

Full Length Research Paper

Environmental impact assessment of oil and gas sector: A case study of Magurchara gas field

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This study focuses on the environmental impact assessment of Magurchara gas field through environmental, socio-economical and meteorological study. The major activities involved are seismic activities, drilling activities, exploration and production. In the case of Magurchara gas field, improper planning and drilling activities have created explosion and caused huge environmental damage. In order to evaluate the environmental damage due to exploration and drilling activities, checklist of possible environmental impact on the nature, society and socioeconomic activities of the proposed area has been identified by focus group discussion, survey and sample testing. During the observation pollution related with noise found as temporary and minor but the air is observed to be polluted by dust, SPM, SO_x, NO_x, and CO₂ etc. The effects of explosion on the natural forests, land, wildlife, tea garden, infrastructure, local people and tea garden workers, livestock feeding, communication and transport etc are measured. During observation, water quality deterioration by spills and leaks of oil and grease, paints, solvents and chemicals was identified. It was found from the cumulative analysis of the study that the project is environmentally feasible.

Key words: Magurchara gas, meteorological study, environmental damage, feasible, socio-economical.

INTRODUCTION

Bangladesh is poor in natural resources by global standards. Natural gas is the most important natural resource that has been discovered and being utilized. Other important discoveries include coal, peat, hard rock and modest reserves of limestone, gravel, glass sand and various types of clay. Environmental issues and problems in Bangladesh are now recognized as the key concerns for the sustainable development of the country. Magurchara gas field, 8 km from Srimangal on the road to kamalganj. The gas field caught fire in 1997 and was ablaze for three months, laying waste to betel-nut plantations and tea estates in the vicinity (McAdam, 2008). Generally, in the petroleum sector major activities involved are seismic activities, drilling activities, exploration and production. During those activities the Surrounding areas are affected

in various ways. During drilling operations, drilling fluid or mud is continuously circulated through drill pipe and back to the surface equipments to balance underground hydrostatic pressure, to cool the bit and flush out rock cuttings. The location of a drill site depends on the characteristics of the underlying geological formation; however, environmental impacts can be minimized by selecting appropriate site for drilling.

One of the earliest contaminant of the drilling site is the mud used while drilling. Huge quantities of drilling mud are required continuously. The returned mud is recycled, but finally to be disposed of the effluent mud is usually stored in large pits. Around four to five thousand cubic meters of mud is stored at a time. Eventually water evaporates, leaving behind the clay in the pit and contaminates top soil. Drilling-mud requires large quantities of water from the nearby sources. It is necessary to check whether the water is contaminated by pathogens. If the water is contaminated, it must be treated. Large quantities

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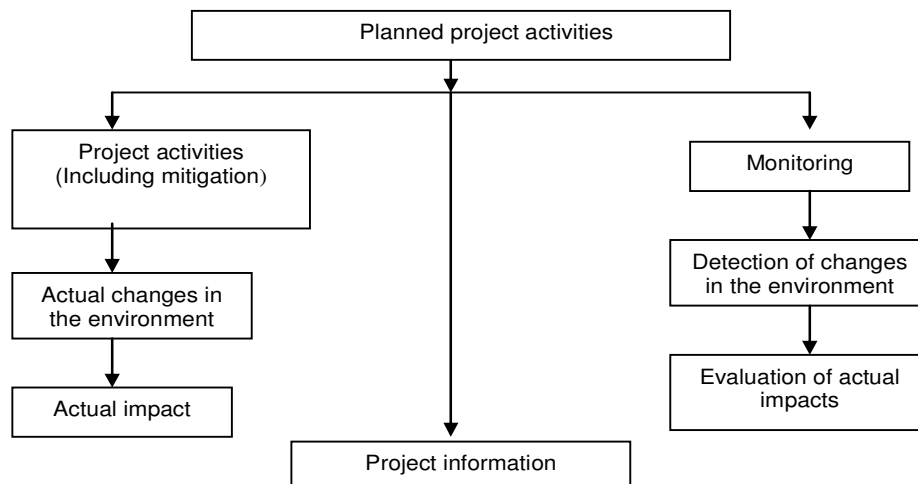


Figure 1. Flow diagram for EIA of the project.

of fluid are let of on the ground or into a nearby stream.

