STANDARDS FOR ENVIRONMENTAL QUALITY ASSESSMENT AND MONITORING

EST

26.1 INTRODUCTION

The necessity for the development of realistic standards for environmental quality assessment and monitoring was felt for a long time. Thus various standards were adopted in different countries to establish the relationships between the intensity, duration and frequency of exposure to pollution and the risk or magnitude of an undesirable effect occurring in the environment.

Each kind of standard has a limit for three distinct aspects, viz :

(a) Limit set for a pollutant taken up by an organism or a population;

(b) Limit set for pollutant present in a specific environment medium or product (food or consumer products); and

(c) Limit set for discharges or emissions from polluting sources.

26.2 ENVIRONMENTAL PROTECTION STANDARDS IN INDIA

In India the initiative for preparing standards for environmental protection was taken by the Bureau of Indian Standards (formerly Indian Standards Institution) long before legislation in this regard came into being. The work on water pollution started in the early seventies and on solid waste management in the late seventies.

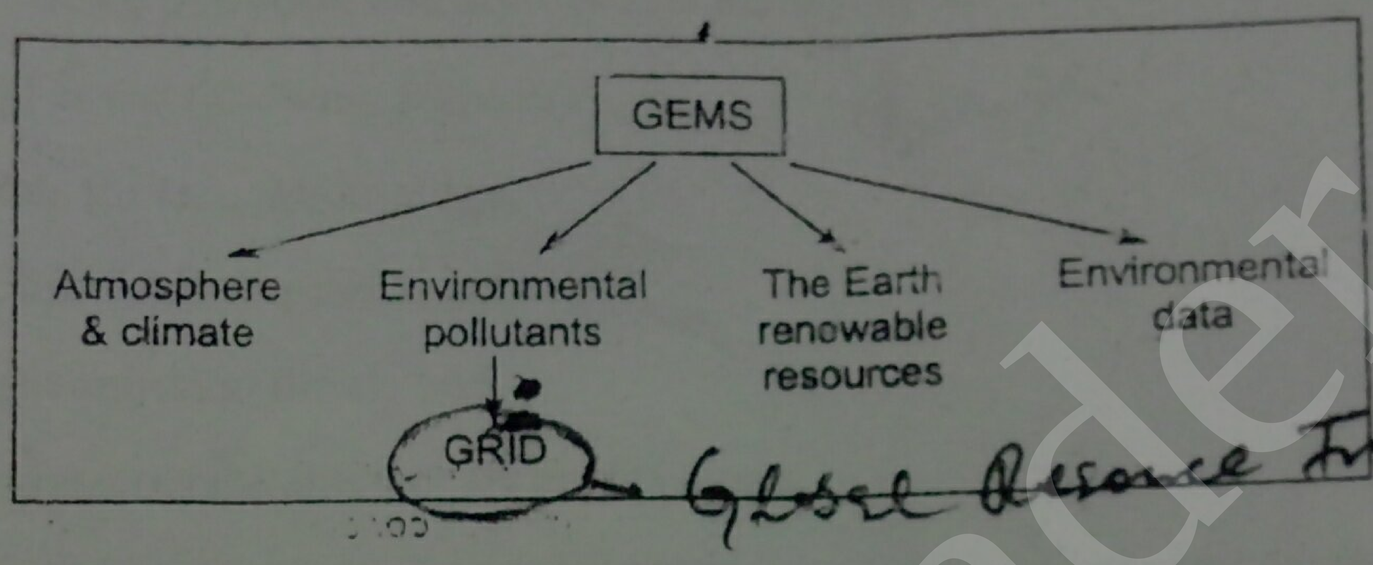
On the basis of experience the world over, it is felt that two types of standards will help in achieving the desired results. One of these falls in the category of environmental quality standards while the other can be described as discharge standards. The environmental quality standards lay down the goals for pollution programme. These are directly related to the maximum tolerance of human, plant, animal or aquatic life to a particular pollutant.

At any given point of time these limits are determined by the available data and to achieve the environmental quality, no relaxation can be allowed, whatever the technological or economic handicaps. The countries of Europe, in particular, could not have been done in the field of environmental [illegible] this regard is equally applicable in India. [illegible]

GLOBAL ENVIRONMENTAL MONITORING SYSTEM (GEMS)

GEMS is a worldwide, collective effort to monitor the global environment and make periodic assessments of the health of its constituents. Data are collected through monitoring and assessment activities covering most of the important environmental parameters. All told, 142 countries participate in at least one of these activities. The system involves the collaboration of hundreds of national and international organisations, of which the most important are the Food and Agriculture Organisation of the United Nations (FAO), the World Health Organisation (WHO), the World Meteorological Organisation (WMO), the United Nations Educational, Scientific and Cultural Organisation (UNESCO), and the International Union for the Conservation of Nature and Natural Resources (IUCN).

GEMS networks monitor changes in atmospheric composition and the climate system, freshwater and coastal pollution, air pollution, food contamination, deforestation, Ozone layer depletion, the build-up of greenhouse gases, acid rain, the extent of global ice cover and many issues related to biological diversity.



GEMS was first proposed in 1971 by the Scientific Committee on Problems of the Environment (SCOPE), later it was formally created in 1975, as a small secretariat of UNEP.

During the 1990s, GEMS took over a newer area of investigation, i.e., early warning system for environmental threats and disasters.

APPENDIX I

INDIAN STANDARDS ON ENVIRONMENTAL PROTECTION— AIR, WATER, NOISE AND SOLID WASTES MANAGEMENT

1. **AIR**

1.1 *Units and Terminology :*

IS : 4167—1980	Glossary of terms relating to air pollution
IS : 9260—1980	Guide for units used in air quality measurement

1.2 *Methods of Measurement of Pollution :*

IS : 5182	Methods of measurement of pollution
(Part 1)—1969	Dustfall
(Part 2)—1969	Sulphur dioxide
(Part 3)—1970	Radioactivity (particulate) in air
(Part 4)—1973	Suspended matter
(Part 5)—1975	Sampling of gaseous pollutants
(Part 6)—1975	Nitrogen oxide
(Part 7)—1973	Hydrogen sulphide
(Part 8)—1979	Sulphation rate
(Part 9)—1974	Oxidants
(Part 10)—1976	Carbon monoxide

The discharge standards lay down limits for the discharge of gaseous, liquid or solid wastes into the environment. The limit may vary from industry to industry and from area to area. The discharge standards are linked with the nature of industry and pollutant, type of receiving media, area in which the industry is located, techniques and economics of treatment.

