ADDENDUM TO THE BIODIVERSITY CONSERVATION IN SRI LANKA

A Framework for Action

CHAPTER REPORT - 11

MONITORING & COORDINATION

Biodiversity Secretariat
Ministry of Environment

Addendum to Biodiversity Conservation in Sri Lanka
A Framework for Action

CHAPTER REPORT ON
MONITORING AND COORDINATION
(TASK FORCE NO-10)

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Cover Page

1. *Stemonoporus moonii Thw.-Hora-wel(S)*
2. *Exacum petiolare Griseb*
3. *Lyriocephaluś scutatus*
   (Linnaeus1758)Gatahombu katussa Karamal bodiliya
   (S)Lyre head lizard Hump snout Lizard(E)
4. *Zeuxina regia*(Lindley)Trimen-Iru-raja(S)
5. *Kaloula trprobanica*
   (Parker1934)Visituru ratu madiya(S)Common bull frog(E)

All photos
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Biodiversity Conservation Action Plan: Monitoring and Coordination

1. Background

The need to develop appropriate structures and indicators for monitoring biodiversity components and coordination of action plans is recognized as an integral part of the national implementation of commitments of the CBD. Monitoring consists of intermittent surveillance to ascertain the extent of compliance with a predetermined standard or degree of deviation from an expected norm (Hellawel, 1991). It is goal oriented and reveals changes in a particular parameter or parameters. Thus, in monitoring biological diversity, it is executed through the identification of a strategic framework that tracks the behavior of key variables in a manner that allows early warning of system change to undertake necessary management improvement or increase management options. Coordination is defined in relation to the institutional and operational aspects of biodiversity conservation so as to ensure that the necessary structure and procedures for effective implementation is in place.

Monitoring of biodiversity is carried out through the development and use of indicators covering all the thematic areas and cross cutting issues. Thus at various consultations of the Conference of Parties (COP) to the Convention on Biological Diversity (CBD) parties to the convention have been urged to develop and use monitoring indicators within the context of the convention. Programs of Work of various subcommittees under the convention have reflected the importance of this as a means of implementing national commitments. Thus, the information developed by the Committee on Monitoring and Coordination will attempt to service functions of providing both a basis for monitoring national commitments and reference for meeting international obligations. The discussion and recommendations on Coordination will be more inward looking referring explicitly to the adequacy of local institutions to fulfill

the roles and responsibilities arising from the national work program for biodiversity conservation.

2. Gaps in the 1999 BCAP

The BCAP of 1999 provided a broad framework for action and prioritized set of activities to be undertaken in the conservation of biodiversity in Sri Lanka, but failed to provide guidelines for institutional accountability, financial and other resource allocation and timeline for the implementation of recognized activities. As a result, the activity did not examine the key aspect of developing references for monitoring though the development of benchmarks, indicators or other points of reference.

3. Strategies

For the purpose of achieving the goals and objectives of the National Biodiversity Conservation Action Plan, monitoring and coordination are defined to denote following actions:

Coordination: Will explore the BCAP implementation performance with particular emphasis to the adequacy of project inputs and outputs including the institutional arrangements for its implementation.

The objective of the coordination exercise is to suggest institutional arrangements necessary to achieve biodiversity goals.

    a. Clarify roles, authorities and responsibilities of institutions implementing BDCAP (in coordination with TF 11)

    b. Assess adequacy of existing institutional arrangements and operational procedures (for example for the areas described below under action planning)

    c. Propose strengthened and effective coordination arrangements among various stakeholders engaged in BD Conservation

       - Govt. agencies (Central, Provincial and Local levels),

       - NGOs,

- Civil Society Organizations and
- Members of Public

d. Assess procedures and arrangements for international cooperation and proposed measures for its strengthening

e. Resources and capacity building for the above

Monitoring: Will explore the impact of BCAP on biodiversity through the development of a set of impact indicators.

