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MINISTRY OF AGRICULTURE

Environmental Monitoring System

Training manual

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Acronyms

DQOs	Data Quality Objectives
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
ESIA	Environmental and Social Impact Assessment
NOx	Oxides of Nitrogen
QA	Quality Assurance
QC	Quality Control
SOx	Oxides of Sulphur

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1. INTRODUCTION

Ethiopia is endowed with a huge and remarkable natural resource base which could serve as a strong springboard to economic and social development. The country has devised an attractive incentive packages to promote investment in various sectors. One of these sectors is large-scale commercial farming where foreign and national investors have acquired lands for development from the National Regional States where the land is proved to be productive and settlement is sparse.

In an Ethiopian context, any development project should conduct an Environmental and Social Impact Assessment (ESIA) study to get environmental clearance for the competent Authority. This report usually contains information on the baseline conditions of different biophysical and socio-cultural environments of a project area. Following impact identification and analysis, ESIA usually identify mitigation measures for perceived actual and potential impacts of the activities of a project on these receptors. Although development projects taper with the existing baseline conditions, ESIA devises mechanisms to mitigate these impacts. Such mitigation measures are formulated into Environmental Management Plan (EMP), which could be either a standalone report or integrated into the ESIA report.

The approval of ESIA triggers the next steps in the EIA process, supervision of the implementation of mitigation measures by the project proponent (owner) and periodic but regular Environmental Monitoring. ESIA is usually a multidisciplinary study and so is environmental monitoring.

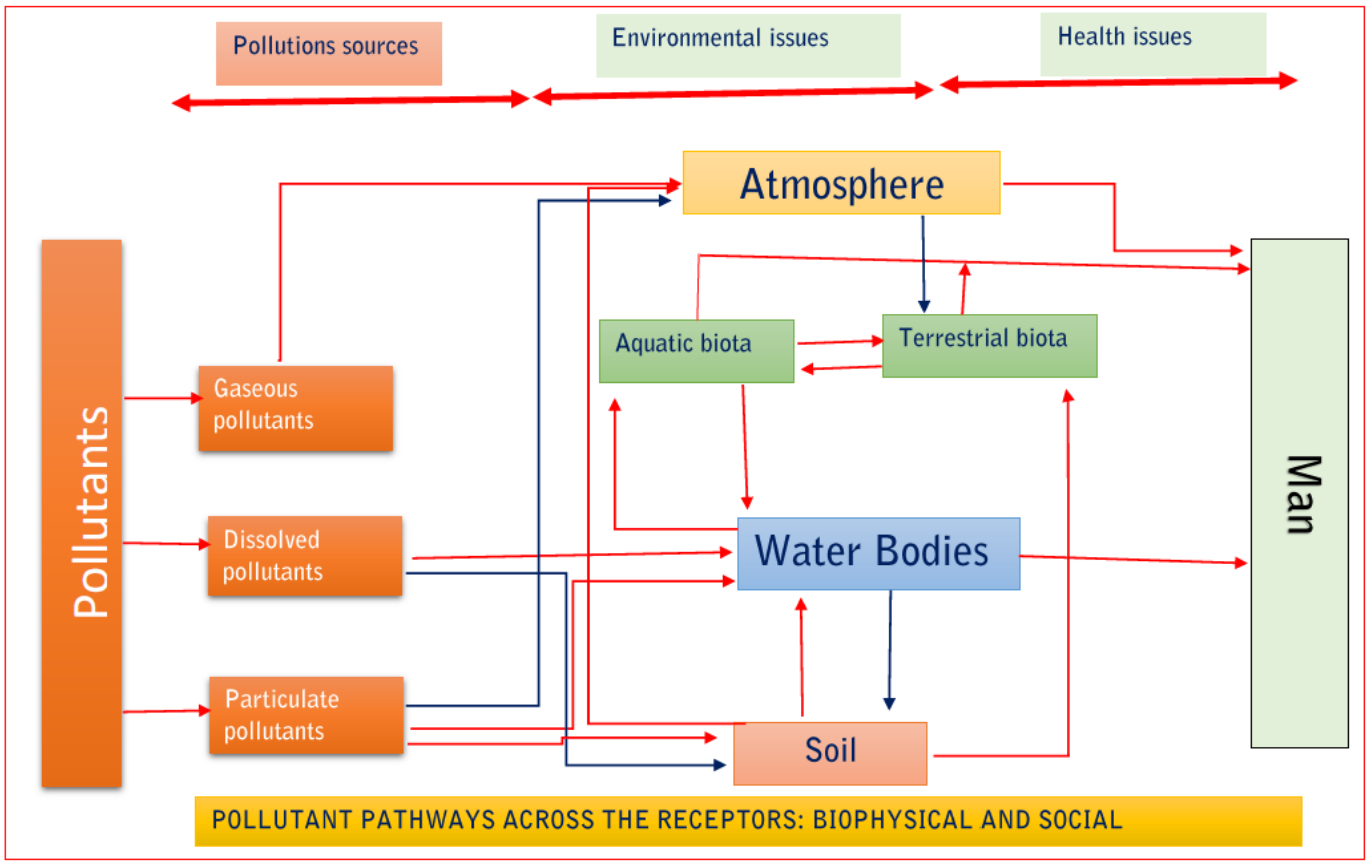
Pollutant sources and pathways

Understanding the sources of pollutants and their pathways is a critical stage in environmental monitoring. In a large-scale commercial farming, there are various chemicals which are used to ensure productivity and health of crops. Fertilizers, pesticides and herbicides are some of the sources of pollutants. These pollutants can enter soil and aquatic environment. Let's further briefly elaborate the pathways of pollutants in aquatic environment. A distinction between two concepts is pertinent to further illustrate pollutant pathways in environmental monitoring: point sources and diffuse source pollutants.

Point source: the pollutants are located in a single place. Examples are wastewater and pollutants that emerge from animal husbandry.

Diffuse source: these pollutants have multiple point sources and locations. They can be controlled once their locations are known. Examples are pesticide spraying and application of fertilizers.

The figure below depicts the principal pollutant pathways that affect the quality of freshwater such as rivers and streams. Pollutants could enter the natural environment in the form of gas, dissolves substances and particulate matters. These pollutants find their way into water bodies, soil and atmosphere. The biodiversity component of the environment (aquatic life and terrestrial biota) are usually impacts by these pollutants that are resulted due to the activities of large-scale commercial farming.



This training manual is designed to enable the trainees to acquire skills and knowledge to conduct environmental monitoring for a large-scale commercial farming. Tools such as exercises and proactive learning are the approaches to be used to intensively engage them. Generally, this Training Manual provides key elements of Environmental Monitoring, which will be further elaborated during tailored group discussions and exercises.

2. WHAT ARE NEEDED TO CONDUCT ENVIRONMENTAL MONITORING?

2.1. Infrastructure

Environmental monitoring usually requires a well-established analytical laboratories and trained human capital. In an Ethiopian context, there are now some environmental laboratories (private and public). One of these is a well-established Water and Energy Design and Supervision Work Laboratory which can generate environmental data for monitoring purposes. This Laboratory can be used for analyses of soil and water quality. The table below provides a snapshots of the environmental parameters that can be analyzed in this Laboratory.

Parameters	Environmental categories		
	Soil	Water quality	Bacteriological
pH	x	x	
Total Dissolved substance		x	
BOD		x	
COD		x	
Dissolved Oxygen		x	
Phosphorus	x		
Nitrogen	x		
Organic carbon	x		
Coliforms			x

Generally, it is possible to conduct a sound environmental monitoring of the impacts of large-scale commercial farming since there are a reasonably acceptable level of Laboratory facilities at a national level. Therefore, a close scrutiny of the baseline data on the different environmental parameters of the ESIA is a necessity rather than an option in order to conduct environmental monitoring. Furthermore, regular supervision of the implementation of the requirements of the ESMP is also useful to provide qualitative data on the status of the environment.

2.2. Multidisciplinary team of experts

Environmental monitoring usually requires a multidisciplinary team where each member contributes to the datasets. These experts work together and analyze results of their monitoring activities to produce a report that is holistic and integrative in nature.

