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IMPACT OF SUGAR INDUSTRY WASTE WATER ON SOME VEGETABLE CROP PRODUCTION

The case of Kenana Sugar Company (KSC)

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Abstract

The study was conducted in White Nile State. It aimed to measure the impact of waste water of sugar industry on production, cost and return of cucumber & eggplant; and how that is reflected on comparison between area that irrigated from Kenana sugar "*Aljanaien*" and area "*Takaspoun*" irrigated from White Nile River. A random sample of 80 respondents, 40 "*Aljanaien*" & 40 "*Takaspoun*" was taken in season 2005/ 2006 using a structured questionnaire. The secondary data was obtained from official documents, reports and previous studies. The descriptive statistics and crop budget analysis were conducted. The descriptive statistics showed that, 70% and 80% of farmers, used waste water and farmers used White Nile respectively, however, were within the productive age. 70% and 60% received some sort of education in "*Aljanaien*" and "*Takaspoun*" respectively. The majority farmers were married. The production cost revealed that cost of the two crops in the area irrigated from waste water lower, while their productivity was higher, hence the returns from used waste water was higher, so the impact was positive. The net present value of the area under irrigation with fresh water gave a positive value in the case of discount rate of 15%, and the B/C Ratio of the area under irrigation with waste water was 3 times of that of under fresh. The study recommended making maximum benefit and conducting more study in waste water.

1. Introduction:

There are agronomic and economic benefits using waste water in irrigating crops. Irrigation with waste water can increase the available water supply, or release quality water supplies for alternative uses. In addition to these direct economic benefits that conserve natural resources, the fertilizer value of water is important (FAO 1997).

Human activities, since immemorial times, have always resulted in changes in the environment. Yet, it was only in the last few decades that the impact of human activities had become accelerated and more pronounced. Pressures from rapid population growth, uncontrolled and lavish consumption, urbanization, industrial expansion and advances in science and technology have created environmental problems (Taha, 2001).

The recycling of human waste to add nutrients, and improve the physical Quality of the soil is an ancient. Industrial fluid waste is another of waste water that finds their way into rivers, lands and farm lands. The impact industrial effluents have not been studied nor recycled in developing countries. However, in its modern form, the reuse of waste water effluents for irrigation of crop offers attractive benefits. These involved increasing water supplies for productive agricultural use, adding valuable fertilizers and micronutrients to maintain soil fertility and at the same time reduce pollution of surface water sources. Negative effects of such reuse of effluent water are also possible. People consume edible crops irrigated by contaminated waste water; farmers are exposed to pollution as they use this waste water or if they reside on irrigated fields with polluted water.

2. Problem Statement:

As it is known, the Kenana Sugar Factory discharges waste water into near area cultivated by farmers. This creates doubts about suitability of this waste water for crop production. Therefore, this study is conducted to assess the positive and negative impact of such waste water on production and profit of farmers growing vegetables crops on the Kenana Sugar Factory.

3. Objectives of the study:

The main objective of this study is to investigate the impact of sugar factory waste water on some vegetable crop production. The specific objectives aim to:

1- Analyze the quality of waste water for crop production in the study area.
2- Estimate the effect of waste water on the productivity of crops per unit area.
3- Analyze the cost and benefit of the crops irrigated by waste water.

4. Research Method.

4.1 SAMPLING TECHNIQUE:

Random sample technique was used because the farmers in the study area could be regarded as a homogeneous population. This random sample was used in order to increase the level of precision of the sample. Random sampling technique was used and 80 respondents, distributed equally between farmers using waste water and farmers using fresh water were selected.

4.2 SAMPLE FRAME:

The study area consisted of two areas: Aljanaien and Takaspoun.

4.3 METHOD OF DATA COLLECTION INCLUDED:

The technique used for data collection included:

4.3.1 PRIMARY DATA:

Primary data have been collected using structured questionnaire from the field survey carried out in the White Nile State by the researcher during period 2005-2006 among the White Nile farmers

4.3.2 SECONDARY DATA:

The secondary data was collected from report to the field of the study. The data was collected from relevant departments and ministries, which included the Ministry of Agricultural in the White Nile state, Environment Conservation Society, Food and Agriculture Organization (FAO), Sugar Company, and M. Sc. theses.

4.4 METHOD OF DATA ANALYSIS:

In order to achieve the objective of the study, three analytical Techniques were used:

1) Descriptive analysis.
2) Budget analysis.
3) Financial Analysis

4.4.1 DESCRIPTIVE ANALYSIS:

Descriptive analysis was used throughout the study included the means, percentages, and frequency distribution.