The objective of Monitoring is to assess whether interventions are achieving biodiversity goals and adapt management accordingly.

a. Propose arrangements for evaluation of changes or trends of existing stocks of BD

b. Reporting and verification procedures

c. Resources and capacity building for the above

The C&M plan will provide a detailed program of work which defines

a. what monitoring activities will take place, when and by whom,

b. how that information will feed back into management decisions.

c. include an estimate of costs of implementation,

d. identify training and capacity building needs among the staff and institutions responsible for this M&E.

Biodiversity Monitoring - Monitoring biodiversity is not as simple as monitoring other environmental characteristics, such as air or water quality for which there are well established standards or benchmarks. The biodiversity values of an area undergo considerable fluctuations as a result of natural processes. These natural variations need to be recognized and considered so that they can be taken into account

in evaluating the results of project interventions. Moreover it is often difficult to assess the impact of project activities on biodiversity in the short term. Therefore, monitoring must rely on indicators of likely success rather than absolute measurements of biodiversity. Monitoring is measuring trends over time to determine whether management is having the desired result or needs to be changed.

Principles for Developing a Monitoring Scheme

Identification and implementation of suitable set of monitoring indicators in the national context follows an iterative process that matches identified needs, institutional organization and capacities. The process commences with the definition of set of policies and goals spelt out in the National Biodiversity Strategy and Action Plans, specification and selection of relevant indicators, implementation of a suitable monitoring program and culminates with a process of information that feeds back in to re-assessment of the policies and goals at the national level.

Wilson and others (1996) identified attributes of biodiversity that can be assessed at each level of ecological organization.

- At the landscape level, attributes that could be monitored include the identity, distribution, and proportions of each type of habitat, and the distribution of species within those habitats

- At the ecosystem level, richness, evenness, and diversity of species, guilds, and communities are important

- At the species level, abundance, density, and biomass of each population may be of interest. and

- At the genetic level, genetic diversity of individual organisms within a population is important

It is best to assess and interpret biodiversity across all these levels of organization by using various approaches at several spatial and temporal scales (Noss 1990, Noss and Cooperrider 1994).

Gains et al. proposed a three-phase approach to monitoring biodiversity:

i. Identifying monitoring questions;

ii. Identifying monitoring methods; and

iii. Analysis and interpretation of information for integration into management strategies.

Each of these phases is shown in the fig. 1 below.
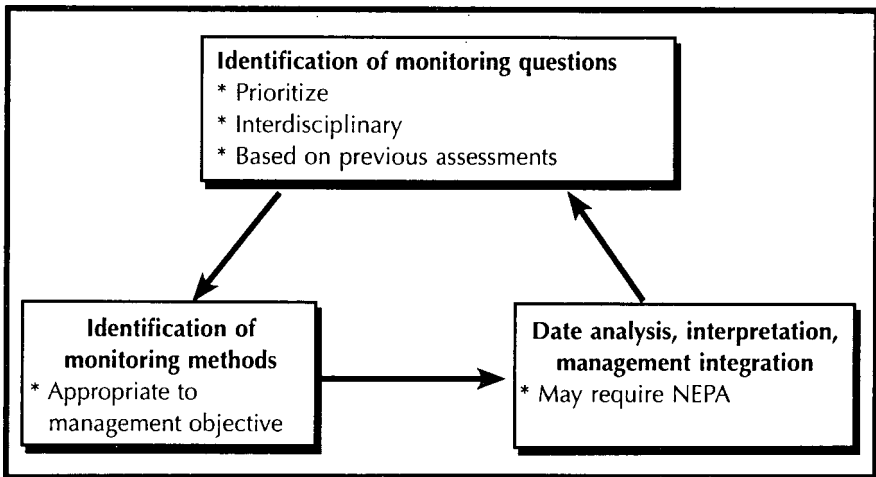
Fig. 1. Three Phases of Biodiversity monitoring – From Gains et al.

i.   Identifying Monitoring Questions

This phase includes identifying and refining biodiversity monitoring questions, determining data needs to address the questions, and prioritizing monitoring questions and data needs. Examples of monitoring questions appropriate to each biodiversity level are shown in Annex A. Prioritizing monitoring questions is important because the resources available to accomplish monitoring are likely to be limited.

