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Research Article

ENVIRONMENTAL IMPACT ASSESSMENT OF HORTICULTURAL PROJECT IN AMHARA REGION, ETHIOPIA: A CASE STUDY

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ABSTRACT
The diverse agro-climatic conditions have been considered as a boon for Ethiopian agriculture to earn income, foreign exchange, and to get employment from agriculture growing the horticultural crops round the year. The proposed horticultural project in the Bahir dar Zuria woreda to produce vegetables, fruits, and flowers has been expected impacts on physical and anthropogenic environment at the catchment territories. The present study was conducted with aims to assess impacts of the horticultural project on the soil, water, ecosystem and society and to explain the influence of the project activities on the socio-economic and health of the people at Sebatemit area. Environmental quality index and range methods were used to reach impact assessment on the environment. The results describe that the different phases of the project may leave high impacts on the water, soil resources, and medium on ecosystem, flora and fauna, human health, and low on the socio-economic conditions at surrounding spaces.

Key Words: *Environment, Assessment, Horticulture, Impact and Population*

INTRODUCTION
Agriculture is a mode of practice for survival of lives from centuries in Ethiopia, which has shaped the traditions, the culture and the economy of the Ethiopians. Agriculture, therefore, is continued to be considered a centre to all strategies for socio-economic development (Ali and Neka, 2012). Rapid growth of agriculture is essential not only to achieve self-reliance at national level but also for household food security to bring about equity in distribution of income and wealth, resulting in rapid reduction in poverty levels in Ethiopia (MFaED, 2002). Despite reaching Ethiopian GDP growth in double digit at turning of 20th century, agricultural sector has still not been benefited, particularly for improving gap between input cost and output price per unit weight of its production by increasing cost of inputs (EEA, 2003; FAO, 2004). Moreover, reduction in the size of operational holdings due to division of holdings among the heirs, drought and soil erosion have also contributed to the reduction of productivity. As a result, the economic viability of growing traditional food crops like food grains has badly affected (MEDaC, 1999; Ali and Khan, 2007; IAASTD, 2009).

Horticulture has been adopted as an alternate in Ethiopia to get maximum profit from agriculture to earn foreign exchange because the agro-climatic conditions of Ethiopia are suitable for farming and the production of a broad range of fruits, vegetables, and flowers (UN, 2004) here, naturally gifted topography, climate, and accessibility to European, Asian and Middle East markets has potential to supply high quality flowers, fruits and vegetables to the world. According to FAO report, the country's production of fruits and vegetable is increased steadily between 2000 and 2005.During this period, the production of fruit has increased from 1,018,000 to 1,249,336 metric ton and vegetable production has increased from 956,800 to 1,124,800 metric ton. According to National Bank of Ethiopia (2004/2005 3rd Quarter report), exports of horticulture products (fruits & vegetables) has increased from 20,734 to 28,592 metric ton in 2000 and 2004 respectively. The rapidly increasing demand of flowers, fruits and vegetables in developed countries has made them best exportable commodities. The flower sector has only recently become an important agricultural sector for Ethiopia when regarding the export potential. It is a relatively new but at the same time very dynamic sector. Since 2001 up to 2007 the export value of flowers has increased from US$ 0.3 Million up to US$ 113 Million attract potential foreign investors many regions (Joosten, 2007; Pretty *et al*., 2010). The project Yemam and Worku horticulture PLC engaged in fruit and

vegetable production at Sebatemit area, which is located in Bahir Dar Zuria woreda about 10 km to the south of Bahir Dar town, along the highway to Addis Ababa. The proposed project intends to produce fruits and vegetables for domestic (30%) and export (70%) markets. The site was selected considering convenience of agro-climatic character to the target of the project and its respective social and economic to the local society, region and the country in general. It is clear that such projects create job opportunity and maximize the exportable items and to increase GDP and foreign currency of the country (UN, 2004; Pretty *et al*., 2010). However, it may have adverse impact on the environment. The present work was conducted keeping the view of importance to assess positive and negative environmental and social impact of the under construction flower, fruits and vegetable project and to fulfill the practical requirement of the course Environmental Impact Assessment (Getnet, 2010).