4.4.2 BUDGET ANALYSIS:

Only actual experience can show how any plan will in fact improve the economic position of the farm. It is however possible, and it may often be desirable to prepare advance estimates of financial analysis of a plan before

putting (Blagburr, 1961). There are two steps or method in budgeting: Complete budgeting and partial budgeting.

1. Complete budgeting: This refers to making of a plan for the whole or for all decisions of one enterprise.
2. Partial budgeting: Refers to estimating the outcome or returns for a small part of a business, such as the poultry enterprise or corn fertilization (Heady, 1964). In this part of the study we used the partial budgeting analysis method. The budget analysis was based on the average prices multiplied by the average production to give the gross returns. Prices difference between variable costs in the production process.

4.4.3 FINANCIAL ANALYSIS:

Financial analysis was used in this study included the Net present Value and Benefit to Cost Ratio.

The formal mathematical of the discounted measures of the project:

$$\text{NPV:} \sum_{t=1}^{n=1} \frac{Bt-Ct}{(1+i)^t}$$

Benefit-cost ratio:

$$\text{B/C} = \sum_{t=1}^{n=1} \frac{Bt}{(1+i)^t} / \sum_{t=1}^{n=1} \frac{Ct}{(1+i)^t}$$

In the two mathematical formulations:

Where:

Bt= benefit in each year

Ct= cost in each year

t=1, 2, …n

n= number of year

i= interest (discount) rate

5. Results and Discussion of Findings

5.1 *WATER ANALYSIS:*

Chemical analysis was done for sugar industry waste water called .Bagasse water in Aljanaien area as indicated in table (5.1). According to the analysis made to the waste water at Department of soil and Environment Science, Faculty of Agriculture,

University of Khartoum Dr: Alamen Abdalmaged classified this water as of high quality water and is suitable for irrigation of all types of crops.

Table (1): analyzed waste water at the Department of soil and Environment Science- University of Khartoum.

PH	Ec(ds/m)	Ca+Mg (mmol+1)	Na (mmol+1)	K (mmol+/1)	TDS (mg/1)
4.00	1	7.2	2.8	1.8	0.72

5.2 SOCIO-ECONOMIC CHARACTERISTICS OF FARMERS IN THE STUDY AREA:

5.2.1 AGE DISTRIBUTION BY USE OF TYPE OF IRRIGATION WATER:

When detecting the age distribution of farmers, we can indicate the quality of farmers with respect to their physical capacity in working the land and in securing high crop productivity (Yassin, 1990, and Ata, 1999).

Table (2) gives the distribution of the respondent farmers by type of use of water for irrigation. It was found that the majority of the farmers who use waste water (70%) and of the farmers who use fresh water (80%) fall within the productive age group of 20-60 years old. The less number of young farmers using the waste water may be attributed to the fact that those farmers were employed by Kenana Sugar Factory, and that their land plots lie nearby the factory.

Table (2) age distribution of respondent (**Source: field survey 2005/2006).**

Age interval	farmers using waste water		Farmers using fresh water	
	Freq	%	Freq	%
21-30	12	30	11	27.5
31-40	8	20	10	25
41-50	8	20	11	27.5
51-60	7	17.5	4	10
61-70	5	12.5	4	10
Total	40	100	40	100

5.2.2 MARITAL STATUS OF FARMERS BY USE OF TYPE OF WATER.

Table (3) shows that about 85% of farmers who used waste water, and about 75% of farmers who did not out of the total farmers were married. Marital status reflects responsibility and attention of farmers to make the best economic uses of the available resources to increase their production level and sustain income for their.

Table (3) respondent marital status (Source: field 2005/2006).

Marital status	Farmers using waste water		Farmers using fresh water	
	freq	%	Freq	%
single	4	10	8	20
married	34	85	30	95
widowers	1	2.5	1	2.5
divorce	1	2.5	1	2.5
total	40	100	40	100

5.2.2 DISTRIBUTION OF EDUCATION LEVEL OF FARMERS BY USE OF TYPE OF WATER

Education is considered as a human investment. It helps the tenants to improve their cultural, technical knowhow that allow them adopt new innovations (Atta, 1999). The level of education and expertise, therefore, are assumed to have a significant effect on the output of the agricultural crops (El feil, 1993).

