IJCTA, 8(4), 2015, pp. 1293-1299

Environmental Impact Assessment of Compost Production Facility, Qaen City

Ali Rezvani Mahmouei*, Mohsen Rezaee, Mohammad Arjmand*****

Abstract: For Qaen city, located at South Khorasan province, researches needs to be done for establishment of a waste-to-compost conversion facility in accordance with environmental laws and regulations, and that is due to lack of proper waste management solutions, as well as existence of suitable areas around the city.

Based on above-mentioned subject, and by collecting and analyzing required information, positive and negative consequences of implementing Qaen city compost facility project is evaluated in two models (including 1: The option of not implementing the project and 2: The option ofimplementing the project by applying methods in order to reduce negative impacts and enhance positive impacts), using modified Leopold matrix.

After analysis of the proposed options, the consequences of its impacts on four environmental aspects in 'The option of not making the project' (-228) was estimated. Therefore, the option of implementing the project by mitigating its negative impacts and strengthening its positive impacts with total consequence of (+366) was accepted.

Keywords: Environmentalimpact assessment, compost plant, Qaen city.

1. INTRODUCTION

The ever-increasing growth of human population and consequently increasing consumption, results in waste production growth. One of the most important environmental challenges of societies is the hygienic and proper management of solid wastes. High costs of making locations for hygienic waste landfill, and the feasibility of reusing solid wastes, caused human to think about reusing and recycling of raw materials. Among different methods for reusing and recycling municipal solid waste, is production of organic fertilizers (compost) from organic materials, which despite from its direct economic benefits, it is used to decrease odor and leachate, and reduce disposal expenses[1].

According to article 105 of the third socioeconomic development plan of Iran, all of major manufacturing and service sections are bound to provide environmental assessment reports, and Environmental Assessment Regulation has bound industrial recycling centers (including compost facilities) to submit related reports. Through recent years, assessment of environmental impacts has taken part in justification of plans along with other criteria, and made projects implementation either possible or impossible[2].

Environmental Impact Assessment (EIA) is a formal procedure, operation,and research used to predict the environmental consequences of a project on environment, human health, and social welfare, or in other word, systematic exploration-and assessment of consequences of projects, programs, and plans on physical, chemical, biological, cultural and social components of environment[9].

In this study, environmental impacts of the proposed plan for Qaen city compost facility is evaluated, and environmental effects of the plan on four environment components in two models of not implementing the project option and implementing the project by considering methods for mitigating negative effects and strengthening positive effects option is studied and evaluated.

* Department of Civil Engineering,Bozorgmehr University of Qaenat, Iran, *Email: rezvani@buqaen.ac.ir*

** Department of CivilEngineering, University of Zabol, Iran, *Email: M59_rezaee@yahoo.com*

*** Department of Civil Engineering,Bozorgmehr University of Qaenat, Iran, *Email: arjmand@buqaen.ac.ir*

2. PURPOSE OF ENVIRONMENTAL ASSESSMENT STUDIES

Environmental Impact Assessment is a systematic exploration and assessment of consequences of projects, programs -and plans on physical, chemical, biological, cultural and social components of environment and in other word, it is a method for determining, predicting, and interpreting environmental impacts of an activity on components of environment, public hygiene and health of ecosystems on which human life is dependent.Environmental impact assessment of industrial development programs, in line with achievement and application of environmental management tools in industrial development programs, as one of the bases ofdevelopment, in order to minimize negative impacts on environment and natural resources and establishment of a widespread and dynamic system to correctly deal with pollution and destruction is a necessity[3].

Major benefits of environmental impact assessment of projects can be summarized as follows:

1. Creating a system to be a decision basis for managers and decision makers of the project
2. Increasing environmental awareness and knowledge at various levels of society, authorities, and decision makers
3. Determination of the impacts and possible consequences of the project on physical and biological resources and socio-economic conditions of the society in three ranges of immediate impacts, direct impacts and indirect impacts, and
4. Making guidelines for continuous monitoring and surveillance of the impacts during construction and operation activities[4].

3. METHOD OF ENVIRONMENTAL IMPACT ASSESSMENT OF QAEN COMPOST FACILITY

Qaen city, as the second most populous city in South Khorasan province, with a population of over 40,000 people, generates 35 tons of waste every day.