Environmental impact assessment (EIA) is a process used to forecast and judge both positive and negative bio-physical and social impacts of the proposed development project (Canter, 1983; Wathren, 1995). Thus, Environmental impact assessment can be defined:

"…an activity designed to identify and predict the impact on the bio-geophysical environment and on man's health and well-being of legislative proposals, policies, programs, projects and operational procedures, and to interpret and communicate information about the impacts" -Munn (1975); *Gotvajn et al.*, (2001).

Objectives of the Work

The present work was conducted to assess environmental and social impacts of the under construction flower, fruits and vegetable project at Sebatemit area, in Bahir Dar Zuria woreda with following objectives.

- To assess the impacts of the horticultural project on the soil, water, ecosystem and society,
- To explain the influence of the project activities on the socio-economic and health of the people.

MATERIALS AND METHODS

Approaches and Methods

Assessing the impact on environment is two phased study that was conducted by reviewing of relevant documents of EIA guidelines, Ethiopian policies, the laws related to environment, and by site visits to collect relevant data of under construction project through prepared checklists, visual observations regarding impact on the bio-physical and socio-economic conditions of surrounding spaces. To prepare checklists, the previous works related to environmental impact assessment of Morgan (1998); Bisset (1980); Lawrence (1994); Canter (1983); Maclearn (1998); EPLUA (2009) and Ali (2013) were studied.

Moreover, double rounds focus group discussions were conducted with project head, construction workers, on farm workers. To assign weight for impacts on the given 0-1 scale, each attribute of soil, water, ecosystem and socio-economic (Table 1), was well discussed related to experts of soil and water resources, agriculture, botany and wildlife, environmental sciences, geography, political science and medical who belonged to Amhara Regional Agriculture and Rural Development Bureau, Amhara Bureau of Investment and Bahir Dar University to recognize possible impacts on soil and water resources, flora and fauna, human health, local society and economy.

The scale 0-1 having 10 points was applied logically based, comparative and relative importance of each parameter to assign weight for every attribute. To assess environment impact assessment, the environmental quality assessment index was used. Moreover, range method was applied to compute high, medium and low significance impact. There were 30 respondents from the surrounding rural spaces selected randomly to get detail about effect on the socio-economic conditions.

Base Line Information about the Project Site Environment

The project is located 10 km to the south of Bahir Dar town along Gonder-Addis Ababa highway consisting 35 ha land of Amhara Regional State. About 80% of the land is expected to be cultivated whereas the remaining 20% includes free spaces and various infrastructures such as buildings, irrigation canals, farm roads and so on. Development of planting material may take about 3% of total cultivatable

land. The requirement of a crop to the total quantity of water from sowing to harvesting, the farm plans have been to use groundwater as a primary water source for irrigation and domestic purposes. The total average water requirement for vegetables is estimated to be $47m^3$/ha/day (MFaED, 2003).
Physically, the soil where the project is to be implemented is black having better nutrient contents. But there would requirement of additional nutrients. The project intends to use about 2500kg DAP and 600kg Urea annually, by recommended rate 100-150 kg/ha of DAP and 150-200 kg/ha of Urea. At the smaller scale crops are suffering from different insects, pests and diseases so there is a need of pesticides. Moreover, fruits and vegetables would be produced through either closed (i.e. in greenhouses) or open-field production systems (Table 1).