Identifying monitoring questions is a critical and difficult step. It could be accomplished through an interdisciplinary process with experts knowledgeable of the issues at the appropriate level (e.g., landscape, ecosystem, species, genetic, etc.) and should be considered an iterative process that is adapted as new information becomes available. Monitoring questions could be derived from information available in watershed analysis, late-successional reserve (LSR) assessments, or regional assessments. The assessment teams develop monitoring questions, propose data collection methods, and identify appropriate expertise needed to accomplish the monitoring. The monitoring questions can be ranked i.e. low, moderate, and high priority. Ultimately, management must determine which monitoring questions should be addressed.

ii.   Monitoring Methods

Methods selected for monitoring biodiversity depend on management objectives. A management objective of maintaining species viability would involve different monitoring methods than an objective of restoring inherent disturbance regimes. Selecting the appropriate biodiversity monitoring approach includes identifying methods that will provide answers to specific monitoring questions. A variety of methods are available, and selection of methods would be made based on costs, available resources, and statistical constraints. It might be helpful, if not absolutely necessary, to consult a statistician at this stage to determine sampling sizes, strategies, and statistical power.

iii.   Data Analysis, Interpretation, and Management Integration

Periodically, data collected from monitoring would be analyzed and integrated into management strategies based on the knowledge gained. If monitoring reveals that adjustments need to be made in management strategies, then this becomes a decision step requiring National Environmental Policy Act (NEPA 1969) documentation and plan revisions.

Development of Indicators:

Indicators - Indicators can be quantitative or qualitative variables which can be measured or described and which, when observed periodically, demonstrate trends in biodiversity characteristics over time. They should be designed to track changes over time, against a baseline.

The Coordination and monitoring plan being developed will have the following characteristics:

- Address a clearly stated set objectives
- State clearly what indicators will be chosen
- Specify how often monitoring and evaluation will be done, and by whom
- Outline any necessary training or financial inputs that are required
- State the intended audience for the evaluations
- Specify how information will feed back into management decisions; and
- State clearly the decision points at which action must be taken to address negative trends
- Be cost-effective to monitor (maximum information with minimum sampling time, effort and expenditure)

The Monitoring Indicators will have the following features:
- Be measurable
- Reveal meaningful trends
- Point as directly as possible to the state of biodiversity in the subject area or the impact of a project activity on that biodiversity
- Be precise and unambiguous so that they can be clearly defined and understood the same way by different stakeholders

- Allow the identification of effects of "background" processes, such as weather, climate, catastrophic events, and natural variation

- Be selected to address the specific challenges of the individual project

- Be amenable to sampling by non-specialists, including user/local communities (suggesting that the indicators should also be meaningful to local people)

- Be consistent, i.e. continue to measure the same thing over time

- Be consistent with, if not the same as, national level indicators as well as those used in other protected areas, and

- Require the involvement of the minimum possible number of individuals and agencies in their evaluation

Under practical conditions most indicators cannot be expected to meet all criteria mentioned above. Therefore, selections of indicators should be optimized for the purpose and audience. Choosing indicators envisages measuring as little as possible to give the highest policy significance and sufficient scientific credibility.

Indicator Levels:

Identifying and classifying monitoring indicators by major ecosystem types provide convenient spatial units for analysis and reporting. Such ecosystem types should reflect specificities in the national ecosystems and correspond with the thematic areas in the international conventions to enable reporting and thematic, regional and global overviews.

In the context of National Biodiversity Conservation objectives, ten different categories of indicators were identified reflecting varying levels of spatial, biological aggregation and closely linked thematic areas. As seen, certain subject areas are broadly relevant under more than one category of indicators.

Indicator Category	Relevant Subject Area
1. Regional/Landscape Level –	Forest Biodiversity Wild life biodiversity Crop agriculture Biodiversity
2. Ecosystem/Community Level –	Forest Biodiversity Coastal Biodiversity Marine Biodiversity Wet-land Biodiversity Mountain Biodiversity Grassland Biodiversity Dry land Biodiversity
3. Species/Population Level –	Invasive species Endangered species
4. Resource Utilization Level –	Domesticated Animal Biodiversity Fisheries and Aquatic Biodiversity Cultural Biodiversity Urban and built environmental Biodiversity Scenic Biodiversity (tourism industry)
5. Socio-Economics –	Bio-prospecting Environment pollution
6. Legal/Regulatory –	Cross Cutting – All subject areas
7. Management –	Trade related Biodiversity Bio-Industry

8. Community Participation	(Cross Cutting – All subject areas) Participation and partnership of private sector
9. International Cooperation	Conventions
10. Other	GMOs etc.

