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**ENVIRONMENTAL IMPACT ASSESSMENT & MANAGEMENT**

**(15A01804)**

**LECTURE NOTES**

**IV - B.TECH & II- SEM**

**Prepared by:**

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**Department of Civil Engineering**

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| **Course Code** | | **ENVIRONMENTAL IMPACT ASSESSMENT & MANAGEMENT** | **L** | **T** | **P** | **C** |
| **15A01804** | | **3** | **0** | **0** | **3** |
| **Pre-requisite** | | **ENVIRONMENTAL ENGINEERING** | **Semester** | | | **III** |
| **Course Outcomes (CO):** After completion of the course, the student can able to | | | | | | |
| **CO-1:**Perform a critical quality review of an EIA and EIS; | | | | | | |
| **CO-2:**Structure the EIA working process considering the need for interdisciplinarily. | | | | | | |
| **CO-3:**Perform the screening and scoping of an EIA, based on existing requirements, evaluate the impacts and draw meaningful conclusions from the results of the EIA | | | | | | |
| **CO-4:**Clarify the concept of EIA and its application in an international context to those involved in or affected by the EIA process | | | | | | |
| **CO-5:**Interpretate an EIA, present its conclusions and translate its conclusions into actions. | | | | | | |
| **Unit – I:** | **INTRODUCTION** | | | | | |
| Basic concept of EIA : Initial environmental Examination, Elements of EIA, - factors affecting E-I-A Impact evaluation and analysis, preparation of Environmental Base map, Classification of environmental parameters | | | | | | |
| **Unit – II:** | **EIA METHODOLOGIES** | | | | | |
| E I A Methodologies: introduction, Criteria for the selection of EIA Methodology, E I A methods, Ad-hoc methods, matrix methods, Network method Environmental Media Quality Index method, overlay methods and cost/benefit Analysis | | | | | | |
| **Unit – II:** | **IMPACT OF DEVELOPMENTAL ACTIVITIES AND LAND USE** | | | | | |
| Introduction and Methodology for the assessment of soil and ground water, Delineation of study area, Identification of actives. Procurement of relevant soil quality, Impact prediction, Assessment of Impact significance, Identification and Incorporation of mitigation measures. E I A in surface water, Air and Biological environment: Methodology for the assessment of Impacts on surface water environment, Air pollution sources, Generalized approach for assessment of Air pollution Impact | | | | | | |
| **Unit – IV:** | **ASSEMENT OF IMPACT ON VEGETATION AND WILDLIFE** | | | | | |
| Introduction - Assessment of Impact of development Activities on Vegetation and wildlife, environmental Impact of Deforestation – Causes and effects of deforestation.  **ENVIRONEMNTAL AUDIT :**  Introduction - Environmental Audit & Environmental legislation objectives of Environmental Audit, Types of environmental Audit, Audit protocel, stages of Environmental Audit, onsite activities, evaluation of Audit data and preparation of Audit report. | | | | | | |
| **Unit – V:** | **ENVIRONEMENTAL ACTS (PROTECTION AND PREVENTION** | | | | | |
| Post Audit activities, The Environmental protection Act, The water preventation Act, The Air (Prevention & Control of pollution Act.), Wild life Act.Case studies and preparation of Environmental Impact assessment statement for various Industries. | | | | | | |
| **Textbooks:** | | | | | | |
| 1.A.V. Oppenheim, A.S. Willsky and S.H. Nawab, “Signals and Systems”, 2nd Edition, PHI, 2009.  2. Simon Haykin and Van Veen, “Signals & Systems”, 2nd Edition, Wiley, 2005. | | | | | | |
| **Reference Books:** | | | | | | |
| 1. BP Lathi, “Principles of Linear Systems and Signals”, 2nd Edition, Oxford University Press, 015.  2. Matthew Sadiku and Warsame H. Ali, “Signals and Systems A primer with MATLAB”, CRC Press, 2016.  3. Hwei Hsu, “Schaum's Outline of Signals and Systems”, 4thEdition, TMH, 2019 | | | | | | |

**UNIT-I: INTRODUCTION**

**Descriptionofthetechnique**

Environmental Impact Assessment (EIA) is a process by which the likely significant effects of aproject or development on the environment are identified, assessed andthen taken into accountbythecompetentauthorityinthedecision-makingprocess.Itisasystematicprocessthatexamines in advance the environmental impacts of proposed development actions and thereforecancontributetobetterprojects fromanenvironmental perspective.

#### DefinitionforEIA(EnvironmentalImpactAssessment):

A formal process for identifying likely effects of activities or projects on the ENVIRONMENT,and on human health and welfare and also the means and measures to mitigate & monitor theseimpacts.

## Thepurposeofthetechnique

Early work on an EIA initiative in Europe began in 1975 with the European Commission statingthat an EIAprocedure should be drawn up and adopted under the second action programme.SincethosedaysEIAhasmovedawayfrombeingonlyadefensivetooltoprotecttheenvironment to a tool that contributes to environmental sustainability in a more holistic mannerwith feedback loops to and from Strategic Environmental Assessments (SEA). SEA evaluates theenvironmental impacts of policies, plans and programmes on a higher tier of the decision-makinghierarchy. EIAalso provides the frameworkto consider location, design and environmentalissuesinparallel,potentiallyleadingtoimprovedrelationshipbetweenthedeveloper,theplanningauthority and thelocalcommunity.

The statutory requirements of the EIA process, such as the EU's EIA Directive, are generallydesignedinsuchawaythattheycanbeadaptedtodifferentsituationsandcircumstances.Consequently the EIA is a tool that constantly develops within countries' institutional structuresandthedecisionsmadereflect their prevailing environmentalpolitics.

**Circumstancesinwhichitisapplied**

The EIA Directive serves as a good example of the circumstances in which an EIA is required.ThisDirectivehascategorisedprojectsthatarelikelytohaveasignificanteffectontheenvironment, and requiring an EIA, by distinguishing projects (Annex I, see Box 1 *Annex I ofproject classes that always require an EIA*) where the EIA is mandatory from projects (Annex II,see Box2 *Annex II lists classes of project under 13 headings*) where the EIAis discretionary.ForthediscretionaryAnnexIIprojectsMemberStatesmustdecideonacasebycaseexamination,and/orbyreferencetothresholdsorcriteria,whetheraprojectshouldbesubjectto

an assessment or not. Annex III of the Directive sets out the selection criteria that Member Statesmustconsider whenscreeningAnnexII projects.These screeningselectioncriteria are:

* CharacteristicsofProjects(sizeoftheproject,cumulativeimpacts,useofnaturalresources,the productionofwaste,pollutionandnuisance andtheriskofaccidents)
* Location of Projects (environmental sensitivity of geographical areas affected by projects,having regard to existing land use, the nature of the natural resources and absorptioncapacityoftheenvironment)
* Characteristics of the potential impact (the extent of the impact, the transfrontier nature ofthe impact, the magnitude and complexity of the impact, the probability of the impact, theduration,frequencyand reversibilityoftheimpact

Insome casesMemberStateshave setthe thresholdsfor AnnexIIprojectssohighthatinpractice a large number of projects with a considerable environmental impact do not require anEIA. For example the European Court of Justice found Ireland's thresholds for reforestation, landreclamation andpeat extraction to be too high(Commission of the European Communities,2002).

InsomecasesanEIAisrequired,notonlybasedonthetypeofproject,butontheenvironmentally sensitive location of the project. For example the EIA Directive requires an EIAforall projectsthat are likelytohavea significant effect onNatura2000sites.

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***Source:TheclassesaredescribedinmoredetailintheDirective (OfficialJournal,1997).***

* **Oil refineries; large thermal power stations and nuclear power stations and reactors;installationsforstorageordisposalofradioactivewaste;ironandsteelworks;installations for extracting and processing asbestos; integrated chemical installations;constructionofmotorways,expressroads, railway linesandairports;**
* **tradingports and inlandwaterways; installations for incineration, treatmentor landfilofhazardouswaste.incinerationorchemicaltreatmentofnonhazardouswaste;groundwaterabstractionexceeding10 million cu.metresperannum;**
* **worksfortransferringwaterbetweenriverbasins;wastewatertreatmentplants;**
* **extractionofoilandgas;dams;pipelinesforgas,oilandchemicals;**
* **installationsforintensiverearingofpoultryorpigs;pulpandpaperplants;**
* **quarries;overheadpowerlines;andstorageofpetroleumandchemicals.**

**AnnexIofprojectclassesthatalwaysrequireanEIA**

*Main steps in the EIA process* showsthe mainsteps in the EIAprocess. Itis important to notethat the EIA is a cyclical process with feed-back loops between stages as well as links to otherevaluationtools,suchas SEA.Asa consequencethe ordersofthestagesare notsetinstone.

**Box3.MainstepsintheEIAProcess**

**ScreeningofProject~~s~~**

isaformalEIArequired?

**Ifyes**

**Scoping**

Coverage and detail of the EIADescription of the development actionDescriptionoftheenvironmentalbaselineEvaluation ofalternatives

**Impact AnalysisAndMitigation**

Prediction of impactsAssessmentofimpactsMitigation

PublicConsultation

AppraisalofEISquality

**ProductionandReview ofEI~~S~~** SubmittingEIStocompetentauthority

**Decisionmaking**

EISandconsultationfindingstobetakeninto account

**Postdecisionmonitoringandaudit**

Monitoring of impactsComparisonofactual/predicted

#### Step1.ScreeningofProjects

During the screening process the developer has to evaluate whether a formal EIA is required forthe project. Itis the responsibility of the competentauthority to decide whether an EIAisrequiredandthenmakethedecisionpublic.ThedevelopercanalsodecidetovoluntarilyundertakeanEIAwithouttheformalscreeningdecisionfromthecompetentauthority.VolunteeringtoundertakeanEIAcansavetimeand costslaterintheprocess.

#### Step2.Scoping

The scoping stage sets the coverage and detail of the EIA process. Scoping evaluates whichimpacts and issues to consider and ensures that the impact evaluation provides all the relevantinformation. Generally scoping takes place between the developer and the competent authority.During the scoping stage those to be consulted, such as communities, localauthorities andstatutory agencies, are identified. The scoping ought to specify the project in such detail thatpotentialdirect,indirectandcumulativeimpactscanbeidentifiedat alater stage.

Descriptionoftheproject/developmentactionincludesinformationaboutthepurposeandrationale of the project and an understanding of its various characteristics, such as developmentlocationand processes.

Description of the environmental baseline should include present and the possible future state oftheenvironment,assumingthattheprojectisnotundertaken.Thetimespanshouldbethesameas for the project. Baseline data project description and mitigation measures should be developedwithmonitoring implicationsin mind.

Evaluation of alternatives brings into consideration alternative means of carrying out the project,includingtechnicalandtechnologicalalternatives.Mostofthepossiblealternativesthatarisewill be rejected by the developer on economic, technical or regulatory grounds. In the case ofunforeseen difficulties during construction or operation of a projectre-examination of thesealternativesmay help toproducerapid andcost-effectivesolutions.

#### Step3.ImpactAnalysisandMitigation

Duringthisstage issuesidentifiedthroughscopingareanalysedand theimpactsare defined.

The prediction of impacts aims to identify the magnitude and other dimensions of identifiedchangeintheenvironmentwithorwithouttheproject,basedonthebaselineinformationgathered during the scoping stage. The significance of impacts could also cast new light on thescoping exercise.Box4*Types ofimpacts to be consideredduring the prediction ofimpacts*showsthetypes ofimpacts that oughttobetakeninto consideration.

**Box4:Typesofimpactstobeconsideredduringthepredictionofimpacts**

* **Physicalandsocio-economic**
* **Direct,indirectandcumulative**
* **ShortandlongrunLocalandstrategic**
* **AdverseandbeneficialReversibleandirreversible**
* **Quantitativeandqualitative**
* **Distributionbygroupand/orarea**
* **ActualandperceivedRelativetootherdevelopments**

Assessment of impacts assigns relative significance to predicted impacts associated with theproject,andtodeterminethe order inwhich impactsare tobeavoided,mitigated or compensated.

Mitigationconsistsofmeasurestoavoid,reduceandifpossibletoremedysignificantenvironmental effects. At one extreme, prediction and evaluation of impacts can lead to suchadverse effects that the only sensible mitigation measure is to abandon the project. Like manyelementsintheEIAprocess,mitigationis notlimited toonepointofassessment.

#### Step4.ProductionandReviewofEIS

The environmental information acquired during the assessment is submitted to the CompetentAuthoritybythedevelopertogetherwiththeapplicationfordevelopmentconsent.Theenvironmental information is presented in the form of an Environmental Impact Statement (EIS).The EISis made availableto environmental authorities and the public fortheir information andto obtain theircomments.Forthe qualities ofagoodEISseethe[EuropeanCommission's](http://ec.europa.eu/environment/eia/eia-guidelines/g-review-full-text.pdf)guidance document The review involves a systematic appraisal of the quality of the EIS. In someMember States there is a formal requirement for independent review of the adequacy of theenvironmentalinformationbeforeitis consideredby theCompetent Authority.

#### Step5.Decision-making

The competent authority takes all relevant information (including the EIS and the consultationfindings) intoaccount in reachingadecision on theproposedproject.

#### Step6.Post-decisionMonitoringandAudit

Monitoring should include both baseline monitoring (before the project) and impact monitoring(after the project). Post-auditing again involves comparing the impacts predicted in the EIS withthoseactuallyoccurringafterimplementationbasedonthemonitoring.Thisenablesanassessmentof the quality of predictionsand of the effectiveness of mitigation measures. Themain purpose of post-auditing is to provide feedback to the EIA process and apply the lessonslearnedto beimplemented in futureEIAs.

**Strengthsandlimitationsoftheapproach**

The EIA process results in greater environmental awareness among the stakeholders and ideallythe decisions ought to reflect this. However, EIA is only an aid to the decision-making process,makingitmoretransparentandinformed,butitisnotadecisionmakingtoolinitselfanddoesnotguaranteeenvironmentallysustainableoutcomes.TheEIAprocesscanonlyleadtoadecision beneficial for the environment if the required environmental policy and criteria are inplace elsewhere.

Decision-makingremainsaninherentlypoliticalprocessandnotechniquesofrationalassessment can balance away conflicts, which arise from the incompatible objectives of differentinterest groups. Rather the transparency and public openness enabled by EIA makes decision-makingmorepolitical, not less. (Rees 1985, Sheate 1994)

EIAisintendedforthelessstrategicprojectlevelofthedecision-makinghierarchy.Consequently EIAs impact on Structural Funds Programmes, higher on the decision-makinghierarchy, can only be indirect, relying on feedback loops from the project-specific level to theprogrammelevelofSEA.ThisisespeciallyimportantintermsofachievingbettermonitoringandreviewofStructural Funds Programmes.

The strengths of the EIA are closely linked to the quality of the assessment as well as to thedeveloper's attitude towards the process. Forexample potential cost savings could gounnoticedif the EIS is perceived by the developer as a meaningless statutory add on. An example of EIAspotential as a cost saving exercise is shown in Box 5 *Example: The EIA of Billund Airport(Denmark)*andthestrengthsandlimitations ofEIAarehighlightedinBox6*Strengths &limitationsof EIA*.

***Strengths***

***Limitations***

* **Ignorespoliticsandmodelsofdecisionmaking**
* **Uncertaintyanintrinsicfactor**
* **Theinadequateunderstandingofthebehaviouroftheenvironment**
* **Toagreatextentacommitmentdependenttool**
* **Susceptibletobiasandpersonalinterests(developeraswellaspressuregroups)**
* **Qualityofdata(outofdateorthelevelofdetailmaybeinsufficient)**
* **Improvedpublicparticipationandco-operation**
* **Decision-makingbecomesmoretransparent**
* **Universalapplicability(manypositiveoutcomesindevelopingcountries)**
* **Toolforinnovationsandcost-savingalterationsIncreasesenvironmentalawareness**
* **Toolforsustainability**
* **ExtendsintoSEAasanintegratedpartofdecisionmaking**
* **Introducesacyclicallearningprocessintoalinearplanningprocess**
* **Takesintoaccounttransboundaryimpacts**

**Strengths&limitationsofEIA**

#### EnvironmentalImpactStatement

* An Environmental Impact Statement (EIS) is a document prepared to describe the effectsfor proposed activities on the environment. "Environment," in this case, is defined as thenatural and physical environment and the relationship of people with that environment.Thismeansthatthe"environment"consideredinanEISincludesland,water,air,structures, living organisms, environmental values at the site, and the social, cultural, andeconomic aspects. An "impact" is a change in consequence that results from an activity.Impacts can be positive or negative or both. An EIS describes impacts, as well as ways to"mitigate"impacts.To"mitigate"meanstolessenor removenegativeimpacts.
* Therefore, an Environmental Impact Statement, or EIS, is a document that describes theimpacts on the environment as a result of a proposed action. It also describes impacts ofalternativesas well asplanstomitigatetheimpacts.
* EISdocumentgenerally consiston threeparts, introduction, description ofproposedproject and alternatives and description of the environment affected by the proposedactions.
* The introduction part of the document will state overview of the project, the purpose,alternative actions, summary of important environmentalaspects and the methods ofassessment being used. The description of proposed actions and alternative will describethe actions, lists of stage conducted for the project. In this part, alternatives are alsomentioned,includinga“no-action”alternativesaswell.Statementalsoincludestheprojectedactions iftheprojectisnot done.
* The core of the EIS document is actually located on this part. The name of this part isdescriptionoftheenvironmentaffectedbytheproposedactionorproject.Supposethereis one proposed action with another alternative, each of these actions will contain the listsofenvironmentwilllikelytogetaffectedbyparticularactionandalternatives.Themeasurement of the effect is defined by EIU, Environmental Impact Unit. The formula ofEIU is as follows:
* EIU=PIUxEQI
* PIU=ParameterImpact Unit

EQI=EnvironmentalQualityIndex

* The description of the environment affected by the proposed project contains lists ofenvironmental parameters such as ecology, aesthetics and environmental pollution andhuman health. This list is grouped according their characteristics. For example, ecologymay comprise of species or microorganisms live in the location of the proposed project,ecosystemsetc.Severalexamplesare shown below.

Ecology:

* + Species andpopulations
  + habitat
  + wetlands and

-ecosystems

Aesthetics:

* + land
  + air
  + biota(biology)
  + water
  + objectofhistoricalorcultural significance

Environmentalpollutionand humanhealth

* + water
  + air
  + land
  + noise

Economics:

* + jobscreatedor lost
  + propertyvalues
* If you heed on lists above, they are still in general. Therefore, we usually have to makemore detail lists or specific subtopics. For example in environmental pollution and humanhealth, there is water item, we identify the quality of water such as BOD (BiologicalOxygen Demands) or DO (Dissolved Oxygen). If we focus on air, it may have specificsubtopicssuchas soundorodor.
* Each of these items will be assigned a numerical rating to each of them, which is calledEIU. You already know the formula to obtain EIU, we have to obtain PIU and EQI.Environmental Quality Index (EQI) is a ratio between the present value and the predictedvalue after the project. For example DO in surface water where the project is located andmay interrupt the quality of the surface water, at present after laboratory test DO is, say 8mg/L, the predicted DO after the project is 2 mg/L, thus the ration is 2/8, equals 0.25.Each listings has to be assigned this EQI. If you are dealing with quantitative items suchas odor or aquatic life, you may assigned the scale from 0 to 1. To assign the EQI foritems that have natural qualitative characteristics you may want to convert them intoquantitative one. For example, cost spent for population around project location withcurrent odor orsound qualitative condition and with thepredictedcondition. TheEQIwillthen betabulated foreach items.
* Next step is to assign weights for each item, usually by distributing 1000 PIU. Thedistribution of PIU is usually chosen by the decision maker. The number of 1000 PIU issubjective dependsonthe committee of decisionmaker,thisit ispossible aswelltoassign10 or100 PIU.
* I want to make a very simple example, suppose the proposes project is to build shoppingmalls on an empty spot in the center of city near the river. Next step is to list the areas ofenvironmentalimpact.They are:
* -water appearance
  + DO
  + odor
  + turbidity
  + suspendedsolid
  + aquaticlife
* We have to determine the condition before project and prediction after project and thencalculatethe ratio.The listbelowfollows theorder:items, condition beforeproject(unitless;mg/L),condition afterproject,EQI.
* -Waterappearance,10,4,0.4

-DO,8mg/L,2mg/L,0.25

-odor, 10, 5, 0.5

* + turbidity, 15 NTU, 30 NTU, 0.5 (as higher NTU means more turbidity, thus the ratio is15/30)
  + suspended solid,20mg/L,2000mg/L, 0.01
  + aquatic life10, 4,0.4
* The qualitativeitems suchwaterappearance,odor andaquaticlife areassignedvaluefrom10to1inwhichlowervaluemeansdegradationof environment.TheEQIisweighted by 10 PIU in this example and the EIU is calculated. We assign PIU for eachitemasfollows:
* -waterappearance, 1PIU
  + DO,2PIU
  + odor,1PIU
  + turbidity,2PIU
  + suspended solid,2PIU
  + aquaticlife,2PIU
* Totalis10PIU.
* NowwecalculatetheEIUbasedonthefollowingorder:item,PIU,EQI,EIU.
* -waterappearance,1PIU, 0.4EQI, 0.4EIU
  + DO,2PIU, 0.25EQI,0.5EIU
  + odor,1PIU,0.5EQI,0.5EIU
  + turbidity,2PIU,0.5EQI,1EIU
  + suspended solid,2PIU,0.01EQI,0.02EIU
  + aquaticlife,2PIU,0.4EQI,0.8EIU
* TotalEIUis(0.4+0.5+0.5+1+0.02+0.8)3.22EIU.SowehaveobtainedtotalEIUof a proposed action, now analogue with this method, we calculate the total EIU for otheralternatives. Total EIU for each action is then compared to each other. Better action isindicatedby higherEIU.

#### LegalprovisionsonEnvironmentalPolicy/Legislation

Environment clearance of development projects including mining is done by the Government,with the following objectives:**\_**optimal utilisation of finite naturalresourcesthrough use ofbetter technologiesand managementpackages,and**\_** increasingsuitable remedial measuresattheprojectformulation stage.

The Policy Statement of Pollution issued by the Ministry of Environment and Forests Govt. ofIndia in 1992, provides instruments in the form of legislation and regulation, fiscal incentives,voluntary agreements, educational programmes and information campaigns in order to prevent,control and reduce environmental pollution. The establishment and functioning of any industryincluding mining will be governed by the following environmental acts/regulations besides thelocalzoningandland uselawsoftheStates andUnion Territories:

1. The Water (Prevention and Control of Pollution) Act, 1974 as amended from time to time(WaterAct)
2. TheWater(Prevention andControlofPollution)CessAct, 1977,asamended (WaterCessAct)
3. TheAir(PreventionandControlofPollution)Act, 1981asamended (AirAct).
4. TheEnvironment(Protection)Act,1986(EPA)
5. TheWildlife(Protection)Act,1972asamended
6. TheForest(Conservation)Act,1980as amended
7. ThePublicLiabilityInsuranceAct,1991
8. The Mines and Minerals (Regulation and Development) Act, 1957, as amended (MMRDAct)
9. CircularsissuedbytheDirector-GeneralMinesSafety (DGMS).

## Unit II

## EIA METHODOLOGIES

### EIAMethods

#### Introduction

EIAmethodsareusuallytakentoincludethemeansofgatheringandanalyzingdata,thesequence of steps in preparing a report, and the procedure (who does what and when). Theessential ingredients of the EIA process, such as scoping, IEE, and detailed EIA, are universallyagreedupon, but EIAtechniques varywidely.

Considering the complexity of the interacting systems that constitute the environment, and theinfinitevarietyofpossibleimpactingactions,itseemsunlikelythatasinglemethodwouldbeabletomeetalltheabovecriteria.Thegeneralapplicabilityofallmethodsalsohastobebalancedagainsttheadministrativeandeconomicconstraintswithinwhichtheyare employed.

ThereisnosingleapprovedmethodforanEIAstudy.Therefore,whatisimportantistheabilitytothink in asystematicway:

* Tounderstandtheinteractionsoftheenvironmentandtechnological change;
* Tomeet,inapracticalway,theneedsofthedevelopment manager; and
* Tofollowthefundamental processofpreparinganEIA.

A distinction between EIA methods and tools must be carefully noted. The four fundamentalmethodswhich are commonly usedasmethodsfor conducting anEIAare

* + Checklists,
  + Matrices,
  + Networks,and
  + Overlays.

Tools for EIA support the application of the above basic methods. Some of the commonly usedtools are prediction models, geographical information systems, and expert systems. These toolscanbeused forpurposes otherthan EIA.

