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Environment Impact Assessment by Rapid Impact Assessment Method (Case Study: Construction of Discharge Berth in North Oil Terminal, Caspian SeaCoast)

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ABSTRACT

Construction and development activities in construction and utilization phases are associated with the generation of a wide range of pollutants which can have potential effects in receptor resources.
Therefore, prior to the start of construction activities, performing Environment Impact Assessment (EIA) is essential. This paper was undertaken to assess the consequences of project establishment and utilization, identify pollutant sources, and offer solutions to reduce negative environmental effects. Data collection method was administered through field observation and document.
To perform EIA, the consequences of project activities were predicted and studied after identification of different phases, by Physical, Chemical (PC); Biological, Ecological (BE); Economic, Operational (EO); and Sociological, Cultural (SC) using RIAM[1]. According to the results of RIAM matrix, project activities have 6 positive, 12 negative, and 12 neutral impacts in construction phase and 8 positive, 12 negative, and 10 neutral impacts in utilization phase. The result of final assessment shows that although most project activities will not leave negative effects in various aspects of environment, the most negative effects are associated with dredging operations and oil pollution in construction and utilization phases, respectively. Therefore, performing EIA for projects is considered a planning tool to identify potential environmental effects, obtain sustainable development objectives, and guarantee environmental protection. The results of this research are consistent with those of Shakib Manesh et al. [1]to assess the impacts of water system modification on social and ecological environment in Finland; or Suthar and Sajwan[2] to assess ecological, sociological, and economic impacts of urban solid waste discharge; and Gilbuena et al. [3] to assess environmental impacts of flood-reduction construction in subway, Manila, the Philippines. All these mentioned studies indicate the fact that establishment and utilization of plans and construction and development projects are associated with some impacts on environment, ecosystems, and accommodations. These potential impacts might be positive, negative, or even neutral.
KEYWORDS: EIA, Pollutants, North Oil Terminal.

INTRODUCTION

Oil Terminal Companies, due to the requirement to berth and basins to discharge ships, take some activities into account which are directly associated with environment in construction and utilization phases. Multiple oil terminal-related accidents have happened worldwide. The damage will be irreparable if standards and principles are not met. Therefore, the correct solution to minimize the negative impacts and modify environmental consequences is predicting the impacts prior to project implementation [4], for this reason, EIA is highly regarded and it is considered one of acceptable methods to reach sustainable development objectives which can be used as a tool in decision-making process. This way, potential environment impacts resulted from project implementation are identified and solutions are proposed [5]. EIA is a documented assessment of impact condition of a given activity on sociological, economic, cultural, and environmental features of a region, leading to decision making. The simplest decision is to perform or not to perform the project [6]. Now, North Oil Terminal berth installments are being constructed next to the crude oil tanks and discharge berth. Although standard environmental distances have been met, the sensitivity and necessity of EIA are felt due to the proximity to oil and gas industry and roads heading to Neka, Behshahr, and Sari, proximity to residential settlements, protecting areas, and beaches. This research intends to study the environmental impacts of project activities using RIAM. Pastakia method is more efficient than old ones because of the execution of the instructions that result in essential budget forecast with great accuracy. This computerized method makes rapid analysis possible. With the usage of qualitative information, it can follow development cycle in different levels. Finally, it creates a guideline for possible negative or positive impacts and it is more sustainable than other methods[7]. RIAM, as a modern method for EIA, has been used in different projects in some countries such as Denmark, Malaysia, Nepal, and Finland. This

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method identified and assessed systematic consequences and impacts of projects, programs, and plans on physical, biological, cultural, sociological, and economic elements of environment[3,8].

RESEARCH METHOD

The area under consideration is located 20 kilometers far from Neka, 35 Kilometers far from Sari, and 30 kilometers far from Behshahr in Caspian Sea coasts. The area is estimated 100 hectares. Caspian Oil Production and Exploration Company is located in southern part of this region and Shahid Salimi Power plant is in southeastern part. "Observation" and "documentary study" were administered to collect operational information and study the library documents from National Iranian Oil Engineering & Construction Company. After identification of construction and utilization phases of the project under consideration and environmental elements of the region, the project impacts were predicted and analyzed on physical-chemical, biological-ecological, economic-operational, and sociological-cultural criteria by RIAM risk assessment, developed by Pastakia, through scoring. RIAM is a comprehensive and complete method whereby project activity elements are located in matrix row and environmental factors are located in matrix column. In this method, "highly positive" to "highly negative" scoring is used. The procedure being used in rapid impact assessment consists of five parts: importance of effect (A1), magnitude of effect (A2), permanence(B1), reversibility of effect (B2), and cumulative effect (B3) summarized as follows: [7].