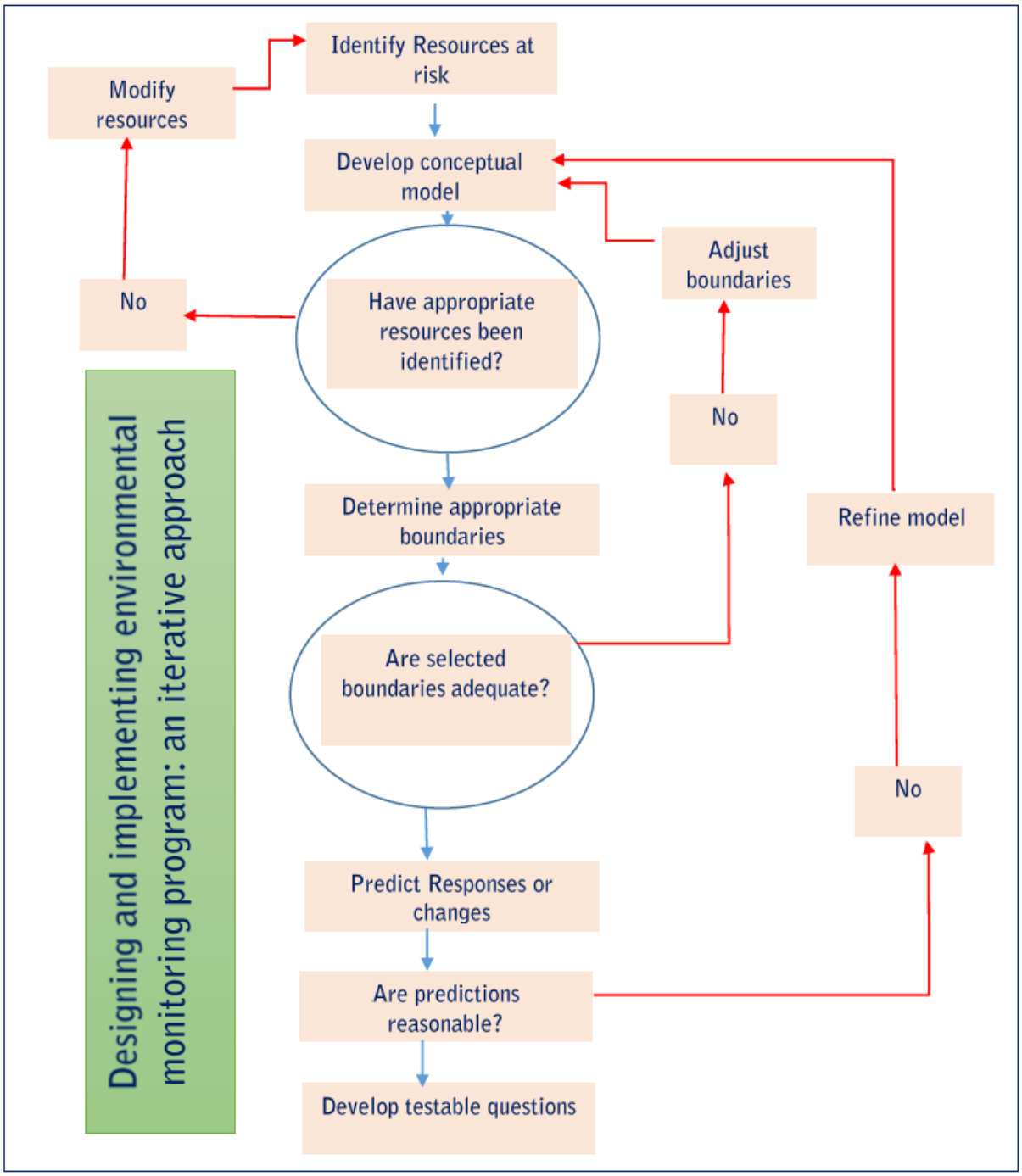
3. CONCEPTUAL BASIS OF ENVIRONMENTAL MONITORING

Environmental monitoring starts with the identification of resources as risks to initiate the development of monitoring program. Such a monitoring program could be viewed as a strategic plan which is interactive and can be elaborated, re-defined based on available resources, technical considerations and defined monitoring objectives. The main strategic approach is the development of testable questions. Let's consider that we perceived that the quality of biodiversity has decreased due to the activities of a development project. In this case, we define the objectives, identify resources to conduct this monitoring, identify sampling sites and determine the types of environmental parameters to be analyzed. Such a planning process could be modified or refined based on the resources (financial and human resources) at our disposal.

Usually, environmental monitoring plan starts with a formulation of a conceptual model which usually begins with qualitative descriptions of casual links in the system bases on the best available technical knowledge. A conceptual model may depict the description of causes and effect that shows how environmental changes may occur. For example, it we want to monitor the toxic effects of point sources of pollutants, we identify critical sources of contamination inputs to the ecosystem and define which ecological receptors[1] are likely affected or changed. It is very useful to develop the extent of boundaries, understand natural variability and address predictions in developing environmental

[1] This could be particular species, habitats or health aspects

monitoring program. If monitoring the impacts of pollutants on river and streams, a definition of the watershed boundaries is required to avoid misinterpretation of monitoring results. Generally, the figure below provides a general overview of an environmental monitoring plan/program which illustrated the process for designing and implementation.



4. COMPONENTS OF ENVIRONMENTAL MONITORING

An integrative environmental monitoring involves multimedia sampling, i.e., taking samples of different components of bio-physical and socio-cultural parameters. It is integrative because it includes these different environmental parameters. Fig. 1 below presented the key environmental compartments for monitoring pollutant pathways. These compartments are linked and interact to serve as interconnected pathways for pollutants due to the activities of large-scale commercial farming in our case. For example, an impact on forest will have a negative consequences on the wildlife and air quality and water bodies. Another example could be high nutrient loads due to the use of fertilizers will usually lead to deterioration of water quality which in turn affects aquatic biota. As environmental parameters are highly interconnected, compartmentalized though, an environmental monitoring program need to thoroughly define these different components and set corresponding monitoring objectives.

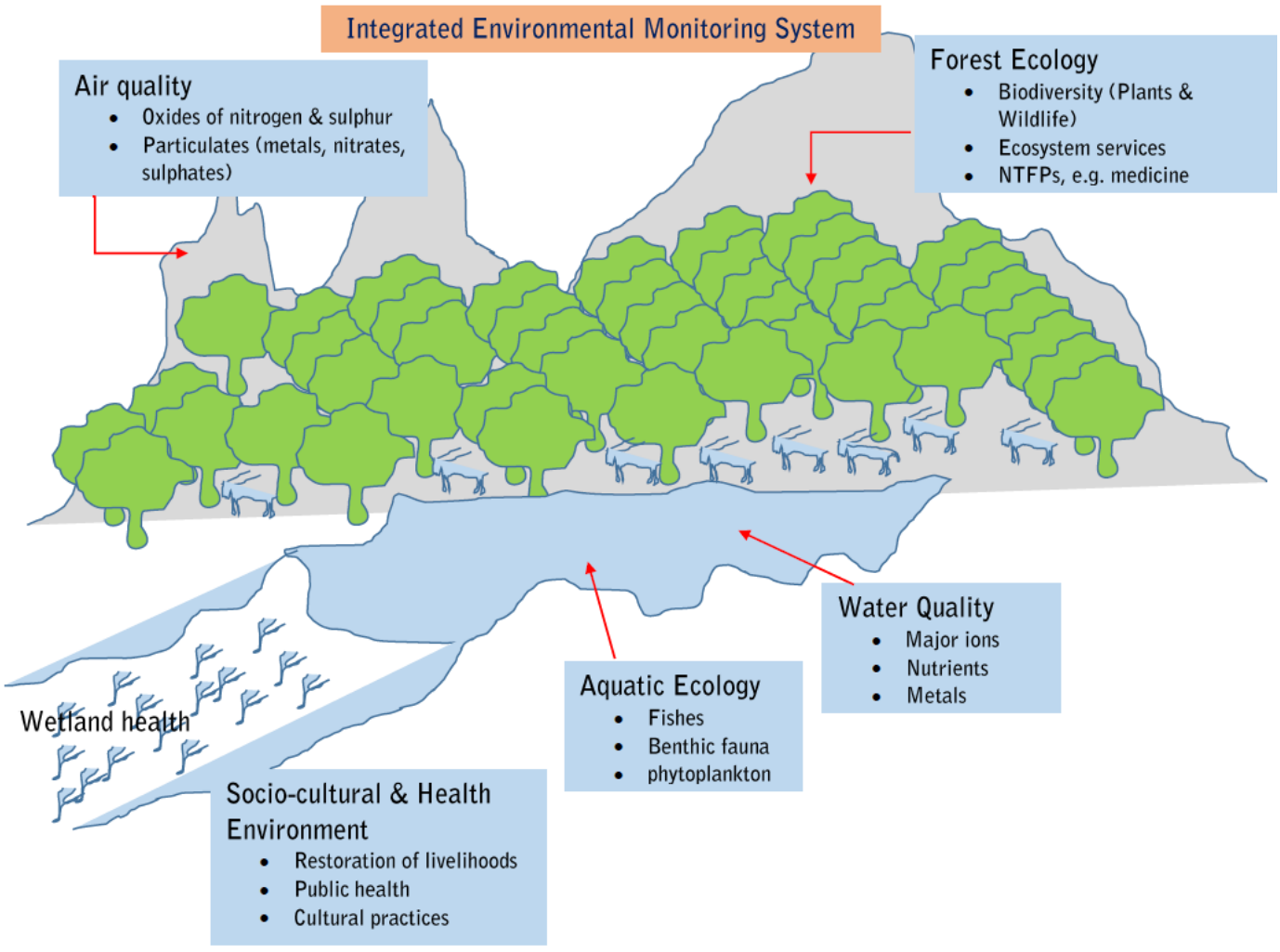


Fig. 1: summarized overview of the components of environmental monitoring

5. THE CONCEPT OF MULTIMEDIA MONITORING

Environmental monitoring is usually carried out on samples drawn from different environmental compartments. Such a sampling strategy is based on the following factors.