The first set of standards were published as Indian Standard 2490 in 1963. These standards set the tolerance limits for industrial effluent discharged into Inland surface waters. After that two more standards —viz. IS 3306 for discharge into public sewers, and IS 3307 for discharge on Land for irrigation purposes were made. Then in 1974 the IS 2490 was revised as industry specific standards, where Part I gave general limits and Part II onwards gave limits for specific industries. In 1976, IS 7968 was made for specifying the limits for discharge into marine coastal areas. Subsequently a number of standards published in the field of water, air, noise pollution and solid waste management.

Each standard has the following features :

(a) Methods for test, terminology;

(b) Guideline for waste treatment;

(c) Effluent/emission limits; and

(d) Receiving courses/ambient air quality limits.

The details of different environmental protection standards as promulgated in India is given in the Appendix I.

There are a number of regulations and legislation promulgated from time to time to protect the environmental changes by following the prescribed regulation of different standards. The standards for sewage and effluent discharges into streams, other water bodies and land are also given. The national drinking water quality, surface water quality, ambient air quality and noise quality are shown in Appendices II to VI.

36.3 INTERNATIONAL STANDARDS

In USA, Environmental Protection Agency (EPA) has prescribed tolerance limits for liquid effluents.

In UK, there is no national standard for liquid effluents. The effluents are controlled on a case-by- case system. Each discharge from a factory is considered on its merits such as capacity of receiving waters to absorb the water and the technology of abatement and finally a consent defining, the allowed volume and the concentration of the individual components is issued by the appropriate water authority.

In Japan, Environment Agency has prescribed separate standards for surface water for the protection of human health, the preservation of the living environment (rivers, lakes and waters), and liquid effluents discharged into inland surface water.

In Finland, there are, at present, no consistent standards for the disposal of liquid effluents in Finland. Accoroing to the water law for Finland, the water courts set waste water standards for each plant separately and grant waste water permits for a fixed time. The criterion for water court permits are usually as maximum allowable concentration in waste water (mg/l) and/or maximum allowable amount per unit of time or of product (e.g. tonnes per day or per ton of production)

ANNEXURE III
Drinking Water Quality Standard (IS : 10500)

Sl. No.	Parameters and Units	Standard
1.	Colour (True) (Hazen units)	5*
2.	Taste	Agrbl*
3.	Odour	Unobj*
4.	Turbidity (NTU)	5*
5.	pH	6.5-8.5*
6.	Total Coliforms (MFN/100 mL)	0
7.	TDS_t (mg/L)	500
8.	Mineral Oil (mg/L)	0.01
9.	Total Hardness (mg/L as $CaCO_3$)	300*
10.	Alkalinity (mg/L as $CaCO_3$)	200
11.	Chlorides (mg/L as Cl)	250*
12.	Sulphates (mg/L as SO_4)	200
13.	Nitrates (mg/L as NO_3)	45
14.	Free Residual Chlorine (mg/L)	0.2*
15.	Fluorides (mg/L as F)	1
16	Calcium (mg/L as Ca)	75
17.	Copper (mg/L as Cu)	0.05
18.	Iron (mg/L as Fe)	0.3*
19.	Manganese (mg/L as Mn)	0.1
20.	Zinc (mg/L as Zn)	5
21.	Boron (mg/L as B)	1
22.	Aluminium (mg/L as AL)	0.03
23.	Arsenic (mg/L as As)	0.05
24.	Mercury (mg/L as Hg)	0.001
25.	Lead (mg/L as Pb)	0.05
26.	Cadmium (mg/L as Cd)	0.01
27.	Chromium (VI) (mg/L as Cr)	0.05
28.	Selenium (mg/L as Se)	0.01
29.	Cyanide (mg/L as CN)	0.05
30.	Phenolic Cmpds (mg/L C_6H_5OH)	0.001
31.	Anionic Detergents (mg/L MBAS)	0.2
32.	PAH (mg/L)	0
33.	Pesticides (ug/L)	0
34.	Alpha Emmitters (10^-6uc/mL)	0.0001
35.	Beta Emmitters (10^-6uc/mL)	0.001
36.	Pathogenic Organisms or Virus	0

Agrbl : Agreeable Unobj : Unobjectionable

* Essential characteristics

ANNEXURE IV

General Standards for Discharge of Effluents

Sl. No	Parameter and Unit	Into Surface Water	Into Public Sewers	Into Irrigation to Land	Into Coastal Water
1.	Temperature (Degree C)	Note 1	—	—	Note 1
2.	Odour	Note 2	—	Note 2	Note 2
3.	Colour (True) (hazen units)	Note 2	—	Note 2	Note 2
4.	pH	5.5-9.0	5.5–9.0	5.5–9.0	5.5–9.0
5.	BOD (5 days at 20°C) (mg/L)	30	350	100	100
6.	COD (mg/L)	250			250
7.	TSS (mg/L)	100	600	200	100
8.	TDS (mg/L) (inorganic)	2100	—	2100	—
9.	Oils and Grease (mg/L)	10	20	10	20
10.	Chlorides (mg/L as Cl)	1000	1000	600	—
11.	Sulphates (mg/L as SO_4)	1000	1000	1000	—
12.	Nitrates (mg/L as NO_3)	10	—	—	20
13.	Total Residual Chlorine (mg/L)	1	—	—	1
14.	Free Ammonia (mg/L as N)	5	—	—	5
15.	Ammoniacal Nitrogen (mg/L N)	50	50	—	50
16.	TKN (mg/L as N)	100	—	—	100
17.	Fluorides (gm/L as F)	2	15	—	15
18.	Sulphide (mg/L as S)	2	—	—	5
19.	Dissolved Phosphates (mg/L P)	5	—	—	—
20.	Copper (mg/L as Cu)	3	3	—	3
21.	Iron (mg/L as Fe)	3	3	—	3
22.	Manganese (mg/L as Mn)	2	2	—	2
23.	Zinc (mg/L as Zn)	5	15	—	15
24.	Nickel (mg/L as Ni)	3	3	—	5
25.	Boron (mg/L as B)	2	2	2	—
26.	Arsenic (mg/L as As)	0.2	0.2	0.2	0.2
27.	Mercury (mg/L as Hg)	0.01	0.01	0.01	0.01
28.	Lead (mg/L as Pb)	0.1	1	—	1
29.	Cadmium (mg/L as Cd)	2	1	—	2
30.	Chromium (VI) (mg/L as Cr)	0.1	2	—	1
31.	Chromium (Total) (mg/L as Cr)	2	2	—	2
32.	Selenium (mg/L as Se)	0.05	0.05	—	0.05
33.	Vanadium (mg/L as V)	0.2	0.2	—	0.2
34.	Cyanide (mg/L as CN)	0.2	2	0.2	0.2
35.	Phenolic Compds (mg/L C_6H_5OH)	1	5	—	5
36.	Pesticides (ug/L) [Note4]	10	10	—	10
37.	Alpha Emmitters (uc/mL)	10^{-7}	10^{-7}	10^{-6}	10^{-7}

Contd

38.	Beta Emmitters (uc/mL)	10^—6	10^—6	10^--7	10^—6
39.	Percent Sodium (%)	—	60	60	—
40.	Resdl Sodium Carbonate (mg/L)	—	—	5	—
41.	Bio-assay (% 96-hrs Survival)	Note 3	Note 3	Note 3	Note 3
42.	SS Particle size (pass IS Sieve)	850	—	—	Note 5

Note 1 : Shall not exceed 5.0 above the receiving water temperature.