(A1)*(A2)=AT(B1)+(B2)+(B3)=BT (AT)*(BT)=ES

After studying and collecting possible impacts on various environmental aspects of berth constriction location, environment, and environmental issues in regional villages and oases, each of probable factors was numerically rated by assessment criteria in two phases: construction and utilization. Eventually, final analysis was performed by using related tables and diagrams to environment elements and predicted impacts. The results were used to identify positive, negative, and neutral impacts on the criteria under consideration. Then managerial plans and solutions were offered in order to reduce destructive environmental impacts and strengthen positive impacts for the construction workshop, site, and region[7].

CONCLUSION

The following tables shows the collection of impacts resulted from berth construction in construction and utilization phases on Physical-Chemical (PC), Biological-Ecological (BE), Economic-Operational (EO), and Sociological-Cultural (SC) criteria. As it can be seen in table 1, type and severity of project construction and utilization impacts can be clarified and determined on related criteria. The results indicated the fact that this project has 6 positive, 12 negative, and 12 neutral impacts in construction phase and 8 positive, 12 negative, and 10 neutral impacts in utilization phase. The summary of impacts in construction and utilization phases based on Fig. 1 and Fig. 2 indicated that most project activities will not leave negative impacts in construction phase. According to table 2, most negative impacts are associated with dredging in construction phase and oil pollution in utilization phase. Therefore, having environmental plans, an Environmental Monitoring and Supervision (EMS) plan, which is one of macro environmental strategies, can be one of fundamental measures to reduce environmental aspects and it is one project requirement in construction and utilization phases which need to be considered by managers, authorities, contractors, etc.

Table 1. Environmental scoring

Description	Band Range	Environmental score	Description	Band Range	Environmental score
Major positive change/impact	+E	72 to 108	Slightly negative change/impact	-A	-1 to -9
Significant positive change/impact	+D	36 to 71	Negative change/impact	-B	-10 to -18
Moderately positive change/impact	+C	19 to 35	Moderately negative change/impact	-C	-19 to -35
Positive change/impact	+B	10 to 18	Significant negative change/impact	-D	-36 to -71
Slightly positive change/impact	+A	1 to 9	Major negative change/impact	-E	-72to -108
No change/ status area/not applicable	N	0			

Table 2.Physical/Chemical (PC) impacts assessment of berth construction

	Component	Construction phase		Utilization phase	
		Description	Code	Description	Code
Physical/	Noise pollution rise (PC1)	Resulted from equipment and machinery activities fordredging, sediment pouring, piling, constructional material transportation	-A	The sound of pumps, compressors, installations accessories (boilers), pumps for fire stations, emergency power generators	**-A**
	The impact on hydrological power (PC2)	Essential urban drinking water and water requirements in construction phase are supplied from sea water. Therefore, projects activities will not influence this criteria.	N	In addition to terminal drinking water, fresh water, via wells, is used for fire-fighting purposes, tanks, boilers, green space, cooling equipment. Therefore, utilization phase can leave negative impact on hydrological power of the	**-A**