- First: the physical and chemical properties of pollutants demonstrate a wide range of fate and transport mechanisms with different pathways and effects upon ecological receptors.
- Second: a multimedia perspective is useful to understand the fate of the pollutants and their bioaccumulation.
- Third: a holistic approach creates enabling environment for decision-makers to understand the fate of pollutants in the project areas and surrounding landscape or regional context.

The table below provides an example of multimedia parameters for environmental monitoring.

Physical measurements	Natural measurements
Particle analysis: SOx, NOx	Fish, mammals, plants
Trace metals in water, soil	River ecosystem: functional groups
Soil: organic matter, exchangeable cations, pH	Forest ecosystem
Stream/river water chemistry	Endemic species

Ecosystem endpoints

Key ecosystem parameters are useful tools to conduct a meaningful environmental monitoring. Such parameters have mainly focused on indicator species. Indicators species[2] may include those which are tolerant or non-tolerant to habitat disruption and nutrient concentration. An environmental monitoring program need to focus on these types of species. As is evident, baseline data on these status of these species must be thoroughly recorded during the ESIA study. In the absence of baseline conditions of indicators species, an environmental monitoring program can't target these valuable ecosystem endpoints to measure the extent of environmental changes due to the activities of development projects.

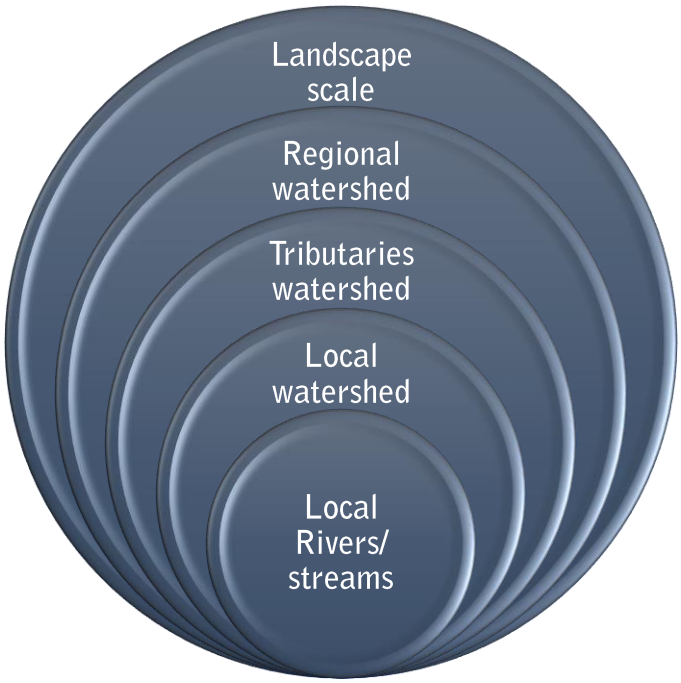
6. LANDSCAPE AND WATERSHED SPATIAL SCALING

Environmental monitoring has both landscape and watershed characteristics. The main reasons are:

- Environmental contaminants in an ecosystem have both scope and extent
- These pollutants/contaminants have a potential for a long-range transport through complex pathways
- The impacts of pollutants span simply beyond local areas

The figure below depicts ecosystem at multiple scales.

[2] Tolerant species thrive and live in, for example, low oxygen environment. Some species may not tolerate environmental perturbations and could become locally rare or extinct.

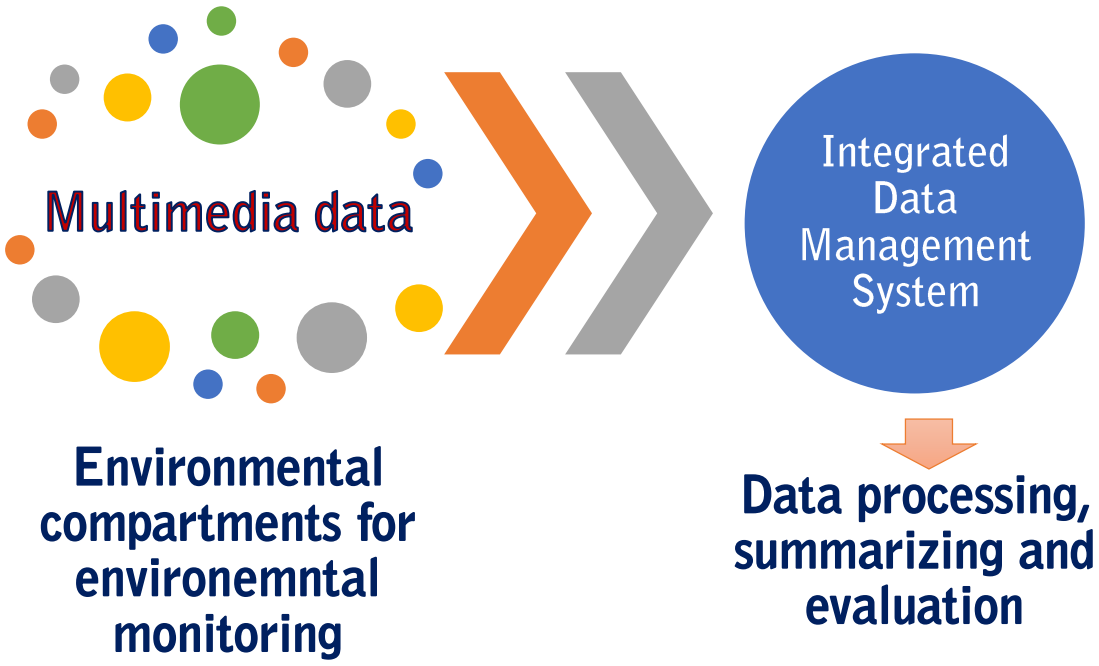


7. INTEGRATED DATA MANAGEMENT FOR ENVIRONMENTAL MONITORING

Environmental monitoring is multidisciplinary in nature and different types of data are usually collected at the end of the program. These data need to be integrated to illustrate the environmental conditions of a given area following various activities of development projects. A general overview of the relevance of data management for an integrative environmental monitoring is given in the following sections.

7.1. Information system development

Establishment of an information system to manage data of environmental monitoring program is very essential. In the course of environmental monitoring, a framework with clearly identified sources of pollution, their pathways and likely environmental endpoints provide a broad overview and context within which data sets will be processed, summarized and evaluated (this is often called data fusion). Such an approach is a key to conduct trend analyses and potential impacts of point sources pollutants on ecosystem. Collecting multimedia data on sensitive ecosystem is a pre-requisite if managers are to manage, protect and sustain environmental system in a holistic manner.



7.2. Data quality

Data quality is a pertinent component of ensuring a robust environmental monitoring plan. In the context of environmental monitoring, the main concern is to distinguish signals from noise or real effects from measured parameters; quality assurance procedure is very crucial. A final element to data integration is the importance of Quality Assurance (QA) and Quality Control (QC) for the data sources themselves, along with metadata on all aspects of data development, processing and integration and analysis. Methods of multimedia field sampling and laboratory analysis generally deal with adequate and established standard procedures.

Setting quality criteria and objectives at the outsets of the monitoring exercise and qualifying the data gathered is essential in an environmental monitoring. Data of unknown quality are as unreliable as poor quality data. Therefore, a management of data quality should be an integral part of the quality system that applies to monitoring program as a whole.

8. APPLICATIONS OF ENVIRONMENTAL MONITORING

The term monitor literally mean "maintain regular surveillance over" It is essential in environmental monitoring to make measurements at regular intervals over a substantial length of time. There are two fundamental reasons for monitoring the environment.

- First: to establish baselines depicting the current status the environmental components. This is one of the major activities of ESIA study.
- Second: to detect changes over time, namely, any changes which are induced by the activities of development projects in our case, e.g. large-scale commercial farming. In this cases, the reasons why these observed changes have occurred or occurring are assessed and analyzed to design interventions.

Environmental monitoring usually falls in four categories and these are briefly presented below.

8.1. Simple monitoring

Simple monitoring records the value of a single environmental variable at one geographical point over time. In practice, however, this single parameter monitoring is frequently expanded to include measurements of the parameter at many geographical locations. Air temperature one example of the application of simple monitoring. In our case, monitoring dissolved oxygen at specific locations can be considered as an example of simple monitoring. It is apparent that dissolved oxygen is required by all aquatic life and its alternation could disrupt the natural balance. Through environmental monitoring program the sources and pathways of pollutants that resulted in the alternation of the status of dissolved oxygen can be analyzed to take correct measures.