Note 2 : All efforts should be made to remove colour and unpleasant odour as far as practicable.

Note 3 : 90% survival of fish after 96 hours in 100% effluents.

Note 4 : Applicable to DDT. Endosulfan, Carbaryl, Malathion, Phenthoate, Methyl parathion, Phenitrothion, Phorate, Pyrethrum and Benzene hexachloride.

Note 5 : (a) Floatable solids : 3 mm. (b) Settleable solids : 850 micron.

* For cooling water effluents 10% above TSS of influent.

ISO 14000 addresses various aspects of Envt mgt. It provides practicals tools for companies and organisat looking to identify the control their envtr impact and constantly improve envtl. perfo

ANNEXURE V
National Ambient Air Quality Standards
NOTIFICATION
Delhi, the 11th April 1994

S.O. 384 (E). — The Central Pollution Control Board in exercise of its powers conferred under Section 16(2) (h) of the Air (Prevention and Control of Pollution) Act, 1981 (14 of 1981) hereby notify the National Ambient Air Quality Standards with immediate effect.

SCHEDULE 1

Pollutant	Time Weighted average	Concentration in ambient air			Method of measurement
		Industrial Area	Residential Rural & other areas	Sensitive Area	
1	2	3	4	5	6
Sulphur Dioxide (SO_2)	Annual Average*	80 µg/m³	60 µg/m³	15 µg/m³	1.Improved West and Gaeke method
	24 hours**	120 µg/m³	80 µg/m³	30 µg/m³	2.Ultraviolet fluorescence
Oxides of Nitrogen as NO_2	Annual Average*	80 µg/m³	60 µg/m³	15 µg/m³	1.Jacob & Hochheiser modified (Na-Arsenite) Method
	24 hours**	120 µg/m³	80 µg/m³	30 µg/m³	2.Gas Phase Chemiluminescence
Suspended Particulate Matter (SPM)	Annual Average*	360 µg/m³	140 µg/m³	70 µg/m³	(Average flow rate not less than 1.1 m³/minute)
	24 hours**	500 µg/m³	200 µg/m³	100 µg/m³	
Respirable Particulate matter (size less than 10 µm) (RPM)	Annual Average*	120 µg/m³	60 µg/m³	50 µg/m³	
	24 hours**	150 µg/m³	100 µg/m³	75 µg/m³	

ish. It indicates Envt friendly products have been estd under discussion by ISO. (International Organisation of

Contd.

(Pb)	Annual Average*	1.0 µg/m³	0.75 µg/m³	0.50 µg/m³	AAS Method after sampling using EPM 2000 or equivalent filter paper
	24 Hours**	1.5 µg/m³	1.00 µg/m³	0.75 µg/m³	
...ide (CO)	8 hours**	5.0 mg/m³	2.0 mg/m³	1.0 mg/m³	Non-dispersive infrared spectroscopy
	1 hour	10.0 mg/m³	4.0 mg/m³	2.0 mg/m³	

...metic mean of minimum 104 measurements in a year taken twice a week 24 hourly at uniform interval.

...hourly values should be met 98% of the time in a year. However, 2% of the time, it may exceed but not ...cutive days.

ANNEXURE VI

[1]SCHEDULE III
(See Rule 3)
AMBIENT STANDARDS IN RESPECT OF NOTICE

Category of Area	Limits in dB(A) Leq	
	Day Time	Night Time
Industrial area	75	70
Commercial area	65	55
Residential area	55	45
Silence Zone	50	40

Day time is reckoned in between 6 a.m. and 9 p.m.

Night time is reckoned in between 9 p.m. and 6 a.m.

Silence zone is defined as areas up to 100 meters around such premises as hospitals, educational institutions and courts. The silence zones are to be declared by the Competent Authority.

...se of vehicular horns, loudspeakers and bursting of crackers shall be banned in these zones.

Mixed categories of areas should be declared as one of the four above-mentioned categories by the Competent Authority and the corresponding standards shall apply.

...le III inserted vide G.S.R. 1063(E) dt. 26-12-89, published in the Gazette No. 643 dt. 26-12-89.

...NMENTAL QUALITY MONITORING : ISO-14000

...tional Standard Organisation (ISO) and International Electro-technical Commission (IEC) Strategic Advisory Group on the Environment (SAGE) in 1991. This Committee, at their ... in July 1993, agreed to set up a number of subcommittees (SCs) to deal with :

1 — Environment management system;

2 — Environmental auditing;

3 — Environmental labelling;

4 — Environmental performance evaluation;