Generally, more than one method and tool are used, depending on the tier of the EIA process, toaccomplish the best results. Recommendations for the use of methods and tools are made in theformofacomprehensiveflowchart.

### Checklists

Checklistsserveasreminderofallpossiblerelationshipsandimpacts,outofwhichasettailoredforthespecificassignmentmay bechosen.

Checklists are designed to establish whether a proposed project is likely to have negative impactson the environment. For such projects, all possible negative impacts must be assessed in detail inrelationtotheproject'spositiveimpacts.This isaccomplishedin thenextsteps oftheEIA.

The checklists help people in key positions to become more aware of whatthey should belooking for when assessing a proposed project. They may also help to develop a higher degree ofawarenessoftheenvironmentalaspects ofaproject.

Checklistscan beclassifiedinto**descriptiveandweight-scalingcategories.**

The purpose of a descriptive checklist is to provide a list of important issues for the purpose ofidentification and scoping. One of the simplest forms of the checklists is the one with project-specific questions. A common, simple and inexpensive method is the checklist. These can be ofdifferenttypes.

Beloware themostcommonlisted:

**Simple checklists** list the components or aspects, usually of the environment that might beconsidered by the assessor but no other assistance is provided to guide the impact identificationprocess.

**Descriptive checklists** provide additional assistance by indicating, for example, the specificvariablestobemeasured to characterizeeachcomponent.

**Scaling checklists** go a step further and include simple devices for assessing importance orsignificance of suspected impacts. This might be through the use of letter or numeric scales,assigned after comparison with criteria supplied in the checklist, to indicate the importance of animpact. Another approach is to use threshold values, based on statutory criteria (e.g. for waterquality standards) or on derived measures (e.g. visitor carrying-capacity for a given locality). Thesuspected impact can be estimated in broad terms and given a value to represent its significance.Onthatbasis,astartcanbemadeoncomparingandrankingalternativeprojectoptions.

**Questionnaire checklist**, is a form of scaling checklist but uses a series of carefully directedquestionstoelicitinformationabout possibleimpactsand theirlikelyimportance.Checklistshelpto organise the work and identify important issues. The risk of using checklists is that importantissuesnot included in thechecklist may exist.

#### Checklist of impact categories for land development projects (summarised fromSchaenam1976).

1. Local economyPublicfiscalbalanceEmploymentWealth
2. NaturalenvironmentAirquality

Water qualityNoise

Wildlife and vegetationNaturaldisasters

1. Aesthetics and cultural valuesAttractiveness

View opportunitiesLandmarks

1. Public and private servicesDrinkingwater

Hospital careCrime controlFeelingofsecurityFire protection

Recreation - public facilitiesRecreation—informalsettingsEducation

Transportation - mass transitTransportation - pedestrianTransportation—privatevehiclesShopping

EnergyservicesHousing

1. Other social impactsPeople displacementSpecial hazardsSociability/friendlinessPrivacy

Checklists can be also developed based on issues. The issues can be later graded to identifythose of significance based on the project and environment features, i.e., relevance. Issues ofhigh significance can be later decomposed into responsible "activities'' and "components ofconcern'' to develop mitigation, protection, and monitoring measures in the succeeding levelsof an EIA. Box 4.2 shows an illustration of an issue-based checklist developed for projects onpowerdevelopment.Theissue-based checkliststhusassistintheexerciseofscopingandIEE.

Environmental impacts often tend to appear in the form of chains of cause and effect. If thefirst link in the chain is revealed, the subsequent impacts will also be uncovered. In order toreduce the number of questions in each checklist, the questions are most often related to thefirstlink in thechain

#### Advantagesofthechecklistmethod

* + Checklistsprovideallpossiblerelationshipsandimpacts,outofwhichasettailoredforthespecificassignmentmay be chosen.
  + Checklistshelppeopleinresponsiblepositionstobecomemoreawareofwhattheyshouldbelookingforwhen assessing aproposedproject.
  + Checklistsmayalsohelptoproduceahigherdegreeofawarenessoftheenvironmentalaspectsofa project.
  + Quantificationofimpactsispossibleusingtheweighted-scalemethod.

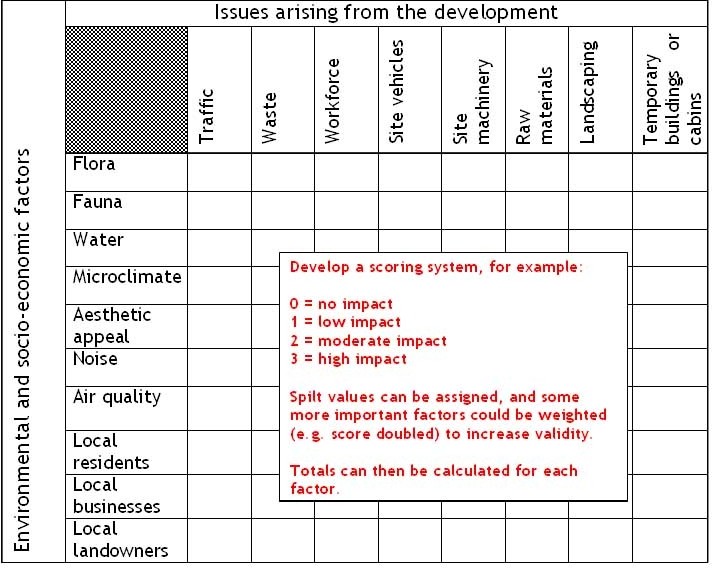
#### Limitationsofthechecklistmethod

* + Descriptive checklists may be exhaustive, including the impacts during the various stages ofthe project. However, no quantitative information is provided regarding magnitude and degreeofimpact.
  + Another important drawback of this method is the way it attempts to compartmentalize theenvironment. Environmental systems comprise a complex web of interrelated parts, oftenincorporating feedback loops. This fact is not included in the weighted checklists. This methodshouldbethereforeusedwithsomecaution.Itsquantitativefeaturesmaybeusedtodistinguish between alternatives and so should be used only when a comparision needs aquantitativeresolution.
  + The main drawback of the checklist method is the inability to relate individual activities toenvironmentalcomponentsaffected bytheseactivities.

#### Matrices

A more detailed approach is given in matrices, whereproject activities are cross-tabulatedwith environmental components. Also matrices can be made quite simple or be developed intoastagewithalargeamountofinformation.Thestrengthofthe matrixapproachis theusefulness in designing further studies, the inexpensive nature (also true for checklists) andtheircomprehensiveness.Limitationsmaybeaninability tohandleindirectimpactsandtemporal aspects, a potential rigidity of categories, an a difficulty to get an overview whenmany variable are included. In many cases numbers of magnitude and severity of impact areincludedonaverypoorbasis("thisfeelslargerthantheother").Thusmanymatricesusedgive muchless andlowerqualityinformationthanthought onfirst impression.

Matrices relate activities to environmental components so that the box at each intersection canbe used to indicate a possible impact. The term "matrix'' does not have any mathematicalimplication,butis merelyastyleofpresentation.



matrix can be used to identify impacts by systematically checking each development activityagainsteachenvironmentalcomponent.Ifitwasthoughtthataparticulardevelopmentactivitywastoaffectanenvironmentalcomponent,amarkisplacedinthecellattheintersectionoftheactivityandtheenvironmentalcomponent.Amatrixanalysiscansystematicallyidentifypotentiallyimportanteffectsdemandingmorecarefulattentionoranalysis or focus attention on important possible effects that might otherwise be overlooked.Matrixis thus an extensionofthebasicchecklist.

Therearethreetypesofcommonlyused matrices:

* descriptivematrices;
* symbolicandpresentationmatrices;
* scaled/weightedornumericmatrices.

Example of plus/minus matrix on the theme "Why does the proposed activity improve the soilcondition?"

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **EnvironmentalComponent** | **Existingsituation** | **Proposedactivity** | **Processalternative** | **Environmentally mostfriendly** |
| Air | 0 |  |  | 0 |
| Soil | 0 | + | + | + |
| Surfacewater | 0 |  | 0 | 0 |
| Waste | 0 | + | + | + |
| Noise | 0 | - | - | - |
| Safety | 0 | (-) | (-) | (-) |
| Nature | 0 | 0 | 0 | 0 |
| Energy | 0 | - | 0 | + |
| Costs | 0 | - | - | - |

Legend: - deterioration compared to the existing situation; + improvement; 0 no difference; (-)insignificantdeterioration.

#### Advantagesofthematrix approach

* A matrix presentation has a better structure framework than the checklist approach. In fact, itmakesasummarizedanalyticalpresentationoftheprojectandenvironment-relatedchecklists.
* Matrix structure allows for speculation of impact characteristics, albeit in a subjective way.Thisprovidesagradationintheimpacts,therebyprovidingafocusforfurtherstudies,verification, or discussions. It also helps in making priorities on some mitigation measureswhichareestimatedtoalleviate theimpactsspeculated.
* Itpresentsaneasilyunderstoodsummaryofalargenumber ofprimaryimpacts.
* Itisageneralizedbutwelldefinedapproach,forcingacomprehensiveconsiderationofenvironmentalcomponentsand primary impacts.
* Itisaneasilyperformedprocesswhichcanspecifytheoverallcharacterofaprojectearlyinthedesign phase.
* Inan extended form,themethod can includeinformation about many impactattributes, andclarifytheassumptionssupportingtheassessments.
* Matriceshavelowresourcerequirements.

#### Limitationsofthematrix approach

* Unless weight-scaled impact scores are used, the comparison of many project alternatives isdifficult.
* Scaling the multitude of scores contained in a matrix is also not a tractable proposition, as theabilitytoindependentlyreplicatethemethodisunderminedbyadependenceonhighlysubjectivejudgments.
* Theimpactcharacterizationstepofthematrixinvolvessubjectivepredictionaswellasassessment.
* There is little opportunity for quantification. However, it is possible to accommodate furtherdetailinginthematrixpresentationifprediction/evaluationtechniquesareseparatelyused.
* While developing matrix structure, it becomes apparent that higher order impacts are notaccountedforusingthisapproach.

### Networkdiagrams

Network diagrams may be used to illustrate linkages and higher order effects in the system.Thisshowshowsecondaryandhigherordereffectsmaybeevaluatedincauseeffectchains.A problem with this kind of diagrams is that i very easily tends to become large and complex.There are no quantitative measures on impact magnitude or significance as is often found inthe matrices. This may be an advantage since the aim of the impact identification is not toquantifyandthequantitativedataisoftenpooratthis stageinthestudy.

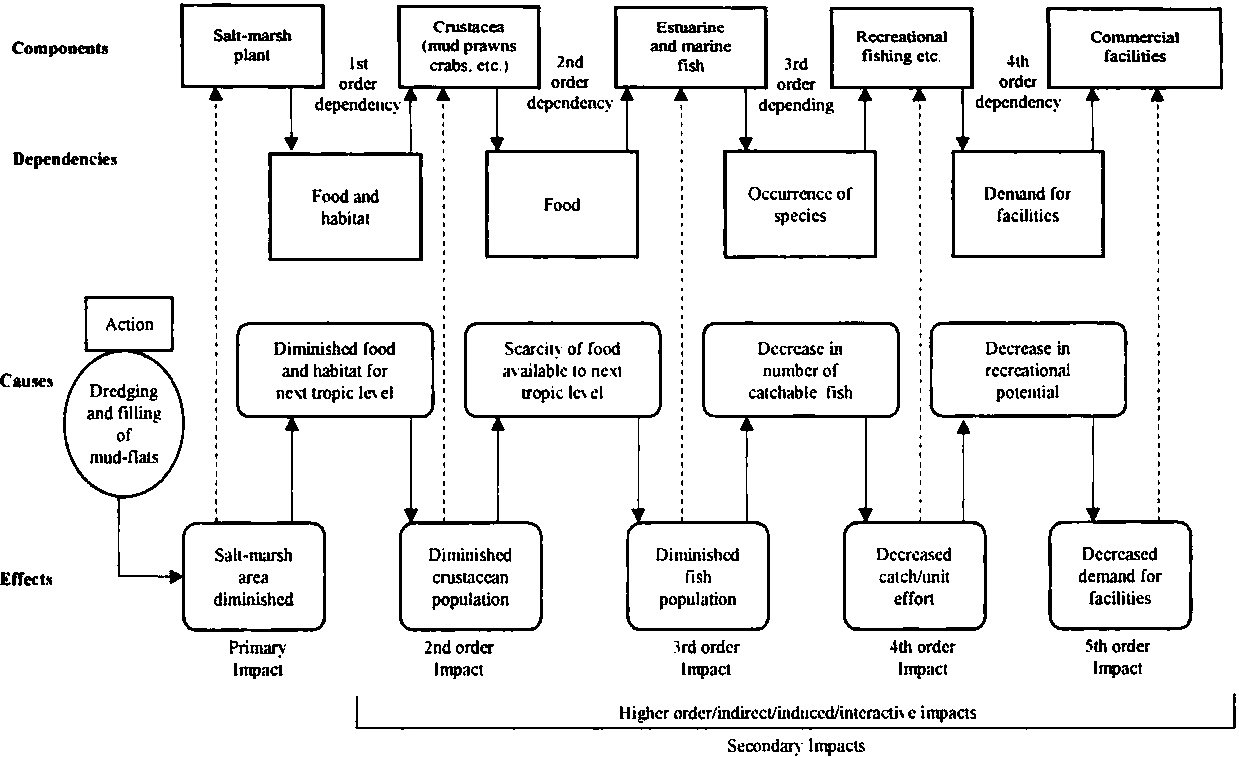
Investigationofhigherorderlinkagesintwodimensionscanbecarriedoutbyusingdirectionaldiagramscalled**networks.**Networks,althoughwidelydiscussedintheEIAliterature, have not been used as extensively as matrices and simple checklists. Networks wereessentially developed to explicitly consider the secondary, tertiary, and higher order impactsthat can arise from an initial impact. Here, any effect on the biophysical and socio-economicenvironments that arises from a cause directly related to the project activities is termed a first-order or primary impact. The secondary impacts are those affecting the biophysical and socio-economic environments which arise from an action, but which are not initiated directly by thataction. Presentation matrices can only clearly show the primary or first-order impacts withinany particular activity-component framework. The network technique developed by Sorensenis probably the best-known approach for investigating higher order impacts. The objective ofthe network approach is to display, in an easily understood format, the intermediate linksbetween a project and its ultimate impacts. This type of network includes the identification ofprobable importance of temporal effects as well as a list of data requirements. Complexityincreases as higher order impacts are considered, and, as a result, the Sorensen network isrestrictedto third andlowerorderimpacts.

#### Advantagesofthenetworkmethod

* Presentation matrices can only clearly show the primary or first-order impacts within anyparticular activity-component framework. It is possible, however, to investigate higher orderlinkagesintwodimensions byusing networks.
* Itispossibletotranslatenetworksintomathematicalmodelsforamorequantitativejudgement.Thenetworkmethodstructurestherelationshipsimpliedinqualitativesimulations.

#### Limitationsofthenetworkmethod

* Oneofthemainlimitationsofthenetworkmethodisthatsinceimpactsarenotscoredinanyquantitativeway,thecomparison ofprojectalternatives isnotreadilyachieved.
* Spatialrepresentationofimpactsisnotpossible.



#### Overlays

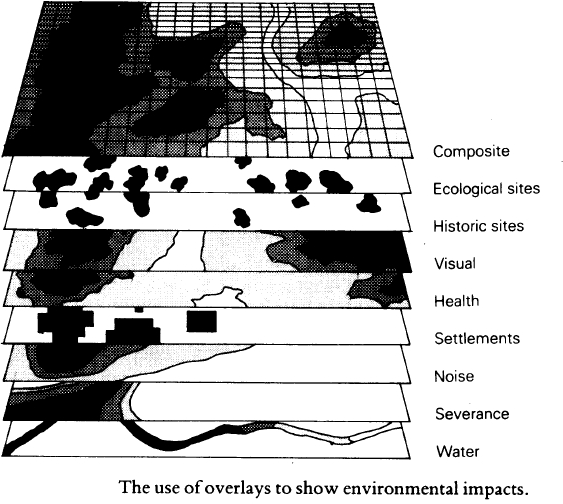
The overlay approach to impact assessment involves the use of a series of transparencies toidentify, predict, assign relative significance to, and communicate impacts in a geographicalreference frame larger in scale than a localized action would require. The approach has beenemployed for selecting highway corridors, for evaluating development options in coastal areas,andinnumerousotherapplications.

The McHargoverlayis basedona set of transparent maps,eachof whichrepresentsthespatial variation of an environmental parameter (e.g., susceptibility to erosion or recreationalvalue).The mapsareshadedto show threedegreesof parametercompatibility with theproposedproject.A composite picture ofthe overallsocial cost of affectingany particulararea is approximated by superimposing allthe transparentmaps. Any number of projectalternativescanbelocatedonthefinalmaptoinvestigatethedegreeofassociatedimpacts.The validity of the analysis is related to the type and number of parameters chosen. For areadable composite map, the number of parameters in a transparency overlay is limited toabout 10 (Munn, 1979). Parameter maps present data in a summarized and easily interpretedform, but are unable to reflect the possibility of secondary impacts. They also rely heavily oncartographicskillsandtheireffectivenessdependstoa largedegree oncartographic execution.

This method is easily adaptable for use with a computer programmed to perform the tasks ofaggregating the predicted impacts for each geographical subdivision and of searching for theareas least affected. Automated procedures are also available for selecting sequences of unitareasforroutinghighways,pipelines,andothercorridors.Thecomputermethodismore

flexible, and has an advantage whenever the reviewer suggests that the system of weights bechanged.

The overlay approach can accommodate both qualitative and quantitative data. The weaknessof the overlay approach is that it is only moderately comprehensive, because there is nomechanism that requires consideration of all potential impacts. When using overlays, theburdenofensuringcomprehensivenessislargelyontheanalyst.Also,theapproachisselective because there is a limit to the number of transparencies that can be viewed together.Finally,extremeimpactswithsmallprobabilitiesofoccurrencearenotconsidered.However,a skilled assessor may makeindicationsinafootnoteoron a supplementary map.



**Cost benefit Analysis (CBA)** is a tool used either to rank projects or to choose the mostappropriate option. The ranking or decision is based on expected economic costs and benefits.The rule is thata project shouldbe undertakenif lifetime expectedbenefits exceedsallexpected costs. The art of the analysis process comes in the measurement of these impacts,theiradjustmentformarketfailure,andfortheeffectsoftime,incomedistribution,incompleteinformationandpotentiallyirreversibleconsequences.Aprincipleofwesterneconomics since Adam Smith is that ‘the market knows best. In a perfect world, the marketwould ensure that land, labour and capital were allocated in a way that would maximize bothprofits, and the welfare of society. Ours is an imperfect world, but CBA is a tool that allowsthe analyst to mimic the welfare optimizing behaviour of the market. Although complexitiesarise when costs and benefits are being measured and corrected, CBA is a simple tool withnumerous uses and applications, especially in the environmental assessment sphere. Its useincreasesaccountability and consistencyin decision-making.

This document has been written for a wide audience. Its objective is to serve as an initialreferencetext.Theaimistoprovideanintroductoryinformationsourcetogovernmentauthorities,environmentalpractitioners,nongovernmentalorganizations(NGOs),industry,projectproponents, academics, students and other interestedand affectedparties (I&APs).This document provides an overview of the theory and methods of CBA. The process on howtoperformCBAisprovided.TheadvantagesanddisadvantagesofCBAisexplained.Key

issuesthatcomplicatetheapplicationofCBAarehighlighted.Thisdocumentisnotprescriptive but rather provides an overview of the key criteria to consider when applyingCBA.

**APPLICATIONSOFCOSTBENEFITANALYSIS**

CBA is used at two basic levels. In the private sector financial CBA is used to justifyequipment and technology investments; measure life cycle costs; meet regulations cost-effectively; and quantify hidden costs and intangible benefits. It is also a useful tool to showhow outsourcing and leasing can result in cost savings, and how quality improvements canaffect returns. Social CBA is used to appraise the social merit of projects or policies. Theprojects may be public or private, and the analysis is typically used to inform public decisionmakers.This typeofCBAis theform typically usedin EIAs.

1. *Evaluate or rank the feasibility of projects-* CBA is used by decision makers to determinewhether asingleactivity or project should beundertaken,or

torankcompetingprojectsorpolicies.

1. *Analyse the effect of regulation-* A typical purpose of new public regulations is to reduce oreliminate specified risks to environmental quality. While scientific and engineering estimatescan indicate how and by what amount the proposed regulations will reduce the risk, the‘optimal’ level of intervention still has to be established. CBA can help inform this process; itcan also indicate whether the risk would be more effectively addressed through private action,newregulation,orstrongerenforcementofexisting statutes.
2. *Justify equipment and technology investment-* CBA can be used to determine whether anew investment in equipment or technology for governmentis an efficient use of thetaxpayers’ money.
3. *Determine the most effective way to cut costs, especially in capital planning.*CBA providesa simplemethod toimplement costeffectivecapitalplanning.
4. *Determine the relative benefits of outsourcing and leasing.* A traditional function of thestateis theprovision of

public goods. These are goods (such as lighthouses or public immunization schemes) that arenot depleted by use and from whose benefits the public are not excluded if they refuse to pay.However, many of the goods and services provided by the state have a ‘private goods’component. Where this is the case, outsourcing part of a project may reduce costs andimprovequality.CBAcanbeused toidentify such opportunities.

1. *Quantify hidden costs and intangible benefits.* A common justification for the EIA processis that it may reveal possibilities that the internal planning process missed. While this isexpected in the scientific studies of an EIA, it can also occur on the economic side. In theprocess of performing financial CBA, unanticipated costs and benefits may be uncovered.More importantly, the valuation of all costs and benefits reveals the full consequences of aproject or policy decision. This is especially important in the public health and environmentalspheres,wheretherelativemagnitudes ofimpactsarecentral.
2. *Ensure accountability by public sector decision-makers-* CBA presents its results after asensitivity analysis. The output should be clear and its interpretation simple. Where it is partof an EIA, CBA provides information for the public, NGOs and the press, and in doing soincreasestheaccountabilityofpublicdecision-makers.

**Rationale**

# ANALYSISOFALTERNATIVES

The consideration of alternatives to a proposed project is a requirement of EIAs in manyjurisdictions and is a core element of the EIA process and methodology. The Trinidad andTobago environmental management regime is no exception: Applicants must identify andappropriately evaluate project alternatives as part of the process. The process for analysingalternatives is designed to incorporate environmental considerations into all stages of projectanddevelopmentplanning.Ideally,thisapproachbeginswithstrategicenvironmentalassessment to analyse broad alternatives within a sector or geographic region. When such aframework is absent, as is the case in Trinidad and Tobago, the key alternatives are examinedaspartofa project-specificEIAas addressedinthis chapter.

In many cases, certain alternatives will have been foreclosed by the overall project approachundertaken and earlier stages of decision-making. Retroactive analysis of alternatives is notconsidered good practice unless the circumstances deem it necessary, for example, when aproposal is well advanced but has a potentially significant impact on the environment orinvolves the relocation of large numbers of people. The relative impact of each alternative iscompared against the baseline environment (with and without the project) to select a preferredalternative,includingtakingnoaction.Electionofthenoactionalternativedoesnotnecessarily correspond to the maintaining of baseline conditions, however, because changesmayresultfrom otheractions.