In order to reduce the volume and weight of solid waste and to reduce emissions of odor and leachate, and to reduce disposal expenses, establishment of a compost plant with a capacity of 15 tons in Qaencity is suggested. The proposed site of the project is located at a distance of 7 km from the legal boundaries of Qaen city,beside the current household garbage landfill.

In order to assess environmental impacts, modified Leopold matrix method was used. This matrix was used in Iran by Mirzaei et al. for the first time[5]ý. Leopold matrix method has good connectivity and flexibility, good abstract shape, high resolution for comparison of alternative options and economical aspects.

In modified Leopold matrix method, in addition to the quantity (importance) and range of the effect, duration of the effect as an independent factor in estimating the impact of activities on environment are alsointroduced into the matrix.

In this method, scoring the quantity of the impact is given from values 1 to 5 considering its strength or weakness and its type of effect, which may be negative or positive.

Table (1) shows the classification method of the effect quantity (importance) in the method described above:

In general, based on current guidelines and with respect to important parameters such as ecological conditions, ecological sensitivity of the region, social and economic structure-and dimensions, and purposes of the project from generated pollutions and manufactured products point of view, three different areas were recognized, monitored, and assessed.These three areas, according to the scope of the environmental impacts of the project include:

- Contiguous area: including the location of the project site and construction base
- Direct impact area: an area within radius of 5 km from the plant site
- indirect impactarea: include the whole Qaen County from the standpoint of administrative divisions.

Scores attributed to each of the three areas described above, is shown in Table (2):

Table 1
Classification of impact quantities regarding their strength and weakness in modified Leopold Matrix method

Statement	*Number*	*Range of Numbers*	*Statement*	*Number*	*Range of Numbers*
Very high positive effect	+5	+4.1 to +5	Very high negative effect	-5	-4.1 to -5
Highýpositive ýeffect	+4	+3.1 to +4	High ýnegativeýeffect	-4	-3.1 to -4
Moderate positive effect	+3	+2.1 to +3	Moderatenegative effect	-3	-2.1 to -3
Littlepositive effect	+2	+1.1 to +2	Little negative effect	-2	-1.1 to -2
Trivialpositive effect	+1	0 to +1	Trivialnegative effect	-1	0 to -1

Table 2
Scores attributed to each of the three areas influenced by the environmental effects of the project

Description of impact range	*Score*
Contiguous area	1
Direct impact area	2
Indirect impact areaý	3

In the proposed Leopold matrix, in order to approximate the effect of the time factor on impacts of environmental components, some variations were defined according to Table 3:

Table 3
Scores attributed toduration of the effects in each of the three areas affected by the environmental impacts of the project

Definition of the effect duration	*Score*
The effects with short term duration (less than 1 year)	1
The effects with middle term duration (between 1 year to 5 years)	2
The effects with long term duration (more than 5 years)	3

In order to estimate the effect of every impact on environmental components, numerical values of the three components are multiplied by each other, which would result a number between (+45) and (45). Finally, by adding the indexes of the environment (physical, biological, and socio economic, cultural, and pollutant emissions) and for each of the phases of construction and operation and for different options, a number is obtained that would be appropriate to select the suitable option.

In this research, considering the condition of the project, which is in study phase, only two options for Environmental Assessment in the form of not implementing the project (option 1) versus the options of the implementation of the project by of mitigating negative effects and strengthening positive effects of the project (option 2) has been studied.

4. LOCATION OF THE PLAN

Proposued Location of Qaen compost plant project is at a distance of 7 km from the Qaencity area and in the vicinity of current household garbage landfill. Based on data from Qaen synoptic station, through the statistical period from 1980 to 2012, maximum and minimum monthly mean temperatures occurred in July and January, which is equal to 32^{oC} and -17^{oC}, respectively. The climate of the area under study, based on Demarton climate classification method, is considered a dry climate,while a cold semi-arid to semi-humid climate according to Emberger's climate classification. In terms of water resources, there is no river, well, infiltration gallery, and so on in the area under study. It should be noted that there is no settlement in the area of direct impacts.

