleviation schemes of the government, details of eco-enterprises, transport, education, etc. A good example of value-addition to generic information that has been acclaimed world over is the 48 h advance information on the sea wave heights in the Bay of Bengal provided round the clock for the benefit of the fishermen in a small village, Veerampattinam, in the union territory of Pondicherry. In this case, the MSSRF downloads the data on the sea wave heights from the US Naval website, which is unclassified and generic. The MSSRF enhances the value of this information by pinpointing the sea wave heights close to Veerampattinam. The value-added information so gained from the use of high technology is announced in Tamil, the local vernacular, through low-tech loudspeakers. The need to use loudspeakers arises from the fact that some of the fishers cannot read and most of them are totally engrossed in their work. Over the years, the fishers have acknowledged how useful this timely, locale-specific and value-added information has been in avoiding risk to lives on the sea in their country rafts (Catamaran). The fisher women are very relieved that their men would not be caught in a severe cyclonic storm, and drown in the sea.

The village knowledge revolution launched by the MSSRF in a few villages in 1997 involved integrated use of the internet, cable TV, radio and the vernacular press. The experience reveals that the internet-radio combination is particularly powerful for 'reaching the unreached' and 'voicing the voiceless' in rural India (figure 8).

The success of the VKCs set up by the MSSRF is not only because of their time- and locale-specific, value-added, demand-driven information content, but also the basic principles of these being user-controlled, and user-managed with strong social and gender equities. In fact, in almost all the VKCs, young women who have studied up to seventh or eighth class and have learnt computer literacy are the operators and managers. The experience of the MSSRF is that given a sense of ownership and training, the rural youth take to making use of the internet like a fish to water.

On the morning of 26 December 2004, the VKC with its loudspeaker system saved many lives in the village Veerampattinam. It so happened that on that fateful Sunday morning, a few young men sitting on the seashore noticed strange behaviour of the sea. The sea first receded and at the very rear, as far eyes could see, the waves were rising alarmingly high. Guessing that something was drastically wrong, they rushed to the VKC and used the loudspeakers to ask the women, children and men to run to higher grounds away from the seashore. This saved the lives of all those who were minding their business in their huts and outside close to the shoreline. Damage to property was inevitable but precious human lives were saved.