The amount of effluent disposed will be very damaging for the neighboring areas. It is particularly damaging in the case of off-shore exploration as there is no alternative but to dispose it off into the sea (BUET, 2003). Environmental Impact Assessment (EIA) for all petroleum projects will allow the planners and imple-enters to understand the environmental impacts and con-sequences of their projects (NEAB, 1998; DoE, 2001).

The EIA process is thought to consist of six main components: basics; impact identification; description of the affected environment; prediction and assessment of impacts; selection of proposed action and documentation in accordance with extant guidelines (Center, 1997). EIA has been followed to define a project and development alternatives, the environment on which it may be affecting, the potential impacts, mitigation alternatives, impact monitoring and public interests. In order to find out possible beneficial and adverse impacts, environmental impact analysis, construction related impacts, air pollution, thermal pollution of waste resources, noise pollution, soil cont-amination, sediment and dust pollution, waste disc-harges, occupational health and safety, changes in aesthetic environment etc were carried out in this study. The major objectives of the present study were (i) to assess the socio-economic impacts of these projects, (ii) to assess the impacts on land use pattern and (iii) to identify and quantify the environmental effects of these projects.

METHODOLOGY

Checklist method was used in this study. A questionnaire was developed and the following assessment was made based on expert's opinion. 100 experts from different fields related to gas and oil sector were asked and the evaluation was prepared. Pollutants emission rates from the power plant are calculated by using the fuel

consumption rate and emission factor (Kato and Akimoto, 1992) for the unit consumption. The Gaussian Plume Model (Peterson, 1978) was used to estimate the pollutant concentration. Environmental Impact Assessment (EIA) was assessed by the graded matrix system developed by Leopold et al. (1971) in which 'magnitude' and 'importance' of the impact in each cell of a matrix can be denoted by assigning numerical values. The flow diagram of the EIA project shown in Figure 1.

Baseline environmental condition of Magurchara gas field

Magurchara gas field explosion

The gas field caught fire in 1997 and caused huge damage of life and property over the whole area. The Magurchara gas field explosion damaged about 60 hectors of natural forest and 300 hectors of land were burnt. A large part of wild life (Deer, birds, foxes, monkeys etc) was destroyed or displaced to other places. Around 3000 people were affected because 31 hectors of tea garden was completely damaged during explosion (EPCT, 1997). So, the overall socio-economic and environmental scenario was highly affected by the gas field explosion. Preliminary assessment of environmental damages and deterioration of Magurchara Gas Field Explosion are given in Table 1 and its effects on plants, soil and atmosphere are shown in Figure 2 which shows the deterioration soil properties, effects on plants on the Magurchara gas field site.

Noise

Noise, which is seldom recognized as a source of pollution, constitutes a danger to people's health through physical, physiological and even psychological stresses. Drilling operations in particular are very noisy and pose a threat to the relevant workers at the site.

Production of formation water

Oils produced from wells are invariably accompanied with water as they are in close association in oil pool. Hence, whenever oil is produced, some quantity of water is also produced. On an average

Table 1. Preliminary environmental assessment of Magurchara gas field explosion.

Resources	Component	Preliminary assessment
Natural resources	Natural forest	60 ha. completely damaged 100 ha completely burnt
	Land (300 ha.)	Partly burned observed Covered with ash and condensate observed Landslide / Land subsidence observed
	Wildlife	Deer, birds, foxes, monkeys etc. destroyed or displaced
	Water logging/ pollution	Observed
Development resources	Tea Garden	31 ha. completely damaged
	Infrastructure	1 km Train line damaged 1 km Medalled road, 2 culverts damaged 1 km Gas line
	Livestock	Not observed
	Fisheries	Not observed
Human interest	Local people and Tea garden workers	Around 3000 people affected
	Livestock feeding	Not observed
	Communication and transport	Disrupted
	Socioeconomic disruption	Observed
	Air pollution	Not measured
	Population / market displacement	Not observed

