ENVIRONMENTAL IMPACT ASSESSMENT (E.I.A) ON SMALL WATER RETAINING STRUCTURES

The abstract

The achievement of sustainable development requires a framework of strategies, approaches and tools. One of these tools is application of E.I.A as an appraisal method and decision-aid. Now, it is widely accepted that the Environmental social consequences of development actions must be mitigated within the scope of the project itself by integrating E.I.A into process designing, management and performance. Many projects do have E.I.A policies, but it is not in the right way for aspects such as adaptability by the community and they are too sophisticated in the terms for local communities to put in use.

This paper will focus on E.I.A on small water retaining structures generally Sand Dams. E.I.A will be used to assess possibilities of both positive and negative impacts while paying great attention to mitigation measures as well as putting into consideration short and long term impacts on; Technology, management and performance

Technological stability- in the first place technological stability is required for development and it should be affordable, simple without necessitating external assistance and with appropriate results, simplicity and less expensive to construct basing on the material availability for the construction, the design adoption by the community (willingness), the alteration of the river course either took or will take another course, depth up and down the stream frequency of repair.

As to Management aspect, E.I.A will assess the role played by community in protecting the environment on riverbanks, control of the number of households and livestock per water point, sanitation at water point as well as the environs, repair of the dams by the community themselves.

E.I.A tool will be used to tell on the Performance of the dams biologically or/and chemically, because it a tool used to asses the water table prior and after construction of the dam, The water availability/volume both up and down steam within the twelve months of the year, recharge, biodiversity (flora and fauna), H_2O quality and microclimate change, study on socio-economic (encouraging economic activities such as tree nurseries, aquaculture, ecotourism, vegetable growing among others), food security, land degradation.

A summary of foreseen positive and negative impacts is given and the possible mitigation measures.

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I INTRODUCTION

Environmental impact assessment is defined as detailed study of the environmental consequences (impacts) of the proposed course of action, including mitigation of, and monitoring to ensure that mitigation is working. It is an instrument, which makes it possible to introduce at an early stage of planning and design process, a systematic methodology to help ensure the environmental, social and economic sustainability of interventions. It is a tried and tested instrument for analyzing the effects of development proposals on the environment and to mitigate their impacts.

An environmental impact assessment should take into consideration direct or indirect effects of the following:

- Biophysical Environment (water (atmospheric, subsurface and surface), land, vegetation, animals,).
- Social cultural environment (Population, Community structure, religion and culture).
- Economic environment.

II GENERAL OBJECTIVE

The overall objective of carrying out an E.I.A is to determine the likely impacts of a given project, might have on the environment; propose possible mitigation measures

II EIA Activities

1. 2.1 Impact Identification

Determine the type of environmental impacts most likely to arise from the development. This involves the compilation of checklists of the environmental characterizes of the site to be developed, and the activities and the structures associated with the development. List of content will vary with the environmental setting and the type of development. Preparation of checklist can be facilitated by reference to published materials and consultation between project designers and environmental specialists.

2. 2.2 Impact assessment

This includes predicting the likelihood of the identified impacts, their magnitude and importance in terms of existing environmental quality. There are three categories of methods, which can be used to, either singly, or in combination, to assess impacts;

Impact Matrix. The matrix is prepared on the basis of impact identification checklists. Development activities are listed across the top of the matrix and environmental characteristics are listed down the side. The effect of each action on each part of the environment are determined quantitatively and entered into the matrix. The matrix is then summarized to show which action is most affecting and which part of the environment most adversely affected.

Multi-disciplinary judgement. This consist of selecting a number of different experts, weighting them for their individual expertise and averaging their guesses as to the effect of development.

Analytical models. The effect of development are defined in terms of the changes they will cause to parameters in a model that simulates the development. The model is then run with these changes, and the output predicts the impact. Predicted impacts may be summarized according to their likelihood of occurrence, intensity, extent, duration reversibility and mode of action.

3. 2.3 Mitigation

The design of project modification to avoid, reduce important advance impacts and enhance environmental benefits.

4. 2.4 Monitoring and Evaluation

A major problem with impact assessment is the lack of knowledge about the effects of development on environment. Frequently, there are few hard data to enter into an impact matrix, and as consequence, guesswork or the outputs from models, which make simplifying assumptions are used as a substitute. In face of the uncertain of outcome, it is important to design and implement a monitoring and evaluation programme to ensure development associated impacts. Such programme provides information, which feeds back into future planning and management activities. Monitoring also provides an opportunity to detect unforeseen impacts and make appropriate modifications to design and implement the project.

5. 2.5 Documentation

Concise reports are required to inform decision-makers of the likely impacts of the project; options for minimizing adverse impacts, and enhancing positive benefits, and proposals for monitoring impacts.