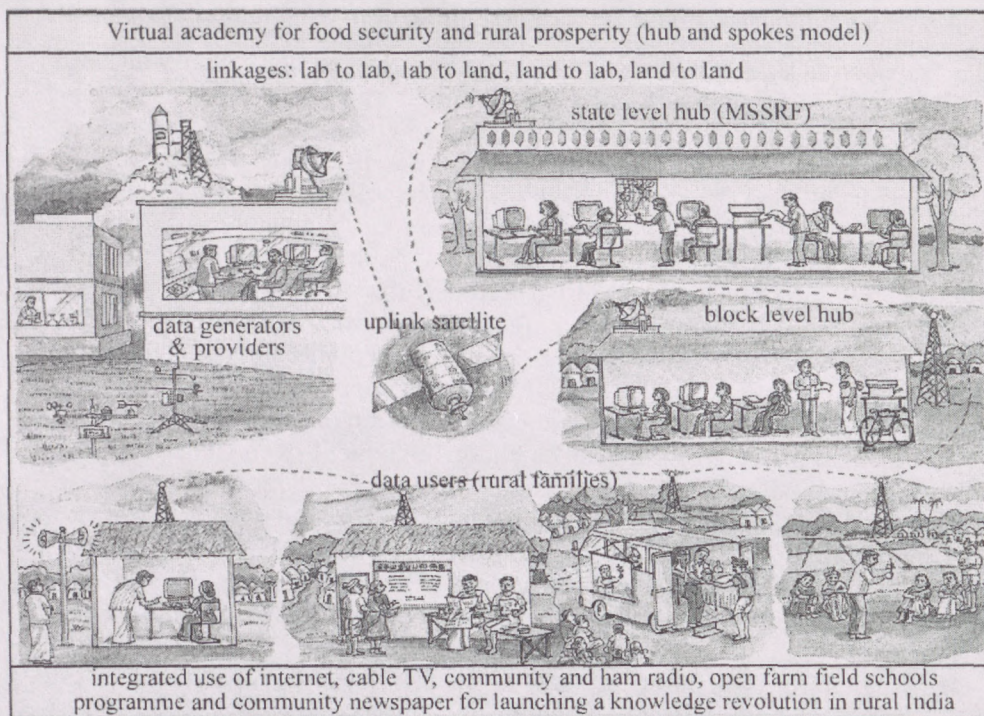


Figure 8. Modern ICT for knowledge revolution in rural India.



Figure 9. Mission 2007: every village a knowledge centre.

With the initiatives of the MSSRF and support of the Government of India, there is now a vigorous movement, by mobilizing the power of partnership, of National Alliance for Mission 2007: Every Village a Knowledge Centre (figure 9). The goal of Mission 2007 is to have a knowledge centre in each of the 600 000 plus villages of India by the year 2007, which marks the 60th anniversary of India's Independence.

At present, 40 VKCs have been set up in various states as indicated by arrows (figure 10), in addition to 13 Village Resource Centres (hubs) each of which has connectivity with several villages falling within a radius of approximately 25 km. The work has picked up momentum involving scores of organizations each concentrating on a particular region/state of the country.