Table 1: Production Systems in Yemam and Worku's Horticultural Project

Product types	• Fruits (mango, banana, avocado, papaya and others) • Vegetables (green beans, tomato, onion, pepper and so on)
Production system	Double cropping (i.e. production of two crops on the same plot of land in a year). It applies rain-fed and irrigated systems.
Production schedule	Two times a year, i.e. using rain from June to end of September and using irrigation water from mid-October to end of May.
Propagation methods	Seeds and/or planting are prepared within the farm land
Soil or bed preparation	Open-field production systems (i.e. no greenhouse)
Irrigation methods	Furrow irrigation system
Drainage system	From the nature of the project site, both surface and subsurface drainage systems can be used where; • Surface drainage to remove excess surface water • Subsurface drainage to maintain groundwater table at required depth.
Fertilizer application	Applied to the soil surface, or are incorporated into the soil.
Pesticide Management	Applied to plant tops (foliage), to the soil surface, or are incorporated into the soil and traditional pest control methods can also be applied.
Pre & Post harvesting	Include activities such as picking, cleaning, grading, transporting and marketing of fruits and vegetables. Transportation will be done with trucks equipped with refrigerators.

RESULTS AND DISCUSSION

Results

Environmental Impact of the Project

Impacts of under construction and operation phases of the project on the environment (Table 2) were identified and analyzed using environmental quality assessment index (Ali, 2013). Similarly methods had been used by Canter (1983); Bisset (1980); Morgan (1998); Lawrence (1994) and Maclearn (1998).

(1) Environmental quality assessment index

$$EQAI = \sum_{i=1}^{n} AiWi$$

Where,

$EQAI$ = Environmental Quality Assessment Index
Ai = Number of environmental attributes
Wi = Weight of the particular attributes

(2) Range method, that was used for significance level of impact assessment

$$LIA = \frac{Hvi - Lvi}{ci}$$

Where, LIA = Level of Impact Assessment

Hvi = Highest value of impact assessment
Lvi = Lowest value of impact assessment
Ci= number of significance classes

Table 2: Checklist for Impact of the Project Activities on the Quality of Environment Attributes

	Parameters	**Impact level**	$\sum_{i=1}^{n} AiWi$	
Water Resources	1 Reduction/lowering of surface or ground water table	0.7±	= 0.72	**High**
	2.Soil water logging results from mismanagement of water	0.7±		
	3. Flooding, channel modification, siltation.	0.8±		
	4. Excess increment of nutrients in water bodies (eutrophication).	0.8±		
	5. Pollution for surface and ground water through waste, organic, toxic chemicals	0.7±		
	6. Resource competition (if there is no water resources development activities)	0.6±		
Soil Resources	1. Soil loss during land preparation	0.7±	= 68	**High**
	2. Nutrient loss during land preparation by water	0.8±		
	3.Use of fertilizer, pesticides and machineries may result in soil physical and chemical disturbance	0.7±		
	4. Soil salinity, alkinity and solidicity	0.6±		
	5. Imbalance biological activities as a result of contamination of soil with toxic chemicals and loss of organic nutrients	0.6±		
Ecosystem (flora & fauna)	1. Contamination or use of polluted water injurious for wildlife and nearby communities to the project area.	0.6±	= 0.65	**Medium**
	2. Introduction of new species or change of cultivation may cause for development of pests, diseases or weeds.	0.7±		
	3. Direct/indirect killing of aquatic and terrestrial animals Spreading of pesticide/insecticide for different purposes.	0.7±		
	4. Loss of flora and fauna can be occurred when projects are established at the spot or in vicinity	0.6±		
Human Health	1.Transmission of disease between human and from plants/animals to humans	0.5±	= 0.64	**Medium**
	2. Emission of toxic gases, vapors, dust, emission of toxic liquid and their cumulative effects badly affect human health inside and around outside of the project	0.7±		
	3. Occupational effects on health of workers due to fugitive dust, material usage, noise and mechanical/chemical contact	0.6±		
	4. Death and injuries to human beings due to improper loading-unloading, storing and disposing of chemicals.	0.6±		
	5.Inhaling polluted air inside/around outside of the project	0.8±		
Socio-economics	1. Land use and tenure conflict may occur around the project	0.7±	= 0.6	**Low**
	2.Inundation of farmlands like loss of agricultural, forest or community grazing land by waste generated from the project	0.5±		
	3. People may expose to further social and economic crises when their farm land is occupied by project	0.7±		
	4. Conflict due to lack of awareness about the project	0.5±		
	5. Impact on culture due to immigrants and additional pressure on the services, i.e., health, dwelling, transportation	0.6±		