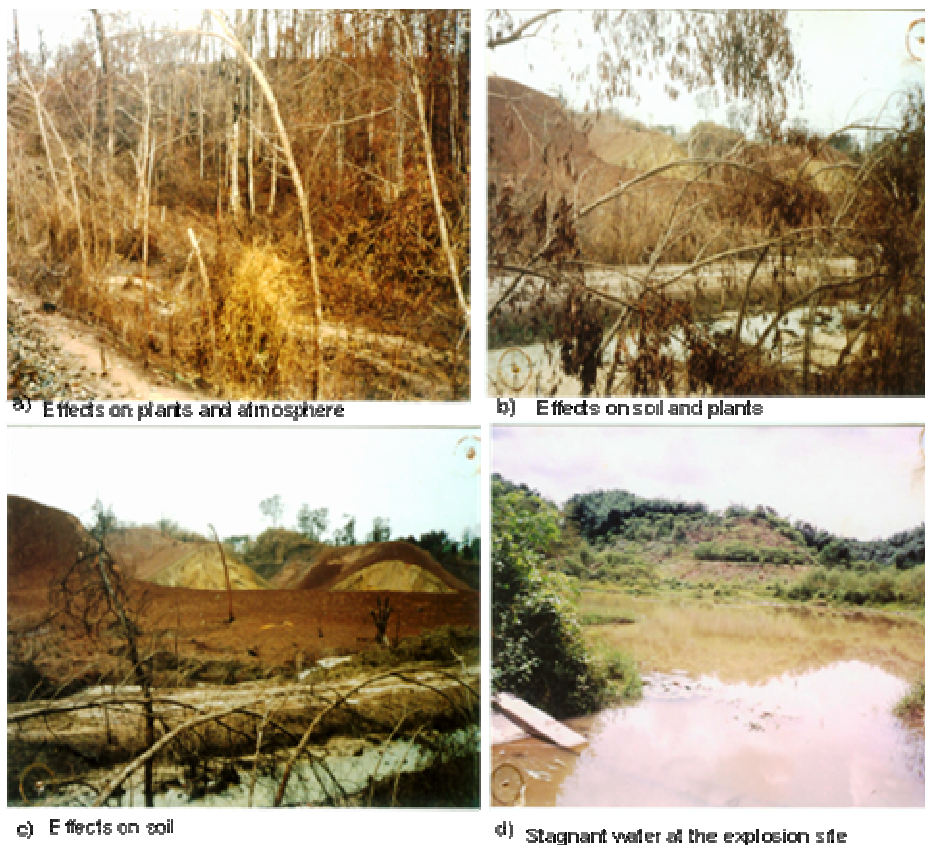
**Figure 2.** Effects of Magurchara gas field explosion on the environment.

Table 2. Possible environmental impacts of pipeline construction.

Environmental component	Positive and negative impact	Mitigation measures
Socio-economic	Negative	Providing temporary housing, eating and sanitary facilities for the construction force to prevent overtaxing the local infrastructure
Land use	Negative	Compensation to owners have to be made for crop loss, land should generally be acquired by individual agreement with the owners
Soil fertility	Negative	Soil fertility is to be preserved by segregating the 30 cm. topsoil layer from common fill material during trenching.
Air quality	Impact is negligible (No)	No mitigation measures are necessary
Surface and groundwater quality	Negative	Potable water used by the construction force have to be tested to ensure that it meets the quality standards of Bangladesh for drinking water. Implementation of Waste Disposal Plan including proper sanitary facilities for the construction force and proper disposal of solid waste generated by the construction activities.
Fish and wildlife	Negative	Select alternate routes of pipeline to avoid forest. Construction force has to be prohibited from hunting to prevent further degradation of this limited resource. Natural fish production has to be protected by controlling water pollution.
Historical and archaeology resources	Impact is considered minor (Negative)	

up to 20% water is associated with oil. This water needs to be separated and disposed off in a suitable manner. This water is usually charged with droplets of oil and some salts. Droplets of oil are collected as far as practicable by using demulsifiers. Sometime this water is used for injecting into the water-horizon in the oil field. The quantity of water to be disposed of is colossal and requires careful thoughts as to how it can be done so that the environment is not damaged.

RESULTS AND DISCUSSION

Environmental impact assessment of drilling and pipe line activities was predicted for the Magurchara Gas Field exploration in oil and gas sector. A questionnaire was developed and the following assessment was made based on expert's opinion. 100 experts from different fields related to gas and oil sector were asked and the evaluation was prepared. In Table 2, Negative and Positive were used to classify the magnitude of the environmental parameters with the relevant mitigation measures. The impact on the socio-economic, land use, surface and groundwater quality, fish and wild life is

stated as negative where the air quality is negligible. A minor impact is stated on historical and archaeological resources.