#### RangeofAlternativesConsidered

Types andrangesofalternativesconsideredinclude:

* **Demand alternatives** – using cogeneration to improve the energy safety and efficiency oftheplant.
* **Inputorsupplyalternatives**–withthecompletionofProjectStages2,3,and4,introducea waste brine stream from DESALCOTT to minimise the need to obtain water required for thechlor-alkali operation from WASA’s potable supply resources. Several suppliers werecanvassed to locate the purest limestone to reduce the quantity of reaction mud produced bytheprocess.
* **Project activity alternatives** – several alternatives were investigated for the piling activitythat would occur during plant construction. The soil conditions and limited availability ofpiling equipment, contractors, tools, and techniques on the island restrict the options availablefor thisactivity.
* **Location alternatives** – For the entire proposal as well as for various project components,several potential locations were evaluated before selecting Trinidad and the proposed ProjectsiteinPoint Lisas.Trinidadwaschosenbecauseofits strategiclocationrelativetothepotential customer base and the attractive energy pricing. Alternative configurations of majorplant components were studied with regard to protecting public health and the environmentwhile simultaneously optimizing operations (e.g., moving cooling towers, the entire chlor-alkali facility,, and the ponds to areas of the site where they would be farthest from nearbyresidences.
* **Process alternatives** – Mechanical vapour recompression, among the most efficient use ofenergy for evaporation, is the technology that would be used for concentrating waste brine.Mechanical vapour recompression was proposed as a design alternative to multiple-effectevaporationforthe brineconcentrator.Thistechnology,alongwith thecellmembraneprocess,wouldsubstantially improvetheplant’senergyefficiency.
* **Start up approach** – The Project would be phased to minimize the risk of an environmentalor health and safety incident during startup and to provide an opportunity to prove the brinepurificationprocess,and test and quantify wastesolids products, onestep at a time. TheProject design calls for the dryer off-gas filtration system to be replaced so that particulateemissions are reduced and all water streams are recycled to achieve a “zero” process wastewater discharge.
* **Use of best available technologies** – The proposed chlor-alkali plant would incorporatestate-of-the-artcellmembrane—notdiaphragmormercurymembrane—technology.Theindustry has largely phased out the use of mercury membrane technology in the United Statesand Europe. The cell membrane would be nameplate rated and would use CONVE equipment.The Project would also use high efficiency scrubbers to minimize air emissions from the plant.TheContainmentPitwouldbeeitheranearth-bermedstructurewithageomembranelineroran engineered concrete structure to minimize the risk of groundwater contamination fromprocesswater.Iftheconcreteoptionischosen,thestructurewouldbedesignedwithleakstops and an underdrain to detect any leakage, and would be designed to meet the appropriateseismicrequirements.
* **Scheduling alternatives** – The Project would be phased, in part, to allow time for theintroduction of greener alternatives, which require large upfront capital investments, includingthe ability to use the waste brine stream from DESALCOTT and to develop the cogenerationplant. Cogeneration has a higher overall efficiency than conventional utility systems, typically85 percent versus 58 percent. This efficient use of fuel would reduce the forecast emissions ofgreenhouse gases by approximately 30 percent. Stakeholder input (through meetings withstakeholders,communityoutreachefforts,andfocusgroups)wasactivelysoughttoinformthegenerationand analysis ofviablealternatives.

#### UNIT-III

#### IMPACT OF DEVELOPMENTAL ACTIVITIES AND LAND USE

**AssessmentofImpact onland,water andair,noise,social,culturalfloraandfauna**

The impacts due to development works construction will be first minimized by adequateplanningandtakingconstructionactivitiesasperPERTandCPMChart.Thespecificmeasuresthatshallbeputtopracticetominimizetheimpactontheenvironmentarediscussedbelow:

#### AirEnvironment

* + Provisionshallbemade forsprinklingofwater onloosesoiltoavoiddust generation.
  + Thedebrisandunutilizedconstructionmaterialandearthfromtheconstructionsiteshall be removed immediately to recycle within the project so that no nuisance dust isgeneratedduetowind.
  + The vehicles employed by the developers shall be checked for vehicular emissions. Thedevelopersshallalsoimpressupontheserviceagenciestogetvehiclesregularlycheckedforvehicularemissions.
  + ConstructionActivitiesshallnotbeallowed atNight.
  + The mitigation measures shall include regular maintenance of machinery and provisionofpersonnelprotectiveequipmentsto workers whereneeded.
  + The steps shall be taken to reduce the impact of noise by taking to plantations from theverybeginning.
  + A Hot Mix Bitumen Plant with air pollution control system shall be used to provideBitumen Macadam Roads and entire operation shall be mechanized to complete theworkin shortest duration andinonego.
  + The permission of the Himachal Pradesh State Environment Protection & PollutionControlBoard shallbetaken asrelevant.
  + A Sewage Treatment Plant with tertiary level of treatment is being provided as perdetails in **Annexure-4.1** to avoid any odour pollution from the sewage generated fromthecolony.
  + Extensive plantation is planned as discussed in Section-4.6 to mitigate the impact ofnoiseandto improvetheambient airin general.
  + The standby generator shall be installed with enclosures as per guidelines of CentralpollutionControlBoardandafter taking consentfromHimachalPradesh.
  + Environment Protection & Pollution Control Board under Air (Prevention and ControlofPollution)Act, 1981.Thedetails are given in **Annexure-4.2**
  + No individual shall, however, be allowed to install generators on roadsides, in corridorsor in such a manner to act as a public nuisance, by way of making this a part ofagreement,whileallotting theflats.

#### WaterEnvironment

* + - Therun-offduringdevelopmentshallbecontrolledbyremovingconstructionrelatedsolidwasteasmalba, loosesoiletc.
    - Furtherlandclearingactivityshallbekepttotheabsoluteminimumbyworkingatthespecific sites onebyonewhereconstruction isto takeplace.
    - Aseptictankshallbeprovidedwithtoiletfacilitiestomeetthedailyneedsoflabourduringworkinghours.Workers shall bediscouraged fromtoiletin open.
    - Bothrooftoprainwaterharvestingandstormwaterrunoffshallbetappedforrechargingtheaquifersandstorage.ThedevelopersshallundertakeRainWaterHarvestingin Parks andPublicPlaces.
    - The provision of the same shall be made compulsory forthose who shall purchaseplots and construct it. The Environment Management Cell of the Developers shallfurther carry out awareness campaigns on the same for the owners of the individualplots.
    - A Roof Top Area of 40000 Sq.m with annual Roof Top Rain Water HarvestingPotential of 32000 m3 is available. The details of rain water harvesting are given in**Annexure-4.4.**TheStromWaterplanis attachedat **Annexure-4.5**
    - A Sewage Treatment Plant of 900 m3/day capacity is planned to treat the sewage toBOD <5mg/l. and recyclethesame.
    - Thedetailsaregiven inAnnexure-4.1.
    - About 1800 Kg/day of solid waste shall be generated from the proposed housingcolony.
    - The Developer plan to introduce a paid house-to-house garbage collection work forwhich cyclecarts shall be provided.A designatedsites for provision ofSafai Kendratosegregatethesolidwastesandundertakingsolidwastemanagementthroughvermiculture biotechnology.
    - The Environment Management Cell by developer in consultation with HIMUDA andHPSEP&PCB shall take all steps to see the compliance of the Municipal Solid Wastes(Management and Handling) Rules, 2000. The details of vermiculture technology aregiveninAnnexure-4.3.TheenvironmentalmonitoringprogrammeisdiscussedinSection-4.5.

#### LandEnvironment

* + - To avoid erosion of the top soil the development is planned in the shortest possibletime and landclearing activity shall be kept to the absolute minimum by working at thespecific sites one by one where construction is to take place so as to increase detentionandinfiltration.
    - The activities that result in soil being laid bare shall be scheduled in such a way thatsome type of vegetative cover appropriate to the site shall be established prior to onsetofmonsoons.
    - Natural waterways/drainage pattern shall be maintained by providing culverts whereneeded. The solid waste generated from the construction activities shall be effectivelyrecycledwithin theproject.
    - The requirements of sand and aggregates for the construction works are met from inandaroundBaddi,where,thesearetakenoutfromseasonalrivuletsthatgetreplenishedannually.
    - The development works shall prefer use of concrete blocks and concrete and use ofbricksshallbe tominimum.Theflyashbasedcementshallbeusedfor thepurpose.
    - Forthedevelopmentworkstheuseofwoodshallnotbeallowed(TimberFreeConstruction)andisreplacedbyMildSteel,Aluminium,GlassandPlastic.
    - The project involves development of a residential colony over an area of 8.79 Ha(21.71 Acres). The residential area is divided into 5 Blocks with a total of 1712 Flats(Block-A 336 Flats, Block-B 368 Flats, Block-C 432 Flats, Block- D464 Flats andBlock-E112 Flats.
    - Permissible Ground Floor Coverageis 50% and Permissible FAR is 1.5. The BlocksA& B are G.F + 4 Floors whereas Blocks C, D & E are G.F + 3 Floors. A totalpopulationof9000 isexpected with an average of5 personsperflat.
    - Area under housing is only 36% of the total area and remaining area is under commonservicesas parks,roads,footpaths, schoolsand healthcenter.
    - A 5 m green bet is placed all along the colony. The land use is thus so planned thatthere is minimum adverseimpact.
    - The solid waste is being managed through vermiculture technology as discussed inAnnexure-4.3tominimizeany impacton land environment.

#### EnergyManagement

* + - The orientation of the plots to maximum extent is planned to make use of natural lightanddirection ofsun.
    - The land use is thus so planned that there is minimum adverse impact and maximumuseofprinciples ofeco design.
    - A fundamental principle of solar design is to maximize the solar gain in the winter andminimizeitin thesummerandisused to theextentpossiblepractically.
    - TheEnvironmentManagementCellforthecolonyshallalsoholdawarenessprogrammes for the individual plot owners in this regard to maximize the benefits ofworkingwith thesun.

#### EnvironmentMonitoringProgramme

Regularmonitoringofallsignificantenvironmentalparametersisessentialtocheckthecompliancestatus vis-à-vis the environmentallaws and regulation. The objectives of themonitoringwillbeas follows:

* + - * To verify the results of the impact assessment study with respect to the proposedprojects.
      * To study the trend of concentrated values of the parameters, which have been identifiedascriticalandthen planningthemitigating measures.
      * Tocheckandassesstheefficacyofpollutioncontrolequipment.
      * To ensure that any additional parameters, other than those identified in the impact, donot turn critical after the commissioning of proposed project.To implement the EMP, astructured Environment Management Cell (EMC) interwoven with the existingmanagement system will be created. EMC will undertake regular monitoring of theenvironment and conduct yearly audit of the environmental performance during theconstruction of the project. It will also check that the stipulated measures are beingsatisfactorily implemented and operated. It shall also co-ordinate with local authorities tosee that all environmental measures are well coordinated. A comprehensiveenvironmental monitoring program that has been prepared for the purpose ofimplementationintheproposedresidentialcolonyby the EMCisdescribed below:
    - TheAmbient Airquality shallbe monitored atprojectSite andtwo upwardanddownstream locations once every quarterfor RSPM, SPM, NOx& SO2, and COlevelsduringtheConstructionPhaseandOperationalPhase.TheAmbientNoiseLevelsshall also bemonitored once everysix months.
    - The Vehicles shall be checked for PUC once every quarter during the developmentperiodand records shall bemaintained.
    - GroundwaterqualityoftheTubewellsinsiteareawillberegularlymonitoredpreferablyonceinaquarter during thedevelopmentperiod.
    - SewageTreatmentPlantshallbeprovidedwithasmallLaboratoryandweeklymonitoring of the parameters shall be undertaken. In addition monitoring shall be gotdonefromanindependentagencyaslaiddownbyHimachalPradeshStateEnvironment Protection & Pollution Control Board. All the above observations will becompliedanddocumentedby theEMCto servethefollowing purposes.
    - Identificationofanyenvironmentalproblemsthatareoccurringinthearea.
    - Initiatingorprovidingsolutiontothoseproblemsthroughdesignedchannelsandverificationoftheimplementationstatus.
    - Controllingactivitiesinsidetheproject,untiltheenvironmentalproblemhasbeencorrected.
    - Suitablyrespondingtoemergencysituations.

The environmental parameters likely to be affected by mining are related to many factors, i.e.,physical social, economic, agriculture and aesthetic. Opencast mining involves extraction ofunderneath minerals, it’s dumping and dumping of waste along with other operations, viz,traffic network, and other vehicular movements. All the operations can disturb environment ofthe area in various ways, such as removal of mass, change of landscape, displacement ofhuman settlement, flora and fauna of the area, surface drainage, change in air, water and soilquality. While for the purpose of and economic upliftment of people, there is a need forestablishment of industrial project, but these have to be environmentally friendly. Therefore itis essential to assess the impacts of mining on different environmental parameters, beforestarting the mining operations, so that abatement measures could be planned in advance foreco-friendly mining in the area. The increasing awareness among the people about ecologicalimbalance and environmental degradation has raised many apprehensions which should beclarified. The impacts on different environmental parameters due to this mining project arediscussedbelow:

#### IMPACTONSOILANDLANDUSEPATTERN

**ImpactofMiningonSoilEnvironment**

There may be some impact on soil of the study area located beyond the working area of themining project due to pollution to air & water, which are the distant carriers of solid, liquid &gaseous matters. Soil samples will be collected and tested regularly for the study area, whichwill show us if there is any effect. By proper mitigation measures, the impact on the soilenvironmentofthestudyarea duetothe miningactivitiescanbecontrolled/minimized.

#### Impact onLandusePattern

Absence of scientific approach for waste recycling through land application may result indegradation of surrounding land. However, controlled recycling through land application, assuggestedinenvironmentalmanagementplan,willresultinimprovedlandusepattern,vegetation and aesthetic quality of surrounding landscape. There may not be any adverseimpact on existing vegetation due to the project activity,whenproper mitigating measuresandorproperreclamation measuresare adopted.

#### ImpactonTopography

Due to mining activity, the topography does change. By proper planning of excavation, road,dumps, & green belt development, plantation, the aesthetic beauty of area can be enhanced.Thisifnotattended properly,the derelictedshapewill leadtouglytopography.

#### ImpactonVegetation

Followingimpactsareinevitable:

1. Deforestationrequiredfor thedevelopmentof themine.
2. Deforestation requiredforthedevelopmentofinfrastructuresuchas approachroads etc.
3. Impactdue torollingdownoftheboulders.
4. Dispersion incharacteristicsoforiginalsoildue towaste dumps.

The impact can be nullified or even better landscape and greenery can be developed by bettereffortson re-vegetationofareaafterminingis overinthat part ofland.

#### IMPACT OF MINING ACTIVITIES ON AGRICULTURALPRACTICEOFTHEAREA

The crops grown in the area are primarily wheat in Rabi crop and paddy and maize duringKharif. Besides small areas are also cropped with vegetables including onion, ginger andpotato. There is no commercial orchard in the area. The crop yield may be affected either duetochangeinsoilcharacteristicsorreductioninagriculturalarea.Unlesssoilremainunaffected by less or no pollution effect or mined out area is converted back to agriculturallandby backfilling& soil cappingoverit.

#### Impact of Mining Activity on Floral and FaunalEnvironment oftheArea

The mining activities have some effect on flora and fauna of the area anditssurroundings toareasonabledistance.Impact onflora/faunaisdueto:

1. Deforestation
2. Blastingoperations&othersounds
3. Interferenceduetohumanpopulation
4. Electrification

The impact on flora and fauna is un-avoidable during operation phase unless efforts are madeto divert them away, by creating suitable environment in extension areas, & restoring thedisturbedareaback to original.

#### IMPACT ONWATERREGIME

It is apprehended that mining activity causes lowering of water table in the area.touched. Theclean mining will have nil to marginal impact. There could be a long term impact on waterresources of the region due to removal of limestone which may be serving as water retentionbody.This,thoughcorrectintheory,isnotgoingtobesignificant incase ofManal

LimestoneMinedue tothe following:-

i.)The totalplan area oflimestonebodydoesnot exceed1.5Sq.kms.

ii.) If the entire area retains 50% of 2000 mm annual rainfall, the quantity of storage waterwillbeveryless,

iii.) If this quantity of water is released over 150 days, the average rate of release will be10,000 m3/day or less than 0.1 cusecs. This will be very small quantity to affect the waterbalance ofthearea,

#### IMPACTONAIRQUALITY

**AirPollutionduetoMining**

1. ***GaseousPollution***

Thegaseouspollutants(SO2,NOxandCO)areanticipatedbyHEMMlike,excavator,dumpers, dozer, compressor and other transport vehicles. By proper mitigation measures vizbettermaintenance andefficientoperation&utilizationwillkeeppollutionunder control.

1. *Suspended ParticulateMatter*

Thegeneration of dustis anticipated fromvarious mining activities i.e. dozing,drilling,blasting, loading, haulage and other transport activities related to mining. These will increaseSPM/RPM in the area if no mitigative measures are taken. Dust suppressive, green belt &efficientoperation will keep it in undercontrol.

#### IMPACTOFNOISE

**NoiseandVibrationProblems**

Thegroundandnoise vibrationsare producedduringfollowingoperations:-

1. Drillingandblasting.
2. Movementof miningequipmentlikeshovels,dumpers,drills,dozers,rippersetc.
3. WorkshopandgaragewheremaintenanceofheavyearthmovingequipmentsandLightvehiclesis done,
4. Noisevibrationsproduced bycrushingplant.

Thenoisegeneratingsourcesaregroupedundertwoheads:

1. Noise dueto blastingoperations.
2. Noisefrom miningandalliedequipments.

By propermitigationmeasures,these aretobekeptundercontrol.

#### Noiseandvibrationsduetoblasting

Noise and vibrations produced due to blasting operations is not a continuous phenomenon,thoughrepetitive,hencelesshazardoustothenearbyareas.Theblastingwasnormallyperformedonceinsix dayscontrolledblastinggives lessnoiseandvibration.

#### Noise and vibration due to movement of mining and alliedequipment

Operationofminingequipmentsisacontinuoussourceofnoisepollutionanddirectlyproportional to the equipments concentration at a point. These equipments generally createnoise levels of about 75 db. at a distance of about 15m. This however, is localized within thevicinity of the equipments. The operator's cabin if equipped with sound-proof system and useofearplugsto operationwillkeepthem safe from badeffectofnoise.

#### SOCIO-ECONOMICIMPACT

**SocialDemographicProfile**

The mines activity generates a lot of socio-economic benefits to the people of the area. Inminesnumbersofskilledandunskilledlocalworkersareemployed.Theminesgeneratedirect and indirect employment to persons. Additional facilities such as medical, educationalandtransportationaremadeavailabletothelocalpopulation.Theimpactsondifferentcomponents viz. employment, housing, education, medical and transporting facilities, fuelavailability, economic status, health and agriculture are increased to the best level. Whileassessing the socioeconomic and sociological impact, it has been noticed that economic statusof the people, level of literacy,general health standards,life style, quality of residentialhouses,etcdefinitelyimprovesinsurroundingareas.Thelivingstandardsalsoimprovegenerally.

#### OccupationalHealthandSafety

There will be some health and safety hazards, which may affect the persons employed in themine. The people may suffer from occupational diseases or may get injured while working inthemine.Therefore, propermeasuresarerequiredtoprotect thepersons fromthese hazards.

#### HistoricalMonuments

No public place/building or monument of historical and archeological value exists in the studyarea.ThenearestplaceofculturalandarcheologicalortouristimportanceintheareaisPaonta Sahib, 22 km in SE direction and Renuka 32 km in NW direction of Manal limestonemineareaby road.

#### Mathematicalmodels

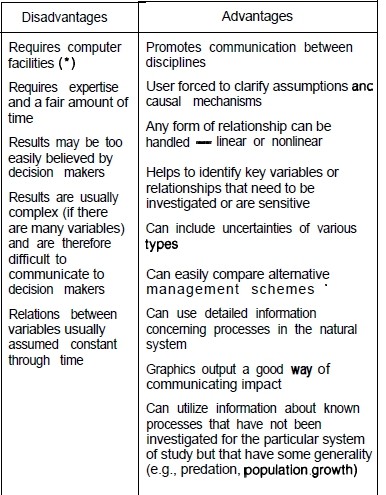
Many problems arise in the evaluation of environmental impacts due to new projects; forinstance:the determination of the pertinentvariables,the choice of methodologyto follow,theneedtoinformtheprojectproponentandregulatoryagenciesateverystepoftheevaluation process, and to present the best assessments possible for a variety of alternatives,thenecessitytoprovideunderstandableinformationtothepublic.Theseproblemsareemphasized by the presence of many specialists of different disciplines who have to find acommon language to integrate their experiences towards the same aim: the prediction of theimpactsofanewproject.Mathematicalmodelingpresentsaunifiedwaytomeettheserequirements. The study was divided into two parts: abiotic and biotic models. Abiotic modelsinclude water quality and water management modelling. Biotic models take into account thebiological aspects which have been used for impact assessments. The work is based primarilyon visits to groups that are active in using modelling (or creating models) and simulation forimpactassessmentand on literaturesurveys

*All decision making involves an implicit (if not explicit) use of models, since the decisionmaker invariably has a causal relationship in mind when he mskes a decision. Mathematicalmodellingcanthereforeberegardedasa formalizationofdecision-making processes.*

Usually environmental management encompasses the following steps: perception of needs,problemdefinitionandmonitoringprogram,problemanalysisandmodelling,simulationtotestalternativestrategies,-Evaluationofalternatives,Selectionbydecisionmakers,Implementationandmonitoringprogram.

Modelling plays an important role in the decision-making process. However, the results areuncertain because: the conceptual analysis (summation of “mental” evaluations and physicalconcepts) is incomplete, the mathematical relations used are representative of presentknowledge,someuncontrollableorunpredictableeven(e.g., naturalcatastrophe)can occur.

#### AdvantagesandDisadvantagesofSimulationModelling:



**FROM BLACKBOXTOWHITEBOX**

Mathematical models are based on the fundamental concepts of physical systems. A physicalsystemisdescribedbyafewmeasurablevariablesandwell-definedboundaries.Modellingthe environment requires finding analytical relationships between variables knowing someresponses of the system under various stimuli. This is known as an inverse problem (Karplus1983) because it can be solved by a variety of mathematical relations. A simple algebraicmode,knownasablackbox,canrepresenttheresponseofasystemforveryspecificapplications. If the model is to be used in a wide spectrum of different situations, it has to relyasmuchaspossibleonprinciplesofphysicalsystems(conservationprinciplesofmass,energyandmomentum).Mostofthetime(Taft1965)duetonumerousfactors(computatiorial limits, unknown parameters, complexity of the formulation,...), mathematicalmodels are simplified, taking into account only some of the fundamental equations. So, in airpollution,eveninthecaseofwindfieldmodelling,theprincipleofmas$conservationaloneis taken into account. Inwater modelling, equations of mass and momentum are c&rentfjUsed,simplifyingassumptionsbeingmadeeitheronspatial“fepresentation(e.g.,omittingone or two dimensions) or on the transient nature of the system. With this perspective, itappears that the robustness of a model will depend updn‘the assumptions which have beenmade. Figure I, taken from Karplus (1983) presents this situation, It appears, that air pollutionand ecological modelling are still at the boundaries between clean mechanistic models (whiteboxmodels)andmodelswithincompletelyknownfactors(blackboxmodels).ThisuncertaintyinthemodelsAsstated byKarpius(1983):Imust beconsideredcarefully.

*it is important to\_ recognize, in evaluating and in using mathematical models, that each* shadeofgrayin the

*spectrum carries with it a built-in “validity factor”. The ultimate use of a model must conformtotheexpectedvalidityo themode/.*

#### SCOPE, VERIFICATION, CALIBRATION ANDVALIDATIONOFMODELS

The precision required of a mathematical model depends upon the output expected from thatmodel.ThestudiesconductedinEIAcanbeschematizedintwoparts.Thefirstisevaluationof different strategies: In such situations, we wish to rank several scenarios which have beenpreviously established. This is the case when several options are in balance. In response to thequestion, “Is it better to develop coal or nuclear plants?“, the decision maker does not ask foran evaluation of his energy policy. He is looking for the optimum way to apply his policy. Inthat perspective, models do not need to precisely predict future impacts. Rather, they have torank the different strategies that the proponent is looking at. The model has to be as simple aspossiblewithsomecomparisonorsensitivityanalysistoestablishitscredibility.Thesecondispredictionofnon-compliancewithstandards:Legislationhasestablishedcertainenvironmentalstandards,necessitating assessmentofnewprojectsorproposed

As the mathematical models are intended to help the decision maker, it is of paramountimportance to analyse their limits.Modifications of existing plants. In these cases, the modelsareusedtoevaluateimpactsconsideringtechnicaldatagivenbytheproponents.Modellingcandirectlyaffectequipmentdesign(stackheight,watertreatmentunit,etc.),thereforeprecise prediction is expected by the proponent. Unfortunately, the nature of systems understudyand stateoftheart inmodelling usuallypreclude accuratepredictions.

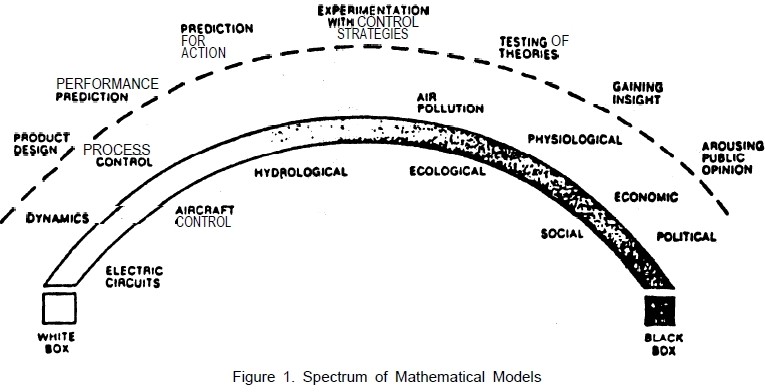
Introductionofahighsecurityfactor(e.g.,asisusuallythecaseinstructuredesign)canmakea project unfeasible. Usually, establishing prediction as precise and reliable as By**calibration,we** meanthatthe parametersof the modelarepossible necessitatesthe utilizationof modelsof

growing chosen. The range of these parameters may be found in the complexity, yieldingsuccessivelylessconservativeevaluations.-literature.CalibrationisdonewhentheparametersoftheIfatanylevelofcomplexitytheprojectrespectsthemodel,whilerespecting some defined ranges, are adjusted to standards, then the modeling effort is endedToestablish credibility of models, we need some concept to measure model accuracy. As seenpreviously, the model might be more reliable if it rests upon physical laws, rather then transferfunctions for which the parameters have been found in a very specific situation. The degree ofconfidence will depend also upon its verification, calibration, and validation (McLeod 1982;Park1982).