8.2. Survey monitoring

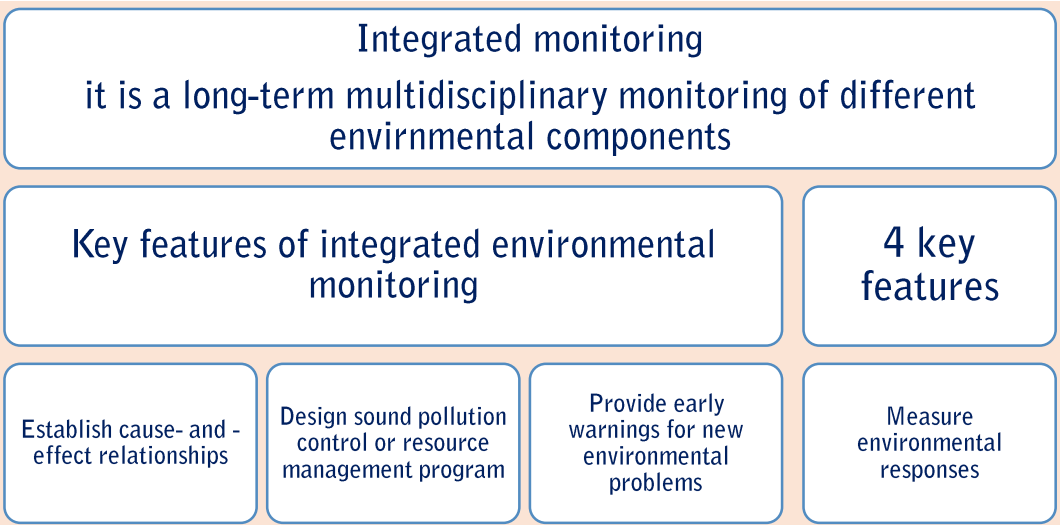
Environmental problems can become problematic in the absence of historical data. We have repeatedly mentioned the importance of documenting baseline environmental (bio-physical and socio-cultural) conditions in the course of the ESIA study. However, the absence of historical data can be replaced (although not recommended in our case) by sampling of a large geographical areas where the project is laying and outside this area.

8.3. Surrogate or proxy monitoring

In the absence of a long-term monitoring record, a surrogate approach can be used. This technique is usually expensive.

8.4. Integrated monitoring

All the above three monitoring methods may not tackle a core question, i.e., why these changes in the environmental parameters have taken place. To address this outstanding issue, a holistic approach of monitoring, integrated monitoring, is required. The concept of integrated monitoring has been developed with the overall objectives of recording changes in the environment and understanding the reasons of these changes. The figure below summarized the basic features of integrated monitoring.

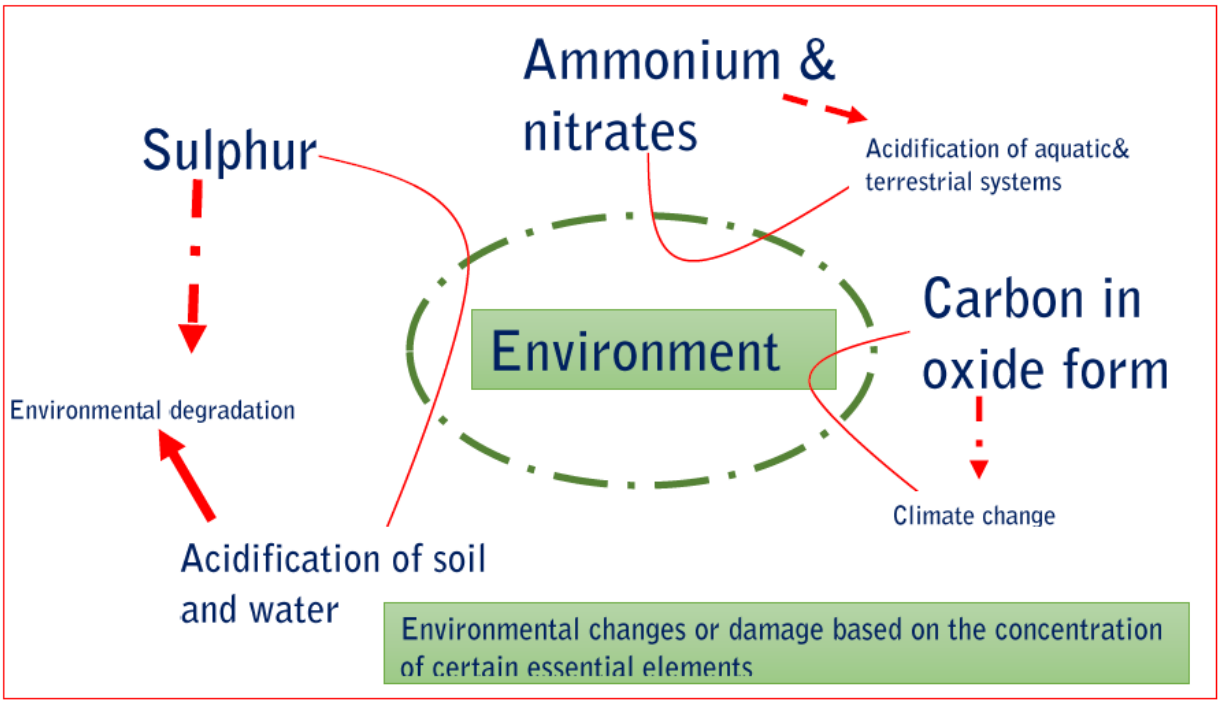


9. NATURE OF ENVIRONMENTAL ISSUES

Integrated environmental monitoring strives to result in the understanding of the causes of environmental changes. On the other hand, environmental components do variously respond to different environmental stresses.

Natural elements and compounds causing environmental problems

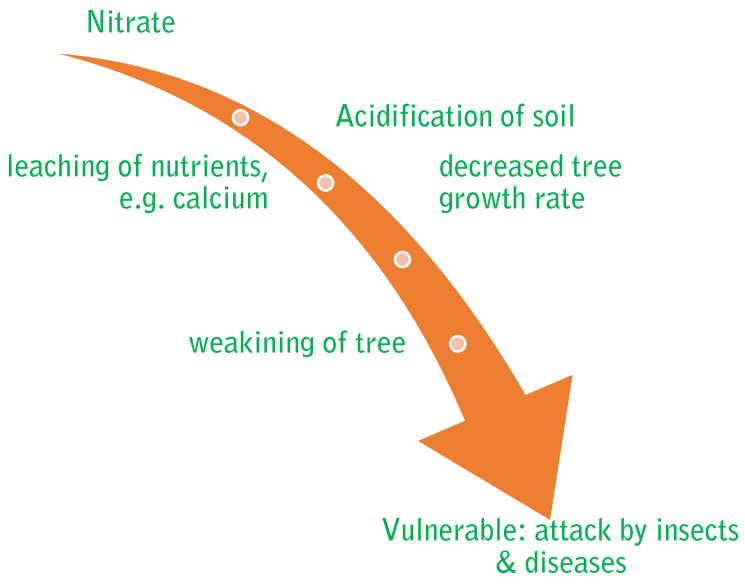
Soil parameters varies over a short distance. This may mean that land management in terms of the frequency and amount of application of fertilizers need to be adjusted accordingly to ensure productivity and economic return of agricultural investments. Essential elements such as Phosphorus, nitrogen, Sulphur and carbon can lead to significant environmental changes and damage if present in the environment in excessive amounts or particular forms. For example, excessive amount of Phosphorus in the water bodies can lead to eutrophication (excessive growth of algae). The figure below depicts the major environmental changes due to excessive amounts or particular forms of the essential elements and compound which will be discharged into the environment due to project activities.



Essential elements usually occur in the environment naturally and we cannot aim at making their value zero. In this case, we aim at meeting certain cult level or ranges which make them harmless to the environment. It is also equally important to understand that the responses of the environment to these elements could be a long-term phenomenon. As these environmental changes due to these elements are gradual, it will take time to understand their environmental problems. To avoid this apparently gradual but steady environmental changes, development of a regular environmental monitoring program enables us to closely follow their concentrations in the project affect areas and beyond.

The effects of essential elements occur at ecosystem level

The biological responses of the stresses are often manifested at ecosystem level leading to a chain of environmental responses. The figure below provides an overview of this long change of environmental responses due to changes in the concentration of essential elements and compounds due to project activities.