Environmental evolution has been shown in Table 3 where the identified environmental parameters are analysed for finding out the feasibility of the project by Leopold matrix. Leopold et al. (1971) have developed graded matrix system in which 'magnitude' and 'importance' of the impact in each cell of a matrix can be denoted by assigning numerical values. This approach is used of gross screening technique for impact identification purposes. This study used checklist method and identified the impact through three different dimensions of environment physical, ecological and socio-economic. The effects are stronger on the eco-logical and socio-economic environment rather than physical environment. The effect on plane land is evaluated on low and hilly terrain land medium. Most of the components of physical environment are evaluated as insignificantly affected. Ecological environment of the study area is seriously affected by the gas field explosion. In the study area a huge amount of forests are distracted and got high grade

Table 3. Environmental impact evaluation of Magurchara gas field explosion.

S/No.	Environmental component	Types of impact			Evaluated grading					
		Negative impact			No Impact	Positive Impact	Insignificant	Low	Medium	High
		Probability (p)	Severity (s)	Impact Value (IV) = p * s						
1.	Physical environment									
	Topography									
	Plane land	1	6	6				√		
	Hilly terrain	2	6	12					√	
	Drainage									
	Congestion	2	2	4			√			
	Flash flood									
	Hazard									
	Earthquake	1	3	3			√			
	Cyclone/storm									
	Water contamination									
	Surface water	1	2	2			√			
	Ground water	1	1	1			√			
	Bio-chemical	2	2	4			√			
	Soil									
	Erosion	2	2	4			√			
	Siltation				√					
	Pollution	2	1	2			√			
	Air pollution									
	SPM, dust	3	2	6				√		
	So _x , No _x , CO ₂	2	5	10					√	
2.	Ecological environment									
	Terrestrial Flora									
	A forestation	1	6	6				√		
	Destruction of plantation	3	6	18						√
	Aquatic flora									
	Eutrophication				√					
	Nuisance plant	1	3	3			√			
	Terrestrial Fauna									
	Disturbance to wildlife	4	3	12				√		
	Disturbance to migrated birds	3	4	12					√	
	Aquatic fauna									
	Destruction of wetland	2	3	6				√		
3.	Socio-economic environment									
	Loss of land									
	Agriculture	4	4	16					√	
	Residential/Community	2	2	4			√			
	Industrial/Commercial	2	3	6				√		

Table 3. Contd.

Impact On					
Crops/Plantation	2	6	12		√
Residential/Community	1	3	3	√	
Commerce/Industry	1	3	3	√	
Indirectly affected					
Household	1	3	3	√	
Transportation					
Land communication	2	4	8	√	
Health and Safety					
Workers	3	6	12		√
Local people	2	4	8	√	
Noise to neighbors	4	2	8	√	
Disturbance to					
Social structure	4	2	8	√	
Major sources					
Irrigation	2	5	10		√
Farming	2	4	8		√

in evaluation. The effects on wildlife and migrated birds are evaluated as low and medium, respectively. Distribution of wetland is also considered by the gas field. In socio-economic environment agriculture sector, crops and plantation, and farming are affected and the effects are evaluated as medium. The workers of the gas field and the irrigation are affected highly by the gas field explosion. Other important components of socio-economic environment like industrial, residential, commerce and industry, household, land communication, social structure are also affected and effects are evaluated as low.

Conclusion

It is clear from the study that the cumulative impact of the project is +220 which indicates that the project is environmentally feasible. During back filling of trench the fertility of soil has been reduced and the water quality has been deteriorated by spills and leaks of oil and grease, paints, solvents and chemicals. The fish production of this area has been observed to be affected by water pollution from oil and grease, chemicals and sanitary wastes. Pollution related with noise found as temporary and minor but the air is observed to be polluted by dust, SPM, SO_x, NO_x, and CO₂ etc. Water used by the construction force have to be tested to ensure that it meets the quality standards of Bangladesh for drinking water, or it should be chlorinated so that the tested chlorine residual is 0.2 mg/l or greater, after 10 min of contact time. Implementation of Waste Disposal Plan including, proper sanitary facilities for the construction force and proper disposal of solid waste generated by the construction activities. Soil

erosion has to be minimized with the measures for conserving soil during stream crossings and during trenching activities.

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