**PROBLEMInvestigate**ifa givenprojectwillresult**inanenvironmentalproblem**

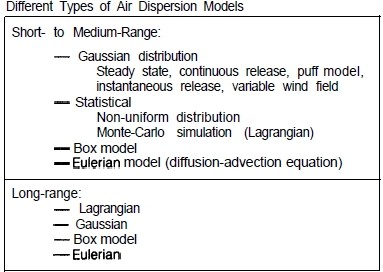
**By verification, we** mean that the fundamental equations with the implied basic assumptionsand the computer code have been checked, and are error-free. It is difficult to get error-freecodes, and techniques of good programming (structured programming with independentlychecked procedures) might be used. The verification of fundamental equations and basicassumptions might involve the proponent and, ideally, independent experts. The robustness ofthe model can be checked with a sensitivity analysis of its parameters and some modificationsmayfollow.

By **validation, we** mean that the model with its previously defined parameters is applied in anewsituationanditsresultsarecomparedwithfieldorlaboratoryexperiments.Thisvalidation step gives to some extent the degree of confidence of the model. This confidence islimited to similar applications. Ifthe natural system is to be perturbedfar from its presentstate,the modelmayonlyyieldat bestthegeneraltrendsoftheperturbedsystem.



**Air dispersion modelling**is, by far, the main mathematical tool used by consultingfirms in the environmental area. This is understandable because air is, with water, oneof the chief dilution and transport media. This is also due to the fact that severalmathematicalmodels areavailable(mainly from U.S. EPA), andareeasytouse.Many

companiesorgovernmentagenciesinhavedevelopedtheirownmodels,andinformation about these models ranges from excellent to very poor. Some calibrationand validation have been done, but the results are not always easy to interpret. Tablegivesaclassification ofthemodelscurrentlyused



Short-range (up to about 10 km) to medium-range (up to about 30 km) models are appliedclose to the source. Long: range models examine the fate of pollutants which travel hundredsor thousands of kilometers, and must generally consider the physical processes of dry and wetpollutant deposition and chemical change. Short-range models are used mainly for hazarddetermination during emergencies, or for assessing impacts of new sources and theircompliance with air quality standards. Long-range models are used for assessing the impactsof distant sources, often in other countries. The impact at any given instant is usually weak,whilethecumulativeeffects may besevere.

#### SHORT-ANDMEDIUM-RANGEMODELS

**GaussianModels**

AirdispersionmodellingislargelydominatedbytheGaussianmodelestablishedsometwentyyearsago(Pasquill-Giffordequations).Thismodelassumesnormaldistributionsofthedirectionofwind.Itpermitsassessmentsofcontinuousorinstantaneousreleaseofpollutants,withorwithoutalinearreactionrateordecay.Furtherdevelopmentshaveconsisted of the inclusion of special features which were not part of the original model:pollutant reflection at the ground and at the inversion lid, introduction of a variety of differentsources (point sources, line sources, area sources, volumic sources, fugitive sources), linearreaction or decay rate, washout by rain, settling of particles, uptake by vegetation or water,topographiceffects,lakeorseabreeze,temporalandspatialvariationofmeteorologicalconditions.GEMIGEMGARisa standardGaussianmodeldeveloped intheUnitedStates.

#### StatisticalModels

Gaussian models cannot constitute the only answer in airmodelling. It was shown by Misra(1982 a,b) and Venkatram (1982) that Gaussian assumptions of normal distributions are notsufficient to represent a convective boundary layer. In that situation, downdraft and updraftplumesarecomposedofstatisticallyindependentdistributionswhichpresentdistinctbehaviors. A normal distribution is kept to model horizontal spreading perpendicular to thewinddirection.Theproductofthedistributionfunctionsgivesanexpressionforthe

concentration which is similar to the Gaussian formulation. Validations of this kind of modelhave been conducted on two different locations (Nanticoke generating station (Misra 1982b)andthelnco stack(Venkatram1982)in Sudbury.Onacompletelydifferentbasis, itispossible to build statistical models from Monte Carlo particle trajectories. Reid (1979b) fromAES applied this technique to estimate vertical dispersion from a ground-level source. Marsanbuilt a model to evaluate the dispersion and impingement on foliage of insecticide dropletssprayed from a plane, based on work done at the University of New Brunswick by Picot. Theresultsofthisshortrange

Lagrangianmodelwerecompared withsitemeasurements.

#### BoxModels

This kind of model assumes constant concentration in a control volume, and has been used topredict average concentrations in cities where the heat-island effect is nonnegligible (summers1967). A box model has been used in a different context by ESL to simulate release of radongas in an open pit mine. This model is built with several adjacent boxes and yields averageconcentrations with time. It has been tested and validated by comparison with a wind tunnelmodel.

#### EulerianModels

These models are based upon the conservation equation, using a co-ordinate system fixed inspace. First-order closure models treat turbulence as diffusion term, and are known as gradienttransport or K models (higher-order closure is not yet used in impact assessment studies). Theuse of gradient transport models is still rare, but they provide some extra possibilities ascompared with Gaussian models. Wind field may vary with space, diffusion parameters mayvary with height, and pollutant kinetics can be as complex as necessary. This method alsopresents several disadvantages. Diffusion parameters are not well known, wind field must becomputedorpartiallyobservedatthesite,andcomputationsarecomplexandleadtonumerical problems. IMPACT is the best-known code (Fabrick et *a/.* 1977) associated withgradient transport models. It contains a submodel (named WEST) which computes the windfield to be non-divergent, with some perturbations to take into account atmospheric stability,while requiring a limited number of meteorological stations to measure wind (typically one ortwo).

#### LONG-RANGEMODELS

**LagrangianModels**

These are based on computation of trajectories between sources and receptors. These modelsare useful to evaluate different strategies of reduction of long-term and long-range pollution(e.g., acid rain). Turbulent diffusion is considered uniform along the vertical. It is also astatistical model because it uses time average rather than meteorological data, except for windfield. This model takes into account four different forms of sulphur (dry and wet Son, dry andwetSod).

Pollutants undergo chemical reactions and are submitted to wet and dry deposition as well asvertical diffusion. Wind field is updated every six hours and the numerical integration isperformed with a time-step of three hours. Precipitation is simulated by way of a Markovchain.Thecumulativeeffectsofdepositionare computed over aseasonora year.

#### GaussianModel

The only model found in this field is MEP model (MEPTRANS code). It follows the sameconcepts as described for short- to medium-range modelling (MUST code). It is a segmentedGaussian model (Gaussian dispersion around a trajectory with four atmospheric layers andmixingdepthvariationswithseasons.IttakesintoaccountSon,SO,wetanddrychemistry

and NO,. Wind field isgenerated by three-hour surfacepressure, andpollutants aretrackedfor fivedays. Somevalidation wasmadefor 1978.

#### BoxModel

ThisapproachhasbeenusedbyMcMahoneta/.(1976)inassociationwithAcres.Assumptions of uniform concentration are made along the vertical and along a circular arcdrawn from the source over an angle representing the angular variation of the plume trajectory.Concentration is lowered with distance as the plume disperses within the widening box. Time-step is one day and meteorogical data are averaged over that time period. Output can be on amonthly,seasonal, or

annual basis. The pollutant trajectory is assumed bounded by the sides of the wedge-shapedbox. Wind data are taken at the station nearest to the receptor considered. (wet and dry), NO,andNo, fortheNovaScotiaPower.

#### EulerianModels

MOE is contracting MEP and ERT to build a gradient transport model for long-range studies.MEP is designing the meteorological model including a detailed profile of the boundary layer.ERT is developing the gradient transport model. The chemistry taken into account is complexand non-linear. At the beginning, the model was looking at 114 different chemical reactions.The number of chemical reactions has been reduced to 35 after some sensitivity analyses. Themodelrequirestwenty-fourhoursofcomputertimeonaCraycomputerforaten-daysimulation,andisstill indevelopment.

#### VALIDATIONSTUDIES

Verification is relatively easy. It can be done comparing output of different models used in thesame relatively simple situation.Forinstance, an Eulerian model can be checked against aGaussianmodel.Calibrationisusuallynotdone.Plumeriseandverticalorhorizontalstandard deviations are computed making a choice between well-known available formulae.However, it is interesting to note that this choice is not always well adapted to Canadianconditions (Reid 1979a). Moreover, measurements conducted on different sites by MOE orHydro-Quebechaveshownthatthe“BRIGGS1975”plumeriseformulaleadstoover-prediction of plume heights. Thus at the Nanticoke generating station (Misra 1982b), factor“1.6” had to be changed to “I”, reducing plume rise by 37 percent. l3C Hydro found largediscrepancies between plume rise generated by Briggs’s formula and measurements made byhelicopter. As cited in the text It is difficult to draw general conclusions from these studies forseveralreasons.

#### HYDROLOGYANDHYDRODYNAMICS

A good knowledge of water flow field is a prerequisite to any water quality modelling. Directmeasurement is seldom sufficient to provide good insight into water motion. Many factorsinfluence the behavior of a body of water: seasonal conditions, rain, snow or ice melting,topography of the bottom, characteristics of the bottom surface, thermal motion, wind at thesurface, tidal effects, Coriolis forces, etc. A mathematical or a physical model must be used toobtaintheflowconditions.

#### HYDROLOGICALMODELLING

Many mathematical models are available to calculate flow rates in rivers over time, requiringonly a few meteorological factors. CEQUEAU model from INRS-Eau is a good example ofsuch a model. This model was first used to find the dimensions of the structures of the LaGrande River reservoirs (instead of stochastic models which were common at this time).Presently, this model is the basis for water quality studies (Ste-Anne River) and water qualitymanagement(YamaskaRiver).Thebasinisdividedintosquareparcelsofequalsurface.

Certain physiographic characteristics are obtained for each parcel: a representative elevationand the percentages of forest, lakes and marches. Each parcel is subdivided along the line ofdrainage, and the direction of water flux is indicated. The only meteorological data used areliquid or solid precipit and minimum and maximum. temperatures on a daily basis. The modeliscalibrated to takeinto account:

* snowbuild-upand melting,
* evaporationand evapotranspiration,
* underground accumulationandflow,
* propagationofwater fromone parceltotheother.

#### WATERQUALITYMODELLING

As stated previously, water quality modelling is closely related to flow field. One equation isused to express conservation of mass and, if necessary, another one to express conservation ofenergy.Thestructuresoftheseequationsarequitesimilar.Inrivers,theequationsareintegrated along the direction of flow (one-dimensional) assuming constant properties in across-section. In lakes and reservoirs, concentration of a pollutant is frequently considered asconstant along the depth, leading to two-dimensional models, and temperature is consideredconstantalongahorizontalplane,leadingtoonedimensionalmodels.Inseveralsituations,the flow field is ignored, assuming a uniform state in the body of water. This is often the casewhenaquick evaluationis needed.

#### ONE-DIMENSIONALMODELS

**AlongtheVertical**

In a lake or a reservoir, it is frequently assumed that temperature is uniform along a horizontalplaneandvaryingwithdepth.Thisassumptioniswellcorroboratedinmanylakesandreservoirs. Most of the models used are derived from the work of Ryan and Harleman in 1971.This approach is based on an energy budget between air and water including short-wave andlong-wave radiation, precipitation, evaporation and convection. Water entering the lake orreservoir is introduced at the depth corresponding to the same temperature level. The work ofRyan and Harleman is currently extended to include ice cover with time and the height of avarying mixed zone due to wind shear stress. These models have given good approximationswhen tested in several lakes and reservoirs. The prediction of dissolved oxygen in lakes andreservoirs is a direct consequence of a temperature profile. The equation is quite similar to thetemperatureequation.Itisnecessarytoincludeare-aerationrateatthesurface.Thedifficultyisto define theoxygenuptakeby sediments,andthisfactorisfrequently ignored.

#### AlongtheFlow

Different models assume homogeneity of parameters over a cross-section perpendicular to theflow. Thesemodelsinclude severalfactors. Beakapplied this kind of modelforpulp andpaper industries in New Brunswick, Ontario and Quebec. It resulted in the development ofwastetreatmentalternativesandoperationalpolicies.Inanotherfield,winteroxygendepletion in a river in Alberta due to decayof algae andmacrophytes was computed;theeffects of a series of weirs was carried out to evaluate their re-aeration rate. CENTREAUmodelled the change of salinity profile following the flow rate reduction in the Eastmain(Dupuis and Ouellet 198 1) and Koksoak (Ouellet and Ropars 1979, 1980) rivers asIn longlakesor reservoirs, the model LARM assumes variation of temperature vertically and alongtheflow.MacLarenuseditforthermalplumingintheBattleRiverReservoir,andforevaporationstudies in theRaffertyReservoir.CCIWcombined atwo-dimensional modelalong a vertical plane for temperature and dissolved oxygen with a two dimensional modelalong a horizontal plane in Lake Erie (Lam et *a/.* 1983). Lam et *al.* (1981) conducted researchtoevaluatetheturbulentdiffusion parametersfromobservations.

#### AlongaHorizontalPlane

These models are used frequently for large bodies of water (lakes, reservoirs, estuaries, etc.).Theyassumehomogeneousconcentrationsontheverticalaxisforactiveorpassivecontaminants.Transportistheresultofflowconvectionandturbulent diffusion

#### THREE-DIMENSIONALMODELS

Thethree-dimensionalconvection-diffusionmodelcanbesolvedanalyticallyinsimplesituations where flow field can be considered uniform. The treatment of boundary conditions,using the image method, is tedious. This model can provide rough estimates of concentrationwithtimeand position.(Marsan hasused it at KitimatArm.).

**WELL-MIXED MODELS** severalcircumstances,a well-mixed modelgivesveryquickestimates of variation of concentration in a body of water with time. This method is useful tolook at mean content of chemical species. Very often, the body of water can be split intoseveralboxes,with somekind ofinformationabout fluxes between boxes

#### GROUNDWATERQUALITYMODELS

Infiltration of liquid pollutants into the ground is becoming a main concern in environmentalstudies. Pollutants can be soluble in water and partially adsorbed and reacted. Liquid (usuallycontaminated water) percolates through porous materials and flows along fractured rock toreach the water table. Acres developed two two-dimensional finite element models to simulategroundwater transport through porous materials and fractured rock. One model is integrated inaverticalplanetorepresentverticalflowandlateraldiffusion.Theothermodelishorizontalto simulate transport into the water table. These models have been applied to leaching fromradioactive and chemicalwastedisposal areas.

#### EROSIONANDSEDIMENTATIONINRIVERS

The cross-section geometry of a river may be altered if its hydrograph or sediment supply ismodifiedby changes inland useorbyriverdevelopments suchasdams.

#### OILSLICKMODELLING

AsstatedbyHuang(1983)thefateandbehaviourofspilledoilisaffectedbyseveralmechanisms:advection,spreading,evaporation,dissolution,emulsification,dispersion,autooxidation,biodegradationandsedimentation.Manymodelscurrentlyusedtreatthefirstmechanism,while neglectingthe otheraspectswhichareimportantto assessthe impacton thesystemunderstudy.Thesedifferentmechanismsarelargelyinfluencedbyphysico-chemicalpropertiesofthespilledoil,andMacKayetal.(1980)developedsomeequationstorepresenttheseproperties.Mackay(1984)distinguishesfourkindsof mathematicalmodelsin thatfield:“real-timetrajectory”modelsforemergencysituations.“environmentalassessment”modelstoevaluatetheimpactofeventualaccidents.“war-games”modelstotrainpeopleinchargeofemergencysituations.“regionalecosystemimpact”modelstoassesslong-termoildevelopmentimpacts on fisheries,forexample.

AESdevelopedtwokindsofmodels.Thefirst(Venkateshet*al.*1981)isusedforanemergencysituationandisimplementedonmini-computersavailableinsixregionalcentresin Canada. The response-time is of the order of a few minutes, and wind forecast for the nextfourty-eight hours is available at any time. This model takes into account the advection of theoil slick by wind-driven and other residual water currents, plus the spreading of the slickaccording to the Fay algorithm. The model has been tested for actual spills. The second model(Hirtetal.1982)developedincollaborationwithMEP,takesintoaccountthesamemechanisms plus weathering effects such as evaporation, emulsification and dissolution in amore elaborate analysis. For instance, the slick is composed of several parcels to representbreak-up from with a more realistic point of view. .An interactive data base gives wind field.Surface currents are derived from Madsen’s formulae. Operational tests gave good predictionsonthelocationofthespillaftertwenty-four hours.

#### RISK AND PATHWAYS ANALYSISPATHWAYSMODELS

Pathwaysmodellingisusedtoexaminethedistributionoraccumulationofpersistentcontaminantsintheenvironment,usuallywithaccumulationinhumansasthedesiredoutcome.

The accumulation within an organism may then be compared with dose-effect data to evaluatethehealthrisktoanindividual.Criticalpathwaysmodelsexaminedosagestothemostexposedmembersofthepopulation.Mostfrequently,pathwaysmodelsareappliedtoradionuclides, but they are also applied to heavy metals and toxic organic compounds. Thepathways for the transmission of the contaminant through the environment are identified, anduptakecoefficientsareusedtoquantifytransfersfromeachstageofapathwaytothenext.The underlyingsystem(e.g.,foodchain) isusuallyconsidered asbeinginsteadystate.

By itself, pathways analysis is a very simple technique to apply since it is essentially linearalgebra.Oneconsultantusesaspreadsheetprogramtomakethesecalculationsonamicrocomputer.

#### EPIDEMIOLOGICALRISKANALYSIS

Epidemiological risk analysis is essentially based on actuarial calculations. Changes in lifeexpectancyastheresultofexposuretosomesortofenvironmentalchangeareusuallyexamined. For example, if one wishes to know the increased risk to the population of theproposed installation of a certain type of industry, one could examine differences in lifeexpectancyaroundsimilarplantsalreadyexistingelsewhere,ascomparedwiththelifeexpectancy of the population as a whole. Such studies have been applied to plant workers anduranium miners in the United States and Canada, but we did not encounter any publicizedstudiesforimpact assessment.

#### ACCIDENTRISKANALYSIS

Accidentriskanalysisisalsobasedonactuarialcalculations..Usingdirectlyapplicablehistoricaldata,orextrapolatedfromindirectlyapplicablehistoricaldata,probabilitiesofcertain occurrences are calculated. These probabilities are then multiplied and/or summed, toarrive at anoverallprobabilitythatacertainseries of events willoccur.

#### BIOTICMODELS

Far andawaythe vast majority of biotic models have beenusedfor researchpurposes only,and their use in impact assessment has been rare. This is because: many models cannot beappliedgenerally,somemodelshaveprohibitiveinputrequirements,welackadequatequantitative knowledge to model reliably certain processes, especially fluxes of material orenergy between trophic levels,many models aretautologicalin nature, there is a lack ofconfidence in biological models, most biological models have not been validated, there is alackof personnelwith expertise in both biologyand modelling,and quantitative impactpredictionsforbiologicalcomponentsarenotalwaysrequiredbyregulatingagencies.Evenin the academic community there is controversy about the usefulness of biological models.Confronted with these factors, few consultants are willing to devote the time and expensenecessaryforthedevelopmentand/orimplementationofamodel.Inpre-projectimpactassessments reviewed, the only explicit dynamic biological models found were for the sprucebudworm in terrestrial systems or for bacteria in aquatic systems. Implicit modelling is morefrequent. For instance,when a waterquality model examines BOD5,there is implicit modelof the organisms consuming the oxygen. Carbon and phosphorus.cycling are other examplesof implicit biological modelling. Implicit modelling was used for almost all processes inSEBJ’s model of water quality changes as a result of decomposition of vegetation and soil inthe LG-2 reservoir. Somewhat farther removed are models that consider habitat “accounting”,wherechangesintheamountofavailablehabitatarecalculatedbasedonman-induced

changes such as water level or land use? Pathwaysmodels can also be seen as implicitbiological models, since biota are parts (or the endpoints) of the pathways but they themselvesare not necessarily modelled. Since these types of models have been covered elsewhere, thisdiscussion is limited to explicit models. Explicit models of biota are usually compartmentaland treat the various components under examination in terms of biomass, energy, or numbersof individuals. Biomass and energy are in fact equivalent, since biomass can be seen asrepresentingstored potential energy,respiration and naturalmortality as entropy,predationand grazing as energy transfers, etc. For these two approaches, populations are consideredhomogeneous. An example of a biomass model is SEBJ’s phytoplankton model for the LG-2reservoir. When numbers of individuals are used, there is usually also an age structure in thepopulation (e.g., immature VS. mature). In addition to population size, age distribution is alsofollowed over time. An example of this type is spruce budworm modelling as done for NewBrunswick(TaskForce1976)and,by Marsan,forQuebec.

#### MODELLINGAPPROACHES

Bioticmodelscanbegroupedroughlyintotwocategoriesaccordingtotheiroutput:quantitativeandquasi-quantitative.Quantitativemodelsareintendedtogiveprecisepredictions. Quasi-quantitative models are instead intended to give relative predictions, andsometimesthepredictionsarenottheactualpurposeofsuchmodels.Thedividinglinebetween the two types is not clear-cut, because some quasi-quantitative models can give fairlypreciseresults.

#### QuantitativeModels

The use of quantitative models has been far less frequent for biological impact prediction thanfor other aspects of the environment. The work that has been done has for the most partexamined aquatic systems, linked with or part of water quality models. Typical biotic statevariablesarebacteria(usuallycoiiforms),primaryproductivityorchlorophyll-aorphytoplankton, zooplankton, and fish. Most of these models have been research-oriented, buttheyhavebeenapplied by CCIW,SEBJ andBeak.

#### Quasi-QuantitativeModels

These models have been applied to a certain extent in impact assessment, particularly byEnvironmental and Social Systems Analysts Ltd. (ESSA) and associates at the University ofBritish Columbia in what is called adaptive environmental assessment. Examples of use ofthesemodelsincludemanagementoftheBritishColumbiasalmonfisheries,prestudyplanningfortheMackenzieDelta(LiardRiverdeveiopment),andsprucebudwormmanagementinNewBrunswick.MarsanhasappliedthelattermodeltoQuebec.Thesemodelsare used to give relative evaluations of the impacts of policy alternatives, or in somecases, the applications are heuristic to suggest possible types of impacts and focus subsequentresearch directions. The philosophy of such models is that the information and detail requiredto makeprecise predictions arefrequently eitherunobtainable orimpracticalto obtain, butthat by using available quantitative, functional, and empirical information, part of the generalbehaviourofthe systemcanbemimicked.Ifand whenadditionalinformation anddatabecome available, they are incorporated into the model, and sensitivity analyses can direct theeffortsofinformation collection.

#### COMMUNITYTYPES

**AquaticModels**

A large number of aquatic food-chain models have been developed at research institutes anduniversities,butrarelyhavetheybeenappliedtoimpactassessmentinCanada.Applicationsof such models have been done for the Great Lakes (CCIW) and the LG-2 reservoir (SEBJ).Norecol has used the MINI-CLEANER model. Such models are usually linked with waterqualityandtransportmodels,oratleastrequireflowratesandwaterqualityparameters(e.g.,

temperature,oxygen,phosphorus,nitrogen,etc.)asinputs.Allsuchmodelsaresimilarinstructure, and a general examination of these can be found in Jorgensen (1980) and Platt et *al.*(1981).Dynamicfishmodelshavebeenusedtocomparedifferentscenariosformanagementandexploitationofpelagicstocks,especiallyinBritishColumbia(Holling1978).Thesemodelsareusuallybasedonnumbersofindividuals,withanexplicitagestructureinthepopulation.Degreeofexploitationandhatcherymanagementisthemajorperturbationscompared,andfactorsexternaltothequestionsofprimeinterestareconsideredtobeconstant.Fishmodelsdifferinspatialrepresentationsfromotheraquaticmodels,duetothehighdegreeofnon-passivemobility offish.