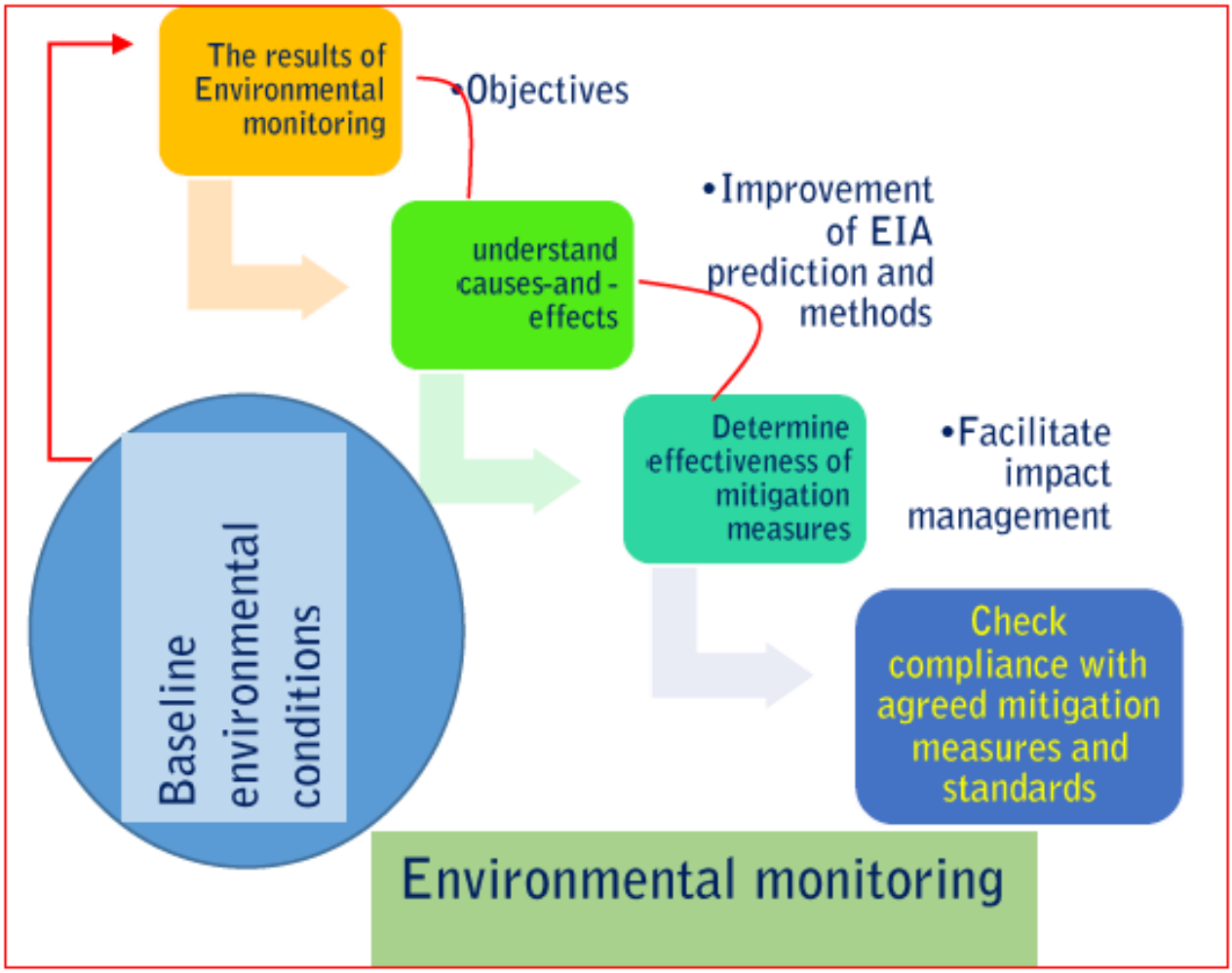


10. APPLICATIONS OF THE RESULTS OF ENVIRONMENTAL MONITORING

Monitoring is the cornerstone of EIA implementation and follow up. The results of monitoring are mainly used as key inputs for the following.

- Enhancement sound management of environment
- Achievement of a better understanding of cause-and effect relationships
- Improvement of EIA prediction and mitigation measures

Generally, environmental monitoring in EIA is a widely recognized phenomenon but not always resulted-oriented for its realization. The following figure presents the overall applications of the results of environmental monitoring.



The results of environmental monitoring establish the basis for corrective actions when actual impacts are unanticipated or worse than predicted. Compliance and effects monitoring permits only reactive impact management since they generate results after implementation of projects, i.e., detect changes after fact. A more proactive approach is to combine compliance or effect monitoring with supervision and regular inspection of the performance of identified mitigation measures during the all stages of the project.

Effective environmental monitoring

- Realistic sampling
- Relevant sampling methods to types of impacts
- Targeted approach for data collection
- Quality control
- Systematic record keeping and data organization
- Reporting
- Provision for input from third part
- Presentation of results to the public

Data collection for environmental monitoring is expensive. As a result, it if often need to target impacts that are of significant value or review of EIA practice of particular importance. It is important to identify the contribution of environmental monitoring to the implementation of EMP and follow-up.

The following points need to be clearly stated in the EMP report in terms of environmental monitoring as conditions for approval.

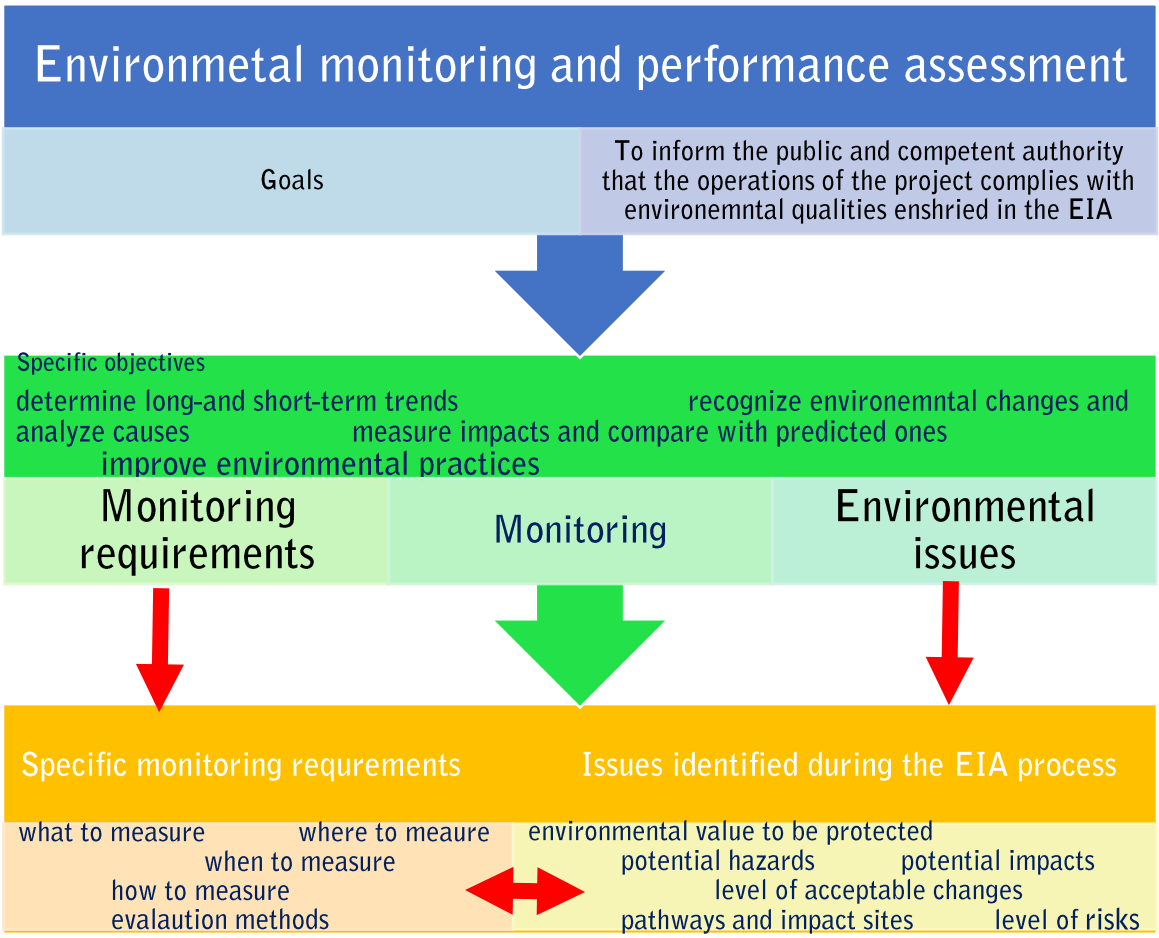
These are:

- Major impacts to be monitored
- Objectives of monitoring and data requirements
- Arrangement (institutional and financial) for conducting environmental monitoring
- Use of information to be collected
- Responses to unanticipated or unpredicted impacts
- Measures for public involvement and reporting

The general approach in environmental monitoring is to compare the pre- and post-project situations.

Process of environmental monitoring and performance assessment

A flow chart given below provides an overview of environmental monitoring and performance assessment framework.



Environmental monitoring and performance assessment is usually presented in matrix form where environmental issues are listed.

The following matrix depicts this fact.