Chemical (PC)				region.	
	The impact on underground water quality (PC3)	Since the activities are performed in the sea, no impact is observed on underground water quality.	N	The main concern is when the oil leakage happensin the tank. Studies also indicate that the underground drainage direction is from the south to the north. So oil spill in the beach does not spread to underground aquifers, but must better solutions need to be sought.	**-B**
	The impact on natural drainage of region (PC4)	Since the project is located next to sea, constructional activities do not impact natural drainage in the region.	N	Since most of the activities of the project in utilization phase is carried out at sea, it does not affect the drainage.	**N**
	The impact on flood prevention of project lands (PC5)	Since the project is located in coastal areas and construction of breakwater will itself play the role of prevention, breakwater can leave compatible effects in flood control system.	+C	Utilization phase will have no impact on the flood of the region, but the role of breakwaters is still highlighted to control sea storms.	**+C**
	Surface water and seawater pollution (PC6)	The most important reasons for seawater pollution in this phase are dredging and sediment pouring behind the berth walls, leading to TDS rise. On the other hand, breakwater and berth construction is performed in the sea which will not influence on surface water quality.	-B	Perhaps the most important environmental issue in the utilization phase is the sea pollution. Another thing that can cause sea water pollution is oil spills to the water that can be associated with ship repairs, ship bunkering operations, repair of pumps, loading arms, etc. The volume of such leakage is little.	**-E**
Physical/ Chemical (PC)	Drinking water pollution (PC7)	Given that thefeeding source of underground aquifers is in the heights overlooking the plains, and rivers` alluvial fan and water flow is from south to north, this project leaves no impact on drinking water.	N	Utilization phase processes and incidents have no impact on drinking water in the region.	**N**
	The impact on humidity and precipitation (PC8)	Since project construction does not create some pollutants such as NOX and SOX and there is no process operation, it does not have influence on rain quality and humidity level.	N	Part of the steam generated by the boiler activity, diesel generators and diesel fire pumps whose value is insignificant does not cause many pollutants and it is ineffective in rain quality.	**N**
	The impact on wind speed and direction (PC9)	Due to not having tall building and equipment such as crane, there is no impact on wind speed and direction.	N	Like construction phase, no impact is reported on wind speed and direction.	**N**
	Air pollution increase (PC10)	The main air pollution sources are associated exhaust gases from cars, trucks, dredgers, and dredging particles emissions.	-A	The sources of emissions in the utilization phase can be associated with diesel generator, boiler, fire extinguisher pumps, traffic, andship engines.	**-A**
	Disagreeable industrial smell (PC11)	The disagreeable odor is associated with exhaust gases and sediments from the bottom of sea during dredging.	-A	There is no source of disagreeable odor in this phase.	**N**
	Disagreeable smell of human waste (PC12)	The main reasons of disagreeable smell are associated with rest room waste which generates methane and disagreeable odor in septic as well as waste resulted from cooking in kitchen in case of incorrect disposal.	-A	Continuous presence of human resources will lead to increased waste. Septic will also play the role of settling. Therefore, disagreeable smell will continue to be generated as a result of waste treatment. Also, septic discharge creates disagreeable odor.	**-A**
	The impact on morphology and the shape of ground (PC13)	Advance is sea is required to erect berths, the creation of dry land, and reservoir tanks, resulting in the removal of 7.5 to 10 million cubic meters of dredged material .Also, surrounding mountains are used to erect breakwater.	-C	No deformation will happen in utilization phase.	**N**
	The impact on installations and building due to earthquake (PC14)	With regard to the fault of the Alborz and the Caspian at less than 50 kilometers from the site, the earthquake is likely to occur. Based on studies, water level depleted as deep as one meter due to earthquake since 1982 which is safe but still sensible. Therefore, irreparable damage will not occur in construction phase.	-B	Given that earthquake is likely to occur, tear and tank deformation are likely to happen since oil and gas are stored in utilization phase which will lead to irreparable consequences such as fire, BLEVE, and VCE. Therefore, it can cause irreparable financial and human damages. Fire is also one of threatening consequences of earthquake.	**-D**
	Coastal soil erosion (PC15)	According to advance from the beach to the sea, coastal soil erosion will not be createdin this phase.	N	Since berths and tanks have been built, soil platform has reached strength and erosion will not take place.	**N**
	Soil pollution	Major pollution is caused by the oil		Oil spill is the main reason of soil pollution	

	(PC16)	spill and oil spills from vehicles, plant and maintenance activities, such as construction debris, chemicals, cement, paint and waste sandblasted	-A	which can be associated with oil pipe repair, valve and flange repair in transfer line, safety valve activation, reservoir tank overload, tank crack, and repair activities on tank such as overhaul, transfer pipe and valve leakage. Also, vehicle oil leakage as well as pump repair oil leakage leads to soil pollution in construction site.	**-B**

This table shows that some environmental parameters with negative consequences require modification measure.