#### TerrestrialModels

These models may examine from one to several species, and infrequently group variousspecies together into a smaller number of compartments. The model of the spruce budworm(Holling 1978; Marsan and Coupal 1981) is an example of a terrestrial model. Budwormpopulation dynamics and forest growth are modelled together, including cross effects. Forestmanagement and insecticide-spraying scenarios are superimposed to evaluate changes in thesystem.Other examples areESSA’s model for evaluatingexploitation ratesfor fur-bearersand ungulates. A model written by the U.S. Fish and Game service evaluates the effects onsummer pest bird densities in the northern United States and Canada resulting from controlmeasurescarriedoutatthewintering grounds inthesouthernUnited States.

#### DATAPROBLEMS

Data problems have plagued quantitative modelling of aquatic systems. Plankton tend to havepatchy distributions, reducing the reliability of density estimates. Patchiness is taken to theextreme in benthic communities, and even researchmodels havetended to ignorethem.Above-sediment macrophyte production is relatively easy to sample, but root biomass is moredifficult. Bacteria, frequently representing negligible biomass but the largest gross turnover ofmaterial, are usually neglected, except, for example, in Beak’s studies evaluating wastewatertreatment.Commerciallyimportantfish**species**arethebest-knownelementsofaquaticsystems,duetolargedata-collectioneffortsformanagementpurposes.Terrestrialmodelshave had greater data problems than aquatic models. A major reason for this is that aquatic(freshwater)systemshavefixedboundaries,andimmigrationemigrationacrosstheseboundaries is limited and quantificiable (e.g. plankton densities in water entering a lake). Incontrast, terrestrial study areas seldom have rigid boundaries. Terrestrial animals, especiallybirds, have a high degree of mobility across these boundaries, and such movement can bedifficult to quantify. (The same is of course true of ocean movements of pelagic fish). Asspatialscaleincreases,thisdifficultyisreducedbutaccuratepopulationestimationcanbecome more difficult. Naturallysuchproblemsdo notexistfor forestmodels.

#### MODELVALIDATION

General validation of biological models hasbeen weakto date. Many models simply cannotbe validated in the strictest sense because the output is in too general a form to be comparedwith specific data. Quite often these models are not meant to be validated anyway. Some othermodels operate over such a long time-scale that validation may not be possible until a decadeormoreafterthesimulationpredictionshavebeenmade.Eveninsomestudieswherevalidation has been attempted, the results have been inconclusive. A case in point is a studyusing a variant of the model CLEANER (Collins 1980). In this study, a very complicatedmodel of plankton dynamics was calibrated to data collected over a one-year period at alake,and was subsequently applied (again over a one-year period) at another lake. Since themodel predictions did not diverge much from observations in the second lake, the model andassociated parameters were considered to be validated. However, there are two problems withthis procedure. One year of data collection may not be adequate to find good parameterestimates (Simons and Lam 1980). In addition, even where parameters have been estimatedusingarelativelylongtime-seriesofdata,applicationofthesamemodelanddatatoanother

location for only a one-year period may not show divergence from observations, while over alonger period divergence becomes significant (Morrison et *al.* 1985). Even if a model hasundergone rigorous validation, there may still be problems. A model that is valid for a systemundergoing limited or no perturbations may not be suitable for a system undergoing radicalmodifications.Thevalidation problemis serious,becauseconfidenceinmodelresults isdirectly related to model validity. There are only a few projects where post project monitoringhas had the time scale necessary for model validation. This situation may **not** improve untilprojectproponentsarerequiredtoundertakelong-scalepost-projectmonitoring.Themonitoringproblem is notuniquetobiological models.

**UNIT-4**

**ASSEMENT OF IMPACT ON VEGETATION AND WILDLIFE**

**INTRODUCTION**

In this section environmental impacts related to construction and the operational phase of theProject are discussed and remedial measures proposed. Options for impact mitigation duringdetailed design are also indicated. Distinction will be made between significant positive andnegativeimpacts,directandindirectimpacts,temporaryandlong-termimpacts.Wherepossible, expected impacts will be described quantitatively and indications made on theirgeographicalextent,thesizeoftheaffectedpopulation,themagnitudeandcomplexity,probability,duration, frequencyandreversibility oftheimpact.

#### IMPACTS ONAMBIENTAIRQUALITYANDTHEIRMITIGATION

Impacts on ambient air quality will occur during the construction and the operational phase oftheProject:*Duringconstruction*dustdevelopmentwilloccurasanimmediateresultofclearanceoperations,site preparation, andthe movement ofheavyconstruction equipment.The operation of heavy machinery will adversely affect air quality through the emission of airpollutants. This impact would affect the workforce, the personnel attached to the DWC Storeadjacent to the site, and the Mandir. The effect of construction-related dust development andair pollution will be short time and local. As regards human settlements the level and thussignificance of such impact can most effectively be reduced by generally avoiding haulage ofmaterials through narrow village roads. Where this cannot be totally avoided another effectivemitigation measure would be to require contractors to regularly water haul routes in sensitivesectionsduringdryperiods.Thepotentialimpactofairanddustpollutiononboththeworkforce and local residents can best be minimized at source by proper maintenance andhandling of construction equipment and by providing appropriate protective working gear(masks,gogglesetc.)asrequired.Duringthe“*Operation”Phase,*impactsonairqualitywillbe due to human activities of a domestic nature and to movement of private vehicles – inparticular cars – within the Housing Estate. Given the size of the development, such impactsare estimated to beinsignificant.

#### Impacts onSoilsandtheirMitigation

The most significant impact on soils will be the permanent and irreversible loss of land due tothe construction of the Housing Estate. Additional areas will be impaired through compactionduetothemovementofheavyvehiclesandequipment-whichareaswilleventuallybeconstructed upon to provide for accesses within the property.In the context of the Project thenet loss of soils cannot be avoided, but the scale of the overall impact will be minimized asfollows: The topsoil will be removed from the working EIA NHDC Project Cap MalheureuxFeb 2011 VI – 2area during the early stages of site preparation and be temporarily stockpiledatsuitable locations. Later onthe top soilwill be reusedin landscapingworks.The cost forthis measure will be made a separately priced item in the BoQ to secure implementation. TheSupervising Engineer shall ensure that the Contractor complies strictly with the requirementsoftheworks contract concerning this issue.

#### Impacts onGeomorphologyandtheirMitigation

The impact of the Project on the natural relief will be permanent and irreversible but restrictedto the project site. The scale of the physical and visual impact can be effectively mitigatedthrough appropriate landscaping measures within the property. It may also be noted that thedegreeofthevisualimpact(s)is memoryandtimerelated.Viewedfromthis angle,itmayalsobesaid that suchvisual impacts are, in fact,temporal.

#### Impacts onWaterResourcesandtheirMitigation

As already mentioned earlier, there are no natural watercourses either crossing the project siteor in the nearby vicinity. Consequently, the project will not have any significant impact on thequality of any surface waters. Further, since all wastewaters will be treated through a STP andtreated to the tertiary level for use as irrigation water for lawns and other landscaping works,thequality ofgroundwaterwillnot beimpacted upon.

#### Impacts onTerrestrial Flora andFaunaandtheirMitigation

It can safely be concluded that the project is not going to have any negative impact on thebiological environment On the contrary, since the built up area will cover only 19% of thearea of the site, the project will provide good opportunities to planting native plants and toenhancinghabitats forbirds andreptiles.

#### NoiseImpacts andTheirMitigation

Construction noise is often explained as sound that is unwanted by the listener. Sound,pressure and noise are measured in units of decibel (dB) using a logarithmic scale. If a soundis increased by 10 dB, it is perceived as a doubling in loudness. Changes in a sound by 3dB(A)2 is barely perceptible to the human ear. Noise is said to cause more off-site complaintsthan any other topic. Construction activities causing the greatest noise problems are: piling,use of pneumatic tools, demolition, earthmoving; scabbling (roughening of concrete surfaces);concrete pours; blasting and maintenance works.2 The unit dBA means that the measuredlevel is in decibels and that it has been passed through a filter so that it represents a level ofnoise that is very close to what can be perceived by the human ear EIA NHDC Project CapMalheureux Feb 2011 VI - 3 Excessive noise levels on site represent a major hazard to siteworkers. If people need to shout to make themselves heard over background noise from a site,background noise is likely to be about 75 – 80 dBA. Continued exposure to noise levels of 90dBA canpermanentlydamagehearing.Suddenor continuousnoiseearlyinthemorningor

late atnight,onrestdaysorholidaysetc.isa frequentreasonforcomplaintsby localresidents.Construction noise problems on site may be most effectively minimized by reducing the levelofnoise generatedatsource,e.g.proper sitemanagementand constructionmethods,plant

used and screening. Where sensitive receptors like residential areas exist in the vicinity of thesite, construction may be limited to the daytime period where less restrictive noise standardsapply(i.e.60 dBAfrom 07:00 to 18:00 hours).

#### ImpactsonLandscapeandTheirMitigation

The impact of the Project on the landscape will be permanent and irreversible, but restrictedto the project site. The scale of the physical and visual impact can be effectively mitigatedthrough appropriate landscaping measures within the property. Further, as already mentionedunder paragraph7.4above,the degree ofthevisualimpact(s)ismemoryand timerelated.

Viewed fromthisangle,itmayalsobe saidthatsuchvisualimpactsare,infact,temporal.

#### Impacts onRoadSafety andTheirMitigation

*During construction* road safety may be impaired through the temporary movement of heavymachinery, bad visibility, muddy, slippery roads etc. Such potential impacts would only betemporary, but may have significant adverse effects at the local level. In general, such riskscan be effectively mitigated through appropriate traffic management, which would include theconstruction site and all temporary haul routes in- and outside the built-up areas. To thisregardthe specificationsshouldrequire the contractor toprovide amethodstatementonhow

heintendstoachieveandeffectivelymaintainroadsafetythroughouttheconstructionprocess.These proposed measures will need to be approved by the Project Manager and will bemonitored by the Supervising Engineer (SE). It may be noted that the site borders the VingtPiedsRoad(B45) toCapMalheureux.Inthisneighbourhood,thetraffic densityisquitelow.

*After the commissioning of the project,* road safety can be maintained and improved by strictlymonitoring compliance with traffic rules and speed limits. However, the scale of thedevelopmentissuchthatroadsafetywillnotbeundulyaffectedbytheproposeddevelopment.EIANHDC Project CapMalheureuxFeb 2011 VI- 4

#### BeneficialImpacts

As already mentioned under Section 3 above, the implementation of the proposed project is inline with Government Policy to provide a roof for everyone. The “Do Nothing” Scenariowould be against such policy, and, obviously, to the detriment of the country. Since themiddle-income group is targeted, the project will result in job creation. Possible jobs willconcern housemaids, gardeners, and other artisans. People in the neighbouring village of CapMalheureux,including fishermen,will certainly benefitfrom theproject.

The **Rapid Environmental Impact Assessment in Disaster** (REA) is a tool to identify,define,andprioritizepotentialenvironmentalimpactsindisastersituations.Asimple,consensus-based qualitative assessment process, involving narratives and rating tables, is usedto identify and rank environmental issues and follow-up actions during a disaster. The REA isbuiltaround conductingsimpleanalysisofinformationinthe following areas:

* Thegeneralcontextofthe disaster.
* Disasterrelated factorswhichmay havean immediateimpactontheenvironment.
* Possibleimmediateenvironmentalimpactsofdisaster agents.
* Unmet basic needs of disaster survivors that could lead to adverse impact on theenvironment.
* Potentialnegativeenvironmentalconsequencesofreliefoperations

The REA is designedfor natural, technologicalor political disasters, andas a best practicetool for effective disaster assessment and management. The REA does not replace an EIA, butfills a gap until an EIA is appropriate. A REA can be use from shortly before a disaster up to120 days after a disaster begins, or for any major stage-change in an extended crisis. The REAdoes not provide answers as to how to resolve environmentalproblems. Itdoes providesufficient information to allow those responding to a disaster to formulate common sensesolutionstomostissuesidentified.Wheresolutionsarenotevident,theREAprovidessufficientinformation to request technical assistance or to advocate action by a third party.The REA contributes to activity and environmental M&E, but does not replace a formal M&Esystem. The REA does not require expert knowledge. Primary REA users are people directlyinvolved in disaster response operations, with a basic knowledge of the disaster managementprocess but no background in environmental issues. The REA process can be used by disastersurvivors with appropriate support. The best results are expected to come when the REA iscompleted with structured input from survivors and organizations providing relief assistance.SectionsoftheREAcanalsobeusedforneedsassessmentandenvironmentalimpactscreeningduringreliefprojectdesign andreview.

*The Rapid Environmental Impact Assessment in Disasters (REA) process involves completingfour modules according to the specific tasks indicated below, preferably though a group-based process. The REA process should begin with a review of the material contained in the****Introduction to the REA*** *section of the Guidelines, and proceed through the four modulessummarizedbelow.*

#### MODULEONE:ORGANIZATIONLEVELASSESSMENT

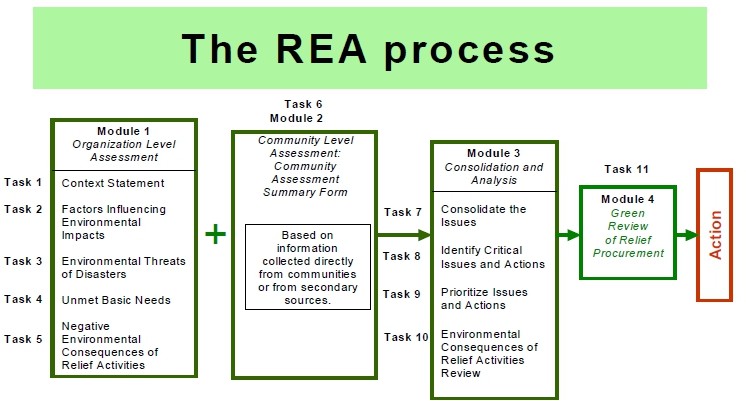
1. Collectbackgroundinformationandidentify assessmentparticipants.
2. Draftthreeparagraphs describingthedisaster forSectionOne.
3. CompleteSectionOne:The**ContextStatement.**
4. CompleteSectionTwocovering**FactorsInfluencingEnvironmentalImpacts.**
5. CompleteSectionThreecovering**Environmental ThreatsofDisasters.**
6. CompleteSectionFourcovering **UnmetBasicNeeds.**
7. Complete Section Five covering **Negative Environmental Consequences of ReliefActivities.**
8. Rank issues by importance within each section as indicated in the *Guidelines.*Note that Sections Two to Five can be completed in break-out sessions.**MODULETWO:COMMUNITYLEVELASSESSMENT**
9. Decideonhowinformationoncommunityperceptionsoftheenvironmentwillbecollected.
10. If a questionnaire or focused discussion method is used, plan, test and administer themethodin communities.
11. Compile the results of the community level assessment into usable form (a report orcompletedquestionnaire)foreach community.
12. If data from other assessments are used, ensure that all the information needed for thismoduleiscollectedorextracted fromexistingassessmentreports.
13. Complete the Community Assessment Summary Form based on the information collectedordrawnfromotherassessments.
14. Ranktheissuesbyrelative importance withineach sectionofthe form.

#### MODULETHREE:CONSOLIDATIONANDANALYSIS

1. Include three to five issues from each section of the Organization and Community LevelAssessmentsontheIssuesConsolidationTableandconsolidate theissuesintoasingle list.
2. Place the single list of issues on the Issues and Actions Table and identify initial actionsandissuesandactions.
3. Prioritize these issues and actions according to the impact on life, welfare and environmenthierarchy.
4. Reviewthepotentialenvironmentalimpactof theactionsandmake changesare appropriate.

#### MODULEFOUR:GREENREVIEWOFRELIEFPROCUREMENT

1. ReviewtheguidanceprovidedinGreenReview ofReliefProcurementmodule.
2. Completetheprocurementscreeningtableprovidedinthe module.
3. Makechangestoprocurementplansasappropriate.



These guidelines for a **Rapid Environmental Impact Assessment** (REA) fill a gap in therangeoftoolsavailabletoassessenvironmentalimpactsduringdisasters.TheREAisdesigned to provide input on environmental conditions in disaster situations in a way which isconvenientforthefastmoving,timecompressedoperationalenvironmentfacedinresponding

toadisaster2.TheREAisoneofseveralinitiativestoimprovethelinkagesbetweensustainable environmental management and disaster response.

#### ConceptsandOutcomes

The REA is based on the concept that identifying and incorporating environmental issues intothe early stages of a disaster response will make relief activities more effective and lay afoundation for a more comprehensive and speedy rehabilitation and recovery. The process andstructureofthe REArecognize thatthosewho respondto disastershavelittle time forindepth research and are not likely to be environmental specialists. A completed REA identifiescritical environmental issues. Some issues arise from conditions existing before the disaster.Others are new to the location or population experiencing the disaster. The nature and impactofenvironmental issues will change during and afterthe disasterand newissues may arise.For these reasons, the output from an REA is not a static assessment but one to be reviewedand revised throughout the post-disaster period. The REA **does not provide answers as tohow to resolve the critical issues** identified in the assessment. A completed REA **doesprovide sufficient information to allow those involved in responding to a disaster toformulatecommonsensesolutions**usinginformationotherwiseavailabletoaddress,mitigate oravoid theissuesraised intheassessment.

Where common sense solutions are not evident or issues are complicated or unclear, a REA**provides sufficient information to request appropriate technical assistance or advocateappropriateaction** by athird party.

#### Approach

TheREAusesasimple,guided,consensus-basedqualitativeassessmentprocessincorporating narratives, rating tables and action lists to develop an overall assessment ofcritical environmental issues and follow-up actions during a disaster. The REA does not callforanyquantitativedatacollection,recognizingthatthisisbothtimeconsumingandoperationally difficult in most disasters. However, quantitative data should be collected andused whenever possible if data collection and use will not slow the overall relief effort. Inaddition, a clear documentation of the REA process and collection of environmental dataduringadisasterwillmakeanEIAforpost-disasterrecoveryplanning easierandmoreaccurate.

#### REAProcess

TheREAprocessisdesignedto:

1. Collectinformationneededtoassess environmentalimpacts,
2. Providesimplestepsforanalyzingthisinformationtoidentifyimportantissuesand
3. Review procurement decisions to reduce the potential negative environmental impacts ofemergencyassistance.

The REA process focuses on the perceptions and concerns about environmental issues anddisaster-environment linkages at two levels. The first level is that of organizations involved inrespondingtoadisaster.Thislevelincludesgovernment,non-governmentandprivateorganizationsthatprovideexternalassistanceandsupportinresponsetoadisaster.Thesecond level is that of communities and groups within communities which are affected by adisaster. Experience shows that those providing disaster relief and those affected directly by adisaster often have different perceptions of the impact of a disaster and corresponding reliefneeds. Identifying organization and community perceptions separately and then consolidatingthese environmental concerns into one set of issues and actions will improve the efficiency ofreliefeffortsbydiminishingthegapinunderstanding betweenreliefprovidersand survivors.

#### AssessmentModules

A complete REA is accomplished through four modules. The first two modules,anOrganization**Level Assessment** and a **Community Level Assessment**, are designed tocollect the basic information necessary to identify critical environmental issues. Thesemodulesfocuson fiveareas:

1. Thegeneralcontextinwhichthe disasteristakingplace,
2. The identification of disaster related factors which may have an immediate impact ontheenvironment,
3. Theidentificationofpossibleimmediateenvironmental impactsof disasteragents,
4. The identification of unmet basic needs of disaster survivors that could lead to anadverseimpact on theenvironment, and,
5. Theidentificationofnegativeenvironmentalconsequences ofreliefoperations.

Theinformationcollectionprocessdiffersbetweenthetwomodules.The**OrganizationLevel Assessment** uses a combination of narrative and rating tables which correspond closelytothefivetopicalareassummarizedabove.The**CommunityLevelAssessment**canuseoneof several sources, including a specifically designed questionnaire, focused discussions, orinformationcollectedduringothertypesofassessments(e.g.,afoodsecurityassessment).The tasks to complete these two assessments are described in more detail in the respectivemodules below. It is possible to complete a rapid environmental impact assessment using onlythe **Organization** or the **Community** level assessment module. Using only the **OrganizationLevel Assessment** is conceivable when there is no opportunity to collect information fromcommunities, as is likely in rapid onset disasters. Given this possibility,the **Organization**level module also provides basic guidance on how to link assessment outcomes to immediaterelief actions. It is **strongly recommended** that if only an **Organization Level Assessment** isinitially done, a **Community Level Assessment** should be completed as soon as possible toavoidany gaps betweenorganization and community levelperceptions ofenvironmentalissues. and how these issues should be addressed. On the other hand, sometimes only a**CommunityLevelAssessment**canbecompletedandanalyzed.However,limitingtheREAto only community level input presumes those organizations (and their personnel) respondingto a disaster do not have their own perceptions of environmental issues and will completelyacceptthecommunity perceptions.Therealityis thatorganizations(andespeciallytheirfunding sources) usually hold strong views on the nature and modalities of relief assistance.Conducting both **Organization** and **Community Level Assessments** ensures that assistanceproviders and survivors are, at the least, not working at cross purposes. The consolidation andanalysis of issues identified in the assessment occurs in the two assessment modules andthroughaseparate**Consolidation andAnalysis**module. Inthe

**Organization Level Assessment,** a preliminary ranking of issues occurs as the result of theissue rating process. In the **Community Level Assessment,** a preliminary ranking of issuesoccurs through the process of extracting information from a questionnaire, reports on focuseddiscussionsorfrom otherassessment reports.

The**ConsolidationandAnalysis**modulemovestheanalysisprocessfurtherbyprovidingsimpleprocedurestohelpconsolidate andprioritizetheissuesidentifiedintheassessments.

Theconsolidationandanalysisprocessdoesnotidentifyspecificsolutionstotheissuesidentified, but does provide a simple approach to initiate the process of addressing the issuesidentified.Thefinalmodule,on**GreenReviewofReliefProcurement**,aidsrelieforganizations in identifying whether the services and material assistance they are providing inresponse to a disaster have the least negative environmental impact possible. This module laysout the background to green (sustainable) procurement and provides a simple evaluation toolforuse inemergencyprocurement.Anumberof sourcesofinformationcanbeusedtosupportthecompletionoftherapidenvironmentalimpactassessment.Annexestothis

*Guidelines* include sources of information on environmental and disaster issues (**Annex A**),generalguidanceonmanaginggroupmeetings(**AnnexC**)andonparticipatoryrapidappraisal (**Annexes F** and **G**).It is important that users fully complete the assessment processbefore taking any significant action to address identified environmental or disaster-relatedproblems. The REA is an incremental process designed to draw together many diverse aspectsof disaster environment linkages. The most significant issues requiring highest priority actionwillnotbefully evidentuntilall theassessmentresults are consolidatedandanalyzed.

#### Good PracticeandStandards

The REA has been developed as a good practice for rapid environmental impact assessment indisasters. The REA is expected to evolve to take into account changes in the way disasters aremanagedandnewinformationsourcesandprocedures.TheREAprocesshasalsobeenlinked,where appropriate, to the minimum humanitarian assistance standards described in the SphereProject Manual (see [http://www.sphereproject.org/).](http://www.sphereproject.org/)) However, completing the REA is notdependent on the Sphere standards, and the REA can easily be used in conjunction withalternatesto theSpherestandard.

#### Applicability

TheREAisdesignedforuseinalltypesofdisastersituations,includingnatural,technological and political events.3 The REA supplements specific technical assessments andactions initiated following a technological disaster. In political disasters, such as a civil war,theremaybeconsiderableperiodswhentheaffectedpopulationsareindisaster-likeconditions.TheREAismostusefulwhenthereisasignificantrapidchangeintheseconditions, such as a change in the mode of conflict, livelihoods or mechanisms of assistance.For instance, the REA process would be extremely useful in developing a rapid response toassist returning populations following a peace agreement ending a civil war. However, anassessment of rapid changesin a long-termsituation needsto take into consideration thatthere are likely to be overlapping short-and long-term environmental issues. Some of theseissues can be addressed through immediate relief efforts, but others need more substantiallong-termsolutions.Theselongertermsolutionsneedtobebasedonamoredetailenvironmental impact assessment than that provided in a REA. The REA can be used inmultiple or concurrent disasters. In these situations there is a need to differentiate between theimpactsofthedifferentdisasters,andcorrespondingdifferentreliefoptionsandoperations.Forinstance, the human and environmentalimpacts of an earthquakeand a droughtaredifferent. Addressing environmental issues arising from each disaster will occur in differenttime frames and require different types of assistance. These differences need to be taken intoaccount in the assessment process, and in the process of linking actions to issues identifiedduringtheassessment.TheREAcanbeusedtoprovideinputintoaMonitoringandEvaluation(M&E)system(discussedbelow).Italsohasusesasthebasisforanenvironmental impact check list in relief project design and as a basis for reviewing plans andoperations.Thisprocessisbestdoneincollaborationwiththepersonsdesigningorrunningthe relief operation. The REA can be modified to reflect the typical disasters and relief andrecoverymodalitiesofaspecificregionorcountry.Suchmodificationshouldfocusonchangingterminologytoreflectlocalapproachestodisastermanagement,eliminatingunneeded items from various rating tables, focusing the community assessment process onlocal conditions and established assessment procedures and integrating the REA process andanalysis into other routinely done disaster assessment procedures or protocols. SignificantlychangingtheREAprocessoreliminatingmodulesisnot recommended.