Table (4) shows that 30% of farmers who use waste water and 40% of farmers who use fresh water were illiterate. About 50% of the first category and 43% of the second category had elementary and Khalwa education. Very few of the tow categories had secondary and university education.

Table (4) respondent education level (Source: field survey, (2005/06).

Education level	Farmers using waste water		Farmers using fresh water	
	freq	%	freq	%
illiterate	12	30	16	40
Khalwa*	9	22.5	11	27.5
elementary	11	27.5	6	15
secondary	6	15	7	17.5
university	2	5	0	0
total	40	100	40	100

*Khalwa: an informal education of Holy Quran.

5.3 RESULTS OF THE CROP BUDGET ANALYSIS:

This part of the chapter discusses the results of the crop budget analysis it involves the production cost, yields, and farm gate prices of cucumber and egg plant. The budget gives the estimation of the gross two crops For the 2005/06 season.

5.3.1 PRODUCTION COSTS:

The production cost is the cost production a certain amount of product in a particular time period. For the purpose of calculating the production cost, certain items are to be determined. This includes land preparation, seeds, irrigation, fertilizer, harvesting and other costs. The average production cost of cucumber and egg plant is shown in the table (5).

5.3.2 *LAND PREPARATION COST:*

The land preparation is done by tractor in the area where farmers use fresh water, but in the area where farmers use waste water it is done manually as the wet land does not allow the introduction of the tractors into the field. On average the cost of land preparation for cucumber and egg plant were found to be about SD 4030/ feddan, SD 5410/feddan and SD 6207/feddan in the two areas respectively. The cost of land preparation in the area that uses waste water was lower than that of the other.

5.3.3 *SEEDS COST:*

Some of farmers retained their own seeds from the previous harvest while the other obtained their seeds from the local market and the state ministry of agriculture (field survey, 2005/2006). On average the cost of seeds was found

to be SD 2013/ feddan, SD 2000/ feddan for cucumber and egg plant in the area uses fresh water respectively.

5.3.4 *IRRIGATION COST:*

The average cost irrigation for cucumber and egg plant was found to be negligible while it accounted for about, SD 5400/ feddan, and SD5630/ feddan in the area uses waste water for the two crops respectively. The difference in cost of irrigation between the two areas is due to use of pumps in the case of fresh water, were as it was driver by gravity in case of waste water

5.3.5 *FERTILIZER COST:*

Fertilizer was not use of waste water. On average cost of fertilizer was about SD 6000/feddan and SD 6090/ feddan for cucumber and egg plant in the area that uses fresh water respectively table(5) shows that the farmers who use waste water never use fertilizer because they think that the waste water contain chemicals and organic matter that can compensate for the use fertilizer.

5.3.6 *PESTICIDE COST:*

On the average the cost of pesticides for cucumber and egg plant was found to be SD 5055/feddan, SD 4000/feddan in the area that uses waste water. On other hands it was found to be SD 2450/feddan and SD 3033/feddan in the area that uses fresh water respectively. Table (5) shows that the cost of pesticides was higher in that area uses waste water due to higher build of pests and insects.

5.3.7 *HARVESTING COST :*

The harvest of cucumber and egg plant were manual (cutting and collection). On average, the cost of harvesting of the two crops for cucumber and egg plant was found to be SD 5000/feddan for cucumber, SD 6250/feddan, for egg plant in the area using waste water, and SD 2850/feddan in the area that uses fresh water respectively. Table (5) shows that the cost of harvesting of cucumber and egg plant in the area uses waste water was higher than the area uses fresh water because of the higher level of production obtained.

5.3.8 *OTHER COSTS:*

The other costs included transportation and marketing costs. On average, these costs accounted to be SD 1630/feddan for cucumber, SD 1700/feddan for egg plant and SD 2100/feddan for egg plant in the two areas respectively.

5.3.9 *THE TOTAL VARIABLE COST OF PRODUCTION:*

The average total variable cost of production for cucumber and egg plant was found to be SD 17728/feddan, SD 18460/feddanin the area that uses waste water and SD 25955/ feddan and SD 28638/ feddan in the area that uses fresh water respectively. It was found that the total variable cost of production of the tow crops was higher cost of land preparation, irrigation and fertilizer use. To identify the magnitude of each item in the total cost of production was calculated table (6). The highest cost item for cucumber is pesticides 28.5% followed by harvesting 28.2%, land preparation 22.7%, seeds 11.4%, and finally others 9.2% in that area uses waste water.