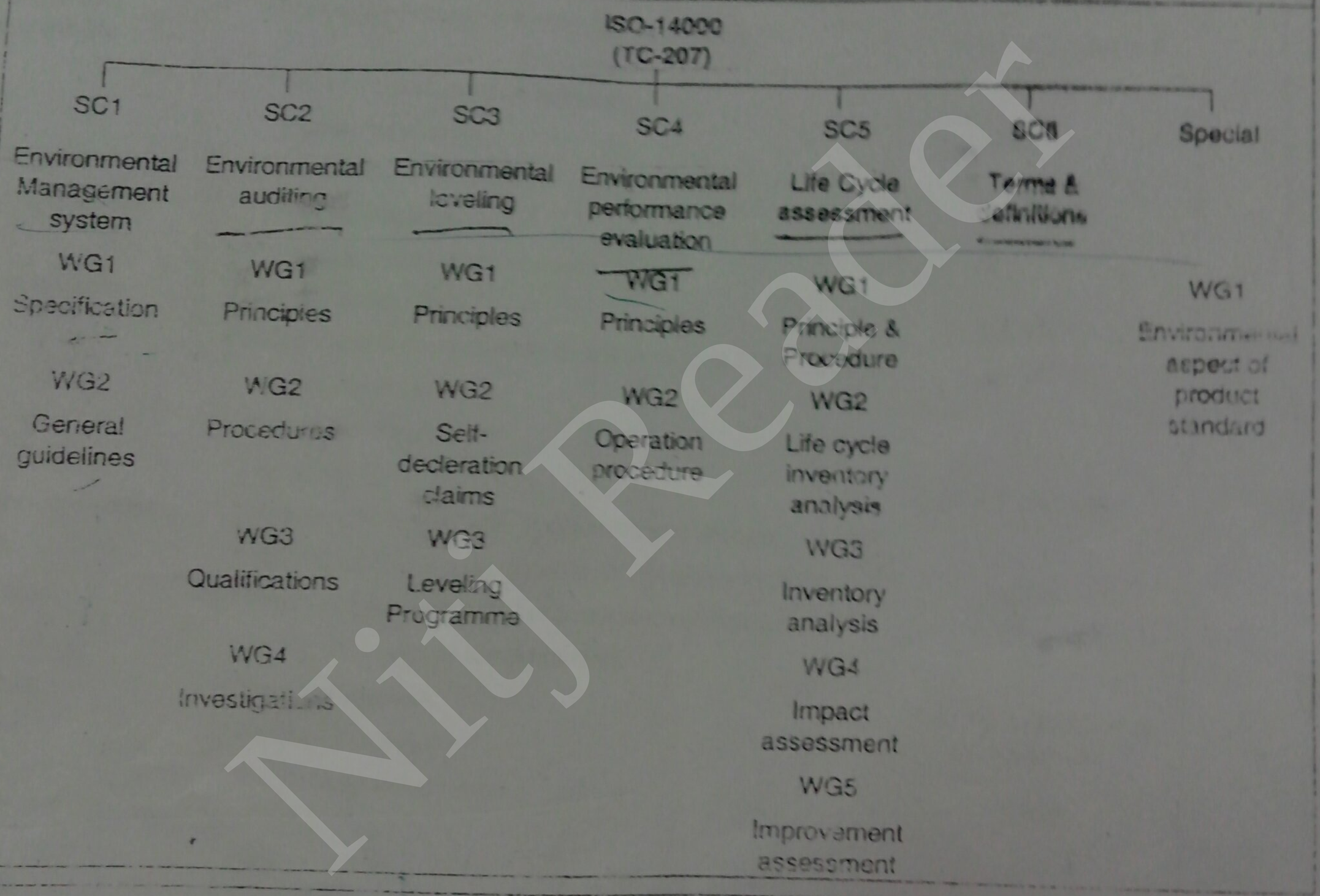
... Life cycle analysis, and

... Term and definitions.

Each of the subcommittee further set up working groups (WGs) for appropriate functioning. The details are given in the Table 36.1. The ISO-14000 have five basic principles :

- Should focus on what needs to be done;
- Should formulate a plan to fulfil its environmental policy;
- Should develop the capabilities and support mechanisms necessary to achieve its environmental policy;
- Should measure, monitor and evaluate its environmental performance;
- Should review and continually improve its environmental management systems.

Table 36.1 : Structure of ISO-14000 systems



Key Elements of ISO 14001; Comparson With BS : 7750 (1994)

Element of ISO 14001	Brief Details	Correspondence with BS : 7750
1 Policy	* Documented * Communicated * Publicly available * Commitment to continual improvement	4.2 Requires PER
4.1 Evaluation of environmental aspects	* Identify significant aspects	4.4.2
2 Legal/Other requirements	* Identify and track applicable laws, regulations and policies	

Key Elements of ISO 14001; Comparson With BS : 7750 (1994)

Element of ISO 14001	Brief Details	Correspondence with BS : 7750
Objectives and targets.	* Set at all relevant levels * Compliance with regulations * Consistent with policy	4.5
Environmental Management Programme	* Achieve objectives and targets * Designated responsibilities * Apply to new products/developments	4.6
tructure and esponsibility	* Define and document roles responsibilities * Appoint management representative(s) * Provide resources	4.3.1, 4.3.2 & 4.3.3
aining awareness d competence	* Identify training needs * Provide training, * Cover key specified elements	4.3.4
mmunication	* Procedures for : receipt and documentation of and response to inquiries internal communication external communication	4.3.4 & 4.4.1
5 and 4.4.3	* Describe EMS	4.7 and 4.9
ation and records	* Procedures to maintain documents and records	
trol	* Identify functions associated with significant impacts	4.3.2
edures	* Plan functions (including procedures, operating limit) * Address procurement/contracting.	
gency onse	* Evaluate hazards * Prepare procedures	Require evaluation of accidents etc.
oring & urement	* Monitor key procedures * Record results	4.8.3
ctive Action	* Define responsibility and authority to initiate corrective action. * Change procedures as needed	4.8.4
udits	* Verify conformance with standard * Consider system implementation and effectiveness	4.10.3
nent Review	* Periodic review of policy, objectives, targets, programmes	4.11

4000—IMPACT ON DEVELOPING COUNTRIES

he Earth Summit in Rio de Janeiro in 1992, the Business Council for Sustainable Development hasized that "business and industry needs tools to help measure environmental performance p powerful environmental management techniques". ISO was specifically requested to step s in the environmental field in response to such needs. The organisation set up its

37 ENVIRONMENTAL IMPACT ASSESSMENT

37.1 CONCEPT

Environmental Impact Assessment (EIA) means a formalised procedure for examination, analysis and assessment of planned activities with a view to ensuring environmentally sound and sustainable development. The principal goals of EIA practices are :

- To establish that before decisions are taken by the competent authority to undertake some project, the environmental effects of those activities should be taken fully into accounts.
- To promote the implementation of appropriate procedures in all countries consistent with national laws and decision-making processes.
- To encourage the development of reciprocal procedures for information exchange, notification and consultation between states when proposed activities are likely to have significant transboundary effects on the environment of those states.

37.2 PROCESS

There are nine major stages of EIA process (Screening, Preliminary assessment, Organisation, Scoring, Identification, Prediction, Evaluation, Mitigation and Documentation in the forms of Environmental Impact Statement (EIS).

In the process of environmental impact statement (EIS) preparation, there are four areas which need to be reviewed properly. These are :

1. Description of the development, the local environment and the baseline conditions.
2. Identification and evaluation of key impacts.
3. Formulation of alternatives and mitigatory measures.
4. Impact interpretation and communication of results.

The purpose(s) of the development should be described as should the physical characteristics, scale and design. Quantities of materials needed during construction and operation should be included and where appropriate, a description of the production processes. In addition, the site land requirements of the development should be described and the duration of each land use. As and where practicable, specific mitigation measures should be put forward. Mitigation methods considered should include modification of the project, compensation and provision of alternative facilities as well as pollution control. Clear details of how the mitigation measures will be implemented and function over the time span for which they are necessary should be described in depth.