#### WhentoDoan REA

TheREAisdesignedforuseduringthecriticaldisasterresponseperiod,fromwhenawarningofadisasterisfirstreceiveduntilconditionshavestabilized,normallywithin120

days after a trigger event. This 120-day period provides time to begin an EIA as part of therecovery and rehabilitation process. The REA, besides identifying immediate environmentalfactors relevant to the relief operations, provides data and insight that can be incorporated intothe EIA.The REA should be started as soon as practicable after a warning or start of a disaster.The initial (baseline) assessment should be followed by periodic updates to ensure the REAupdates depends on the nature of the disaster. They should be more frequent in large, quicklyevolving events than smaller, more stable disasters. The immediacy of disaster impact andurgencyof reliefshould be takeninto account in decidingon whetherto use a REAor aformal environmental impact assessment process. For instance, the REA can provide a quickidentificationofcriticalenvironmentalissuesfollowingamajorearthquakeleadingtoconsiderable damage and relief needs over a large area. On the other hand, a REA may not beasurgent,orevenappropriate,foradroughtwhichdevelopsoverseveralyears,whereimpactsareseasonalandtimeis availableto

develop a formal EIA. The REA can be used before a disaster to anticipate environmentalissues and impacts. However, if there is any significant early warning (e.g., in excess of 60days), it is more useful to initiate an EIA as part of the pre-disaster planning and mitigationefforts.

The REA provides a “snap-shot” of environmental conditions at the time it is completed. Bysetting out prioritized critical issues the REA allows for some anticipation of environmentalimpacts. These impacts, and the impact of REA-identified actions, can be assessed throughrevisions of the initial REA. Because the REA is based on perceptions and (often) incompletedata, it should not be used to make hard-and-fast predictions of environmental impacts. TheREAresults,likemuchinthereliefphaseofadisaster,aresubjecttouncertaintyandunanticipatedchanges.

Steps can be taken to prepare for a REA as part of disaster preparedness efforts. Pre disastertaskscaninclude:

1. Trainingstaffintheuseof theREA,
2. Collectionofbackgroundinformation(particularlyfor**SectionOne:ContextStatement**),
3. Reviewing potential hazards and their impacts on potential disaster areas and survivors(**SectionThree:EnvironmentalThreats ofDisasters)**,
4. Screening possible relief interventions for negative environmental impacts (**SectionFive:Negative EnvironmentalConsequencesof Relief Activities**),and,
5. Developing skillsandsystems toquicklycollectinformationfrom communitiesforthe

**CommunityLevelAssessment**module.

Taking these steps will considerably shorten the time needed to conduct the REA during adisaster.

#### LinktoFormalEnvironmentalImpactAssessments

A REA does not replace a formal EIA. Rather, it fills the gap between the start of a disasterand when the formal EIA process can be initiated. This gap is expected to correspond closelyto the120 day relief operations period, with the EIA process coming to play with the designand planning of recovery programs. Data collected and data collection systems establishedthrough a REA can provide important inputs into an EIA. A well-documented REA will aidconsiderably in defining the scope and coverage of an eventual EIA and data collected as partofthe REAorsubsequentM&Eefforts mayhaveusein completinganormalEIA.

#### Users

TheREAisintendedtobeusedbypersonswithnospecificbackgroundinenvironmentalissuesandrelativelylittlebackgroundindisastermanagement.TheprimaryREAusersare

expectedtobegovernment,NGOorIOstaffconductingfieldassessmentsordirectlymanaging relief operations. The REA can be used by communities experiencing a disaster,although this will require additional planning to ensure community participants understand theREA concepts and procedures. In any case, **community involvement in the REA should besoughtwheneverpossible**.The**CommunityLevelAssessment**moduleisspecificallydesignedforthis purpose.

The REA can be used by headquarters or donor staff to screen projects under design or review.In particular, Sections Four and Five of the **Organization Level Assessment** module can beused to quickly assess whether a proposed project has considered and is addressing salientenvironmentalissues.The**GreenReviewofReliefProcurement**module isdesignedtoscreenwhetherprocurementproposedunderaprojecthastakenintoaccountstepstominimizenegativeimpactson theenvironment.

#### PersonnelRequirements

Ideally an initial REA will be completed by a group of persons directly involved in thedisaster response. A group approach promotes the presentation of various views andperspectives on environmental issues and disaster impact. This limits the chance that issues orproblems will be missed in the initial assessment or an individual’s own personal views willresult in a narrow perspective of environmental conditions. This group process should bemanaged by one person charged with leading the assessment process, collecting backgroundinformation,andrecording andkeepingafileoftheassessmentresults.

The REA can be done by a single person. Care is needed, however, to ensure that this personhas adequate time and meansto collect the information needed to accurately complete theREA modules. In addition, having one person completing all four modules of the REA willlikelytakeconsiderabletimeanddetractfromtherapidnatureoftheassessment.Theassessment process laid out in the **Organization Level Assessment** module is best completedby a group of ten to twelve persons. This allows for a diversity of views and for the largergroup to be broken-up into working groups for work on the rating forms. When the REAinvolves planned or on-going projects, the key staff of these projects should be involved incompletingandupdating theREA.

The **Community REA Questionnaire** (provided for in the **Community Level Assessment**module) can be done by one person, although it is preferable for at least two persons to worktogether on completing the questionnaire. To cover as many communities as possible, severalteamscanconcurrentlyadministeranassessmentquestionnaireorotherdatacollectionprocedure to anumberofcommunities.

The REA results should be updated periodically and this updating done by the same groupwhich completed the original assessment. A single person can update a REA, although thisperson needs to have a good knowledge of how the disaster is progressing and of changes inimpacts and relief requirements. As noted, the REA can be done with (or even by) disastersurvivors.Thiswillinvolvemorepre-assessmentpreparationtoensurethecommunityunderstands the concepts and basis for the REA process, and adds to the time and workload oftheoverallassessment. However,the benefits, in improved understanding oflocalconcernsfor the environment and closer links between survivor needs and assistance plans, can besignificantandwarrant theextraworkload.

#### TimeRequiredforCompletion

The timeneededtocompleteafullREAdependson:

* Thenatureof thedisaster,
* Whetherboth**Organization**and**CommunityLevelAssessments** arecompleted,
* Thelevelofpreparationofthosecompletingtheassessment work,and
* The amount of training on the REA which has been provided.The timeneededtocompletethe

**Organization Level Assessment** can range from under four hours to one and one half days,depending on participant familiarity with the REA and the *Guidelines*, the need for translationand the extent of preparations. Itis recommended that four to six hoursbe allocatedtopreparation for the **Organization Level Assessment**, covering the collection of backgroundinformation, drafting parts to the **Context Statement**, and translation of key materials asneeded.

If a number of organizations are involved in the **Organization Level Assessment**, a secondmeetingof the participantsin the initial assessmentis recommendedto validate results oncethe REA has been completed. This validation meeting can require up to two hours with asimilar period of time for preparation of briefing materials. Time needed to complete the**Community Level Assessment** depends on whether the assessment can be based on existinginformationsources(i.e.,otherassessments)orwhetherthereisaneedforaseparatecommunity data collection effort. Experience indicates that administering a questionnaire orfocus discussion process in a community requires two to four hours per group contacted. Inpracticalterms,thismeanscollectinginformationfromonecommunityperdayifthecommunitiesarereasonablyaccessible,withthetotalnumberofdaysdependentonthenumber ofcommunitiesincludedintheassessmentandthenumberof survey teams.

Theextractionandpreliminaryanalysisofcommunityinformation,whetherfromquestionnaires, focused discussions or other assessment reports requires anywhere from fourhourstoonedaydependingonhowwellrecordsarekeptandthenumberofgroupscoveredin the assessment. Needing to read several assessment reports to become familiar with theinformation available can add to the time required. Completing the preliminary analysis at theend of each community visit can shorten the time required to complete a preliminary analysis.Aswith the**Organization.**

#### LevelAssessment,

Good planning and preparations are critical to a rapid completion of the assessment process.Completingthe**ConsolidationandAnalysis**modulecanrequirefromthreehourstouptoadayandahalfofgroupdiscussionsanduptoanadditionalonehalfdaytowrite-upresults.Thetimeneededforthismodulecanbeshortenedbyhavingtheanalysisdonebyoneperson,althoughtheadvantageofusingagroupprocessforvalidationandbuy-intotheassessmentresultsis significant. Theworkneeded to completethe **Green.**

**Review of Relief Procurement** module is relatively short if information is available on theservices or materials to be procured. Ideally, the check list review should be completed asprocurement specifications are developed or procurement plans are reviewed. In this situation,the **Green Review of Relief Procurement** should not add measurably to the time needed tocomplete the normal emergency procurement process. When considering the time needed tocomplete the REA it should be kept in mind that the REA is a **rapid, not a comprehensive**,assessment. The REA is not designed to clarify all possible environmental issues linked to adisaster, or to provide detailed answers to issues which are identified as being critical. Effortsto address issues identified during the assessment should take place after the assessment andnot unnecessarily lengthen the assessment process itself. Completion of the whole REA by asingleindividualwilltakesomewhatlongerthancompletionwithgroupparticipation,particularly because of the time needed to contactand interview knowledgeable persons.UpdatingorrevisinganinitialREA,ifdoneregularlyandbypersonsknowledgeableaboutthedisasterandwhoparticipatedintheinitialREA,shouldtakenomorethanacoupleof

hours.TheREAwillgeneratefollow-upactivities.Thisworkiscloselyrelatedtotasksnecessary for an efficient relief operation and should not add significantly to the disaster-related work load. However, these follow-up activities may lead to work in areas where reliefoperationshavenot beengivensufficientattention,and generate newworkloads.

#### Diversity

The gender, social, cultural, ecological, and economic diversity of the area covered by a rapidenvironmentalimpactassessmentshould be considered in organizing and conducting theassessment.Perceptionofenvironmentalconditions,salientissuesandwaystoaddressenvironmental issues can vary by gender, age, social status, culture and economic status.ParticipantsintheREAshouldreflectthegender,socialandculturaldiversityofthepopulation within the area for which the assessment is being conducted. This is particularlytrue forthe

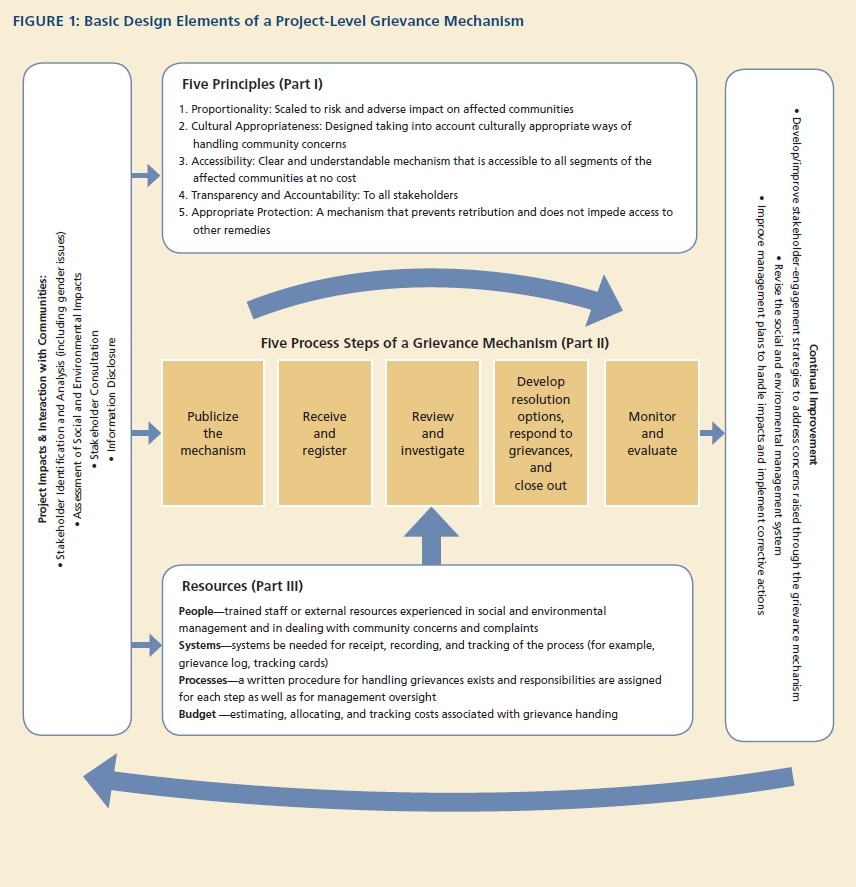
**Community Level Assessment** where contacts with communities should include an accuraterepresentation of the different groups within a community. In turn, this implies that personsparticipating in the REA be aware of the diversity of groups within the assessment target area.TheREAisoflittlevalueifitdoesnotrepresentthesocialenvironmentoftheareaaffectedbyadisaster.

#### MonitoringandEvaluation

The REA can contribute to the monitoring and evaluation (M&E) of relief activities andenvironmental impacts. The initial REA provides a baseline on environmental conditions andissues, and an indication of possible environmental impacts of relief activities. REA updatesprovideinformationusefultomonitorprogresstowardobjectivesandchangesinimpactontheenvironment.Thisinformationcanbeusedinevaluatingreliefandenvironmentalinterventions. The REA can also point to environmental issues to be included in the follow-uptoemergencyinterventionsaswellasidentifypossibleindicatorsfora formalM&Esystem.

Users are cautioned that REA is not a stand-alone M&E system but a tool available to aformally organized and managed M&E process. Over time the REA results will likely becomelessimportantasformalM&Edatacollectionsystemsareinstituted.TheUNHCR*EnvironmentalIndicatorFramework:AMonitoringSystemforEnvironment-RelatedActivities in Refugee Operations* provides a process and indicators which can be adapted tomostdisasterresponsesituationsandcomplementmonitoringdatacollectedthroughtheuseofthe*Guidelines*.

#### Addressingtheissuesrelatedto theProject AffectedPeople:



This Good Practice Note defines a grievance as a concern or complaint raised by an individualoragroupwithincommunitiesaffectedbycompanyoperations.Bothconcernsandcomplaints can result from either real or perceived impacts of a company’s operations, andmay befiled in thesame mannerand handledwith thesame procedure. Thedifferencebetween responses to a concern or to a complaint may be in the specific approaches and theamountof time neededto resolveit. Theterm “grievance”implies thattheremaybe aproblem.Inpractice,however,thenatureoffeedbackthatcommunitiesmaywanttobringtoa company’s attention will vary, since communities often find it appropriate to use the samechannels to communicate not only grievances but also questions, requests for information, andsuggestions.Communities

A project-level grievance mechanism for affected communities is a process for receiving,evaluating,and addressingproject-relatedgrievances from affectedcommunities at the levelof the company, or project.7 In the contextof relatively large projects, this mechanism may alsoaddress grievancesagainstcontractors and subcontractors.

Aproject’sgrievancemechanismshouldbespecificallydesignedwithafocusonlocalcommunities affected by the project.10 The task of understanding who will be potentially affected by project operations, and who will therefore use the company grievance mechanismtoraisecomplaints,isnotalwaysstraightforwardanddependsontheproject’sparticular

circumstances. Thus, it is beneficial to review who may be affected by the project, and thenature of the potential impact, during the broader stakeholder analysis phase of the Social andEnvironmental Assessment. Early and strategic interaction with communities will help ensurethatthegrievancemechanismisculturallyacceptabletoallaffectedgroupswithincommunities,integratestraditionalmechanismsforraisingandresolvingissues,andreasonablyaddressesaccessibility and otherbarriersthatmaypreventcommunities fromraisingtheirconcerns

Principlesofa GoodGrievance Mechanism

Develop specific approaches acceptable to communities for raising and resolving grievances,depending on volume and types of grievances that are anticipated, and the remedies thecompany can offer. In this process, information disclosure and stakeholder consultation withcommunities are key. • Determine the level of detail for grievance mechanism procedures (forexample, a brief procedure document. or an elaborate policy, detailed guidelines for staff, andproceduresforcontractors).•Decideonfinancialresourcestoinvestinproceduresforgrievance receipt and tracking, such as number and locations of places where grievances canbecollected,whetherto establish adedicatedtelephoneline(s),and thetypeof trackingsystem to use (for example, a log or spreadsheet or a computerized system). • Determine thenumber and requirements of personnel dedicated to collecting grievances and managing oroverseeing the entire process, and the expense their training will require. • Decide whetherexternal resources are required, and how and to what extent to involve independent thirdparties.Comprehensivegrievancemechanisms—basedonadetailedpolicy,advancedsystems, and dedicated staff time and resources—are especially useful in situations wherecompanies anticipate a wide range of grievances due to ongoing risks to or adverse impacts onaffectedcommunities, and those whereprojects result in economicor physical displacementor affect indigenous peoples. Less comprehensive grievance mechanisms may be sufficientwhere there are very few people affected and impacts are likely to be low. These projects mayoptforestablishingastraightforward andless formalizedmechanism.

#### ProjectScaleandGrievanceMechanisms

**ProjectswithPotentialSignificantImpacts.**Projectswithpotentialsignificantadverseimpacts that are diverse, irreversible, or unprecedented, and that pose risks to communities,willrequireamoreextensiveandfar-reachinggrievancemechanism.Thesegrievancemechanisms are best established at the outset of the project, and backed up with significanthuman and financial resources. They may offer multiple options for addressing complaints,includingoperation ormonitoringby third parties.

**Projects with Medium Impacts.**Adverse impacts of these projects are limited, site-specific,reversible,andreadilyaddressedbymitigation.Eventhoughtheimpactsmaybelimited,theseprojectsshouldestablishgrievancemechanismsifprojectscanreasonablyexpectgrievances from local communities. In these projects, the mechanism need not be as complexorextensiveasthat inahigh-impact project.

**Projects with No or Minimal Impacts.**Even in projects involving minimal or no adversesocial and environmental impacts, if the project is located near communities, and sporadiccomplaintscanbeexpected,establishingastraightforwardprocedureanddesignatinganindividual within the company to act as a point of contact to receive complaints can fosterpositiveengagementwhenissuesarise.

1 Theimpactsofdevelopmentprojectsoccurindifferentforms.Whilesignificantbenefitsresultforthesociety,theprojectareapeoplemayoftenbearthebruntof

adverse impacts. This can happen, for example, when they are forced to relocate tomake way for such interventions. There is now a growing concern over the fate ofthe displaced people. This has given rise to the need to understand beforehand theimplications of adverse project impacts so that mitigation plans could be put inplace in advance.

1. The National R&R Policy, issued in 2007, recognizes the need to carry out SocialImpact Assessment (SIA) as part of the resettlement planning and implementation processes.Section4.1inChapter IVSocialImpactAssessment(SIA)of thePolicyreadsasfollows:

Wherever it is desired to undertake a new project or expansion of an existing project,whichinvolvesinvoluntarydisplacementof400hundredormorefamilies,*enmasse*in plain areas, or two hundred or more families *en masse* in tribal or hilly areas, DDPblocks or areas mentioned in the Schedule V or Schedule VI to the Constitution, theappropriate Government shall ensure that a Social Impact Assessment (SIA) study iscarriedoutintheproposedaffectedareasinsuchmanner asmay beprescribed.

1. While an assessment of social impacts prior to the commencement of a new project orexpansionofanexistingisnowobligatoryunderthenewnationalR&Rpolicy,theappropriate guidelines for the purpose do not yet exist. This Handbook on Conducting SocialImpactAssessments aims to fill this gap. Itexplains the basic conceptofsocialimpactassessment, the step-by-step process of conducting SIA, and the SIA methodology. In short, itaims to provide practical guidance on carrying out Social Impact Assessment, as envisaged inthenationalR&R policy,2007.
2. There is going to be an increase in demand for a set of how-to-do guidelines onconducting social impact assessments, especially from Government resettlement planning andimplementation agencies. This Handbook has been prepared to meet this demand for projectpersonnel,bothplanners andpractitioners,involvedinconductingR&R operations.
3. In addition, this Handbook will also be useful to consultants, NGOs and the othersinvolved in conducting social impact assessments. Applied social scientists, trainers, NGOs,othersconcernedwithresettlementissues,andtheaffectedpeoplewillalsofindinthisHandbookmuch that is relevantto theirinterests.
4. This Handbook is organized into six chapters. Chapter I is a brief introduction to theHandbook. Chapter II explains the meaning of social impact assessment and what SIA can doto help design projects that genuinely respond to the needs of the affected people. Chapter IIIdescribes the methodology of data collection for purposes of impact assessment. Chapter IVpresents an overview of the principles for social impact assessment. Chapter V outlines stepsinvolved in carrying out social impact assessment. Finally, chapter VI provides guidance onpreparingaSIAReport.

#### SOCIALIMPACTSANDSOCIALIMPACTASSESSMENT

1. Planners and decision makers increasingly recognize the need for better understandingofthesocialconsequencesofpolicies,plans,programmesandprojects(PPPPs).SocialImpactAssessment(shortformforSocio-economicImpactAssessment)helpsinunderstandingsuch impacts.
2. Social Impact Assessment alerts the planners as to the likely benefits and costs of aproposedproject,whichmaybesocialand/oreconomic.Theknowledgeof theselikelyimpactsinadvancecanhelpdecision-makesindecidingwhethertheprojectshouldproceed,

orproceedwithsomechanges,ordroppedcompletely.ThemostusefuloutcomeofaSIAisto develop mitigation plans to overcome the potential negative impacts on individuals andcommunities.

1. SIAs can assist advocacy groups as well. A Social Impact Assessment report, donepainstakingly, showing the real consequences of the project on affected people and suggestingalternativeapproaches,gives credibility totheircampaigns.

AHistorical Overview

1. Social scientists have long been involved in doing impact assessment, almost since thedawn of their discipline. A canal study carried out by Condorcet in the nineteenth century isbelievedtobethe firstSocialImpactAssessment.(Prendergast1989)However,SocialImpactAssessment, as itis knowntoday,emerged much later.
2. The beginnings of social impact assessment can be traced to developments as recent asthoseduringthe1970’s.Bythistime,“developmentagenciesbegantouseimpactassessments–whichwereaboutpredicting,beforethestartofaproject,itslikelyenvironmental, social, and economic consequences – in order to approve, adjust, or reject it.”(Roche 1999: 18)
3. Fromthe early1980s, severalnewmethodsofenquiryemerged,includingRapidRural Appraisal (RRA), Participatory Action Research (PRA), Participatory Rural Appraisal(PRA) (Chambers 1997; Oommen 2007). These sought to make people and communitiesactive participants, ratherthanmereobjectsofassessment.
4. Bytheearly1990s,socialscienceprofessionalswerealsoabletodevelopanacceptablesetofSIAguidelinesandprinciples.(IOCPGSIA:1994and2003,andIAIA:2003)Aroundthis time, thepracticeof SIAalso gotfirmly establishedamongdevelopmentagenciesasawaytoassesstheimpactsofdevelopmentprojectsbeforetheygoahead.SIAisnowpartoftheformalplanningprocessesinmostdevelopmentorganizations.Insomecountries,SIAisalegalrequirement.
5. Social impact assessments have been carried out for a variety of projects, includingprojects in such diverse sectors as water, sanitation and health, coal sector, urban transportsystems,pastoraldevelopmentprogrammes,andlivelihoodsupportprojects(CerneaandKudat 1997; Roche 1999). But it is for resettlement projects that SIAs have been foundparticularlyuseful. ModakandBiswas(1999:209)observe:

Thesubjecthasevolvedbasicallytoidentifyproject-affectedpeopleandfindmeasures to mitigate negative impacts, or compensate irreversible losses following aparticipatoryprocess

1. In recent years, much has been written on applications and methodology of SocialImpact Assessment. The subject is widely taught, often in conjunction with other professionaland academic courses, and training programmes. Numerous consulting firms have come up tooffer SIA expertise in project preparation, implementation, monitoring and evaluation. Thesefirms,alongwithskilledpractitionersandacademicsareregularlyhiredbyprojectstoproduceSIAreportsthatare requiredinadvanceofproposed newprojects fortheirapproval.
2. Inthebeginning,SIAwascarriedoutaspartofEnvironmentalImpactAssessment (EIA). Increasingly, SIA is now carried out as an exercise independently of EIA,because thesearetwo different kinds ofassessments.