A large number of Indicators categorized by various levels of organization are available to choose from. A list of suggested indicators was compiled using different sources so that the most appropriate for the local situation can be selected (Annex B). However, for ease in tractability at this stage suggested indicators were categorized under the subject areas and thematic and cross cutting areas and sector identified for the BCAP exercise. The final set of Indicators to be monitored will be chosen from the Annex B list through a consultative process while keeping the features described earlier in focus.

4.   Implementation

Coordination and Monitoring should begin as early as the implementation has begun and training and other facilities necessary should be delivered immediately. As monitoring data becomes available, evaluation of success of conservation efforts should be carried out. Such evaluations should serve 3 functions:

a. determine if the objectives of addressing threats to biodiversity being achieved,

b. assess the reasons (technical/institutional/other) why the targets were either met, missed, or exceeded

c. assess any ancillary effects (benefits/costs) achieved by the Action Plan implementation.

However, Coordination and Monitoring continue to be a learning exercise because during the implementation phase it becomes necessary to,

1. validate the relationship between indicators and objectives of biodiversity conservation

2. verify the quality, quantity and rapidity of information transfer,

3. review the extent to which the monitoring scheme facilitates successful BCAP implementation.

5. Recommendation

Based on the foregoing discussion, following suggestions appear important to be addressed in drawing up the Monitoring and Coordination arrangements for the BCAP:

i) Establish biodiversity monitoring indicators within a common, flexible and transparent framework.

    a. The framework should provide a hierarchy with multiple spatial and temporal scales in which to identify, structure, combine and aggregate indicators.

    b. It should enable to identify the strengths and weaknesses of indicators taking into account an ecosystem's: diversity of elements (e.g. flora and fauna); complexity of interactions (i.e. social, economic and environmental) and the interaction with other ecosystems (e.g. terrestrial, aquatic and coastal and marine).

    c. It should recognize the hierarchical structure within the ecosystem.

ii) Integrate the biodiversity indicators into policy monitoring, evaluation and predictive scenarios to improve policy effectiveness in promoting conservation objectives.

iii) Indicators should be revised periodically to reflect improving scientific understanding and research of the linkages between the genetic, species and ecosystems levels related to biodiversity.

iv) Monitoring and Coordination scheme should engage a wide range of stakeholders in monitoring biodiversity indicators, including producer groups, environmental groups, government scientists, members of public and policy advisors and draw on and share their perspectives, expertise and information for policy purposes.

v) Contribute and cooperate with other international initiatives related to developing biodiversity indicators, especially those under the Convention on Biological Diversity.

ANNEX A:

Sample Monitoring Areas and Methods for Each Level of Ecological Organizatio

Monitoring Scale	Monitoring Areas	Monitoring Methods
Landscape Level	A. Trends in Landscape Diversity	a. Indices of Landscape patterns
		b. Historic reference conditions
		c. Remote sensing and GIS
	B. Trends in Habitat Availability and Destruction	a. Indices of Landscape patterns
		b. Historic reference conditions
		c. Remote sensing and GIS
	C. Trends in Landscape Elements (e.g. Edge Fragmentation, Interior Forest)	a. Indices of Landscape patterns
		b. Historic reference conditions
		c. Remote sensing and GIS
Community or Ecosystem Level	A. Management Actions or Natural Disturbance Affects On Species Diversity	a. Species diversity indices
	B. Function-Role of Species in Community or Ecosystem	a. Function, Group and Guild analysis
	C. Level of Protection of Areas with High Species Richness	a. Rapid assessment
		b. Gap analysis
Species or Population Level	A. Species/Population Trends	a. Abundance indices
		b. Population estimates
	B. Affects of Management Actions or Natural Disturbance on Species-Population	a. Abundance indices
		b. Population estimates
	C. Probability of Species or Population Persistence	a. Qualitative population viability analysis
		b. Quantitative population viability analysis
Genetic Level	A. Genetic Diversity within a Population/Species	a. Morphological variation
		b. Allozyme analysis
		c. DNA Analysis
	B. Genetic Diversity among Populations	a. Morphological variation
		b. Allozyme analysis
		c. DNA Analysis
	Effects of Management Activities or Habitat Fragmentation on Species Diversity	a. Morphological variation
		b. Allozyme analysis
		c. DNA Analysi