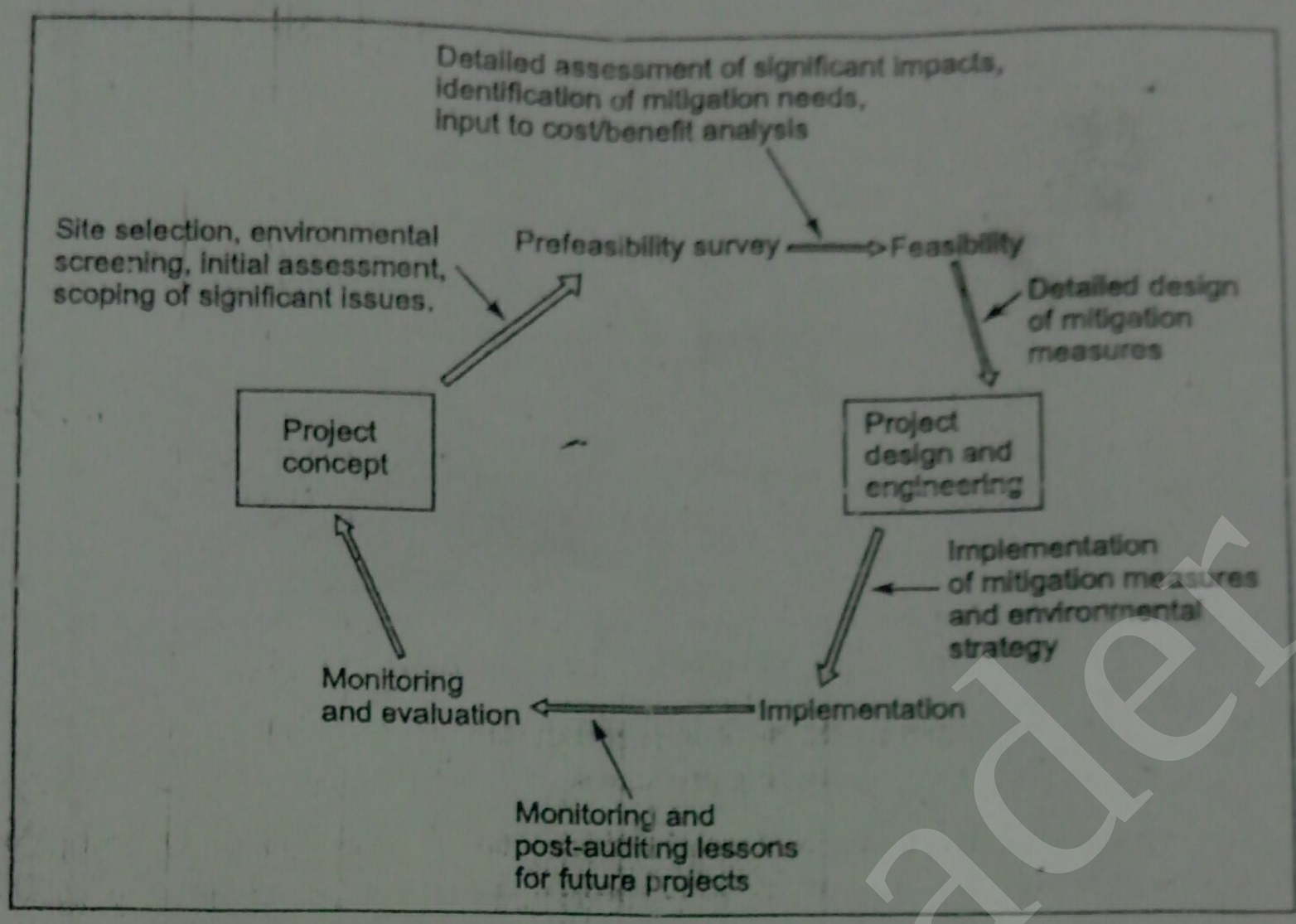


Fig. 37.1 : A generalised scheme for project evaluation monitoring

Each EIS should have an executive summary. The summary should be comprehensive, containing, at least, a brief description of the project and the environment. an account of the main mitigation measures to be undertaken by the developer and a description of any remaining or residual impacts. A brief explanation of the methods by which these data were obtained and an indication of the confidence which can be placed in them, should also be included.

In every project formulation, EIA preparation is one of the mandetory aspects as it forms an integral part of the project cycle (Fig. 37.1). On the whole the purpose of EIA is to give the environment its due weightege the decision making process by clearly evaluate the environmental consequances of a proposed activity. A simplified checklist for the procedure of EIA is given in Fig. 37.2.

37.3 EVALUATION METHODOLOGY

Different methods currently used for EIA evaluation are summerised below with respect to their criteria suitability in Table 37.1.

Among these. four methods are often used for their various criteria suitability. A detailed account of criteria suitability is given in Table 37.2.

From the Table 37.2, it appears that for most of the project's impact evaluation matrix system is most suitable. Quite considerable number of matrix system application were known in recent years. Among these, Leopold and Lohani and Thanh's procedure is often applicable in most cases. A case study example of a model dam project impact evaluation is given in the Table 37.3.