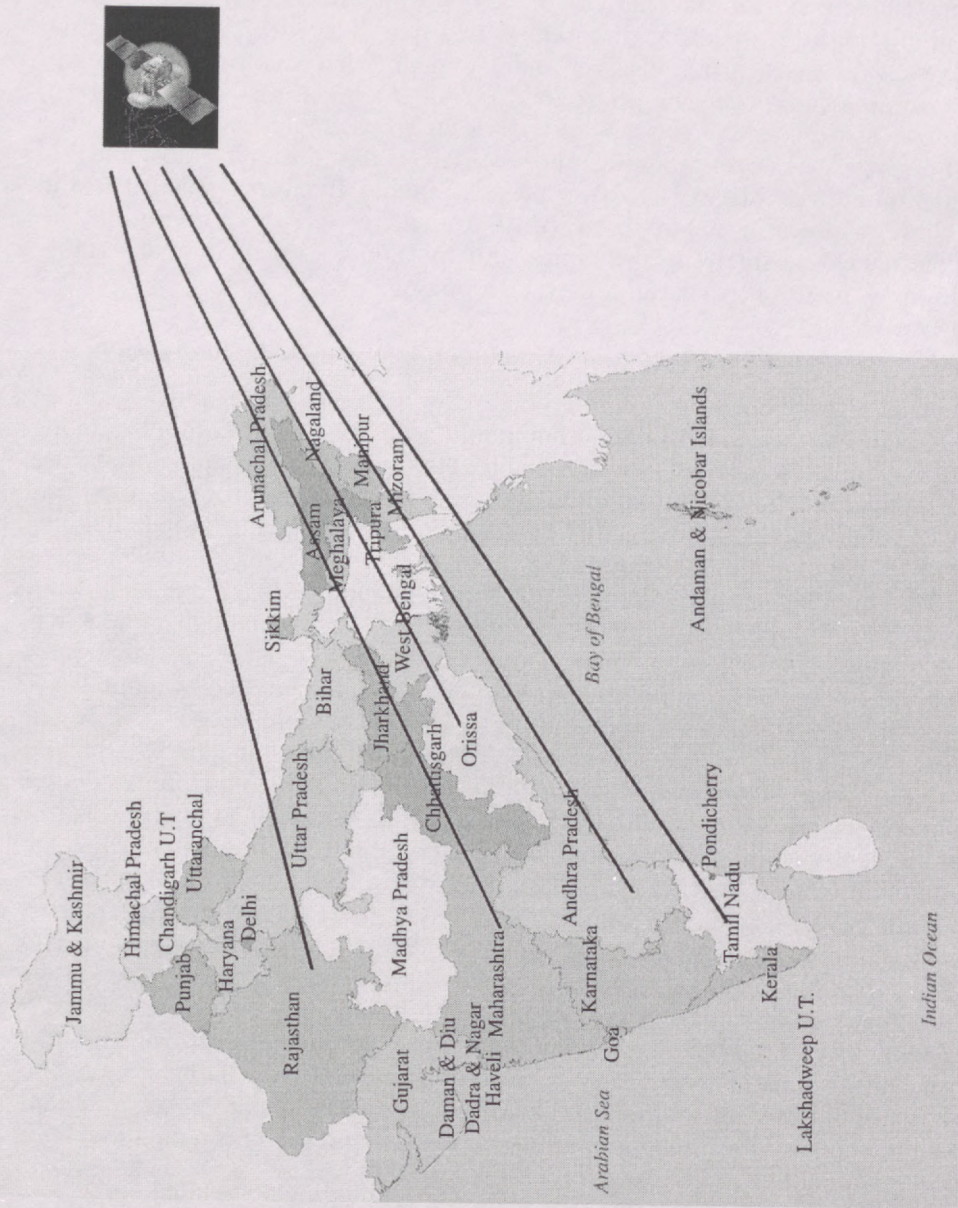


Figure 10. Location of 13 village resource centres and 40 village knowledge centres in India.

In the disaster-prone rural areas, at least one woman and one man will need to be trained to make use of the internet, GIS, remote sensing and communication systems. GIS can help in improving the quality and power of analysis of mitigation measures and in the implementation of emergency preparedness and response action. Identification of hazardous areas and monitoring the planet for its changes on a real time basis and to give early warning about many impending disasters is now possible with remote sensing. Practical ways of integrating disaster management with sustainable development are summarized by Swaminathan (2005*b*). As medium- and long-term rehabilitation strategies, he has suggested three steps of action all along the coast. These are: (i) strengthening the ecological foundations (bioshield) of sustainable human security; (ii) fostering sustainable livelihood security; and (iii) putting in place a network of rural knowledge centres. Swaminathan (2005*b*) has also described the principles and methodologies of mainstreaming disaster management into sustainable development.

(e) *Genetic shields in coastal areas vulnerable to seawater inundation*

In his Anniversary Address (2004), Lord May refers to the rapidly growing water shortage as a global problem that could lead to armed conflicts among neighbouring countries which share rivers, etc. He also suggested appropriate use of the recombinant DNA technology to produce crops that are drought-resistant, and/or salt-tolerant, thus moving in the direction of producing crops that are adapted to their environment (figure 11).

Based on the suggestion of Prof. M.S. Swaminathan as early as 1988 at a meeting on climate change in Kyoto, Japan, the scientists at the MSSRF identified several salt-tolerant genes from the mangrove species, *Avicennia marina* (Mehta *et al.* 2005) and transferred these through the recombinant DNA technology to rice. It is an important crop in the coastal areas, which are threatened by increasing sea level, and frequent storms and cyclones. The salinity-resistant rice developed with the help of genes transferred from unrelated mangrove species (*A. marina*) also emphasizes the urgent need to prevent loss of valuable genes through conservation and enhancement of biodiversity in the developing countries. The transgenic rice tolerates salinity up to 150 mM. The development of transgenic salt-tolerant rice (Prashant & Parida 2005) is scientifically fascinating and socially relevant. MSSRF is currently engaged in transferring drought-resistant genes from *Prosopis juliflora*, a common desert tree, to water-thirsty rice. Such genetic shielding of crop plants against salinity, submergence and drought would sustain the coastal agriculture and the livelihoods of millions of resource-poor farming families, even if the frequencies and intensities of extreme hydro-meteorological disasters increase. Recombinant DNA technology provides an opportunity to design and develop genetic shields against adverse changes in temperature, precipitation and sea level as a result of global warming.