Table 4. Biological/Ecological (BE) impacts assessment of berth construction

	Component	**Construction phase**		**Utilization phase**	
		Description	Code	Description	**Code**
Biological/ Ecological (BE)	The impact on environmentally sensitive habitats (BE1)	The nearest sensitive habitat is LapouZaghmarz wetlands. Construction phase has no effect on this habitat due to lack of oil in this phase and drainage from underground waters.	N	Oil spill from ships can reach Miankaleh wildlife within 14 hours. In this case, a national disaster occurs. Since oil transfer is performed from North Oil Terminal to other regions through transfer pipe, leakage is likely to pollute LapouZaghmarzwetland.	**-C**
	The impact on Fauna and Flora (BE2)	Plant species is sand friendly one such as reed which will be lost during construction phase. Also, the fish in the beach are forced to leave this placeas a result of dredging operations.Dredging operation will rise the probability of damage tobenthos. Also, this region is the habitat to diverse range of migrating birds.	-A	In this phase, sand habitats have gone due to manipulation. Since the project is completed, migrating birds and aquatics can return to this place. This region is not considered a sensitive andquadruple region.	**+A**
	The impact on rare and endangered species (BE3)	The nearest wildlife withendangered species isMiankalehwetland. There is no impact on this region due to far distance and no oil spill in this phase.	N	In the case of oil spill to sea and, accordingly, the Miankaleh wetland contamination, damage to endangered plant and animal species are possible.	**N**
	The impact on view (BE4)	Construction phase will lead to heterogeneous nature of the region due to splashing sea floor mud, plant coverage loss, and loss of natural landscape. Therefore, this phase will not create appropriate view.	-B	In this phase, the regional landscape design experiences tremendous changes because of different reasons: the construction of breakwaters, reservoirs berths, traffic, routes, and equipment installation.	**+C**
	The impact on ship ballast water (BE5)	Ballast water will not be discharged to the sea due to absence of ship in this phase.	N	According to the main objective of this project during utilization, an equal amount of water with oil cargo is pumped into reservoirs. Therefore, there is no threat concerning the entrance of invasive species. If loading is required in berths, since the ships are in surrounding area of Caspian sea (no other sea), the presence of invasive species is less likely to occur. It is noteworthy that strange species will likely enter the region due to increased salinity and solute in Caspian Sea from north to south.	**-A**

This table shows that as many as five environmental parameters are identified and evaluated in biological and ecological environment in construction and utilization phases.

Table 5. Solution to reduce negative impacts of biological/ecological criteria (BE) of berth construction

	Component	**Proposed solution**	
		Construction phase	**Utilization phase**
Biological/ Ecological (BE)	The impact on environmentally sensitive habitats (BE1)	----------	With some measures, transferring the released oil in the basin is prevented. Also, transfer pipes need to be continuously checked to find the leakage. Oil leakage needs to be collected from sea surface.
	The impact on Fauna and Flora (BE2)	Big damages are not created to the region due to the vastness of beach. However, some measures are proposed to compensate the damage.	----------
	The impact on ship ballast water (BE5)	----------	Controlling and monitoring measures of beach, ship, and equipment need to be taken into account. If ballast water is discharged into sea water, waste treatment measures must be taken into account.

This table shows that the most important effective factor in environment (BE) are oil and microbial pollution as a result of oil release or ship ballast water discharge.

Table 6. Economic/ Operational (EO) impacts assessment of berth construction

	Component	Construction phase		Utilization phase	
		Description	Code	Description	**Code**
Economic / Operational (EO)	Creating job opportunities (EO1)	Since the project requires a wide range of related jobs, some local contractors, a regional transformation will happen.	+D	Permanent job opportunities will flourish concerning employment.	**+D**
	Local migration prevention (EO2)	Construction of the project is an important step to prevent the migration of local people.	+C	Migration of local workforce will dramatically decline due to permanent job opportunities.	**+C**
	Activation of additional services (EO3)	Additional project-related services such as transportation of raw material, personnel, and recreational units are created.	+C	In this phase, many people are indirectly involved where their services are related to the company.	**+C**
	Conflict with existing land uses (EO4)	No conflict is created due to separation of industrial zone and agricultural lands through asphalt road.	N	In this phase, no conflict is observable with other uses.	**N**
	The impact on other uses (EO5)	Not issuing unrelated license during construction will be effective in local fishers` income, leading to damage to this group of people.	-B	Fishers will continue to work if ships are not intervened.	**-B**

This table shows that as many as five Economic/ Operational criteria were identified in both construction and utilization phases. The impact component on other uses is one of negative consequences.