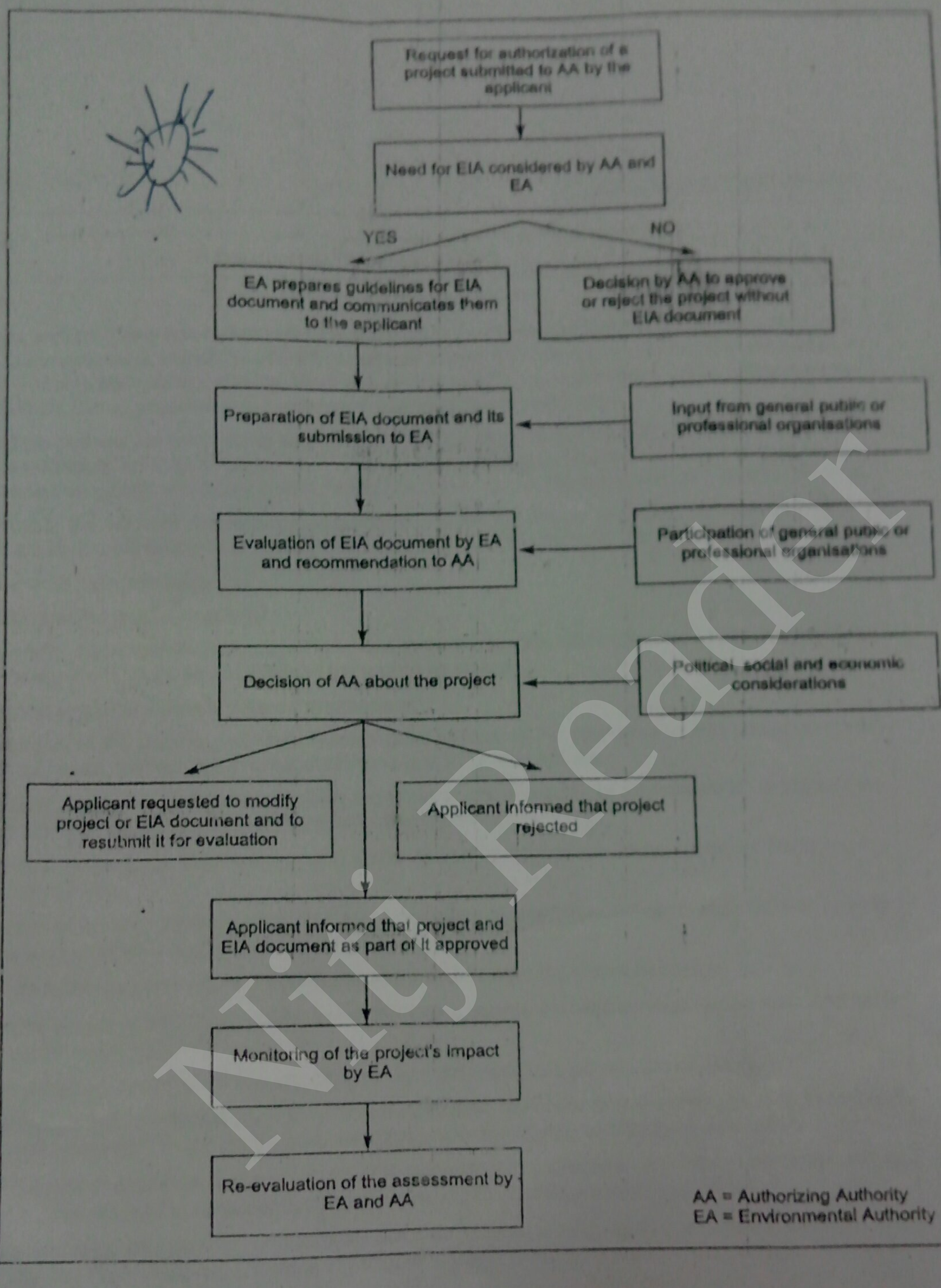


Fig. 37.2 : Simplified flow chat of the EA procedure
(Source : UNEP. An approach the environmental impact assessment for projects effecting the coast and marine environment, Nairobi, Kenya, 1990 p. 10)

UN Environment Program (UNEP)

Principles of EIA

1. States (countries, including their competent authorities) should not undertake or authorise activities without prior consideration, at an early stage, of their environmental effects. Where the extent, nature or location of a proposed activity is such that it is likely to significantly affect the environment, a comprehensive environmental impact assessment (EIA) should be undertaken in accordance with the following principles.
2. The criteria and procedures for determining whether an activity is likely to significantly affect the environment and is therefore subject to an EIA should be defined clearly by legislation, regulation, or other means, so that subject activities can be quickly and surely identified and EIA can be applied to the activity as it is being planned.
3. In the EIA process, the relevant significant environmental issues should be identified and studied. Where appropriate, all efforts should be made to identify these issues at an early stage in the process.
4. An EIA should include, at a minimum :
   (a) A description of the proposed activity;
   (b) A description of the potentially affected environment, including specific information necessary for identifying and assessing the environmental effects of the proposed activity;
   (c) A description of practical alternatives, as appropriate;
   (d) An assessment of the likely or potential environmental impacts of the proposed activity and alternatives, including the direct, indirect, cumulative, short-term and long-term effects;
   (e) An identification and description of measures available to mitigate adverse environmental impacts of the proposed activity and alternatives and an assessment of those measures;
   (f) An indication of the gaps in knowledge and uncertainties which may be encountered in compiling the required information;
   (g) An indication of whether the environment of any other State or areas beyond national jurisdiction is likely to be affected by the proposed activity or alternatives;
   (h) A brief, non-technical summary of the information provided under the above headings.
5. The environmental effects in an EIA should be assessed with a degree of detail commensurate with their likely environmental significance.
6. The information provided as part of an EIA should be examined impartially prior to the decision.
7. Before a decision is made on an activity, government agencies, members of the public, experts in relevant disciplines and interested groups should be allowed appropriate opportunity to comment on the EIA.
8. A decision as to whether a proposed activity should be authorised or undertaken should not be taken until an appropriate period has elapsed to consider comments pursuant to principles seven and twelve.
9. The decision on any proposed activity subject to an EIA should be in writing, state the reasons therefore and include the provisions, if any, to prevent, reduce or mitigate damage to the environment. This decision should be made available to interested persons and groups.
10. Where it is justified, following a decision on an activity which has been subject to an EIA, the activity and its effects on the environment or the provisions (pursuant to principle nine) of the decision on this activity should be subject to appropriate supervision.
11. States should endeavour to conclude bilateral, regional or multilateral arrangements, as appropriate, so as to provide, on the basis of reciprocity, notification, exchange of information and agreed-upon consultation on the potential environmental effects of activities under their control or jurisdiction which are likely to significantly affect other States or areas beyond national jurisdiction.
12. When information provided as part of an EIA indicates that the environment within another State is likely to be significantly affected by a proposed activity, the State in which the activity is being planned should, to the extent possible :
   (a) Notify the potentially affected State of the proposed activity;
   (b) Transmit to the potentially affected State any relevant information from the EIA, the transmission of which is not prohibited by national laws or regulations.