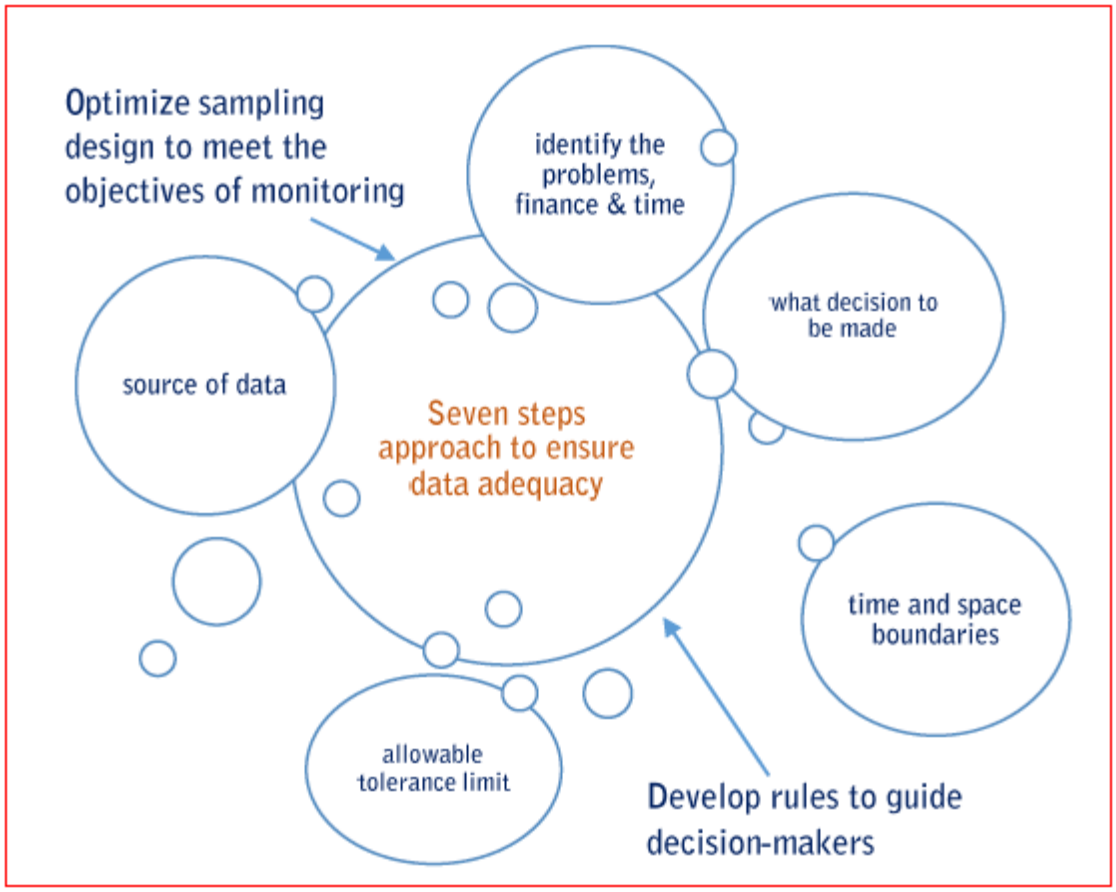
Environmental issues	Environmental monitoring components				
	Frequency	Procedure	Analysis and review of results	Compliance requirements	Remarks
Surface water	Weekly, monthly, quarterly, etc.	Water chemistry Water level	Comparing results	Limits established	Water quality management
Uptake of pollutants by biota	Annual or occasional	Samples from organisms of interest	Results compared	Results checked against the national standards	
Soil	Annual or as required	Soil samples	Compare results	Check the standards	
Wildlife	Annual	Counting populations	Compare results	Check against baseline data	
Health	Annual or as required	Communities consultation	Compare results	Compare against baseline conditions	

11. DESIGNING ENVIRONMENTAL MONITORING

Environmental monitoring involves systematic data collection, physical, chemical, biological and socio-cultural, for decision making. One of the first step in any monitoring program is to ensure that the data will be sufficient to provide a sound technical basis for intended decision. To ensure data adequacy to support management decisions, a seven steps Data Quality Objectives (DQOs) approach was developed (see below).

Critical factors for achieving the DQOs include the following.

- Representativeness of the data with respect to decision. Representativeness is the degree to which monitoring data accurately and precisely represent the variations of a characteristic either at a sample point or an entire area.
- Quality of data collection and handling methods
- Laboratory analysis
- Data management
- Statistical analysis
- Interpretation of results
- Communication of the results of environmental monitoring to decision-makers and the public



12. ECOLOGICAL INDICATORS FOR MONITORING TERRESTRIAL SYSTEMS

This section of the Training Manual describes criteria for selecting ecological indicators for use in monitoring the status of ecological systems. A series of criteria is proposed by which potential indicators of cause and effects relationships may be evaluated. By applying these criteria during the planning stage, it is anticipated that monitoring programs can be more readily developed to provide sound, quality-assured data in the most cost-effective manner.

The general approach used for developing an environmental monitoring program based on the application of ecological indicators is given as follows.

1. Collect useful site specific information on:
    a. The ecosystems of concern
    b. The potential critical receptors or components within the ecosystems
    c. The potential that affect the health of these ecosystems, e.g. disease, air pollution, water pollution, biodiversity loss, threats to socio-cultural practices….
    d. The relationship between stressors and receptors
2. Develop a conceptual framework to understand the dynamics of this ecosystem of interest based on the collected information above

3. Establish criteria for evaluating indicators of ecosystems to select appropriate indicators

12.1. Monitoring terrestrial ecosystem

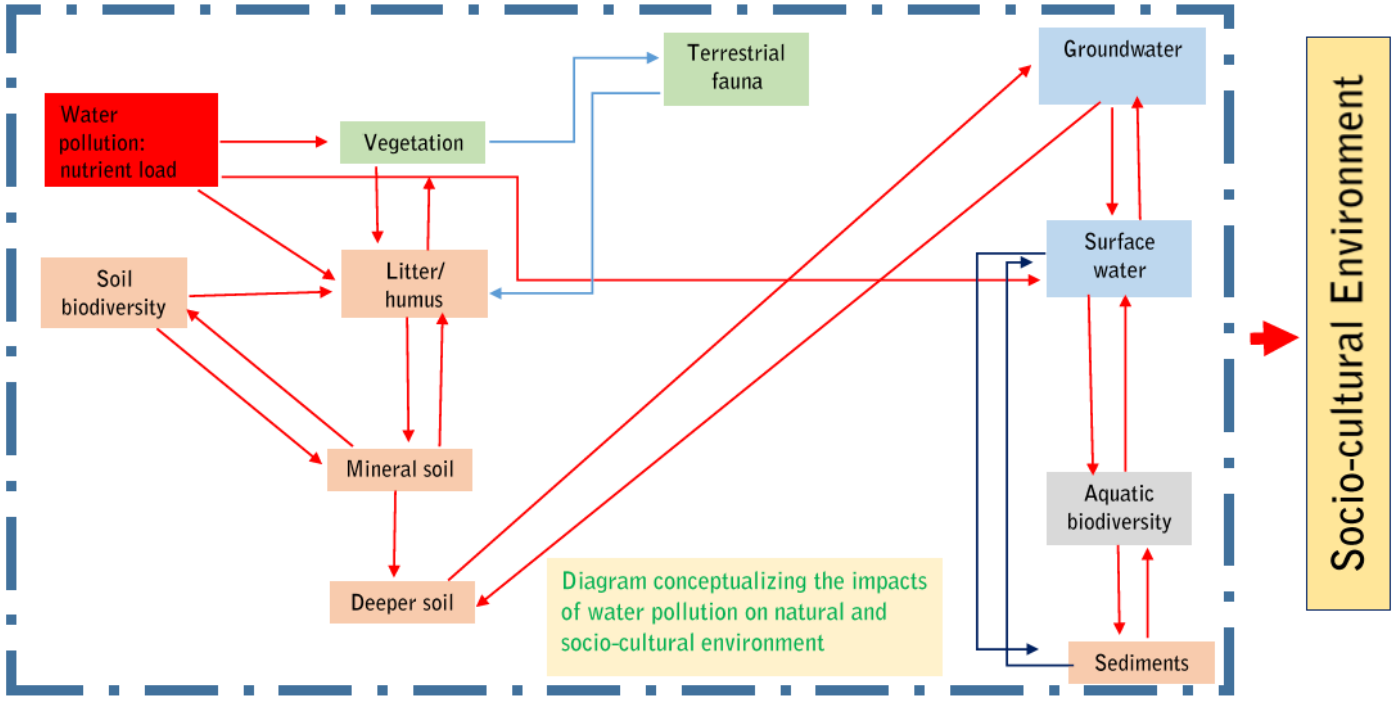
The approach

Let's see a step-by-step overview of the approach for designing environmental monitoring program for terrestrial ecosystem.

First step: the first step is to identify what resources are of concern and where these resources of concerns are located. For example, it the concern is the death of fish populations due to water pollution, the receptors of interest are aquatic fauna & flora and the area of concern is the entire direct and secondary impact zones of a development project.

Second step: here, we need to determine the factors or agents impacting the status of these resources. These factors could be either natural or anthropogenic. In some cases, it may prove difficult to distinguish natural causes from human ones. Generally, environmental monitoring is conducted to establish the magnitude of environmental changes in relation to the baseline conditions given in the ESIA report of projects.