Adapted from Gaines et al. 1999

Annex B.

Suggested List of Indicators[1]

[The list is only suggestive at this stage. The final set of Indicators is to be determined through a consultation process]

Classification Level	Suggested Indicators
In-Situ Conservation	Common
	Total area classified as "Protected Areas"
	Percentage of protected area to total area – land and water
	Size and distribution of protected areas
	Change in mean nearest distance between blocks of a particular habitat type
	Change in average width of break in an identified habitat corridor
	Contribution of forest sector to GDP
	Extent/Area of new land classified under Protected Areas
	Percentage of Conservation area under management plans
	Number of endemic/threatened/ endangered/vulnerable species by group
	Species threatened with extinction (number or percent)
	Endemic species threatened with extinction
	Endemic species in protected areas
	Threatened species in protected areas
	Number of entries/Species covered under the 'Gene' databank
	Flora
	Total forest area
	Total forest area as a percentage of total land area
	Extent/Percentage forest cover by forest type (primary, secondary or plantation)
	Extent/Percentage forest protected areas (by forest type, age, class, and successional stage)
	Extent/Percentage protected area of total forest area

1   The list does not directly resemble activities proposed under different 'Task Forces' as impacts captured in Indicators being reflected mostly in in-situ populations, overlapping of actions with those proposed by other groups and due to a number of actions directly leading only to knowledge development.

	Extent of reforested and afforested areas
	Extent allocated/used for agro-forestry
	Forest area change by forest type (primary, secondary or plantation)
	List of flora – New additions
	Diversity index of native flora
	Extent/Percent of selected indigenous forest species
	Change in land use, conversion of forest land to other land uses (deforestation rate)
	Change in area under 'chena' cultivation in high-forest areas
	Area and percentage of forest area affected by anthropogenic effects (logging, harvesting for subsistence)
	Annual volume and area of timber harvested-indigenous and plantation
	Wood harvesting intensity
	Per capita wood consumption –overall and from domestic production
	Ratio of forest area under management plans
	Number and size of forest fires
	Percentage forest managed for wood production
	Existing strategies for in situ/ex situ conservation of genetic variation within commercial, endangered, rare and threatened species of forest flora and fauna.
	Threatened tree species as a percentage of the 20 most used for commercial purposes
	Area and percentage of forest area affected by natural disasters (insect attack, disease, fire and flooding)
	Changes in the proportions of stands managed for conservation and utilization of genetic resources (gene reserves, seed collection stands, etc.)
	Extent/Number of "urban-forest" stands
	Estimate of carbon stored
	Percentage forest land managed for recreation and tourism to total forest area
	Fragmentation of forests
	Area and extent of degraded lands reclaimed through forest operations

Area and percentage of forests managed for catchment protection
Extent specified as protected corridors
Self-regenerating area as a percentage of total area
Population levels of representative species from diverse habitats monitored across their range
Fauna
List of flora - New additions
Diversity index of native fauna
Recorded species present by group
Species richness (number, number per unit area, number per habitat area)
Species with decreasing populations
Absolute and relative abundance, density, basal area, cover, of various species
Number of extinct, endangered, threatened, vulnerable and endemic forest dependent species by group (e.g. birds, mammals, vertebrates, invertebrates)
Existence of procedures for identifying endangered, rare, and threatened species
Number of threatened, keystone, flagship species
Number of forest dependent species whose populations are declining
Population growth and fluctuation trends of special interest species
Temporal change in number of species (increase/decrease)
Species with stable or increasing populations
Sex ratio, age distribution and other aspects of population structure for sensitive species, keystone species, and other special interest species
Change in number and/or distribution of keystone or indicator species
Change in habitat boundaries
Change in composition of species over time
Changes in average size of a particular habitat type
Changes in limiting factors for key species e.g. nest holes, roosting trees
Diversity in total area of a particular habitat type