The higher cost item for egg plant is harvesting 33.9 followed by land preparation 24.4%, pesticides 21.7%, and seeds 10.8% and finally other 9.2% in that area uses waste water.

The highest cost item for cucumber is land preparation 23.3% followed by fertilizer 23.1%, irrigation 17.3%, harvesting 11.0%, pesticides 9.4% seeds 8.2% and finally other 7.7%, in that area uses fresh water.The higher cost item for egg plantis land preparation 21.6%, followed by fertilizers 21.3%, irrigation 19.6%, harvesting 13.3%, pesticides 10.6%, other 7.3% and finally seeds 6.3%, in that area uses fresh water.

Table (5) the average production cost SD feddan Source: field survey (2005/2006).

Cost Item	Cucumber			Egg plant		
	Waste water	Fresh water	%	Waste water	Fresh water	%
Land preparation	4030	6050	66.61	4510	6207	72.66
Seeds	2013	2105	95.63	2000	1805	110.80
Irrigation	0	4500	0	0	5603	0
Fertilizer	0	6000	0	0	6090	0
Pesticide	5055	2450	206.33	4000	3033	131.88
Harvesting	5000	2850	175.44	6250	3800	164.47
Other	1630	2000	81.5	1700	2100	80.95
Total	17728	25955	68.30	18460	28638	64.46

Table (6): The percentage share of each item in the total cost of production (source: field survey 2005/ 2006)

	Cucumber		Egg plant %	
	Waste water	Fresh water	Waste water	Fresh water
Land preparation	22.7	23.3	24.4	21.6
Seeds	11.4	8.2	10.8	6.3
Irrigation	0	17.3	0	19.6
Fertilizer	0	23.1	0	21.3
Pesticide	28.5	9.4	21.7	10.6
Harvesting	28.2	11.0	33.9	13.3
Other	9.2	7.7	9.2	7.3
Total	100	100	100	100

5.3.10 ANALYSIS OF CROP RETURNS:

The average yield and price for 2005/2006 season was used in this analysis.

5.3.11 CROP YIELD :

The average yield of cucumber and egg plant were found to be 50.50 sacks/feddan, 63.50 for the area uses waste water and 28.50 sacks/ feddan, 38.50 sacks/ feddanfor the other area respectively table (7).

The table shows that the average yield of cucumber and egg plant in area that was irrigated with waste water from Kenana Sugar Factory was higher than the area irrigated from White Nile River. That was because there inherent agronomic and economic benefits in the waste water.

When analyzing the chemical composition of waste water it was found that this water is suitable for irrigation all type of crops.

Table (7) Average yield of crops per feddan season 2005/06 (Source: field survey 2005/ 2006):

	Yield sack/feddan		
	Waste water	Fresh water	
Cucumber	50.50	28.50	177.19
Egg plant	63.50	38.50	164.94

5.3.12 FARM GATE PRICES:

The average farm gate prices for 2005/06 season were used in this analysis. The farm gate prices are the price that farmers receive for his crop when he sells his product at the boundary of his farm. These prices are less than the market prices by the marketing cost margin. The average farm gate price obtained for two crops were found to be SD 4150/sack for cucumber and SD 3550/sack for egg plant respectively table (8).

Table (8) Average farm gate prices for two crops (**Source: field survey 2005/06).**

Crop	**Farm gate price SD/sack**
Cucumber	4150
Egg plant	3550

5.3.13 GROSS RETURNS:

The crop yield and prices mentioned were used to calculate the gross returns per feddan for two crops in the two areas. On average, the gross returns for cucumber and egg plant were found to be SD 209575 /feddan, in the first area, and SD 118275/feddanand SD 136675/feddan in the second area. Table (9) shows a higher average gross return for cucumber and egg plant in the first area compared to the second area.

Table (9) Average gross returns SD/feddan for cucumber and eggplant in the two areas (Source: field survey 2005/ 2006):

Crop	**Average gross returns(SD/feddan)**		
	Waste water	Fresh water	
Cucumber	209575	118275	177.19
Egg plant	224225	136675	164.06

5.3.14 GROSS MARGIN RETURNS:

Gross margins reruns are the difference between gross returns and the total variable cost of production. The gross margin for cucumber and plant were found to be SD 191847/feddan, SD 108037/feddan in area uses fresh water respectively table (10).