Table 7.Solution to reduce negative impacts of Economic/Operational criteria (EO) of berth construction

	Component	Construction phase	Utilization phase
		Description	**Description**
Economic / Operational (EO)	The impact on other uses (EO5)	According to fishers` capabilities and skills, they can be hired in different parts of the project.	Local fishers can also continue to work by creating margin of safety in ship traffic.

Based on studies, fisher are more likely to experience damage as a result of project. Therefore, some solutions are proposed in table 7.

Table 8. Sociological/ Cultural (SC) impacts assessment of berth construction

	Component	Construction phase		Utilization phase	
		Description	Code	Description	**Code**
Sociological / Cultural (SC)	Conflict with public places and urban-rural settlements (SC1)	The nearest urban and rural settlements are located 4 and 20 kilometers far from the project, respectively. No conflicts is observed in this regard.	-C	No conflict is likely to happen if standard distance is met between gas, oil and product transfer line and rural and urban regions.	**-C**
	Sociological and public acceptability (SC2)	There is general acceptance due to the importance of national projects and the creation of essential infrastructures for industrial development as well as creation of direct and indirect job opportunities for the residents. This project is highly regarded by the public.	+D	In Caspian field, not only is cultural and economicboom doubled, but also it is highly regarded and valuable by the national authorities because of revenue.	**+C**
	Cultural growth of local people (SC3)	Economic growth and increased income created as a result of construction of this project result in cultural growth of local residents.	+B	This project will lead to economic and cultural sustainable growth due to population movements around the project including residential communities movement, businesses, shops, industries, schools and other cultural buildings	**+C**
	The impact on historical, religious, and cultural attractions	There is no historical, cultural, or religious attractionaround the project.	N	There is no damage on historical buildings due to coastal nature of project and absence of historical attractions around the berths.	**N**

This table shows that “conflict with public places and rural and urban places” can have negative environmental impact.

Table 9. Solution to reduce negative impacts of Sociological/Cultural criteria (SC) of berth construction

	Component	Construction phase	Utilization phase
		Description	Description
Sociological / Cultural (SC)	Conflict with public places and rural and urban places	Installing warning signs, respecting speed limit, respecting the permissible load are essential due to the movement of trucks and of cargo trucks in urban and rural roads.	Tankers fueling stations must follow safety standards in order to prevent irreparable damage caused by the explosion and fire incidents.

Table 9 shows that engineering and preventive measures are essential in order to prevent accidents in project implementation phase and process accidents.