Spatial differences in the number of rare vs. common species
Changes in largest block of a particular habitat type
Species risk index
Species with small populations vs. larger population size
Spatial differences in the restricted vs. wide range species
Aquatic Environment –Marine & Fresh Water
Number of endemic aquatic flora and fauna
Fish family diversity
Wetland area
Groundwater level (water table level)
Number of inland fish species introduced
Number of extinct, endangered, threatened/endangered/vulnerable/ endemic inland water species by group (e.g. birds, aquatic mammals, invertebrates, amphibians, vascular plants, bottom fauna)
Threatened freshwater fish species as a % total freshwater fish species known
Changes in fish catches by species
Population of Indicator species of fish/aquatic micro and macro-phytes
Changes in distribution and abundance of native aquatic flora and fauna
Species richness (number per unit area, number per habitat)
Stream sediment storage and load
Extent of wetland drainage and filling
Changes in vegetation type along water courses
Water resource vulnerability index
Quantity/Ratio of 'cultured' aquatic plant species traded/exported
Change in area threatened by pollution and other waste disposal
Area reserved for protection of Nesting/Breeding areas –coastal, mangrove etc.
Forest conversion affecting rare ecosystems by area
Change in area, length and numbers of biological corridors specified
Area of private lands acquired for biological corridors
Surface water quality: Nitrogen, Dissolved oxygen, pH, pesticides, heavy metals, temperature

	Ground water quality: nitrates, salinity, toxicants
	Biological Oxygen Demand (BOD) on water bodies (re: eutrophication)
	Soil/habitat quality
	Slope failure (landslides/earth slips)
	Degree of connectivity of food webs
Ex-situ Conservation	
	Number of newly extinct/endangered species
	Threatened species in ex-situ collections
	Threatened species with viable ex-situ populations
	Species group: total number versus threatened species
	Indigenous species present in ex-situ collections by group
	Extent/Number of species under 'Recovery' plans
	Stock of 'endangered' species released to and thriving in natural habitat
	Area reserved for ex-situ collections of flora and fauna from different ecological systems
	Number of acquisitions of endangered species under long-term 'preservation'
	Number of different species collections held in 'custody' by all sources
Access to Genetic Resources	
	Availability of a legal framework to trans-boundary exchange genetic resources
	Number of patents issued for biological agents developed for commercial use
	Number of detections of attempted export of unauthorized genetic material
Traditional Knowledge and Life-Styles	
	Number of plants species identified for traditional medicinal purposes
	Commercial availability of lesser-known plant food species
	Representation of traditional nomenclature in modern development projects
	Area reserved for urban forests, roosting purposes in cities
	Number of accredited practitioners of traditional medical and healing systems

Impacts on Biodiversity (Including invasive species)	
	Number of introduced species and genomes
	Number and extent of invasive species
	Non-indigenous species present by group
	Ratio between exotic species and native species in forest/nature reserve/wetland area
	Change in presence, location, area, numbers of invasive plant or animal species
	Percentage of area dominated by non-domesticated species
	Percentage of area dominated by non domesticated species occurring in patches greater than 100 km2
	Number of exotic flora and fauna species (e.g. fish, aquatic weeds)
	Area/Number of exotic invasive species eradicated
	Number of elephant deaths caused by conflicts with humans
	Number of flora/fauna species required to be relocated due to development projects
	Amount of use of agrochemicals (in proximity to protected areas)
Sustainable Use	
	Number of citations in the national registry of traditional knowledge
	Number of entries in registry of endangered animals kept in captivity
	Types of use of certain destructive harvesting practices in near-shore fishing
	Area identified/reserved for habitat restoration
	Number of species included in population restoration programs
	Quantity of firewood harvested from natural forest areas
	Tourist visits per unit area to Protected and other Sensitive areas
	Agricultural
	Ratio of land under agro-forestry/mixed cropping to total ag. area
	Ratio of land under mixed cropping or integrated farming systems by type
	Change in share of output of indigenous varieties of crops/livestock in total output
	Use of genetic material from indigenous spp. in upgrading domesticated species