Now that we have defined the system in terms of location, impacting factors (e.g. activities of large-scale commercial farming) and critical receptors (e.g. aquatic biodiversity), it is often useful to develop a conceptual model of the system of concern. This conceptual model could take a form of simple box -and -arrow diagram that describes the components of the environment. The figure below represents such a conceptual model which is developed following the two steps described above.



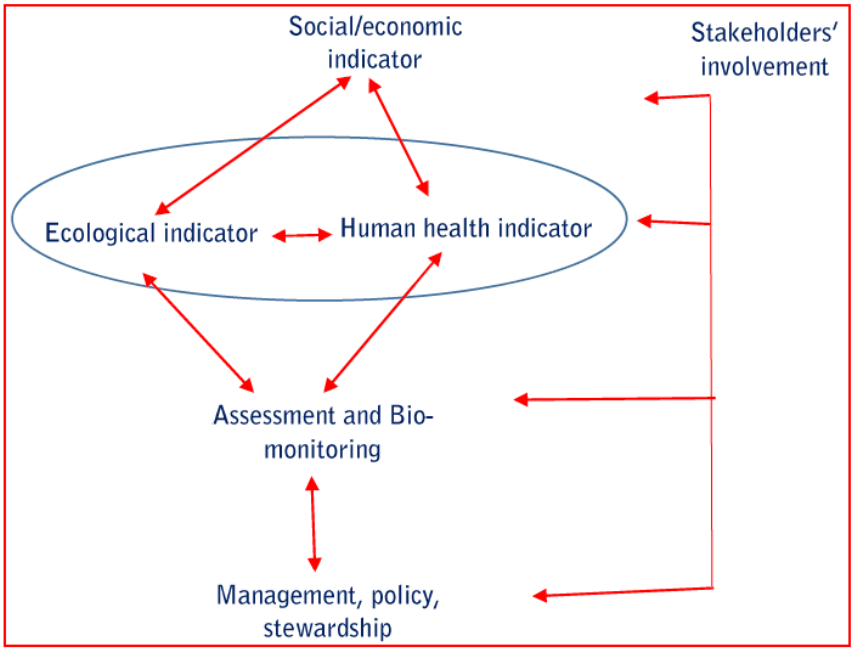
This conceptual model could be used to monitor the application of chemical inputs into large-scale commercial farming. In contaminant monitoring programs, this diagram is helpful in determining source-receptor relationships, contaminant pathways, critical receptors and the ultimate fate of the contaminants. This ecosystem-based approach to environmental monitoring establishes the interrelationships of different components of ecosystems whereby a change in one component triggers cascading changes across the ecosystem itself.

Conceptual models are useful to provide information that may be sued to determine which receptors are at risk by what stressor and what indicators could be used to link the stressors to the receptors. Models could also help to identify gaps in the existing data.

Once the stressors and receptors are identified, it is necessary to narrow this down to specific stress and receptor. Generally, organisms or people directly respond to stressors due to project activities. Furthermore, information/data of an environmental monitoring need to be site specific. For example, it soil is of interest for monitoring, information of soil physic-chemical properties are to be collected.

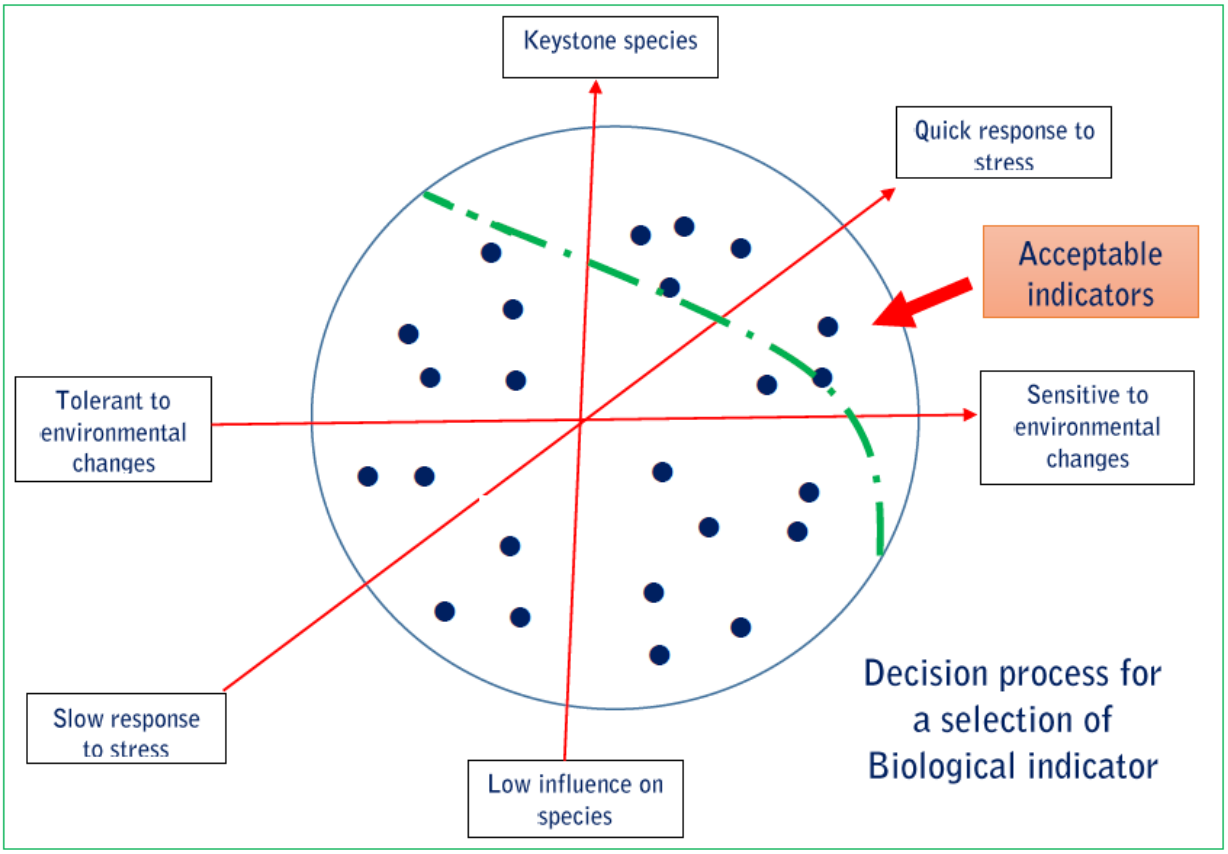
12.2. Bio-indicators for assessing human and ecological health

The responses of species to environmental changes is different. Some may respond to changes due to project activities very quickly while others exhibit a slow trend. Those species which show rapid responses to environmental perturbations can be used as indicators to measure ecological and human health. Generally, the livelihoods of local communities are mainly based on natural resources. That means, ecological structure and functions are the cornerstones of the social and economic conditions of a society. Generally, ecological indicators are interrelated to economic/social indicators. Therefore, human and ecological well-being includes economic features. To be useful, ecological and human health indicators should be combined. The following figure presents the relationship between social/economic and human/ecological indicators.



13. SELECTION OF BIOLOGICAL INDICATORS

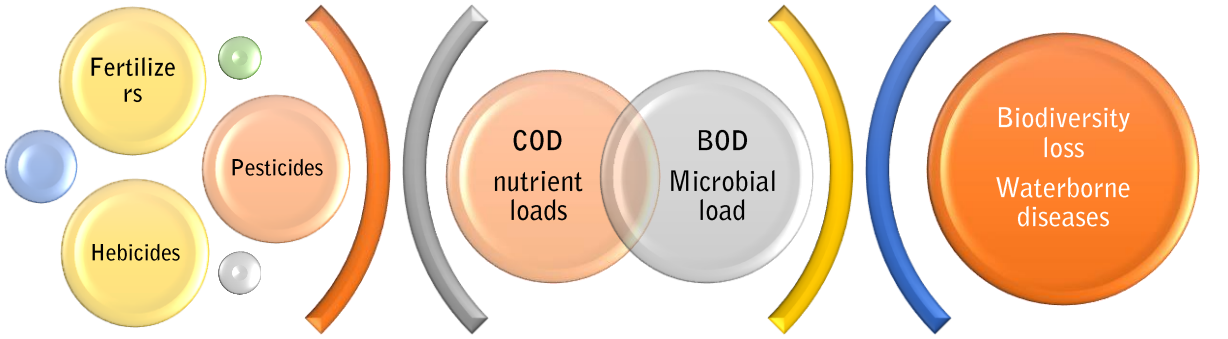
As briefly indicated above, the responses of species to environmental perturbations is specific and varies across the biological spectrum. This individualistic response to environmental changes is a key criterion to select biological indictors and the latter could be measured during environmental monitoring. It is very essential that the baseline data incorporated into the ESIA report should provide comprehensive information on the biological environment of project areas as this is a reference for environmental monitoring programs. Regular and period monitoring of different biodiversity elements could create enabling environment to understand the responses of species to changes that has come due to, for example, the activities of large-scale commercial farming. Such a knowledge of the responses of species to environmental changes could facilitate a selection of biological indicators which could be used as a comprehensive, objective yardstick during environmental monitoring. The figure below shows a key feature of species suitable as a biological indicator.