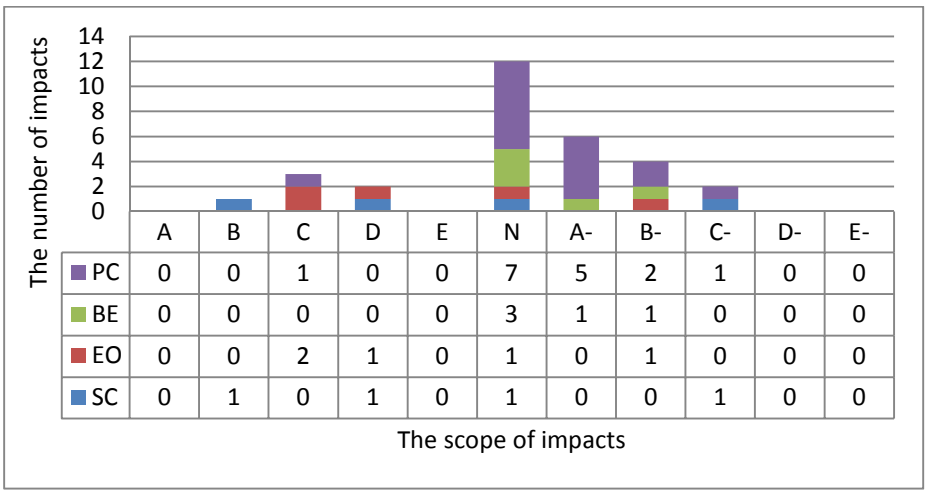

Figure1. The results of environmental impacts in construction phase

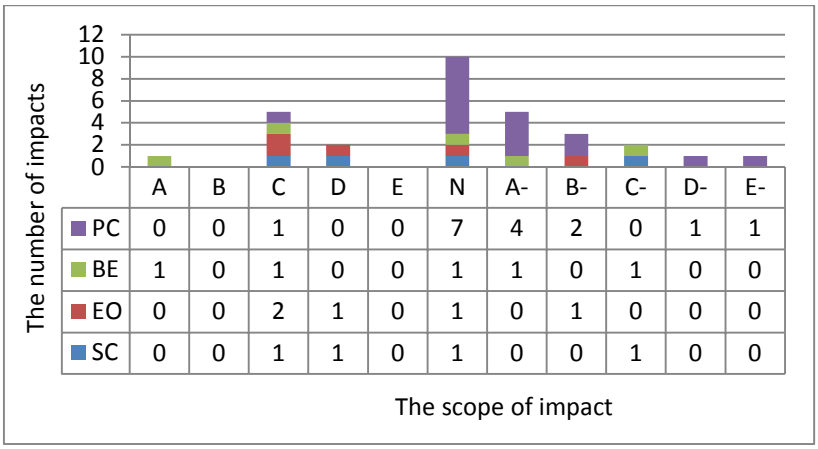

Figure2. The results of environmental impacts in utilization phase

DISCUSSION

The results of this study are consistent with those of ShakibManesh et al. (2014) to assess the effects of water system modification on sociological and ecological environment in Finland; Sutar et al. (2014) to assess ecological, sociological, and economic effects of urban solid waste discharge; Farhadian and Moradi (2012) to assess the environmental effects of Roudbar Dam, Lorestan; Gholamalifard et al. (2013) to assess the environmental effects of solid waste disposal in ShahreKord; Gilbuena et al. (2013) to assess environmental effects of construction implementation to reduce flood in subway, Manila, the Philippines. All these studies indicate that construction and utilization of construction and development projects and plans are associated with some impacts on environment, ecosystems, and settlements. These effects might potentially be positive, negative, or neutral. Therefore, it is necessary to perform EIA prior to the implementation of project and then solutions and measures are essential to remove the negative effects and strengthen and promote positive effects.

Proposed solutions in oil terminal construction phase:

1. Using appropriate dredgers such as hydraulic suction dredger to reduce dredged material dispersion,
2. Decreasing dredging duration and increasing the operation speed,

3. Splashing on depot soil and erected roads,
4. Following speed limit during construction operation,
5. Using geotextile sheets in tanks area to prevent surface water contamination,
6. Minimum amount of concrete needs to be used in loading -berth construction phase in order to prevent oilloss and splurge in utilization phase. Also, in construction phase, the floors need to be erected with proper slope in order to direct spilled oil and polluted rainwater with oil materials or washing water to basins, then oil and water separator tank,
7. Reservoir tanks need to be surrounded by band Walls in order to collect tank leakage and oil in the field.

Proposed solution in oil terminal utilization phase:

1. According to OPRC standard, this system needs to have proper organizational structure and equipment for quick reaction against unexpected accidents. Since oil pollution is one of the most important accidents leading to negative environmental effects, essential and immediate measures are required to prevent and remove pollution and accordingly, reduced damages.
2. Some ways to control the leakage and oil spill are oil barriers to enclose and thicken oil layer such as Boom, OSD, absorption pads, skimmer to collect oil in sea, and Hooper to collect oil in the beach.
3. According to international MARPOL Convention, all ships are required to have oil pollution Emergency Label on the ship.
4. In case of oil spill, polluted soil needs to be taken out and replaced with appropriate soil.
5. Since using absorption well is not possible to be used for waste disposal due to high level of underground water table, taking an appropriate measure into account seems essential to collect and dispose waste such as wastewater treatment package systems.
6. Another important pollutant resources in utilization phase is industrial waste. Constructing an industrial waste treatment system is essential due to high percentage of oil pollution by oily waste of ship and ship water balance discharge.

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