	Aquatic and Fishery
	Change in proportion of fish catches by species per specific season
	Threatened fish species as a percentage of total fish species known
	Escherichia coli counts and nutrient levels as % of baseline levels
	Lake levels and salinity
	Changes in the shoreline position
	Percentage coastal zone with populations exceeding 100 inhabitants/ km2
	Change in coral growth pattern and live corals
	Annual rate of mangrove conversion
	Algae index
	Number of large scale bottom trawling vessels per 1 000 km of coastal area
	Amount of poison chemicals and dynamite used for reef fishing.
Biosafety	
	Quantity of trans-boundary movement of GMOs, LMOs and their products
	Number of microorganisms and LMOs approved for import/ exportation
	Potential incidents of accidental release of GMOs/LMOs to non-controlled areas
Economic Aspects	
	Number of research publications on environmental/biodiversity valuation
	Number of qualified biodiversity researchers
	Allocation of budgetary resources for biodiversity activities/ programs
	Number of visitors to Ecotourism parks/sites
	Revenue generated from Ecotourism/Other BD related enterprises
Institutional Aspects and Capacity Building	
	Number of staff in the public service specialized in biodiversity conservation
	Number of biodiversity-related legislation (Acts) passed in Parliament
	Number of registered Community Organizations in biodiversity

Legal and Ethical Aspects	
Education, Awareness and Training	
	Number of Diploma courses available at the Undergraduate/Graduate level
	Number of practitioners receiving hands-on training
	Number exposed to awareness courses on biodiversity
	Number of articles/media events on biodiversity conservation
	Number of internet citations pertaining to Sri Lankan BD
Research, Development and Technology Transfer and Information Management	
	Number of entries in BD research projects completed
	Amount of funds allocated annually to BD research
	Quantity/Share of renewable energy from the total national energy output
	Number/Ratio of new buildings receiving 'Green' classification
	Number of BD research grants approved
Indicators of agricultural biodiversity	
	Agricultural area by crops (cereal, oil crops, forage, woodlands)
	Change in area of agricultural land (conversion to or from agriculture)
	Agricultural area (intensively farmed, semi-intensively farmed and uncultivated)
	Intensification and extensification of agricultural land use
	Erosion/Loss of genetic diversity
	Species diversity used for food
	Replacement of landraces/indigenous crops with introduced species
	Crops/livestock grown as a percentage of number of 30 years before
	Number of vertebrate species using habitat on agricultural land by species.
	Number of species threatened by agriculture by group (e.g. birds, mammals, vascular plants, vertebrates, invertebrates)
	Accession of crops and livestock in ex-situ storage (number or percentage)
	Accessions of crops generated in the past decade (per cent)
	Differences in species diversity and abundance of arthropods and earthworms in organically and conventionally cultivated arable land
	Coefficient of kinship or parentage of crops
	Rate of change from dominance of non-domesticated species to domesticated species
	Inbreeding/outbreeding rate
	Rate of genetic interchange between populations (measured by rate of dispersal and subsequent reproduction of migrants)
	Use of agricultural chemicals – i.e. pesticides

5. References:

CBD 2003. Monitoring and Indicators: Designing national-Level Monitoring Programmes and Indicators

Gaines, William L, Harrod, Richy J, Lehmkuhl, John F. 1999. Monitoring biodiversity: Quantification and interpretation. U.S.D.A. Forest Service

Hellawel, J.M. 1991. Development of a Rationale for Monitoring in Goldsmith F.B. (ed.) Monitoring for Conservation and Ecology. 1-144 Chapman and Hall, London.

USAID, June 2002. Biodiversity Conservation Program Design and Management: A Guide for USAID Staff.

The World Bank, (OED) 1996. Lessons and Practices: Designing Project Monitoring and Evaluation

The World Bank, (GED) June 1998. Guidelines for Monitoring and Evaluation for Biodiversity Projects