(f) *Guiding principles for integrated coastal zone management*

For integrating disaster management strategies with sustainable development, the developing countries need to adhere to certain guidelines. An Expert Committee chaired by Prof. M. S. Swaminathan has proposed 12 basic guiding

principles for the sustainable and scientific management of the coastal zone (Swaminathan 2005a,b). The first and the foremost one is that ecological security, cultural security, livelihood security and national security should be the cornerstones of an integrated coastal zone management policy. The coastal zone would include the area from territorial limits (12 nautical miles), including its sea bed, to the administrative boundaries or the biological boundaries demarcated on the landward side of the sea coast. The coastal zone management should also include the island water bodies influenced by tidal action and the land area along such water bodies. The *precautionary approach* should be used where there are potential threats of serious or irreversible damage to ecologically critical coastal systems and to living aquatic resources. Scientific uncertainty should not be used as an excuse for the unsustainable exploitation of coastal resources—both living and non-living. Ecological economics should underpin economic activities, so that present day interests and future prospects are not antagonistic. Significant biological, cultural and natural assets should be considered incomparable, invaluable and irreplaceable and should receive overriding priority in the allocation of resources for coastal area protection and conservation.

5. Tsunami devastation of Andaman and Nicobar Islands: converting calamities into opportunities

(a) Nature of devastation

According to Government of India reports (see the document of United Nations Country Team India, March 2005 on 'Recovery Framework in Support of Government of India' for a Post-tsunami Rehabilitation and Reconstruction Programme), 10 749 people in India lost their lives, and 5640 persons were still missing, after the tsunami of 26 December 2004. Approximately 7000 people escaped with injuries (Tsunami Rehabilitation Programme Planning Commission Government of India March 2005, Link: <http://www.icsf.net/jsp/english/flashnews/rehabDocs/ind0236.pdf>).

The island of Andaman and Nicobar archipelago consists of 572 emerald islands, islets and rocks. It stretches approximately 750 km from the northern most Andaman to the Southern most Indira point in Great Nicobar. Located in the Bay of Bengal, these islands stretch from approximately 6 to 14° north latitude, and approximately 92 to 94° east longitude.

The Sumatra-Andaman earthquake (M 9.3) on 26 December 2004 released 4.3×10^{18} J, equivalent to the energy of a 100 Gton bomb. Shifts in the sea floor displaced more than 30 km³ of seawater (Bilham 2005), generating powerful tsunami waves. The rupture process was initially slow, but picked up speed at approximately 2.5 km s⁻¹ and proceeded north northwest approximately 1200–1300 km along the Andaman trough (Ammon *et al.* 2005).

From the point of rehabilitation and preparation of an action plan to integrate disaster management with sustainable development, the geological and geomorphological changes induced by the earthquake and tsunami need to be taken into account. Denyer (2005) has reported that the Andaman and Nicobar Islands appear to have shifted southwest by around 4 m (13 feet), according to GPS data. The northernmost inhabited island Diglipur in the north Andamans