14. WATER QUALITY MONITORING: GENERAL INTRODUCTION

One of the major impacts of large-scale agricultural investments is the potential pollution of the water bodies in their surroundings. Water, apart being the major components of life, is a very essential component of the natural environment which drives the perpetuation of the different components of biodiversity and plays tremendous roles for the normal functioning of the different activities of the socio-cultural environment. Therefore, it goes without saying that any Environmental and Social Impact Assessment study of a large-scale commercial farming is required to provide reliable and rigorous data on the baseline conditions of the water bodies (rivers and streams) in and around the planned development areas. Here, I would like to provide a general overview of the parameters which are vital for monitoring water quality in the course of the operation of commercial farms. The latter usually results in the discharge of nutrients, chemicals due to the use of pesticides and herbicides which could potentially alter the physico-chemical and biological settings of water. These changes usually affects aquatic biodiversity (life) and human health. Noteworthy is that water bodies are characterized by three major components, i.e., hydrology, physico-chemistry and biology. A complete assessment of water quality is entirely based on the appropriate monitoring of these components.

The effects of commercial farming activities on the key properties of water and its imminent impacts on aquatic biodiversity and human health



Robust and reliable baseline data on water quality and hydrology create enabling environment for designing a meaningful monitoring plan/program in the course of the operation of commercial farming.....no baseline ....no monitoring

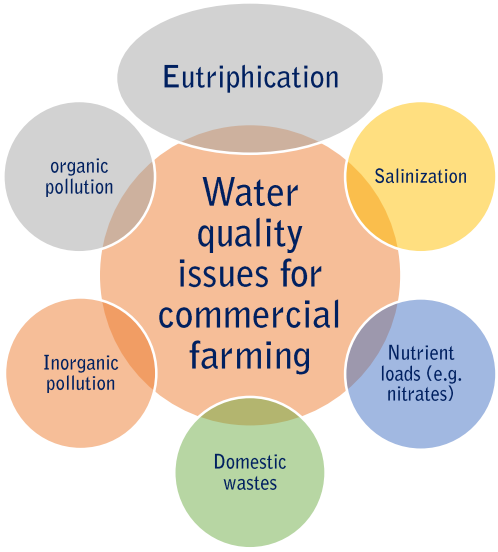
If the water bodies are used for the development of commercial farming, the hydrological balance of the area may change. In such a circumstance, the ESIA provides reliable models

that depict the trends over a certain period of time as part of the hydrological baseline study. These baseline data are very important to design monitoring plan and identification of appropriate types of measurable data and field protocols. In the absence of a robust baseline hydrological data or the presence of scanty and less informative datasets, designing a meaningful hydrological monitoring plan/program is not possible.

As water quality is determined by a variety of factors, we may not find a simple definition for it. But we may provide the following working definitions to enable us to do the exercises provided at the end of this Training Manual and further water quality monitoring effort as well.

Terminology	Definition
Quality of the aquatic environment	• Set concentrations, changes and physical divisions of inorganic and organic substances • Composition and states of biodiversity in the water body • Temporal and spatial variations of these components due to factors internal and external to water body
Pollution of the aquatic environment	Introduction by man, directly and indirectly, resulting in the following severe impacts: • Harm to aquatic biodiversity • Hazards to human health • Hampering fishing • Make water unusable by humans and livestock

Our understanding of water quality has changed over years. The figure below provides a snapshot of the water quality issues related to commercial farming activities.



15. EXERCISES

Exercise 1: Developing Environmental Monitoring Program for water pollution by agro-chemicals of large-scale commercial farming

Brief notes

Environmental monitoring is part and parcel of the Environmental Management Plan (EMP). The latter could be either a standalone report of part of ESIA Report. In principle, environmental monitoring should be costed where institutional arrangements to conduct the study are identified. It is obvious that this part of the ESIA is perhaps less attended to due to various reasons. Some of these are limited finance, institutional capacity and lack of trained and organized human resources. As a result, environmental monitoring has been reduced to purely qualitative data where the rigor of them is questionable. The first step for conducting an environmental monitoring of certain contaminants usually starts with the development of monitoring program.

Instruction

In this exercise, we will design an environmental monitoring program for water pollution due to the agro-chemicals of a certain large-scale commercial farming in Benshangul-Gumuz National Regional State. We will have 6 groups, each group comprised of 5 trainees. Each group is required to state the objectives of monitoring, develop a schematic map of the design approach, identify impacting factors and receptors, and identify parameters to be studied, identify national standards of water quality and propose intervention measures and decisions.

Presentation of results

Each group will present its findings/results by using a flip chart.

Exercise 2: Environmental Monitoring terrestrial system during (a) the construction and (b) operation phases of a certain large-scale commercial farming: forest and wildlife monitoring

Brief notes

Projects have different components and each component has various activities which could potentially impact the natural and socio-cultural environment. The construction phase is usually characterized by civil works, establishment of nursery, and preparation of land for cultivation and construction of access roads. On the other hand, operation phase entails maintenance of the health of crop (application of agro-chemicals), use of water for irrigation and etc. Baseline data and mitigation measures of such type of project are given in the ESIA. As you are familiar with the different environmental components under stress due to the activities of large-scale commercial farming, this exercise enables you to reflect on the experiences you have already gained and share these to the other trainees.

Instruction

This exercise will focus on the formulation of monitoring objectives, designing environmental monitoring program for forests and wildlife as a result of the implementation of large-scale commercial farming in your area. In this exercise, identify parameters to be monitored, assess and present a selection of biological indicator, propose species that could be used as biological indicator based on your local experiences and present the results of your environmental monitoring for a decision.

Tips: identify sites, assure data quality, discuss about the reference (baseline data), propose actions to be taken and etc.

Presentation of Results

Each group will present its findings/results by using a flip chart.

Exercise 3: Monitoring biological component of aquatic environment focusing on aquatic biodiversity

Brief notes

Aquatic environment is a home to different kinds of organisms and any impact that disrupts its functional components will have remarkable environmental implications. This environment harbors different species of fishes, small & microscopic organisms which are often used as a sole source of food for fish and different frogs.

Instruction

In this exercise, you are expected to formulate monitoring objectives, identify required infrastructure and data requirements for this task, identify parameters to be monitored and analyze for decision making. Develop a conceptual model that depicts the overall causes-and-effect and stressor – receptor. Identify and discuss the baseline conditions as perceived by you and from your experiences and present the potential trend due to the implementation of projects in your area. Identify parameters to be monitored and discuss the reasons for your decision for selecting these parameters.

Presentation of results

Each group will present its findings/results by using a flip chart.

Exercise 4: Human health monitoring

Brief notes

Large-scale commercial farming which irrigated could pose health risks for the local communities. Waterborne diseases are one of the potential health risks.

Instruction

Consider an irrigated large-scale commercial farming in Benhangul-Gumuz National Regional State. In this exercise, you formulate monitoring objectives, design monitoring of human health by developing a conceptual model, and identify monitoring parameters.

Presentation of results

Each group will present its findings/results by using a flip chart.

Exercise 4: Water Quality monitoring – physico-chemical parameters

Brief notes

Commercial farms use a large quantity of agro-chemicals and when these find ways to rivers and streams, the physico-chemical properties of water change. Such changes are the main causes triggering subsequent impacts on the other component/elements of ecosystem.

Instruction

In this exercise, you are required to state monitoring objectives, identify monitoring parameters, discuss standards and limits for the concentrations of different chemical in water bodies and discuss baseline data in relation to perceived trends due to the implement of projects in your area.

Presentation of results

Each group will present its findings/results by using a flip chart.

Exercise 5: Socio-cultural monitoring

Brief notes

Development projects usually affect the social and cultural settings of a given area. Such effects include land expropriation and resettlement. As a result of these events, the livelihoods of local communities are affected.

Instruction

In this exercise, you are expected to formulate monitoring objectives, develop conceptual models, based on the latter identify stress – receptor relationships, identify monitoring parameters and develop a report for decision-making. Discuss the baseline situation and anticipated trends.

Presentation of results

Each group will present its findings/results by using a flip chart.

Exercise 6: Environmental Management Plan implementation and supervision for large-scale commercial farms

Brief notes

Implementation and supervision of EMP of the ESIA is one pertinent part in the EIA process. This activity is usually taken care of by the competent authority and the project proponent. The latter need to have an Environment officer/manager who follows day-to-day activities and prepare weekly and monthly report of the performance of the mitigation measures outlined in the ESIA.

Instruction

In this exercise, you will review the mitigation measures and environmental monitoring plan of a large-scale commercial farming project. Each group will share their experiences in the supervision and implementation of the requirements of EMP. This exercise is designed in such a way that the trainees grasp the very basics of EMP of the ESIA.

Presentation of results

Each group will present its findings/results by using a flip chart.

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