Current SceneinIndia

1. InIndia,SIAhasbeengenerallycarriedoutaspartoftheEnvironmentImpactAssessment clearance process. As part of the EIA process it has therefore not received theattentionit deserves.
2. Social Impact Assessment has now become an important part of the projectpreparation process, especially for the preparation of Resettlement Action Plans (RAPs).Inthis process, SIA is carried out as socio-economic survey that identifies social and economicimpacts on peopleandcommunities facing project-induceddisplacement.Inaddition, datathus generated is used in designing mitigation measures as well as in monitoring mitigationimplementation.
3. Resettlement policies have lately made social impact assessment a major part of theresettlement planning process. In 2006, a provision was included for conducting SIA in theOrissaR&RPolicy2006.TheNationalR&RPolicy2007hasmadeaprovisionforconducting SIAwhenever a new project or expansion of an existing project is undertaken.(SeeAnnexIV)Butthisprovisionislimitedtoonlythosecaseswhichinvolvedisplacementof 400 hundred or more families, *en masse* in plain areas, or two hundred or more families *enmasse*intribalorhillyareas,DDPblocksorareasmentionedintheScheduleVorScheduleVI to the Constitution. Undoubtedly, these are good beginnings, but as yet the guidelines togive effecttothesepolicy provisions do notexist.
4. The World Bank, ADB, IFC, UNDP, as well as most multilateral and private agencies,including commercial banks, require some kind of prior social impact assessment for all theprojectsthat they finance.
5. The issue is no longer whether SIA should be carried out or not, but how it should becarried out so that the local people benefit from the project and not lose from it, certainly notthosewhoarepoorto begin with.

WhatareSocialImpacts?

1. SocialImpactsarethechangesthatoccurincommunitiesortoindividualsasaresultofanexternally-inducedchange.IOCPGSIA(2003:231)definessocialimpactsas“theconsequences to human populations of any pubic or private actions that alter the waysinwhichpeoplelive,work,play,relatetooneanother,organizetomeettheirneeds,andgenerally cope as members of society. The term also includes cultural impacts involvingchangestothenorms,values,andbeliefsthatguideandrationalizetheircognitionofthemselvesandtheirsociety.” Social Impactsarebothpositiveandnegative.
2. Changesmayeffect:employment,income,production,wayoflife,culture,community,politicalsystems,environment,healthandwell-being,personalandpropertyrights, and fears and aspirations. These impacts can be positive or negative. In short, a socialimpactis asignificant improvementordeteriorationin people’swell-being.
3. Examples of projects with significantsocial impacts include: dams and reservoirs(disruption due to relocation), power and industrial plants (influx of work force, pressure oninfrastructure), roads and linear projects (dislocation of activity networks), and landfill andhazardouswastedisposal sites (seenashealth risks).

DifferentialImpacts

1. Projects affect different groups differently. Some people tend to benefit, others lose.Often, impacts are particularly severe for vulnerable groups: tribal people, women-headedhouseholds,elderlypersons, landless persons,andthepoor.

TypesofImpacts

1. Notallprojectscausesimilarimpacts.Forexample,impactsthatarecommonlyexperienced in urban projects are different from those in hydropower projects. The commonhydropower projectimpacts includethefollowing:

Submergenceofvastareas,usuallyinhilly,sparselypopulatedregions,inhabitedbyagriculture-dependentruralandtribal communities

* + Forceddisplacement(oftenresultinginimpoverishment)
  + Boomtowns(uncontrolledinfluxofconstructionworkers, crime, socialevils)
  + Downstreamadversechanges inagro-productionsystems

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1. On the other hand, there is no submergence in urban projects. People are affected bylossofjobs, not by lossofagricultural lands.
2. Thefollowingisanillustrativelistof possibleimpacts:

*Social/Cultural*

* + Break-upofcommunitycohesion
  + Disintegrationofsocialsupportsystems
  + Disruptionofwomen’seconomic activities
  + Lossoftime-honouredsacred placesof worship
  + Lossofarcheological sitesandotherculturalproperty

*Economic*

* + Lossofagriculturallands,tress,wells
  + Lossofdwellings and otherfarm buildings
  + Lossofaccess tocommonproperty resources
  + Lossofshops,commercialbuildings
  + Lossofbusinesses/jobs
  + Overallreductioninincomeduetoabove losses

*PublicInfrastructureandservices*

* + Governmentofficebuildings
  + Schoolbuildings
  + Hospitals
  + Roads
  + Streetlighting

IdentifyingImpoverishmentRisks

1. Identifying impoverishment risks which projects often create is part of the exercise toidentifyadverseprojectimpacts.Theimpoverishmentrisksanalysismodeladdssubstantiallyto the tools used for explaining, diagnosing, predicting, and planning for development. (WCD:297) The eight most common impoverishment risks to the project area people, as described byCernea (1996),areas follows:
   * *Landlessness*:Expropriationoflandremovesthemainfoundationuponwhichpeoples’productive systems,commercialactivitiesand livelihoodsareconstructed.
   * *Joblessness*: Loss of employment and wages occurs more in urban areas, but it alsoaffects rural people, depriving landless labourers, service workers, artisans, and smallbusinessownersoftheirsourcesofincome.
   * *Homelessness*: Loss of housing and shelter is temporary for the majority of displacees,but threatens to become chronic for the most vulnerable. Considered in a broadercultural sense, homelessness is also placenessness, loss of a group’s cultural space andidentity.
   * *Marginalization*:Marginalizationoccurswhenfamiliesloseeconomicpowerandspiral downwards. It sets in when new investments in the area are prohibited, longbeforetheactualdisplacement.Middle-incomefarmhouseholdsbecomesmalllandholders; small shopkeepers and craftsmen are downsized and slip below povertythresholds.Economicmarginalizationisoftenaccompaniedbysocialandpsychological marginalization and manifests itself in a downward mobility in socialstatus, displaced persons’ loss of confidence in society and in themselves, a feeling ofinjusticeandincreasedvulnerability.
   * *FoodInsecurity*:Forceddisplacementincreasestheriskthatpeoplewillundergochronic food insecurity, defined as calorie-protein intake levels below the minimumnecessary for normal growth and work. Sudden drops in food crops availability andincomeare endemictophysicalrelocationandhungerlingersasalong-termeffect.
   * *Increased Morbidity and Mortality*: The health of affected persons tends to deterioraterapidly due to malnutrition, increased stress and psychological traumas. Unsafe watersupplyandwastedisposaltendtoproliferateinfectiousdisease,andmorbiditydecreasescapacityandincomes.Theriskishighestfortheweakestpopulationsegments– infants,children, andtheelderly.
   * *LossofAccesstoCommonProperty*:Lossofaccesstocommonlyownedassets(forestlands,waterbodies,grazinglands,andsoon)isoftenoverlookedanduncompensated,particularly fortheassetless.
   * *Social Disarticulation*: Community dispersal means dismantling of structures of socialorganization and loss of mutual help networks. Although this loss of social capital ishardertoquantify,itimpoverishes anddisempowers affectedpersons.
2. TheseadverseimpactsmustbeidentifiedbyaSIAstudy.WCD(2000:241)isemphatic that the impact assessment studies must identify and delineate various categories ofadversely affected people in terms of the natureand extent of their rights, losses and risks.This signals a departure from the way that social impacts were assessed in the past and willempower the planners and stakeholders to incorporate the full extent of social impacts andlossesin thedecision-making process.

WhatisInitialSocialImpact Assessment(ISIA)?

1. An Initial Social Impact Assessment (ISIA) is carried out if the project impacts arelikely to be minor or limited, which can be easily predicted and evaluated, and for whichmitigation measures can also be prescribed easily. Generally, information for ISIA is obtainedduring a field visit to areas that will be affected by the project and through discussions withpeople whom it may affect positively or otherwise. The ISIA is also done to confirm whetherthis indeed requires a full-scale Social Impact Assessment (SIA). Usually a comprehensiveSIAisrequiredfor largeprojects,which entailsamoredetailedstudy, time,and resources.

WhatisSocialImpact Assessment?

1. There is no generally agreed definition of Social Impact Assessment (SIA). It may bedefined as a process that seeks to assess, in advance, the social repercussions that are likely tofollowfromprojectsundertakentopromotedevelopment,suchasdams,mines,industries,

highways, ports, airports, urban development and power projects. It is a tool that can helpdecision-makers to foresee the likely negative impacts of their actions so that steps necessaryto prevent or at least to contain them could be taken in time. As an aid to the decision makingprocess, SIA provides information on social and cultural factors that need to be taken intoaccountin anydecisionthat affects thelivesofprojectareapeople.

1. Goldman and Baum (2000:7) define Social Impact Assessment (SIA) as a method ofanalyzing what impacts actions may have on the social aspects of the environment. It involvescharacterizing the existing state of such aspects of the environment, forecasting how they maychange if a given action or alternative is implemented, and developing means of mitigatingchangesthat are likely tobeadverse from thepoint ofviewoftheaffectedpopulation.
2. The IOCPGSIA (2003: 231) defines SIA in terms of efforts to assess, appraise orestimate, in advance, the social consequences that are likely to follow from proposed actions.These include:specific governmentor private projects,such asconstructionof buildings,sitingpowergenerationfacilities,largetransportationprojects…
3. Finsterbusch and Freudenburg (2002: 409) define the three terms in ‘*Socio-economicImpactAssessment*’‘(socio-economic,impact, andassessment)asfollows:

*Socio-economic*: In essence, the *socio*-half of the term *socio-economic* can be seen ascovering social and cultural impacts of development, and as incorporating the traditionalsubjectmatter of sociology,anthropology,andpsychology,in particular,withinput fromother fields as well. The *economic*-half of the term is generally seen as including not onlyeconomics, but also demography and planning, again with input from other fields, as needed.These areemphases,ratherthan rigiddistinctions.

*Impacts*: The *impacts* are the direct as well as indirect “effects” or “consequences” ofanaction(suchasconstructingadam,diggingacoalmine,orbuildingahighway).“In short, impacts include all of the significant changes that take place because of whatanagencydoes andthat would nothaveoccurredotherwise”

*Assessment*: In the SIA context, *assessment* tends to have an unusual meaning: The“assessment” of impacts is carried out before the impacts actually occur. In otherwords, an SIA is often anticipatory rather than empirical. It attempts to assist theplanning process by identifying the likely effects before they take place. The estimatesoflikelyfutureimpactsarebasedontheexistingempiricalknowledgeoftheimpactsofsimilaractionsinthepast.

AdvantagesofDoingSocialImpact Assessment

The main advantages of doing a systematic Social Impact Assessment (SIA) includethefollowing:

* + *IdentifyingAffectedGroups*:SIAhelpsinidentifyingpeopleandgroupswhoaffectorareaffectedby theproject
  + *Allying Fears and Winning Trust*: SIA can help allay fears of affected groups andbuild a basis of trust and cooperation which is so essential for successful projectimplementation
  + *AvoidingAdverseImpacts*:SIAprovidesthebasisforpreparingmitigationmeasuresto avoid, reduceormanage adverseimpacts
  + *EnhancingPositiveImpacts*:SIApreparationalsohelpsidentifymeasurestomaximize/share projectbenefits
  + *Reducing Costs*: Addressing social impacts at an early stage helps to avoid costlyerrorsin future
  + *GettingApprovalFaster*:AwellpreparedSIAdemonstratesthatsocialimpactsare takenseriouslyand helpsin getting projectclearancefaster

1. Social impact assessment is predicated on the notion that decision makers shouldunderstandthe consequencesof their decisions beforethey actand that the people affectedwill not only be appraised of the effects, but have the opportunity to participate in designingtheirfuture.(IOCPGSIA2003:248)

#### STEPS IN CONDUCTINGSOCIALIMPACTASSESSMENT

1. When planning to conduct a social impact assessment, time spent in preparation israrelywasted.Itisimportant,attheoutset,tobeclearaboutthepurposeoftheassessment,the unit of assessment, time available, the competence of the team for the task, and such otherissues.
2. A social impact assessment process, as WCD (2000) envisaged, should be built onthree elements:
   * A detailed assessment of the socio-economic conditions of the people who may benegativelyaffected(Cernea’srisk assessmentmodel canbe useful);
   * A detailed study of the impacts in terms of the extent of displacement, the loss oflivelihoods, the second-order impacts as a result of submergence, constructionmitigationmeasures,downstreamimpacts,andhost communities;and
   * A detailed plan to mitigate these impacts and an assessment of the costs of suchmeasures.
3. ThischapteroutlinesthestepsinvolvedincarryingouttheSocialImpactAssessmentprocess,andincludessuggestions onhowtofollowthem. (IOCPGSIA1994)

Step1:DefinetheImpactArea

1. The first step is to define the *Area of Impact*. The size of the area varies according to aproject. A dam submerges a large, contiguous geographic area affecting several villages. Theimpact from a highway and other linear projects occurs along the corridor as small strips ofland on either side of the road. The SIA team must get a map showing clearly demarcated areathatwill beaffectedby theproject(both directly andindirectly).
2. Inaddition,fieldvisittotheareaneedstobeundertakentohaveabetterunderstandingofthegeographiclimitsofthearea and thepeoplelivingthere.

Step2:IdentifyInformation/DataRequirementsandtheirSources

1. Review the existing data on impacts likely to follow from the project to see if thatcould be used for assessment purposes. This may provide disaggregated data according tocaste, religion, sex and other administrative categories, such as persons below poverty line.The secondaryshould becheckedasmuch for itsadequacyas for itsreliability.
2. This review will also help identify the need for collection of additional primary datathroughsurveysand participatorymethods.

Step3:InvolveAllAffected Stakeholders

1. Share information and consult with all stakeholders.Stakeholders are people,groups,or institutions which are likely to be affected by a proposed intervention (either negatively orpositively), or those which can affect the outcome of the intervention. Develop and implementaneffectivepublicinvolvementplantoinvolveallinterestedandaffectedstakeholders.The

first step in developing plans for consultation and participation is to identify stakeholders whowill be involved in the consultative processes. The basic questions to consider in identifyingstakeholdersinclude:

* + Whowillbedirectlyorindirectly andpositivelyand negativelyaffected?
  + Whoare themostvulnerable groups?
  + Whomighthave aninterestorfeel thatthey are affected?
  + Whosupportsor opposesthechangesthattheprojectwillproduce?
  + Whoseoppositioncouldbedetrimentaltothesuccessoftheproject?
  + Whosecooperation,expertise,orinfluencewouldbehelpfultothesuccessoftheproject?

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Step4:ConductScreening

1. SocialImpactAssessment(SIA)processbeginswithscreening.Screeningisundertakenintheverybeginningstagesofprojectdevelopment.Thepurposeofscreeningisto screen out “no significant impacts” from those with significant impacts and get a broadpicture ofthenature,scaleand magnitudeoftheissues.
2. This helps in determining the scope of detailed SIA that would be subsequently carriedout.

Step5:CarryOutScopingintheField

1. Thenextstepisscoping.Essentially,thisinvolvesvisittotheprojectsite,andconsultation with all stakeholders. It is important to confirm their understanding of key issues.On-site appreciationof impacts is indispensable forprojectsthatcause displacementonalarge scale. The local knowledge can be invaluable in finding alternatives that help avoid or atleastreducethemagnitudeandseverityofadverseimpacts.
2. This is an initial assessment of likely impacts and not meant to determine the level ofimpact. It should only identify all of the issues and affected groups to get ‘all the cards on thetable’
3. The next step is undertaking Social ImpactAssessment andthe following are themajoractivities:

Step6:PrepareaSocioeconomicProfileofBaseline Condition

1. To assess the extent of social impacts, it is necessary to assess the socio-economic conditions of the affected people. This assessment generally involves conducting asocioeconomic surveyand abroadbasedconsultation withall affectedgroups.
2. The socioeconomic profiling should not be restricted to adversely affected population.Thesurveyshould include thosewho benefitfromthe employmentandothereconomicopportunitiesgeneratedby theproject.

Step7:Survey ofHostPopulation

1. This survey is carried out to see that in the host area enough land, income earningopportunities and other resources exist to sustain additional population from the affected area,and that this influx does not put pressure on local resources that the host population mayresent. The other important thing to see is that the people being relocated and the hosts aresocially from a similar socio-cultural background. The similarity in background helps greatlyreduce social/ethnicfrictions.

Step8:Identifyand AssesstheImpacts

1. Once the range of impacts that are predictable has been identified, the next step is todetermine their significance (that is, whether they are acceptable, require mitigation, or areunacceptable).Sincemanyimpactsarenotquantifiable,itisimpossibletorankthemobjectively. The community perceptions of an impact and those of the SIA team are notnecessarily thesame.Theaffectedpeopleshouldthereforebeconsultedinrankingimpacts.
2. If impacts are found unacceptable, the SIA must clearly state that giving reasons.Generally, the Social Impact Assessment is expected to result in specific mitigation plans toaddressrelevant social/resettlement issuesand potential impacts.

Step9:Develop aMitigationPlan

1. Develop a mitigation plan to firstly avoid displacement, secondly to minimize it, andthirdly to compensate for adverse impacts. The major contribution of a SIA study is to helpplan for, manage, and then mitigate any negative impacts (or enhance any positive ones) thatmayarisedueto aproposedproject.

#### PRINCIPLESFORSOCIALIMPACTASSESSMENT

1. Theprinciplestoguidetheconcepts,process,andmethodsofconductingsocialimpact assessment are by now well established. These are meant to ensure sound scientificenquiry.The principles are basedon expertjudgmentof the professionals fromrelevantdisciplines, including sociology, anthropology, development studies, economics, geography,policy planning, and management, and the best practices established in this area over the pastthirtyyears.

PrinciplesofSIAGoodPractice

1. TheprinciplesforsocialimpactassessmentwerefirstdevelopedbytheInter-organizationalCommitteeonPrinciplesandGuidelinesforSocialImpactAssessment(IOCPGSIA1994). Basically,theseprinciplesareas follows:
2. : *Involve theDiversePublic*

It is important to first identify all potentially affected groups and individuals,and involve them throughout the SIA process. This involvement must reach out to groups thatare routinely excluded from decision making due to cultural, linguistic and economic barriers(lower caste and tribal groups, minorities and poor people). The involvement should be trulyinteractive, with communication flowing both ways between the agency and affected groups.This engagement will ensure that stakeholder groups understand what the project is about andthepossiblewaysitmightaffect them, bothpositiveand negative.

1. : *AnalyzeImpact Equity*

Projectsaffectdifferentgroupsdifferently.Impactsshouldthereforebespecifieddifferentially for affected groups, not just measured in the aggregate. Identification of allgroups likely to be affected is central to the concept of impact equity. There will always bewinnersandlosersasaresultofthedecisiontobuildadamorundertakesomeotherdevelopment work. SIA should identify who will win and who will lose, but no groups andindividuals thatare consideredvulnerabledue to race,ethnicity,caste,gender,occupation,age orother factors should haveto bearthebrunt ofadverse social impacts.

1. : *FocustheAssessment*

Often, time and resources available for doing social impact assessment are verylimited. In such circumstances, the best course is to focus on the most significant socialimpacts, giving high priority to impacts identified by the people themselves. It is well knownthat some groups low in power do not usually participate in project preparation stage, but SIAmust ensure that their concerns are fully addressed. At the same time, the role of SIApractitioners in impact analysis and assessment remains important. They have the expertise tohelp prioritize issues, and are able to identify impacts often missed out by the peoplethemselves.

In addition to impacts on households, an accurate assessment of loss to the communityassets also needs to be carried out. This impact assessment should include the following: (a)Commonpropertyresources,(b)Publicstructures,(c)Culturalproperty,and(d)

Infrastructure

1. : *IdentifyMethods andAssumptionsandDefineSignificance*

SIA should use easily understood methods and assumptions that are transparent andreplicable.ThemethodsandassumptionsusedintheSIAshouldbemadepubliclyavailable.A brief summary should clearly describe the methods used, the assumptions made, and thesignificanceofimpactsdetermined.Thiswillallowdecisionmakersaswellasaffectedpeople to evaluatetheassessment process.

1. : *ProvideFeedbackonSocialImpactstoProjectPlanners*

TheSIAfindingsareinputsfordesigningaprojecttomitigatenegativeimpactsandenhancepositiveimpacts.Theprojectdesignprocessmustensurethatallaffected and interested persons get an opportunity to comment on the draft before it is given afinalshape.

1. : *UseSIAPractitioners*

Trained social scientists using social science research methods alone will get the bestresults. An experienced SIA practitioner will know what data to look for. His familiarity withimpacts that have occurred elsewhere under similar settings will be an asset. It will be easierfor him to identify the full range of impacts and then select procedures appropriate for theirmeasurement. The presence of a social scientist in the interdisciplinary team will reduce theprobabilityofanymajorsocialimpact remaininguncounted.

It is extremely important that the SIA practitioner be an independent social scientist,notapartoftheregulatoryauthoritysponsoring theSIAstudy.

1. : *EstablishMonitoringandMitigationProgrammes*

The monitoring of important social impact variables and the mitigation programmes iscritical to the SIA process.The monitoring and mitigation should be a joint responsibility oftheprojectandtheaffected community.

A social impact assessment not only predicts the likely impacts, it should also identifymeans to mitigate those adverse impacts. Mitigation includes: avoiding the impact by notundertaking the project; or undertaking it with a modified design that reduce the impact; or bycompensatingforunavoidableand/orirreducibleimpacts.

1. : *IdentifyDataSources*

Generally, SIAs draw on the following three sources of information: (a) Publishedscientific literature, (b) Secondary data sources including various government documents andofficial reports, and (c) Primary data from the affectedarea. All these three sourcesareimportant, but not all projects may need them in equal measure. Some SIAs may require moreprimary data from the affected area than the published materials from journals or books, forexample.

TheSIAcanusefullyconsultpreviouslypublishedsocialsciencebooks,journalarticles that document knowledge of impacts and case studies from similar projects. The bestsecondarydatasourcesincludecensus,compendiumofstatistics,landrecordsdata,andseveral government planning and development reports. Survey research, informant interviews,and participant observation are among the important primary data sources that can be used toverify data collected from other sources. Often, project area people are quite knowledgeableabout the local socioeconomic situation and can provide a better understanding of the broaderrange oflikely impacts.

1. :*PlanforGaps inData*

Often, data relevant and necessary to carry out an assessment is not available yet theSIA is to be carried out. In circumstances when information is incomplete or unavailable, itshouldbemadeabundantlyclearthatassessmenthasbeenmadeintheabsenceofrelevantandnecessary data,explainingwhy this couldnot beobtained.

#### SOCIALIMPACT ASSESSMENT-METHODSANDTOOLS

1. SocialImpactassessmentstudyshouldbecarriedoutasearlyintheprojectplanningstage as possible. Thebasicobjectivesofthis studyaretoprovide:
   * Baselineinformationaboutthesocialandeconomicconditionsintheprojectarea
   * Informationonpotentialimpactsoftheprojectandthecharacteristicoftheimpacts,magnitude, distribution, and theirduration;
   * Informationonwhowillbetheaffected group,positivelyornegatively
   * Informationonperceptionsoftheaffectedpeopleabouttheprojectanditsimpact
   * Informationonpotentialmitigationmeasures tominimizetheimpact
   * Information on institutional capacity to implement mitigation measuresExamplesofQuestions to beAddressed in SIA
2. Somequestionsthatarecommonlyaddressedinsocialimpactassessmentincludethefollowing:
   * Who are the key stakeholders? What do they already know about the proposedproject,itsimpactandthemeasuresbeingcontemplatedtomitigateitsnegative impact
   * Whataretheirinterests?Aretheobjectivesoftheprojectconsistentwiththeirneeds,interests and capacities?
   * Whatistheimpactoftheprojectonvariousstakeholders,andparticularlyonwomenand vulnerablegroups?
   * Whatsocialfactorsaffecttheabilityofstakeholderstoparticipateorbenefitfrom theoperationsproposed? (gender,caste,ethnicity,orincomelevel)
   * Whatinstitutionalarrangementsareneededforparticipationandprojectdelivery?
   * What are the risks which might affect the success of the project? (lack ofcommitmentorcapacity,resourcecrunch,incompatibilitywithexistingconditions)
   * Howdoestheproject addressneedsofdifferentstakeholders?
   * Do any of these issues pose risks to overall project success and sustainability?SourcesofInformation
3. TheSIAreliesonbothsecondary andprimarydata.
4. SecondarySource: Suchsourcesofdatainclude:
   * Governmentcensus data
   * Land records,includingrecordsoflandtransactions
   * Districtgazetteers
   * Otheradministrativerecords(suchasNSS)
   * Documentsfromnon-governmentalorganiztions
5. Primary Source: The existing data from secondary sources cannot however be asubstituteforproject-specificsurveys.Inaddition,SIAderivesmuchmorerelevantinformationdirectlyfromsurveysofvariouskindsincludingsocioeconomic survey,and meetingswith theaffectedpeople.