From the table the gross margin for cucumber and egg plant is higher in the first area than in the second area because of the higher production and lower cost.

Table (10) the average gross margins SD/ feddan (Source: field survey 2005/06)

Crop	**Average gross returns(SD/feddan)**		
	Waste water	Fresh water	
Cucumber	191847	92320	207.81
Egg plant	205765	108037	190.46

5.3.15 THE BREAKEVEN YIELD:

The breakeven yield is defined as the yield that just covers the cost of production. It is the equal to the total cost of production per feddan divided by farm price per unit yield.

Breakeven point (yield=total cost of production/ feddan Price/unit of yield.

Accordingly, the breakeven yield of cucumber in the waste water was 4.27 sacks/feddan when the farmers were able to produce about 50 sacks/feddantable(11).for cucumber in the area that uses fresh water, the even break yield was 6.25 sacks/feddan when the farmers were able to produce 28.50 sacks/feddan.more the breakeven yield for egg plant in that area uses waste water was 5.2 sacks/feddan and the average yield was more by 63.5sacks/feddan. the breakeven yield for egg plantin area that uses fresh water was 8.06 sacks/feddan and the farmers obtained 38.5 sacks/feddan. In the tow cases the farmers were able to produce more than almost five times of the breakeven yield. The farmers in this area gained better yields and advantage than other farmers.

From above calculation, the breakeven yield was less than the average yield per feddan for the two crops and this results indicates that the output per feddan for the two crops were able to cover their actual cost of production in the two areas in 2005/06 season.

Table (11): The breakeven yield (sack/ feddan) (Source: field survey 2005/06)

	The breakeven yield (sack/ feddan)	
	Waste water	Fresh water
Cucumber	4.27	6.25
Egg plant	5.2	8.06

5.3.16 THE COEFFICIENT OF PRIVATE PROFITABILITY (CCP):

The coefficient of private profitability is extent to which the production of crop is profitable or unprofitable.

The coefficient of private profitability is equal to the total returns per feddan at farm gate price divided by the total cost per feddan.

Coefficient of private profitability= Total returns/feddan at farm gate price.

Total cost/feddan

The private profitability coefficient is same as the benefit/cost ratio, if CCP is less than unity (1), then it is unprofitable to produce that product at its present productivity level, and/or the present price level.

Table (12) shows that this ratio (CCP) was greater than one for two crops in the two areas. From the table the CCP for cucumber and egg plant were found to be 11.8, 12.1 in the areas that uses waste water and 4.1, 4.7 in the area that uses fresh water respectively.

Hence the two crops are profitable at producer level farm gate prices in the two areas. However, the CCP for cucumber and egg plant in the area that uses waste water were greater than those in area that uses fresh water.

Table (12) the coefficient of private profitability (Source: field survey 2005/ 2006).

	CCP ratio	
	Waste water	Fresh water
Cucumber	11.8	4.1
Egg plant	12.1	4.7

5.4 FINANCIAL ANALYSIS:

In This part of the financial analysis including Net Present Value (NPV) and Benefit to Cost Ratio (B/C) were presented.

5.4.1 NET PRESENT VALUE:

The net present value is computed by finding the difference between the present value of the benefit and present value of cost. The calculation of the net present value requires determination of the appropriate discount rate. The formal selection criterion for the net present value measure of the project is to accept all projects that have a zero or greater than zero for the net present value when opportunity cost of capital is discounted (Elsharif, 2006).

From table (13) and table (14) the net present value of the area under irrigation with waste water (Aljanaien) and the area under case of discount rate of 15%.

5.4.2 BENEFIT/COST RATIO (B/C RATIO):

This ratio is obtained by dividing present value of the benefit by the present value of the cost. It compares the present value of the benefit and cost of the project as fallow:

Benefit/Cost ratio = Discounted gross benefit/ Discount gross cost.

We used the B/C ratio to evaluate the project and decide whether to accept or reject it. If the ratio is one or more than one we are going to accept this project. On the other hand if it is lower than one we well reject it.

The benefit/Cost ratio in case of irrigating with waste water according to table (13) was B/C (at discount rate 15%) = $\frac{2860023.1}{260300.28} = 10.99$

The result of this measure indicated that the area irrigated with waste water would be beneficial and feasible at the discount rate 15%.

The benefit/cost ratio in case of irrigating with fresh water according to table (14) was.

B/C ratio at discount rate 15%

B/C = $\frac{1441168}{392687} = 3.67$

The result of this measure indicated that the area irrigated with fresh water would be beneficial and feasible at discount rate 15%.