III THE EIA PROCESS

Environmental impact assessment is undertaken as a sequential process, which ensures that the effort put is appropriate to the type and magnitude of anticipated impacts.

6. 3.1 Screening

A process used to examine the potential implications of development proposals and determine whether they should be subject to a detailed EIA. This can be done in a number of ways, either singly or in combination:

- A list of those types of development for which an EIA is required
- Define development thresholds above which EIA is required. Thresholds may be expressed in terms of area of land, size of investment, number of people affected among others.
- According to specified ecological criteria such as conservation value of plants and animal communities, potential for pollution etc.

7. 3.2 Preliminary *assessment*

A preliminary assessment uses readily available information to determine whether a proposed development is likely to cause any significant environmental impacts and it involves:

- Identifying the development site, nature of development, design, cost, water, power, roads etc. and feasible alternatives.
- Collecting readily available data on climate, landscape, geology, soils, vegetation animal population etc.
- Preliminary identification and assessment of impacts using checklists and matrices
- Assessment for need for assistance from specialist disciplines

8. 3.3 *Scooping*

If the preliminary assessment and screening indicates that a detailed assessment is required, the first part of the process is to determine the range of issues to be investigated. Scoping is undertaken to identify major issues, design appropriate study methods and identify data requirements. The output of scoping exercise is a set of terms of reference for the detailed assessment. Scooping is best undertaken as a consultation process between the proponent, environmental investigators, the EIA review agency, other ministries/ departments, NGO's and local community. The consultation process involves the dissemination and receipt of information, which improves understand of the development and potential environmental impacts.

9. 3.4 detailed assessment

The nature of assessment will vary with development type and site environment, but usually consists of the following:

- Baseline studies of the existing environmental conditions;
- Process studies of detailed aspects of the development and its alternatives;
- Identification, confirmation and assessment of impacts through checklists and interaction matrices;
- Design of mitigation measures to minimise adverse impacts;
- Formulation of a programme to monitor the environmental performance;
- Preparation of an environmental impact statement (EIS), which reports on the development and the environmental investigation.

10. 3.5 Environmental statement review

The EIS is reviewed in terms of its quality and content to;

- Ensure that the environmental investigation and analysis discloses all relevant environmental considerations; and
- Enable the decision-makers to determine whether the environmental consequences are acceptable.

In this regard, reviews should ask

- Does the report focus on key questions which need to be answered to make a decision about the proposed development?
- Is the report scientifically and technically sound?
- Is the report clearly and coherently organized so that it can be understood?

11. 3.6 Project Implementation and Monitoring

A monitoring programme is required to ensure that the development is undertaken in accordance with the conditions and design criteria established to mitigate adverse

environmental impacts, and to evaluate actual environmental impacts. Evaluation results are fed back into environmental management of the project and future development planning.

IV Environmental impact assessment checklist

Collaboration between environmental specialists and project designers is essential for a proper understanding of the interactions between development and environment and identification of potential impacts.
These are types of impacts, which might be expected as a result of any development

12. 4.1 Potential Environmental Impacts

Increased soil erosion
Soil contamination
Accelerated landscape change
Disruption of stream flow
Water pollution
Disruption of nutrient cycles
Air pollution
Noise pollution
Loss of vegetation
Loss of or reduction in size of habitats
Loss of or reduction in population size of species
Disruption of migration patterns
Illegal hunting introduction of exotic or domestic species
Fire hazards
Damage to roads
Damage to palaeoecological sites
Damage to historic, cultural or archaeological sites
Social and socio-economic impacts on surrounding communities
Employment
Increased exposure to diseases
Secondary impacts induced by the initial development

13. 4.2 Potential impacts on area management

Modification of existing plans
Additional staff requirements
Change of duties and allocation to new work plans
Additional equipment needs
Financial allocations for development, maintenance, monitoring and evaluation

V General Environmental Impact Assessment on any project

14. 5.1 Technological Aspects

Sustainable technology has to be appropriate for a given situation. It should be compatible with natural, economical, technical/design and social environment of the ecological area.

More specifically, these criteria also taken into consideration will include

Design; does the design brought have by the technology cover seasonal effects like saturated soils and heavy rains.

The ability of the community to adapt it even after the sponsor leaves the area as well as the design being conducive to the climate and soils of the area.

Management; what is the capability of the community in future maintenance of the project? And how frequent does it need repair, are the materials for repair and maintenance easy to get?

Performance; Here the year round performance of the technology is assessed, does it serve the community every time and how many benefintiaries?