MethodsandTools

1. Conductingsocialimpactassessmentinvolvestheuseofabroadarrayofdatacollection methods, quantitative and qualitative, common in social science research. Often, acombination of tools may be required to do social assessment. In addition to substantiveanalyticaltools,SIAusesparticipatorymethodsthatcontributetoabetterunderstandingoftheproject.Thesecanalsohelp increasetheownershipofprojects.
2. Thechoiceoftoolsandmethodswilldependonseveralfactors,suchastheprojectand the affected people. The methods that work for urban projects may not prove much usefulfor projects located in tribal areas, for example. Other factors will include: time and resourcesconstraintsforsocial assessment, andtheavailability ofexperts.
3. Clarityonsocialassessmentmethodologyisimportant.SIAoftenneedstousemultipleunitsofanalysis,suchashouseholds,individualswithinthehouseholds,andcommunities. The household unit is generally used for purposes of resettlement planning. (Ahousehold may consist of a nuclear family, extended family, or a unit including non-relatedmembers).
4. It is important to always consider the gendered nature of impacts.Data CollectionMethods
5. Thereareseveralmethodsofcollectingsocioeconomicdataforpurposesofconductingsocial impactassessment. The methods generally inuseinclude:

*QuantitativeMethods*

* + LandAcquisitionSurvey(personswithtitles,thosewithouttitlesandothersincludingtenants,sharecroppersshouldall becounted)
  + CensusSurvey
  + SocioeconomicSurvey(Thisshouldinvolveonlyapercentageoftotalpopulationselectedon arandom basis)
  + Otheradministrativerecords(suchasNSS)

*QualitativeMethods*

* + KeyInformantInterviews
  + FocusGroup Discussions(FGDs)
  + RapidandAppraisal
  + PublicHearing

QualitativeMethods

1. *(a) Key Informant Interview*: A questionnaire helps to establish baseline conditionspriorto undertakingaproject.Thequestionsshould coverallaspectsofsocioeconomicsituation(suchasreligion,caste,familysize,education,skills,occupationandincome).
2. Thedesignofthequestionnaireisratherimportant.Itshouldfocusonkeyissues,yetbe simple and in the local language. Persons selected to conduct the interviews should beproperlybriefed andtrainedto get thequestionnairescompleted.
3. The team conducting the interviews should include female members, as they alone arein a position to talk to women, especially in rural areas and among communities where thereare restrictionson theirmovements.
4. Thequalityofinformationgeneratedthroughinterviewsisdependentonanumberoffactors,whichincludethefollowing:
   * Therelationshipthattheinterviewerisabletoestablishwiththerespondent.
   * Willingness toadjustinterviewstothetimeconvenienttorespondents
   * Abilitytolistentoanswerspatiently,andtoprobeandcross-checktheminathoroughbut politeway
   * Recognizing thatsamequestionscanbeasked(andanswered)inseveralothersways
   * Takingnotesinawaythatdoesnotinterrupttheflowofconversationandappear threatening
5. *(b) Focused Group Discussions (FGDs)*: In FGDs, one or more researchers guide agroup discussion using probes but letting group members discuss the topic among themselves.The group has 6 to 10 participants to discuss issues set out by the researcher. The researcherusuallyuses aninterviewguidebut minimallystructuresthediscussion.
6. FocusedGroup Discussions(FGDs)Disadvantages:
7. They donotgivequantitativeestimatesofcharacteristicsofapopulation
8. They aresusceptibletointerviewerbaises
9. Therearemanythingsthatparticipantswillnotrealingroup situations
10. FocusedGroup Discussions(FGDs)Advantages

1.Group interviews can…provide background information for designing projectsandprogrammes,generateideasandhypotheses,forinterventionmodels,providefeedbackfrombeneficiaries,andhelpinassessingresponsestorecommendedinnovations.Theyarealsousefulforobtainingdataformonitoring and evaluation purposes and for interpreting data that are alreadyavailable.(Kumar1987av)

1. *(c) Rapid Appraisal*: Sometimes the approach known as ‘rapid appraisal’ (known byseveraldifferentnames)maybevaluable.Partly,thisapproacharoseasareactionagainsttime and budget consuming surveys. This low-cost method is based on in-depth interviewswith critical informants known to be knowledgeable about the issues to be explored. In-depthinterviewingissupplementedbyanalysisofsecondarydataandgroupinterviewswith

representatives of relevant groups in the community. The key to rapid appraisal techniques isto compress the research process so that data are collected, analyzed and put together in auseable formintheshortestpossibletimespan.

1. *(d)PublicHearing*:Apublicmeetingisopentoallaffectedandinterestedpersons.The team first describes the project and its likely impacts, both positive and negative, and thenallowsfreediscussiononallissues.Peopleoftenprovideusefulfeedbackontheprojectanditsimpacts which canbeausefulinputto theprocessofdecision-making

QuantitativeMethods

1. *(a) Land Acquisition Survey*: Land acquisition for projects leads to displacement andloss of livelihoods for local people. A land acquisition assessment survey provides detailedinformation on who and how many will be adversely affected by land loss. This survey islargely based on government land records, land use maps, statistical information, and existinglegislation and administrative practice with respect to land acquisition, and project planningdocuments,but thedataoften requireon thespotverification duringafieldvisit.
2. This is a rapid, low-cost preliminary assessment done at the project identification stage.TheLandAcquisitionSurveyisexpectedtoprovideanswerstoquestionssuchasthefollowing:
   * Where isthelandthatisrequiredfortheproject?
   * Whoistheland’scurrentowner?
   * Whatisthe tenurestatusof thepresent landusers?
   * Whatisthe procedurefor land acquisition?
3. Typically,thelandacquisitionsurveyincludesonlypersonswithlegaltitletoland.The non-titled persons (sharecroppers, tenants, informal dwellers) are not included. This isoftenreferred to as the“official”listofaffectedpersons.
4. *(b)CensusSurvey*:Thisisthemostimportantsurvey,asithelpstodeterminetheexact number of people who will bear the brunt of adverse project impacts, and the totalproperty affected. Since the purpose of the census survey is to prepare an inventory of allaffectedpersons andproperties,itshould cover thefollowing:
   * Allaffected personslivingintheprojectarea
   * Allaffected property
   * Thelevelandsourcesofallincomes,andtheproject’simpactonthem
5. Typically, the census uses the household as the basic unit for data collection. Datashouldbedisaggregatedby gender,caste, tribeandothersocialcategories.
6. Inaddition,acomprehensivelistofcommonpropertytobeaffectedbyaprojectshouldalso beprepared.This willinclude:
   * Commonpropertyresources:Theseincludepastures,fishingpondsandforestsincludingsourcesofbuildingand craftmaterials,biomassfordomesticenergy.
   * Publicstructures:Theseincludeschools,clinics,placesforworship,bathingandwashingplaces,communitycentres,lampposts,playgrounds,wells,andbusstops
   * Cultural property: Cultural property includes archeological sites, monuments, burialgrounds,placesofhistorical or religious importance.
   * Infrastructure:Thisincludesallinfrastructuredestroyedordisruptedbyprojectconstruction activities, including roads, bridges, power lines, and water and sewagelines.
7. *(c) Socioeconomic Survey*: This study generates information on impacts on criticalsocioeconomic aspects of the affected population. These include: demographic details (familysize,sexratio,literacy/educationlevels,populationbycaste,tribe,religion,gender,agegroups,andvulnerablegroups)socioeconomicproductionsystems,sourcesofincome,patternsofsocialorganizationandleadership,women’seconomicactivitiesandincome,ancestralpropertyprovisionsand custom,levels ofhealthandnutrition,etc.
8. Inprojectsthatdonotinvolvealargepopulation,socioeconomicsurveyandcensusare usually combined. In projects that cause large scale displacement, the socioeconomicsurvey is a separate sampled survey of roughly 10-20 percent of the total affected population,selected on a randombasis. Itis, however, importantthatthe survey coversa statisticallyvalid representative sample of all strata of the affected population (including women and othervulnerable groups).
9. The socioeconomic profiling should not be restricted to adversely affected population.Thesurveyshould include thosewho benefitfromthe employmentandothereconomicopportunitiesgeneratedby theproject.

TheLimitationsofQuantitativeMethods

1. Quantitative data collection methodology also has its limitations. Factors such as theadequacyofsample,thecooperationofrespondents,theexperienceofthesurveyteamandthe adequacy of supervision over the team in the field can bias not only sampling but datacollectionas well.
2. SIA practitioners usually balance quantitative and qualitative methods of collectingdata to ensure as complete an understanding of the project’s impacts on the affected people aspossible.

#### UNIT-V

#### ENVIRONEMENTAL ACTS (PROTECTION AND PREVENTION

#### FORMATOFASOCIALIMPACT-ASSESSMENTREPORT

OnceaSocialImpactAssessmenthasbeencompleted,aformalReportwithabriefExecutive Summary should be prepared for submission to the authority which sponsored it.ContentsofaSIAReport

ThisReportshouldbedividedintoseveraldistinctsections,eachsectiondealingwithdifferentaspects oftheSIAprocess.

***Introduction:*** This section includes the purposeof the report. Itdescribes its scopeandhowitisorganized (providebrief outlineofthecontentsofthereport).

***Description of the Project:*** Provide in this section brief details of the project, theobjectives of the project, need for the project, the project location, the proposed schedule forimplementation.Furnishadrawingshowingtheproject layout,anditslocation.

***Methods in Identifying Project Impacts:*** Describe the methods used in conducting theassessment,bothquantitativeand qualitative.

***AnticipatedProjectImpacts****:*Describeprojectimpactsondifferentgroups,bothpositiveand negative,as identifiedby theSIA.

***Affected Population****:* This section contains details about the total affected population,suchasmaleandfemale ratio,age profile, maritalstatus,occupationalstructure,etc.

***AffectedVulnerableGroups****:*Providedetailsregardingallvulnerableaffectedhouseholds,includingscheduledcastes/scheduledtribes/otherbackwardclasses,Women-headed households, squatters and encroachers, disabled and those unable to work, elderly andchildrenwithoutsupport, andthevery poor

***Inventory of Losses to Households****:* This section contains full information on losses tobothassetsimmovableaswellimmovable.Theseincludeland,houses,otherstructures,income and livelihood, and social networks

***Losses to the Community****:* Provide a complete list of community property affected bythe project. This will include all public buildings, common property resource (such as pasturesand rivers), cultural property (includes archeological sites), and infrastructure (roads, bridges,andcanals)

***PublicConsultationandDisclosure****:*Thissectionwilldescribetheprocessfollowedto involve the affected people and other stakeholders. It summarizes their comments anddescribeshow thesewere addressed.Describe activitiesundertakentoshare information

***Findings and Recommendations****:* This section will provide an overall assessment ofimpacts and make recommendations for further action on the basis of the impact assessment,including abandonment of the project if in relation to the benefits the impacts are too severe tomanage.

***Mitigation Plan****:* If the recommendation is to mitigate the project impacts, providedetailsofanactionplanformitigation,includingrelocationandincomeandlivelihoodrestorationplans.

**Recommendations**

1. On the basis of its findings the Report should finally make its recommendation to thesponsoring authority. It should clearly state whether the project could proceed as it is, orproceedwith somechanges, ordroppedcompletely.

SharingSIAReportwithStakeholders

1. TheSIAsponsorsshouldensurethattheReportispubliclymadeavailableonceithasbeenformally submitted tothem.

**ISO14000**

The**ISO14000**environmentalmanagementstandardsexisttohelporganizations(a)minimize how their operations (processes etc.) negatively affect the environment (i.e. causeadverse changesto air,water,or land);(b) comply withapplicable laws,regulations,andother environmentallyorientedrequirements,and(c) continually improveintheabove.

ISO 14000 is similar to [ISO 9000](http://en.wikipedia.org/wiki/ISO_9000)[quality management](http://en.wikipedia.org/wiki/Quality_management)in that both pertain to the process ofhow a product is produced, rather than to the product itself. As with ISO 9000, certification isperformed by third-party organizations rather than being awarded by ISO directly. The [ISO](http://en.wikipedia.org/wiki/ISO_19011)19011auditstandardapplieswhenauditingforboth9000 and14000compliance atonce.

Abriefhistoryofenvironmental managementsystems

The concept of an environmental management system evolved in the early nineties and itsorigin can be traced back to 1972, when the United Nations organised a Conference on theHuman Environment in Stockholm and the United Nations Environment Programme (UNEP)was launched (Corbett & Kirsch, 2001). These early initiatives led to the establishment of theWorld Commission on Environmentand Development(WCED) andthe adoption oftheMontrealProtocol and Basel Convention.

In 1992, the first Earth Summit was held in Rio-de-Janeiro (Jiang &Bansal, 2001), whichserved to generate a global commitment to the environment (RMIT University). In the sameyear,[BSIGroup](http://en.wikipedia.org/wiki/BSI_Group)publishedtheworld'sfirstenvironmentalmanagementsystemsstandard,BS

7750.Thissuppliedthetemplateforthedevelopmentofthe**ISO14000**seriesin1996,bythe International Organization for Standardization, which has representation from committeesallovertheworld(ISO)(Clements1996,Brorson&Larsson,1999).Asof2010,ISO14001isnowused byatleast 223149 organizations in159 countriesandeconomies.

DevelopmentoftheISO14000series

The ISO 14000 family includes most notably the ISO 14001 standard, which represents thecore setof standards used by organizations for designing and implementing an effectiveenvironmental management system. Other standards included in this series are ISO 14004,which gives additional guidelines for a good environmental management system, and morespecialized standards dealing with specific aspects of environmental management. The majorobjectiveoftheISO14000seriesofnormsis"topromotemoreeffectiveandefficientenvironmental management in organizations and to provide useful and usable tools - ones thatarecosteffective,system-based,flexibleandreflectthebestorganizationsandthebestorganizationalpracticesavailableforgathering,interpretingandcommunicatingenvironmentallyrelevant information"

Unlikepreviousenvironmentalregulations,whichbeganwithcommandandcontrolapproaches, later replaced with ones based on market mechanisms, ISO 14000 was based on avoluntaryapproachtoenvironmentalregulation(Szymanski&Tiwari2004).TheseriesincludestheISO14001standard,whichprovidesguidelinesfortheestablishmentorimprovement of an EMS. The standard shares many common traits with its predecessor ISO9000, the international standard of quality management (Jackson 1997), which served as amodel for its internal structure (National Academy Press 1999) and both can be implementedside by side. As with ISO 9000, ISO 14000 acts both as an internal management tool and as away of demonstrating a company’s environmental commitment to its customers and clients(Boiral2007).

Prior to the development of the ISO 14000 series, organizations voluntarily constructed theirown EMS systems, but this made comparisons of environmental effects between companiesdifficult and therefore the universal ISO 14000 series was developed. An EMS is defined byISOas:“partoftheoverallmanagementsystem,thatincludesorganisationalstructure,planningactivities,responsibilities,practices,procedures,processesandresourcesfordeveloping, implementing, achieving and maintaining the environmental policy’ (ISO 1996citedinFederal Facilities CouncilReport 1999).

#### ISO14001

The standard is not an environmental management system as such and therefore does notdictateabsoluteenvironmentalperformancerequirements(NationalAcademyPress1999),butservesinsteadasaframeworktoassistorganisationsindevelopingtheirown

environmental management system (RMIT University). ISO 14001 can be integrated withothermanagementfunctionsandassistscompaniesinmeetingtheirenvironmentalandeconomic goals.

ISO 14001, as with other ISO 14000 standards, is voluntary (IISD 2010), with its main aim toassist companies in continually improving their environmental performance, whilst complyingwith any applicable legislation. Organisations are responsible for setting their own targets andperformancemeasures,withthestandardservingtoassisttheminmeetingobjectivesandgoals and the subsequent monitoring and measurement of these (IISD 2010). This means thattwo organisations that have completely different measures and standards of environmentalperformance,canbothcomplywithISO14001requirements(FederalFacilitiesCouncilReport1999).

The standard can be applied to a variety of levels in the business, from organisational level,right down to the product and service level (RMIT university). Rather than focusing on exactmeasuresandgoalsofenvironmentalperformance,thestandardhighlightswhatanorganisation needs to do to meet these goals (IISD 2010). Success of the system is verydependant on commitment from all levels of the organisation, especially top management(Standards Australia/Standards New Zealand 2004), who need to be actively involved in thedevelopment,implementationandmaintenanceoftheenvironmentalmanagementsystem(iso14001.com.au2010). In2008 therewerean estimated188 000 companiesfrom155countries,certifiedasISO14001compliant (ISO14001.com.au2010)

ISO14001isknownasagenericmanagementsystemstandard,meaningthatitisapplicableto any size and type of organisation, product or service, in any sector of activity and canaccommodatediversesocio-culturalandgeographicconditions(StandardsAustralia/Standards New Zealand 2004). All standards are periodically reviewed by ISO andnew ones issued(StandardsAustralia/StandardsNewZealand 2004).

#### Basicprinciplesandmethodology

The fundamental principle and overall goal of the ISO 14001 standard, is the concept ofcontinual improvement (Federal Facilities Council Report 1999). ISO 14001 is based on thePlan-Do-Check-Act methodology (Standards Australia/Standards New Zealand 2004) whichhas been expanded to include 17 elements, grouped into five phases that relate to Plan-Do-Check-Act;EnvironmentalPolicy,Planning,Implementation&Operation,Checking&CorrectiveActionand lastlyManagement Review(Martin 1998).

#### Plan–establishobjectivesandprocesses required

Prior to implementing ISO 14001, an initial review or gap analysis of the organisation’sprocesses and products is recommended, to assist in identifying all elements of the currentoperationandifpossiblefutureoperations,thatmayinteractwiththeenvironment,termed

environmental aspects (Martin 1998). Environmental aspects can include both direct, such asthose usedduringmanufacturingandindirect,suchasrawmaterials(Martin1998).Thisreviewassiststheorganisationinestablishingtheirenvironmentalobjectives,goalsandtargets,whichshouldideallybemeasurable;helpswiththedevelopmentofcontrolandmanagement procedures and processes and serves to highlight any relevant legal requirements,which canthenbe builtintothepolicy(StandardsAustralia/StandardsNew Zealand2004).

#### Do–implementtheprocesses

Duringthisstagetheorganisationidentifiestheresourcesrequiredandworksoutthosemembers of the organisation responsible for the EMS’ implementation and control (Martin1998).Thisincludesdocumentationofallproceduresandprocesses;includingoperationaland documentation control, the establishment of emergency procedures and responses, and theeducation of employees, to ensure they can competently implement the necessary processesand record results (Standards Australia/Standards New Zealand 2004). Communication andparticipation across all levels of the organisation, especially top management is a vital part ofthe implementation phase,with the effectivenessof the EMS beingdependanton activeinvolvementfromallemployees (FederalFacilities CouncilReport1999).

#### Check–measureandmonitortheprocessesandreportresults

Duringthecheckstage,performanceismonitoredandperiodicallymeasuredtoensurethattheorganisation’senvironmentaltargetsandobjectivesarebeingmet(Martin1998).Inaddition, internal audits are regularly conducted to ascertain whether the EMS itself is beingimplementedproperlyandwhethertheprocessesandproceduresarebeingadequatelymaintainedandmonitored(Standards Australia/StandardsNew Zealand 2004).

#### Act–takeactiontoimproveperformance ofEMSbasedonresults

After the checking stage, a regular plannedmanagementreview isconducted to ensurethattheobjectivesoftheEMSarebeingmet,theextenttowhichtheyarebeingmet,thatcommunications are being appropriately managed and to evaluate changing circumstances,such as legal requirements, in order to make recommendations for further improvement of thesystem (Standards Australia/Standards New Zealand 2004). These recommendations are thenfedbackintotheplanningstage tobe implemented into theEMSmovingforward.

#### ContinualImprovementProcess

The core requirement of a continual improvement process (CIP) is different from the oneknown from quality management systems. CIP in ISO 14001 has three dimensions (Gastl,2009):

* Expansion:More andmore businessareasgetcovered bytheimplementedEMS.
* Enrichment: More and more activities, products, processes, emissions, resourcesetc.get managedby theimplemented EMS.
* Upgrading: An improvement of the structural and organizational framework of theEMS, as well as an accumulation of know-how in dealing with business relatedenvironmentalissues.

Overall,theCIP-conceptexpectstheorganizationtograduallymoveawayfrommerelyoperationalenvironmentalmeasurestowardsastrategicapproachonhowtodealwithenvironmentalchallenges.

#### Benefits

ISO 14001 was developed primarily to assist companies’ in reducing their environmentalimpact,butin additionto animprovementin environmentalstandardsandperformance,organisations can reap a number of economic benefits including higher conformance withlegislativeandregulatoryrequirements(Sheldon1997)byutilisingtheISOstandard.Firstlyby minimizing the risk of regulatoryand environmentalliability fines and improving anorganization’s efficiency (Delmas 2001), leading to a reduction in waste and consumption ofresources,operatingcostscanbereduced(ISO14001.com.au2010).Secondly,asaninternationallyrecognizedstandard,businesses’operatinginmultiplelocationsacrosstheglobe can register as ISO 14001 compliant, eliminating the need for multiple registrations orcertifications (Hutchens 2010). Thirdly there has been a push in the last decade by consumers,for companies to adopt stricter environmental regulations, making the incorporation of ISO14001 a greater necessity for the long term viability of businesses (Delmas&Montiel 2009)and providing them with a competitive advantage against companies that do not adopt thestandard (Potoki&Prakash, 2005). This in turn can have a positive impact on a company’sasset value (Van der Deldt, 1997) and can lead to improved public perceptions of the business,placing them in a better position to operate in the international marketplace (Potoki&Prakash1997;Sheldon1997).Finallyitcanservetoreducetradebarriersbetweenregisteredbusinesses(VanderDeldt, 1997).

OrganisationscansignificantlybenefitfromEMSimplementationthroughtheidentificationoflargecleanerproductionprojects(e.g.whichcandrasticallycutelectricitycostsinmanufacturing industries). ISO14001 canbe a veryeffective toolto identify thesecostsavingsopportunitiesforsomeorganisations.Someotherorganisationscanfalterinitsplanning, lack of senior management commitment and poor understanding of how it should beimplementedandfindthemselvesmanaginganineffectiveEMS.Improvementsthatorganisationscantakeincludeadequatelyplanningitsstructureandallocatingadequateresources, providing training, creating forums for discussion, setting measurable targets andworkaccording tothephilosophy ofcontinuousimprovement (Burden,2010).

#### Certification

OnceabusinesshasfullydevelopedandimplementedtheirISO14001compliantenvironmental management system, they can choose to apply for certification (also referred toas registration). Certification involves evaluation of the company's EMS system, including acomprehensiveon-siteaudit,to determinewhetheritmeetsthe ISO14001requirements(Martin 1998). If the company conforms to the ISO standard it is issued with a certificatewhichisgenerallyvalidforaperiodofthreeyears(ISO14001.com.au2010).Insomecountries, certification can only be granted by an ISO-accredited Certification Body: ANSI-ASQ National Accreditation Board in the USA, the United Kingdom Accreditation Service inthe UK, or the National Accreditation Board in Ireland. Certification auditors need to beaccredited by the International Registrar of Certification Auditors. Some countries howeverallowbusinessestoself-certify(Martin1998).

#### ListofISO14000seriesstandards

* **ISO14001**Environmentalmanagementsystems—Requirementswithguidance foruse
* **ISO 14004** Environmental management systems—General guidelines onprinciples,systems andsupport techniques
* **ISO14015**Environmental assessmentofsitesand organizations
* **ISO14020**series (14020to14025)Environmentallabelsand declarations
* [**ISO14031**](http://en.wikipedia.org/wiki/ISO_14031)Environmental performanceevaluation—Guidelines
* **ISO14040**series(14040to14049),[LifeCycleAssessment,LCA](http://en.wikipedia.org/wiki/Life_cycle_assessment),discussespre-productionplanning andenvironment goalsetting.
* **ISO14050**termsanddefinitions.
* **ISO14062**discusses makingimprovementstoenvironmentalimpactgoals.
* **ISO14063**Environmental communication—Guidelinesand examples
* [**ISO14064**](http://en.wikipedia.org/wiki/ISO_14064)Measuring, quantifying,and reducing[**GreenhouseGas**](http://en.wikipedia.org/wiki/Greenhouse_Gas)emissions.
* [ISO 19011](http://en.wikipedia.org/wiki/ISO_19011)which specifies one[audit](http://en.wikipedia.org/wiki/Audit)[protocol](http://en.wikipedia.org/wiki/Methodology)for both 14000 and 9000 seriesstandards together. This replaces **ISO 14011** meta-evaluation—how to tell if yourintended regulatory tools worked. 19011 is now the only recommended way todetermine this.