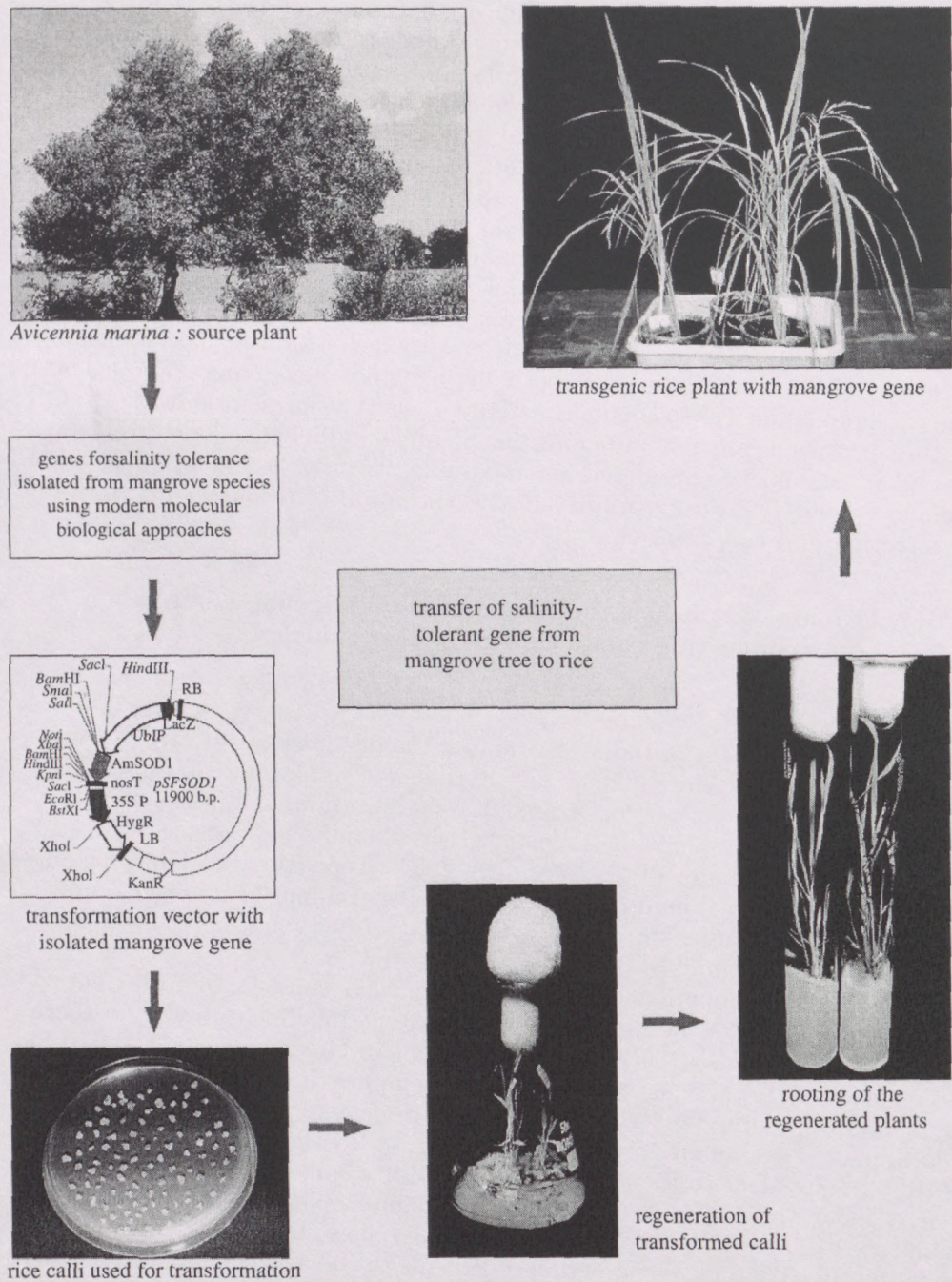


Figure 11. Genetic engineering of crop plants against abiotic stress.

has risen by 0.5–0.8 m (1.7–2.6 feet), whereas the southernmost Indira point (Great Nicobar) has sunk by approximately 1.4–1.8 m (4.6–5.9 feet). Many of the islands suffered extensive damage, as is shown for Katchal islands before (figure 12a) and after the tsunami (figure 12b).