- Adaptability: The ability of the said technology to be adapted to circumstances and by the community as well as possibility for innovation and/or combination with other technologies/solutions.
- Durability: The lifetime of proposed technology
- Flexibility: Sensitivity of the technology concerning specific condition, like; seasonal effects, special characteristics among others.
- Maintenance: Type and frequency of maintenance
- Performance: Existence of performance indicators

15. 5.2 *Economical Aspects*

Alternative solutions will be based on cost effectiveness. Mainly the cheapest solution to any problem is chosen. Some criteria are developed to evaluate the feasibility of the proposed technologies, they are:

Design; considering the design by technology, is it the cheapest? And are there possibilities to change the design to lower costs.

Maintenance; Does the labour and expertise come from far in case a repair is required in future

Performance; after intiating the projects are the returns worth the investment cost, including manual work and local resources utilised.

- Affordability: Total investment of proposed technology relative to the budget
- Cost: Total cost including investment, operational cost and maintenance cost
- Labour : Type of labour and expertise required for implementing the proposed technology.

16. 5.3 *Environmental Aspects*

Water provision, its utilization and environmental problems are inter- related. In this case, it is wisely to propose environmental friendly technologies to supply water. Assessment of the environmental impacts of proposed technology will be conducted, ensuring that input required for a complete analysis have been accomplished. Some environmental aspects, which will be assessed, are listed below:

Design, The possibility of landscape changing because of implementation of proposed technology, for some changes land use.

Flora and fauna, which will be affected by the implementation of proposed technology, like new species of plants making others, disappear, and some animals migratory or movement paths altered by the design

Maintenance; Type and sustainability of natural resources, which will be explored, in future will they be available for expansion or repair,

Performance; Amount of water up and down stream as well as its quality prier to and after implementation of the technology. For how many months of the year and is it enough?

17. 5.4 *Socio – Cultural Aspects*

Both social and cultural are often difficult to quantify. However, these aspects play an important role in the selection and implementation of solutions or technologies.

The social aspects are related mainly to the social welfare. Some criteria can be used to evaluate whether the proposed solutions will increase the social welfare or not. They are:

Design; Increasing of level of employment, the design should be easy to be adopted by locals to learn such that some gets jobs any case repair or more of the same may be needed in future.

Maintenance; the technology and the its services does not interfere with the residents way of life; if any thing its to strengthen the normal way of living and their organization in maintenance of various resources.

In **performance**; the technology has to provide equal services to all; rich and poor and within the catchment area, and to an extent of achieving over 90% of the expected output.

Cultural criteria are referred mainly to the acceptance of people. Different culture should have different perception about the proposed technology.

IX Major Issues and Potential Impacts that are to be considered in sand dams project:

After global over view of what can be looked at in development of water projects, now narrowing down to what can be looked at within Sand Dams; the following as an example you can find a summary of impacts and mitigation on table 1.

18. 6.1 *Environmental Issues and Impacts*

a. Biodiversity

Design may create a pronounced throw back, and lateral recharge, which enables water availability through out the year and thus emerging of various tree and animal remaining in one place all the year round, meaning no migratory.

It might have some negative impacts mainly during construction as trees a cut to pave way for site, and for the first rains before the dam matures some vegetation are or have banks on water making them dry up.

Maintenance; attraction of many animals becomes a disaster to residents farms.

Clearing of vegetation along river/stream banks for vegetable growing is a major threat to flora.

Positively, Sand dams do not have impacts on material for maintenance, for once perfectly build no more materials are required for repair.

Performance there is short term positive impact noticed on sand dams, as before the dam is filled up with sand fishing is done on the dams, as well as evergreen area, thus positive climate change mainly to atmospheric water. Generally, the biodiversity of both flora and fauna increases considerably with water availability.

b. Water Quality/quantity

Design; it has be noticed that, when rains are failure or little and the sand damson a certain stream are high/ big, the down stream volume received is little, although not common and is a short term impact. While the up stream receive high volumes of surface water.

As this is not the key objective of the technology, when the dam is mature water is stored under sand and both sides up and down stream have almost the same volumes, and of recommended quality.

Positively on the design, the lateral recharge/subsurface flow raises the water table and individuals can have their own shallow wells as a result, along term impact

Location of shallow wells, have minimized water contamination.

Maintenance; the clearing of vegetation near dam site may lead to sedimentation of the dam and vegetable growing using pesticides have an increased water quality problems.

The number of household per water point is also a source of pollution as many carts and donkeys means more possibilities of polluting/contamination.

Performance; well-designed and constructed sand dam have tremendous water volume increase and available through out the year. When the sand dam matures there is evergreen vegetation, which controls any future wind and runoff erosion.

19. 6.2 *Socio-economic Issues*

The socio-economic impacts are addressed under four headings:

Land Use, Economic Impacts, Health and Safety Impacts (Social Impacts)

Design; The design of sand dam technology has increased the economy of the people leaving within the area, for it does not consume much surface area of arable land and is mostly on water way and the wings on land are under soil.