The result of B/C analysis revealed that both types of irrigation (waste and fresh) gave B/C greater than one. However the B/C of waste water was three times that of fresh water. This indicates that waste water had increased the benefit of farmers better that the use of fresh water.

From the result obtained it is quite clear that waste water had increased the yield substantially compared to fresh water. However further research is needed to verify the safety of using waste water for producing vegetables.

6. Summary, Conclusions, and Recommendation

6.1 *SUMMARY:*

The study compared between farmers irrigating their crops from waste water (Kenana Sugar Factory effluent water). There is a difference in production, cost and income between the two practices. The objectives of this study were to estimate the effect of waste water on the productivity, cost and benefit of crops irrigated by the two types of water. The hypotheses were that sugar industry waste water had a positive effect on crop production, would reduce the cost of production and increase farmer's income.

The study depended mainly on primary data, collected by means of a questionnaire and direct interviews of respondent in the White Nile for the season 2005-2006. A random sample of 80 respondents was selected (40 farmers from the area that uses

fresh water). Also, secondary data was used reports and previous theses. Descriptive statistics have been used throughout the study to evaluate the socio-economic characteristics of the respondents. It revealed that 30% and 40% of respondents are literate in the two areas respectively.

The majority of the farmers (70% and 80%) were within the productive age group in case of those using waste water and fresh water respectively. About 45% and 38% of the two types of farmers had family members their number ranged between 5 and 9 respectively. The majority of farmers (85% and 75%) were married. About 60% and 45% of two types of farmers had farm experiences ranging between 10 to 19 years in the waste water and fresh water respectively. Farming process was the main source of income (70% and 60%) for farmers in the two areas.

The gross returns for cucumber and egg plant in the area that uses waste water was about SD 209575/feddan and SD 224225/feddan; and was about SD 118275/feddan, SD 136675/feddanin the other area using fresh water.

The analysis of the crop budget showed that the crop had positive marginal returns per feddan of SD 191847, and SD 025765 for cucumber and egg plant in the first area; and SD 92320 and SD 108037 for the two crops in the second area.

The analysis of cost structure showed that farmers had never used fertilizers; and that the cost of irrigation as nil. The study also showed that the total cost of cucumber and egg plant were SD 17728 per feddan, and SD 18460 per feddan in the area that uses waste water and SD 25955 per feddan, and SD 28638 per feddans in the other area that uses fresh water respectively. The highest cost incurred in the first area uses were of pesticides, harvesting and land preparation of the two crops, whereas they were cost of land preparation, irrigation and fertilizer application in the second area.

The yield in the first area water was about 50 sacks per feddan for cucumber, 63 sacks per feddan for egg plant; while it was 28 sacks per feddan and 38 sacks per feddan for the two crops respectively. Hence the total cost of crops in the waste water had been lower, while the production had been higher; and hence their profit had been higher than those crops in the areas that use fresh water.

This study showed that the waste water from sugar industry had positive effect on production of crop, cost of production and income of farmer in this area.

The financial analysis indicated that the area that irrigated waste water and area that irrigated fresh water were financially feasible, having the net present values (NPV)

at discount rate 15% to be SD 2599722 and SD 1048480 respectively, Benefit/Cost ratio (B/C) in the area irrigated waste water and area irrigated fresh water to be 10.99 and 3.67 respectively.

6.2 CONCLUSIONS :

The main conclusions are reported in the following indicators.

I. The production of cucumber in the area that uses waste water were higher by 22 sacks/feddanand egg plant by 25 sacks/feddan that in the area that uses fresh water.
II. The cost of crop production was lower in the first area, by SD 8227/feddan for cucumber and by SD 10178/feddan for egg plant.
III. The income of farmers increased by SD 99527/feddan for cucumber and by SD 97728/feddan for egg plant.

6.3 *RECOMMENDATIONS:*

The following recommendations were drawn for future research and studies:

1. Further research needy to verify the safety of using waste water for producing vegetables.
2. To study effect of each type of waste water on each crop alone to avoid mixed effect of using mixed waste water effluents from the sugar factory.
3. To provide closed irrigation net works to conserve water from evaporation and drainage or other types of losses.
4. To study the economic value of collecting waste water in one reservoir and distribution to farm.
5. To study the economies of using sprinkler and drip irrigation in increasing economic benefits of waste water.

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