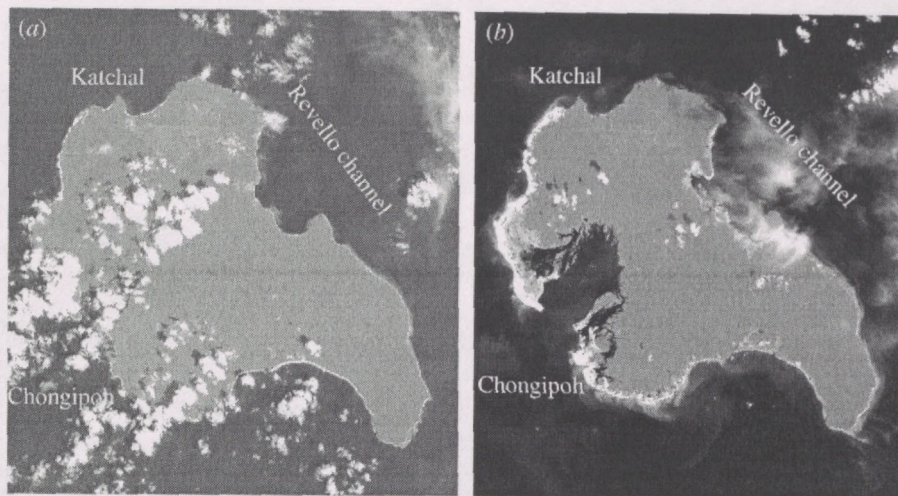


Figure 12. Remote sensing picture of Katchal islands of Andaman-Nicobar archipelago (a) before tsunami (February 2004) and (b) after tsunami (January 2005).

(b) *Integrating disaster management with sustainable development of post-tsunami Andaman and Nicobar island archipelago*

The extensive geographic and geological changes caused by the extreme natural disaster have necessitated a new outlook and action plan for the Andaman and Nicobar islands. The past unsustainable practices should be brought to an end so that a new era, in which humans and nature are in a harmonious and mutually reinforcing relationship, can begin.

Keeping all these in view, the MSSRF has recommended locale-specific, sustainable solutions. The main focus is to integrate ecological security with livelihood security largely based on forestry and fisheries and put in place rural knowledge centres with the internet and GIS for early warning and disaster mitigation. The blue print for integrating disaster management into sustainable development was presented by Swaminathan (2005b).

The agriculture recommended is *organic* agriculture with *low input, low volume* and *high value crops*. The first and foremost is the erection of bioshield or the shelterbelt with mangrove or non-mangrove tree species based on ecological, edaphic and the hydrological conditions. After several rows of these, the other salt-tolerant, and economically useful species (e.g. coconut, *pandanus*, bamboo, canes, cashewnut, arecanut, etc.) which are all capable of reducing the velocity of cyclones, tsunamis, and the harmful effects of seawater rise due to global warming, should be planted. In between the rows of coconut or arecanut trees, spices (especially pepper, clove and nutmeg) can be grown organically as intercrop. This approach will effectively protect the lives and enhance the livelihoods.

The forest cover of Andaman and Nicobar islands is approximately 86%; the biodiversity is rich, and it includes a few unique fauna and flora which are endemic. Particular care needs to be taken to protect the uniquely rich biodiversity not only from human encroachment (i.e. subsistence farming with low value grain crops, polluting industries, etc.) but also from erosion and

extensive intrusion of seawater on account of natural disasters and sea-level rise due to climate change. For these reasons, the MSSRF has laid stress on limiting the kind of agriculture that requires chemical inputs (i.e. fertilizers, pesticides, etc.) on one hand, and promoting organic agriculture that totally forbids application of chemical inputs, on the other. In a few areas, 'mixed dynamic farming' systems (organic agriculture with farm animals to establish a symbiotic relationship with the farm providing fodder and feed to animals and the animals in turn enriching the soil organic nutrients with dung and urine) with *Low External Input Sustainable Agriculture* is recommended. These are the pathways to achieve the Evergreen Revolution.

Livelihood based on fisheries has enormous potential. Both culture fisheries (i.e. ornamental fish, prawn and crab), and capture fisheries (i.e. pelagic, demersal and deep sea) will provide eco-friendly livelihoods. Women, men and mixed SHGs can take up prawn culture and crab fattening in the areas of South Andamans and Campbell Bay (Great Nicobar) where continuous intrusion of seawater during high tides has rendered paddy cultivation difficult. Preparing fish pickles from certain types of fish is an ideal value-enhanced eco-enterprise for women.

Organically grown coconut-centred eco-enterprises in the Nicobar groups of islands have high potential. Processing dry coconut kernels (copra) for oil extraction, making furniture from the coconut trunk, and handicrafts articles from coconut shell and fibre are just a few to mention. Most importantly, the thick forest absorbs a great deal of carbon—a benefit for the entire planet.