Table 37.1 : Currently used impact evaluation methods

Types	Detailed methodologies
I Ad hoc	These methodologies provide minimal guidance for impact assessment beyond suggesting broad areas of possible impacts (e.g., impacts upon flora and fauna, lakes and forests), rather than defining the specific parameters within the impact area which should be investigated.
II Simple check-lists	These methodologies present a specific lists of environmental parameters to be investigated for possible impacts, or a list of agency activities known to have caused environmental concern. They may have considerable value when many repetitive actions are carried out under similar circumstances. They do not, in themselves, establish a direct cause-effect link, but merely suggest lines of examination.
III Overlays	These methodologies rely upon a set of maps of project area's environmental characteristics (physical, social, ecological, aesthetic). These maps are overlaid to produce a composite characterisation of the regional environment. Impacts are identified by noting the congruence of inherently antagonistic environmental characteristics within the project boundaries. The Geographic Information System (GIS), ie modern development of this method.
IV Matrices	The matrix methodologies incorporate both a list of project activities and a checklist of potentially impacted environmental characteristics. In a way, the matrix presents both alternatives from the check-list approach (i.e., both attributes and activities) to be considered simultaneously. The two lists are then related in a matrix which identifies cause and effect relationships between specific activities and impacts. Matrix methodologies may either specify which actions impact which environmental characteristics or may simply list the range of possible actions and characteristics in an open matrix to be completed by the analyst.
V Networks	These methodologies work from a list of project activities to establish cause condition-effect relationships. They are an attempt to recognise that a series of impacts may be triggered by a project action. Their approaches generally define a set of possible networks and allow the user to identify impacts by selecting and tracing out the appropriate project actions.
VI Combination computer-aided	These methodologies use a combination of matrices, networks, analytical models and a computer-aided systematic approach : — Identify activities associated with implementing major federal programs; — Identify potential environmental impacts at different user levels; — Provide guidance for abatement and mitigation techniques; — Provide analytical models to establish cause-effect relationships to quantitatively determine potential environmental impacts; — Provide a methodology and a procedure to utilise this comprehensive information in responding to requirements of EIS preparation.

The Role of EIA in Society

1. Provides a procedure for the full consideration of the possible adverse environmental impacts of policies, programs, activities and projects before any decision to proceed; it precludes 'behind-closed doors' decision-making in the public and private sectors;

2. There is opportunity to present recommendations to the decision-maker on the suitability of the policy, program (groups of projects, either sequential or concurrent), activity, or project, to proceed or not, on environmental grounds;

3. For proposals which proceed, there is the opportunity to present the incorporation of conditions of consent that should mitigate some of the adverse environmental effects;

4. It is an avenue for the public to contribute to the decision-making process, through written and oral contributions to the decision-maker(s)' appearances at public inquiries and hearings and possible participation in mediation processes;

5. The whole process of development is open to scrutiny for the benefit of all the key players : proponent (applicant), government and public, resulting in better projects more carefully thought-out;

6. Basically unsatisfactory projects (including otherwise satisfactory projects on the wrong site) tend to weed themselves out before advancing far into the EIA process and certainly before reaching a public enquiry stage;

7. Conditions of approval may ensure monitoring, annual reporting by the proponent, post-project analyses (PPA) and independent auditing;

8. Alternative approaches, mixes of technology, and sites, can be thoroughly examined;

9. EIA is seen, however, as the servant of development : promoting better developments, at best, but basically supporting economic growth;

10. The process endorses waste discharges, the emission of greenhouse gases in many cases and the profligate use, mining, extraction, and processing of natural resources;

11. The whole process as a creature of government, is subject to political pressures; key players within government have no security of employment whatever;

12. Officers of integrity have little chance when confronted by a combination of hostile interests at a political level;

13. On the other hand, a vigilant public, skilled objectors and organisations with a range of legal rights to object, access to the courts, and a supportive media with some political sympathy, can exercise countervailing power and influence.

PROCESS

There are two 'tiers' of assessment which should be applied to the project before proceeding with a full scale EIA. Screening and preliminary assessment. Where these first tiers of assessment are a regulatory requirement, the developer normally does the work and submits the results to the regulatory agency. The agency may then decide that either there is nothing to be concerned about or the evaluation should proceed to the next tier.

The most important step in the process of obtaining environmental clearance under the EIA notification is for the project proponent to conduct an environmental impact assessment of the project. For this purpose the project proponent engages an environmental consultant to prepare an EIA report. The EIA report must be prepared by incorporation of data during all the four seasons of the year. Such an EIA is termed a "**comprehensive EIA**". How ever, there is provision for a single season collection of data, but this should not be done during the monsoon season. Such an EIA reports is termed a "**Rapid EIA**". There are two tiers of assessment which should be applied to the project before proceeding with a full scale EIA – Screening and Preliminary Assessment. Wherever these first tiers of assessment are a regulatory requirement, the developer normally does the work and submits the results to the regulatory agency. The agency may then decide whether there is anything to be concerned about or whether the evaluation should proceed to the next tier.

BEFORE STARTING THE EIA

SCREENING: The screening is the first and simplest tier in project evaluation. Screening helps to clear those types of projects, which from past experience are not likely to cause significant environmental problems. The activity may take one of the following several forms:

1- Measurements using simple criteria such as size or location.
2- Comparing the proposal with list of projects rarely needing an EIA (e.g. schools) or definitely needing one (e.g. coal mines).
3- Estimating general impacts (e.g. increased in infrastructure needed) and comparing these impacts against set thresholds.
4- Doing complex analyses, but using readily available data.

Draw back in the Indian system:

1- Even though some of the industrial set ups do not require EIA as per the statutory norms, they might involve certain technological processes which could be harmful to the environment, as a result of which such enlisted industries could have potential impacts on the environment and on public health.
2- Exempting industries from the EIA requirements based on the investment value of specific projects is not acceptable. There are no specific studies conducted till now which demonstrate that environmental impacts are always inconsequential for projects under a given value. It is a well established fact that the small scale industries are contributing more pollution with respect to the major industry.

PRELIMINARY ASSESSMENT: If screening does not clear a project, the developer may be required to undertake a preliminary Assessment. This involves sufficient research, review of available data and expert advice in order to **identify the key impacts** of the project on the local environment, **predict the extent of the impacts** and briefly **evaluate their importance** to decision makers. The preliminary assessment can be used to assist early project planning (for instance, to narrow the discussion of possible sites) and it can serve as an early warning to the serious environmental problems that the project may cause. It is in the developer's interest to do a preliminary assessment since, in practice, this step can clear projects of the need for a full EIA.

FORMATION OF AN EIA TEAM: If after reviewing a preliminary assessment the competent authority deems that a full EIA is needed, the next step for the project developer is the preparation of the EIA report. This entails

1- Commissioning and briefing an independent co-coordinator and expert study team.
2- Identifying the key decision makers who will plan, finance, permit and control the proposed project, so as to characterize the audience for the EIA.
3- Researching laws and regulations that will affect these decisions.
4- Making contact with each of various decision makers.
5- Determining how and when the EIAs finding will be communicated.

Draw back in the Indian system:

It is being found that the team formed for conducting EIA studies is lacking the expertise in various fields such as Anthropologists and Social Scientists (to study the social impact of the project) or even wild life experts.