Table 3: Significance Level of Environmental Impact Assessment

Assessment level $LIA = \frac{Hvi - Lvi}{ci}$	Significance Level	Environmental attributes
±.068-0.72	High	Water and soil resources
±0.64-0.68	Medium	Ecosystem and human health
±0.6-0.64	Low	socio-economics

Discussion

High Level of Impact on Water and Soil Resources

The high impacts on water resources may be associated with significant reduction of groundwater levels or drawdown, soil water logging results from mismanagement of water, flooding, channel modification, siltation, excess increment of nutrients in water bodies (eutrophication), pollution for surface and ground water through waste, organic, toxic chemicals, competition for water resources (Gotvajn *et al.*, 2001).

Removing of trees, shrubs, and grasses during land preparation for project activities will break the natural compactness of soils and holding capacity of water and due to erratic nature of rainfall, soil erosion and loss of nutrients may be happened. Use of fertilizer, pesticides and machineries may result in soil physical and chemical disturbance (Pimentel, 1996). Imbalance in biological activities may appear as a result of contamination of soil with toxic chemicals, loss of organic nutrients, salinity, alkinity and solidicity (Smith, 2008).

Medium Level of Impact on Ecosystem and Human Health

Loss of flora and fauna can also be occurred when projects are established at the spot or in vicinity. Moreover, introduction of new species or change of cultivation may cause for development of pests, diseases or weeds. To get proper benefit of horticulture, it is necessary to use of biocides to keep away fruits, vegetables and fruits from the pests, bacteria, weeds and diseases. If doses of fertilizers and biocides are not carefully used, directly/indirectly water will be contaminated or polluted that can be injurious for aquatic and terrestrial animals and nearby communities (MEA, 2005; Plestina and Mercier, 1996).

Modern agricultural schemes especially horticulture is labor intensive; as the studied project will engage more than 1350 workers. They may get health problems as transmission of disease between human and from plants/animals to humans. Due to content with chemicals and pesticides, skin allergy and irritation and by inhaling polluted air, chemicals and pesticides inside/around outside of the project cardiovascular may appear among the workers and they may be victim of occupational deficiency by short temperament due to fugitive dust, material usage, noise and mechanical/chemical contact. Emission of toxic gases, vapors, dust, emission of toxic liquid and their cumulative effects can badly affect human health inside and around outside of the project (Pingali and Roger, 1995; Kampa and Castanas, 2008). There may be death and injuries to human beings due to improper loading-unloading, storing and disposing of chemicals.

Low Level of Impact on Socio-economics

The social benefits of the projects are substantial as the project will create job opportunities for at least 750 farmer's community and labourers of the surrounding spaces. It will also provide work for unskilled and semi-skilled manpower of the nearby, small towns such as Sebatamit and Anidassa. In addition to the technology transfer especially, in fruit and vegetable production and skill development will have positive impact on socio-economy of the society. Based on the economic value (productivity) of the land local people was not satisfy for the payment that they got as compensation. Lack utilization skill of money, they spent unproductive means. As a result, migration, poverty, and unemployment were commonly reported by villagers. The loss of land for grazing for livestock, and accumulation of the project waste were other common problems. However, arrival of workers from outside of the study area creates

additional pressure on the services; transportation, health and dwellings (Woolcock, 1998). Moreover, the engaged workers coming far away from the home may contribute to so social mal-adjustments that may appear in forms of prostitution, crime and so on in the adjacent areas of the project.

Conclusion

The project Yemam and Worku horticulture will have significant contribution to the region as well as to the country in general by producing high quality exportable flowers and fruits. At a local level it will create job opportunities and will diffuse technologies, especially in the production of fruits, vegetables and flowers. However, there are negative impacts on the environment which are expected to happen at different levels water, soil, ecosystem, human health and socio-economics aspects of surrounding people and spaces Therefore, joint efforts of Horticultural project authority and civil administration by appropriate mitigation measures and monitoring plan are needed manage and mitigate each negative impact on the environment and local society.

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