Tourism should be eco-tourism. The tourists could choose to have pleasure and thrill of staying at the Nicobari huts (figure 13) rather than in five star concrete buildings. The Nicobari huts were resistant to the powerful earthquake (M 9.30), while almost all the concrete buildings collapsed.

The VKCs with early warning systems are very important. The spectrum of time- and locale-specific, demand-driven information content, developed in a bottom-up approach is rather wide. Broadly, these would fall under tele-fisheries, tele-agriculture, tele-medicine, tele-health, tele-education and tele-forestry. Particular attention should be given for local weather forecasts and locations of safe havens in case of an extreme natural hazard. The Andaman and Nicobar islands require multi-purpose cyclone/tsunami shelters as community-centred facilities. Adequate food and drinking water supplies must be stored and managed by local women and men SHGs along with elected representatives of grassroot level institutions or the Tribal Councils, whichever is appropriate. These are the MSSRF's banks with a difference already described above.

The VKCs will have a major role in the community-based disaster preparedness. Women and men attached to the VKCs are already well-trained in the use of the internet, video-conferencing, etc. In addition, they should be trained to use GPS and to locate safer areas within a short time when an extreme natural disaster strikes, and to evacuate the women and children immediately to these safer areas.

(c) *Alternate land-based livelihoods for fisher women*

The 1999 supercyclone in Orissa, and the 2004 tsunami have revealed the extreme vulnerability of livelihoods based only on capture fisheries. The boats and fishing nets were severely damaged. Replacement and repair involve huge



Figure 13. Nicobari hut living space inside the thatched part standing on stilts.

capital investment, often beyond the means of marginal and resource-poor fishermen. Secondly, major changes in the sea, and coastline often exert an impact on the concentration and dynamics of the fish population, which are within the access of the resource-poor fishers. After the tsunami, many fishermen observed plenty of fish in some places, and very few in other places. The livelihood is therefore disrupted.

The MSSRF provided solution to this malady by training and capacity-building of the women of the fishing communities for taking up land-based alternate livelihoods. In the tsunami-devastated fishing village Sadras Kuppam, approximately 50 km south of Chennai, the fisher women were given necessary training, capability and capacity for taking up eco-enterprises, such as mushroom cultivation and poultry rearing. A rural knowledge centre with internet facilities and provision for early warning system has also been set up. The fisher women are now experts in mushroom culture, rearing and management of poultry that is disease-free, and in operating the modern ICT-based VKCs. Soon, they will receive from the MSSRF the value-added information on the sea wave heights so that their men could avoid venturing to sea in their catamaran (country raft) when the sea waves are likely to turn dangerously high and violent.

6. Conclusions

In terms of loss of human lives and erosion of natural resource base for livelihoods, the coastal areas are highly vulnerable to extreme natural disasters. The resource-poor farming and fishing communities in the small island developing countries, and the countries with long coastlines are the worst hit. Apart from a low level of technology development, social, economic and gender inequities greatly accentuate their susceptibility to, and suffering from, natural disasters. Concurrent attention to ecotechnological and knowledge empowerment as well as elimination of social and gender inequities will enhance the resilience and coping capacity of the resource-poor rural women and men. Strengthening the livelihood and knowledge bases of the rural communities through biovillage paradigm and rural knowledge centres helps in linking livelihood security with ecological security. That is also the pathway of mainstreaming disaster mitigation/management with sustainable development. The current movement in India, of 'Mission 2007: Every village a knowledge centre' with emphasis on time- and locale-specific, demand-driven and value-enhanced information content will greatly strengthen the capacity of local populations to manage natural disasters in a much more effective manner in the future.

In addition to these, genetic shielding of the major crops for coastal agriculture with genes for abiotic stresses from widely unrelated species through recombinant DNA technology will strengthen crop security in areas prone to seawater inundation, drought and other abiotic stresses.

To sum up, there can really be no effective disaster management without sustainable management of natural resources, poverty reduction, and food, water and work security in the vulnerable rural areas of the developing countries. Disaster management procedures must become integral components of future development paradigms.

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