SCOPING: The first task of the EIA study team is scoping the EIA. The aim of scoping is to ensure that the study address all the issues of importance to the decision makers. First of all the team's outlook is broadened by the discussions (with the project proponents , decision makers, the regulatory agency, scientific institutions , local community representative and others) to include all the possible issues and concerns raises by various groups. Then the study team selects primary impacts for the EIA to focus upon depending on the basis of magnitude, geographical extent, significance to decision makers or because the area is special locally (e.g. soil erosion, the presence of an endangered species, or a near by historical sites) or is an eco-sensitive area.

Draw back in the Indian system:

1- There is a lack of exhaustive ecological and socio-economic indicators for impact assessment.
2- Public comments are not taken into account at the early stage, which often leads to conflict at the later stage of project clearance.

All prediction techniques by their nature involve some degree of uncertainty. So along with each attempt to quantify an impact, the study team should also quantify the predictions uncertainty in terms of probabilities or margins of error.

Draw back in the Indian system:

1- The detail method used for the prediction and evaluation of the project is not mentioned in the report. Limited explanations are given both to quantitative estimation of magnitude of impact and to the assumptions and judgments used in the evaluation of impacts.
2- The limited coverage of scoping is confined mainly to direct impacts.

EVALUATION: The third question addressed by the EIA – do the changes matter is answered in the next step. Evaluation is so called because it evaluates the predicated adverse impacts to determine whether they are significant enough to warrant mitigation. Thus judgment of significance can be based on one or more of the followings.

1- Comparison with laws, regulations or accepted standards.
2- Consultation with the relevant decision makers.
3- Reference to pre set criteria such as protected sites features of species.
4- Acceptability to the local community or the general public.

MITIGATION: In this phase the study team formally analyses mitigation. A wide range of measures are proposed to prevent, reduce, remedy or compensate for each of the adverse impacts evaluated as significant. Possible mitigation measures include:

1- Changing project sites, routes, processes, raw materials, operating methods, disposal methods, disposal routes or locations, timing or engineering designs.
2- Introducing pollution controls, waste treatment monitoring, phased implementation, landscaping, personal training, special social services or public education.
3- Offering (as compensation) restoration of damaged resources, money to affected persons , concessions on other issues, or off site programmes to enhance some other aspects of the environment or quality of life for the community.

All mitigation measures cost something and this cost must be quantified too. These various measures are then compared, trade-offs between alternative measures are weighed, and the EIA study team proposes one or more action plans, usually combining a number of measures. The action plan may include technical control measures, an integrated management scheme (for a major project) monitoring, contingency plans, operating practices, project scheduling, or even joint management (with affected groups). The study team should explicitly analyze the implications of adopting different alternatives, to help make the choices clearer for the decision makers.

MAIN EIA: After "scoping" the main EIA begins. The EIA attempts to answer five questions basically:

1- What will happen as a result of the project?
2- What will be the extent of the changes?
3- Do the changes matter?
4- What can be done about them?
5- How can decision makers be informed of what needs to be done?

The EIA becomes a cyclic process of asking and further asking the first four questions until decision makers can be offered workable solutions.

IDENTIFICATION: Identification means the answer to the first question, i.e. "what will happen as result of the project?" If a preliminary assessment has been done it will have broadly reviewed the projects effect, also scoping will have focused the study on the most important issues for decision makers. Taking these findings in to account the full EIA study now formally identifies those impacts which should be assessed in detail. This identification phase of the study may use these or other methods

1- Compile a list of key impacts (e.g. changes in air quality, noise levels, wild life habitats, species diversity, landscape views, social and cultural systems, settlement patterns and employment levels from other EIA s for similar projects)
2- Name all the projects sources of impacts (e.g. smoke emissions, water consumption, construction jobs) using checklists of questionnaires, then list possible receptors in the environment (e.g. crops, communities using same water for drinking, migrant of labour) by surveying the existing environment and consulting with interested parties.
3- Identify impacts themselves through the use of checklist, matrices, networks, overlays, models and simulations.

Draw back in the Indian system:

1- There is always a lack of reliable data sources.
2- The secondary data is also not reliable.
3- The data collectors do not pay respect to the indigenous knowledge of local people.
4- The credibility of the primary data collected by the data collectors is doubtful.

PREDICTION: The next step called predictions answers the EIA's second question: "what will be the extent of the changes". As far as is practicable, prediction scientifically characterizes the impacts causes and effects and its secondary and synergetic consequences for the environment and the local community. Prediction follows an impact within a single environmental parameter (e.g. toxic liquid effluents) in to its subsequent effects in many disciplines (e.g. reduced water quality, adverse impacts on fisheries, economic effects on fishing villages, and resulting socio-cultural changes). Prediction draws on physical, biological, socioeconomic and anthropological data techniques .In quantifying impacts, it may employ mathematical models, physical models, socio cultural models, economic models, experiments or expert judgments.

Several analytical techniques are available for this purpose as given below:

1- Cost benefit analysis in which all quantifiable factors are converted to monetary values , and actions are assessed for their effect on project costs and benefits
2- Explaining what course of action would follow from various broad 'value judgments'(e.g. that social impacts are more important than resources)
3- A simple matrix of environmental parameters versus mitigation measures, contain brief description of the effects of each measure.
4- Pair wise comparisons, whereby the effects of an action are briefly compared with the effects of each of the alternative actions are briefly compared with the effects of each of the alternative actions, one pair at a time.

Draw back in the Indian system:

1- Details regarding the effectiveness and implementation of mitigation measures are often not provided.
2- Often, and more so for strategic industries such as nuclear energy projected, the EMP s are kept confidential for political and administrative reasons
3- Emergency preparedness plans are not discussed in sufficient details and the information not disseminated to the communities.

<u>DOCUMENTATION:</u> The last step in the EIA process, which answers the question – how decision makers be informed of what needs to be done? In documenting an EIA, this means identifying the key decisions makers, perceiving the question they will be asking and providing them with straight forward answers formatted for easy interpretation in relation to their decision making (e.g. tables, graphs, summary, points). Successful EIA documentation is more readily produced if the audience and their needs are established at the start of the EIA, and then made to affect how the research is focused and reported. It is the job of the study team's communications expert to make this happen. An EIA report should contains:

1- An executive summary of the EIA findings.
2- A description of the proposed development projects.
3- The major environmental and natural resource issues that needed clarification and elaboration.
4- The projects impacts on the environment (in comparison with a base line were identified and predicated.).
5- A discussion of options for mitigating adverse impacts and for shaping the project to suit its proposed environment, and an analysis of the trade offs involved in choosing between alternative actions.
6- An over view of gaps or uncertainties in the information.
7- A summary of the EIA for the general public.