5. PREDICTION AND EVALUATIONOF THE ENVIRONMENTAL IMPACTS OF THE PROJECT DURING CONSTRUCTION AND OPERATION OF THE PROJECT ON PHYSICAL, BIOLOGICAL, ECONOMICAL, SOCIAL ANDCULTURAL ENVIRONMENTSAND POLLUTANTS OF THE PLAN

Major activities of the plan, considering its technical and operational characteristics and characteristics of physical, biological, economic, social and cultural environments in the areas of immediate (contiguous), direct and indirect impacts of the project, is predicted to be as follows:

- Land trimming, shrub removal
- Excavation, filling and land grading
- Land Use Change
- Construction of technical and administrative buildings
- Construction of major and minor access roads
- Waste and residual generation
- Transport of required construction materials
- Construction of leachate disposal system
- Supply and consumption of energy
- Workforce employment
- Construction of temporary ýcamps
- Landscaping and fencing

Studies on the effects of construction activities on four environmental areas show little impact on the physical and biological environment because of the low sensitivity of the region under study. Through the project implementation period, due to inexistence of rural areas near the site, and direct relation of the workers and personnel to Qaen city, the least social and cultural tensions at this stage can be expected. However, the economic consequences of the project are mainly found in the labor force of Qaen city.

In operational phase, considering the proposed location of the Qaen compost plant and with respect to study of composting plants constructed in Iran, the impacts of this projects are estimated as in Table (4) and Table (5):

In summary, the results of analysis in modified Leopold Matrix method is explained in Table (6):

Table 4
The negative effects of the project on the four environmentalareas during operation period

Type of impact	*Environment affected*	*Impact strength*	*Solutions for mitigating negative impacts on affected environment*
Air pollution	Pollutants of the Plant	Moderate	Temperature and humidity control, installationof filter in the fermentation room, installation of filter to control dust
Noise pollution	Pollutants of the Plant	Negligible	–
Dangers and accidents	Economical, social and cultural environment	Negligible	Observance of safety Instructions appropriate to the workplace
Pollution of surface and underground water resources	Physical and biological environment and pollutants of the plant	Negligible	Construction of septic tanks to collect domestic wastewater of the plant, suitable management of leachate produced, hygiene observance
Soil pollution	Physical and biological environment	Moderate	Limiting project site as much as possible, suitable management of leachate

(*contd...*)

Table 4 (*contd...*)

Type of impact	*Environment affected*	*Impact strength*	*Solutions for mitigating negative impacts on affected environment*
Impact on plant and animal ecology	biological environment	Negligible	Limiting project site as much as possible, suitable management of leachate
Impact on residential areas and its social impacts	Economical, social and cultural environment	Negligible of leachate	Limiting project site as much as possible, suitable management
Social tensions	Economical, social and culturalenvironment	Little	Use of indigenous specialist and non-specialist workforce of the area

Table 5
Positive effects of the plan on four environmental areas in operation period

Type of impact	*the environment influenced*	*Impact strength*	*Solution to increase the positive effects on the environment influenced*
Increasing employ-ment	Economical, social and culturalenvironment	Little	Training and use of specialists and non-specialists in plant and in related industrial units
Activation of ancillary services	Economical, social and cultural environment	Moderate	Agricultural growth and construction of industrial units related to productions of the facility in the region
Impact on social and cultural Texture of the region	Economical, social and cultural environment	High	Advancing cultural level of citizens on source isolation and separation of the wastes and to encourage them to produce less waste, source recycling program, saving tools and separating machinery in composting industry and related cost savings
Region capabilities	Biological, economical, social and cultural environment	High	Promote the use of compost instead of manure to reduce pollution
Health of the area	Economical, social and cultural environment	Very high	Controlling insects and noxious animals, pH control and collecting gases emitted from fermentation, controlling pathogens

Positive

Table 6
Summary results of the analysis of environmental impacts of Qaen composting plant establishment for implementing the project option and not implementing the project optionin modified Leopold Matrix method

Not implementing the project option				*Implementing the project option*			
Operation period		*Construction period*		*Operation period*		*Construction period*	
Positive effects	*Negative effects*	*Positive effects*	*Negative effects*	*Positive effects*	*Negative effects*	*Positive effects*	*Negative effects*
+243	-183	+427	-121	+94	-177	+146	-291
+60		+306		-83		-145	
+366				-228			

In this study, theassessmentresults indicate that the current procedure waste management in Qaen city (stuffing and burning) has adverse environmental impacts on quadruple environments and is not an appropriate method for disposal of the waste in the city at all.

The option that is proposed at present time is construction of a composting plant near current waste disposal site. Regarding Positive and negative impacts of the project, and its destructive and useful consequences, and

considering all environmental impacts during construction and operation of the project, this plant would be a useful step toward controlling environmental pollutions.