Developing access like roads to the site is a negative impacts if not well planned, and sitting the dam in a main route or road may isolate or cut off the way through due to saturation of soils and stagnant water before the dam if filled up with sand.

Maintenance; Has stated earlier on, the sand dams does not require repair, there is no money needed for that as well as materials plus extra labour. Migration of youth and men to town is reduced as income-generating activities such as brick making tree nurseries, vegetable growing and good animal husbandry do arise with water availability. Any money that used to go out of the area through buying of vegetables circulates in the area, for the area becomes self-sufficient in vegetable growing.

The leadership and the number of household which share a water point has a tremendously changed the people's way of day to day life.

Performance; its only during the first rains when down stream people may receive less amount of water but rear cases that is when rains fail.

Breeding places for malaria vector mosquitoes may be reported as a short-term impact.

Shortened distance to fetch water has improved people health as well as diet from vegetables and fruits grown.

Water being an entry point to development, marginal areas have turned to be productive due to sand dam performance and peoples are now migrating to this area thus demographic and institutional impacts for even investors are attracted.

Mitigation Measures:

Biodiversity:

- Planting of selected indigenous species of vegetation in areas where the soil has been disturbed by the construction activities (river/stream banks)
- Having controlled number of vegetation gardens around the dam site
- Encourage many people to plant mainly same variety/type of crop to divide pests

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Water Quality and quantity:

- Sediments: Flood management and sediment traps like terracing farms
- Having controlled number of animals and households per watering point. Meaning many dams
- Strategy placing of water collection point
- Removal of vegetation and soil on the dam site
- Controlled amount of water held during the first rains and before the dam matures. Can improvise sequential building. Meaning increasing heights year after year.
- Size of dam to be constructed.

Socio Economic:

- **Health Impacts**:

1. By designing and implementation of waterborne disease vectors control programs, which will involve the suppression of potential vectors of disease
2. By the introduction of easily accessible medical clinics and dispensaries in project-affected communities and in areas where population densities are increasing this is possible with government collaboration.
3. Training community on Participatory Health and Sanitation (PHAST) to have toilets at least in each home compound and at all water points.

4. Through designing and implementation by a team of specialists, of case detection and epidemiological surveillance programs to monitor changes to public health for local and regional populations

- **Land use:**

1. In the upstream catchments, implementation of watershed protection programs which may involve the acquisition of sensitive conservation areas, the control of vegetation cover and the regulation of watershed development.

- **Social Impacts:**

1. By reducing the numbers of migrant workers (and dependents) living on or close to the construction site

2. Sound social analysis, reliable demographic assessments, and technical expertise in planning for development-oriented resettlement

3. Public participation in setting resettlement objectives, identifying reestablishment solutions and in implementing them

Table 1. SUMMARY OF POTENTIAL ENVIRONMENTAL IMPACTS AND MITIGATIONS

Component	Major Issues	Major Potential Impacts	Mitigation Measures	Remarks
A. Environmental				
	Biodiversity	+ve Long term there is emergency of new flora species (performance) -ve Trees near the site area cut to pave way for site (Design)	Controlled tree/ vegetation cover clearing and tree nursery starting.	
	Water quality	-ve Turbidity of rivers, build up of sediments (maintenance) +ve Increased amount upstream; Raised water table and available through out the year. (Performance)	Management of water levels, Flood management and sediment traps (for sediments)/terracing	
	Soils	-ve Erosion, contamination of soils from pesticides (maintenance)	Plantation of traditional tree spp, and use organic pesticides	
	Landscape	-ve Deforestation and land changes like channel alteration (design) +ve barren land turned to forestry land. (performance)	Afforestation and sitting at the right place. Also controlled number of garden s for vegetables.	
	Water quantity	-ve down stream having less water in the first rains.(performance) +ve Amount upstream increases. (performance)	Size of the dam strategic spacing as well as sequential building.	
B. Socio economic	Land use	-ve access roads to the site and to the other	Implementation of watershed protection	

		side of the stream may be blocked with stagnant water.(design) -ve impassable roads by traffic due to soil saturation (design) +ve Marginal land turned to productive use. (performance) +ve materials for use got locally not for buying. (design)	programs, and sitting far from main roads.	
	Economic	+ve increased income as the availability of water open chances for income incoming generating activities. (performance)		
	Health	-ve Waterborne diseases (performance) +ve good diet from vegetables grown (performance) +ve good health as distance to collect water is reduced/short distance. (performance)	Construction of treatment plants, implementation of waterborne disease vectors control programs, introduction of easily accessible medical clinics and dispensaries in project affected communities	
	Social	-ve Demographic and institutional impacts, Resettlement and rehabilitation.9 maintenance) +ve employment and job opportunities +ve minimized migration of the youth and men	Public participation in setting resettlement objectives, compensation for land, creation of jobs with the new construction of industries and plants etc	

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