Therefore, in order to reduce negative impacts and enhance the positive effects of the project, purposeful specialized ýtraining programs should be implemented (for organizations and personnel associated with the plan), and in general for the target society (Qaen county). These programs can be executed in the following objective formats:

- Increasing public awareness regarding the conversion of waste to organic fertilizer (compost)
- Improving cultural level of citizens on isolation and separation of the wastes in the source and to encourage them to produce less waste
- Implementing source recycling programs and therefore savings in utilities and machinery in composting industryýand saving costs
- Study on selection of suitable and compatible methods in compost plant processes considering different patterns
- Detailed feasibility studies to minimize the risks of investment and facility construction
- Preventing interference of industrial, hospital and hazardous wastes with municipal wastesin order to improve the quality of compost
- Developing laws and standards for the quality of compost produced
- Support of domestic industries for producing equipment and appliances required for construction of compost plant
- Considering the possibility of developing compost industries and assessment of the development effects
- Paying attention to participation of the private sector in collection and recycling of wastes
- Using the experiences of different countries in the composting industry and its related industries and their localization.

6. CONCLUSION

The purpose of the environmental assessment of projects is legitimate qualitative and quantitative conversion of their environmental effects on the physical, biological and other environments into numeric values by which the positive and negative aspects of a project can be assessed.

In this regard, the matrix methodscan act as a simple yet effective tool in evaluation of the environmentaleffects of the projects and they are able to employ field information, questionnaire, expert knowledge and other available sources of information, display environmental status of the option and development plans in a quick way both in quantitative and comparable manner.

Study and analysis of data collected from the qualitative and quantitative environmental effects of the project on the physicochemical, biological and socio-economic, cultural environments and environmental pollutants by modified Leopold matrix indicate that in the construction stage, implementation of the plan with taking environmental considerations into account (option 2) with score +60 is prioritized than not implementing the project (option 1) with score -83, because of the lack of critical aspects in biological environment and inactive land use in the physical environment.

In operation phase, because of inappropriate method of waste management in Qaen city, the lack of critical environmental aspects in the plant location and the features of the plan itself which is an accepted procedure for waste management, the option of implementing the project with overall effects of +306 is preferred to the option of not implementing the project with overall score of -145.

According to the results given in Table (6), the total environmental impacts of the project on four areas of physical, biological, economic, social, cultural and project pollutions in two phases including construction and operation of the plan is equal to +60 and +306,respectively.

Therefore, the total environmental impact of Qaen Compost Plant construction in two phases of construction and operation is equal to +366 that indicate positive outcomes of the option of implementing the project compared to not implementing the project.

As it can be seen, the highest negative effects can be observed in construction phase of the project as well as on physical environment and pollution; however, the severity of the effects can be mitigated by the methods presented for decreasing negative effects.

In addition, the most positive effects are observed on the economic and social environment. This is due to the poor living conditions of neighboring residents and the effect of the construction project on employment growth and on agricultural activities of the region.

With regard to all aspects and long-term and short-term effects of the project, construction of Compost Plant in Qaen City is considered as a desirable option for waste management in Qaen city.

References

[1] Abduli, M., recycling and disposal of Municipal Solid Waste, third edition, Tehran, Tehran University Press, 2008.

[2] Saa'ed, N. and Tyla, P., Environment Protection Terms and Regulations of Iran, first edition, Tehran, Khorsandi publication, 2012.

[3] Faghih, M. H., Environmental impact assessment and its role in protecting the environment, second edition, Ahwaz, AgahPublication, 2006.

[4] Shariat, M. and Munawari, M., Introduction to Environmental Impact Assessment, first edition, Tehran, Environmental Protection Agency, 1996.

[5] Mirzaei, N. and Nouri, J., Assessing the environmental impact of the Sanandaj compost plant, Volume XIV, pp.79-88, Journal of Kurdistan University of Medical Sciences, Winter 2008.

[6] Erfanmanesh, M., Afiuni, M., Pollution of environment, water, soil, and air, Seventh Edition, Isfahan, Arkandanesh publication, 2009.

[7] Butkyn, D., and K. Edwards. 1995. Understanding of environmental, translated by Wahab Zadeh. Second Edition, Mashhad, Mashhad Jihad University Press.

[8] EPA, Environmental assessment, Second Edition, USA, MCGraw-Hill, 2002.

[9] Center, L.W, Environmental Impact Assessment, Second Edition, New York, Mc Graw Hill, 1996.