J. Soil Sci. and Agric. Eng., Mansoura Univ., Vol. 3 (3): 335 - 347, 2012

PROFITABLE MAXIMIZING FROM THE TREATED SEWAGE EFFLUENT REUSE FOR IRRIGATING IN NEWLY RECLAIMED DESERT SOILS TO PRODUCE BIODIESEL FROM THE GROWN JATROPHA TREES

El-Tohamy, S. A. ; M. M. El Kholy ; T. A. El-Maghraby and Somaya A. Hassanein

Soils, Water and Environment Res. Inst., Agric. Res. Center, Giza, Egypt.

ABSTRACT

This study is an important strategy to support the local best usage of marginal desert soils as well as low quality water as alternative irrigation water resources, for irrigating. Also, it represents a huge challenge and technical solution for an environmental problem, *i.e*., the utilization of contaminated sewage effluent as an alternative irrigation source for wooding the west desert outskirts of Luxor as well as Ismailia governorates, Egypt. With no competing food uses, this characteristic turns attention to *Jatropha curcas trees*, which grow in tropical and subtropical climates. Among the non-edible oil sources, *Jatropha curcas* is identified as a potential biodiesel source, which has added advantages as rapid growth, higher seed productivity, suitable for tropical and subtropical regions.

The integrated combination between wastewater as an irrigation source, marginal desert soil and *Jatropha curcas* as potential biodiesel source represents a new agriculture strategy as well as affects the country's economy and its development. This is due to the possible adverse effects on either crop products or human health should be alleviated; besides it represents an ideal solution to meet out higher diesel demand.and oil imports. Also, such biodiesel, as a renewable energy source, is becoming increasingly important due to diminishing petroleum reserves and the environmental consequences of exhaust gases from petroleum fuelled engines. However, the released CO_2 as an air volatile pollutant represents a fewer value equal about 20 % of that derived from petroleum fuelled engines.

The special attention was focused to optimize the first step of the process for reducing the possible adverse effects of contaminated sewage effluent, among being passed through an oxidation or bio-remediation pond. The second attention was focused to optimize for reducing the possible adverse effects of the marginal desert sandy soil, among being applied a suitable irrigation system of drip irrigation system that partially capable to retain enough available soil moisture range for grown plants and biological activity. The obtained field studies and analytical data indicate that the experimental soil is encompassing by the aeolian deposits, and classified as Typic Torripsamments, siliceous, hyper thermic Typic.

The suitability criteria of water source for irrigation purpose indicate that it lies in the first category C1S1, *i.e.,* no problems for salinity and sodicity are expected. An elemental composition analysis of N, P, K, Fe, Mn, Zn, Cu, Cd, Co, Pb, Ni and Cr as well as biological criteria (*i.e.,* COD, BOD, Fecal Coli, Salmonella and Shighla) was executed on each of the studied irrigation water and experimental soil, and it was found that their available contents still within the permissible limits, since their soluble values in the used irrigation water source are more than the fresh water. Hence, a field experiment was conducted on the chosen soil sites,.The agricultural management practices were conducted as usual. The obtained results showed also a beneficial effect of the applied irrigation water source on the grown plants, due to caused more pronounced increments in plant growth, seed yield and seed oil yield with high quality. As for, biodiesel production from seed oil of *Jatropha curcas* with a high content of free fatty acid .

Keywords: New agricultural strategy, biodiesel, *Jatropha curcas*, marginal desert soil, sewage effluents.

INTRODUCTION

Today's fresh water resources in Egypt are limited and insufficient either to cope designed agricultural development projects or to other water uses. Therefore, such forefront issue represents the main constraints for any future agricultural expansion (FAO, 1992). Based on this situation, water resources management including unconventional resources (*i.e.,* groundwater, drainage water and treated sewage effluent) is considered as an urgent issue for the expansion of irrigated agriculture. That means the reuse of such alternative water resources becomes part of the official policy of actual and future extension programs for the agricultural development in Egypt, particularly by using a high technology to maximize the use efficiency of these limited water resources. Ministry of Public-Works and Water Resources recycles about 5 billions m^3 of wastewater officially and its goal is to increase that volume to 7 billions m^3 (Kotb *et al.,* 2000).

At the same time, the uncontrolled application of such waters must have many restricted effects on both soil properties and plant growth, especially in the long-term use. The hazardous effects are mainly dependent on the soil nature and water quality, besides the kinds of the crops grown and applied irrigation system. To formulate a responsible schedule for the proper use of the wastewater resources and the protection of the cultivated lands and crops, several attempts must be found out to recommend the superiority of these uses as well as the suitable irrigation system. One strategy to increase the horizontal expansion as well as available wastewater resources for the reclaimed marginally desert soils on both sides of the Nile valley, it should be change the traditional farming systems, and in turn, such soils started to be used in agriculture utilization under the safe limits of water hazard for each soil or plant. Hence, one of the most agricultural developments, which have maximized the desert soil potentiality as well as its sustainability through reclamation process, is the fact that controlling the positive interaction between both soil variables and plant characteristics as affected by different water qualities under different irrigation methods (Ahmed, 2010). Furthermore, use of low quality water such as sewage effluent required for irrigating the newly reclaimed desert sandy soil needs more complex management practices and more stringent monitoring procedure than when good quality water is used (Pescod, 1992). This is mainly due to directly usage of sewage effluent represents one of the main pollution sources for the environmental media. This is because it contains a lot of solids, semi-solids and liquid wastes that are generated substantial amount of toxic organic and inorganic pollutants which if dumped in the soil ecosystem without treatment lead to serious environmental consequences or real problems. So, the management practices for this wastewater before discharging on land represent an urgent process in order to prevent the serious problems of soil ecosystem, i.e., salinity and sodicity stress as well as soil biosphere.

Jatropha is a small tree or tall bush (up to 5 meters in height) which grows in abundance in Africa, Central & South America, the Caribbean, India and Southeast Asia; it, with a seed production lifespan of 50 years, is a fast-growing, drought-resistant perennial producing seeds having an oil content of about 37%. This shrub has thick glabrous branchlets, smooth gray or reddish bark masked by large white patches, large green to pale-green leaves (alternately arranged) and exudes a whitish-colored, watery latex when cut. The plant can grow on poor-quality land unsuitable for food crops and needs little water or fertilizers (Mkoka & Shanahan, 2005); they also thrive in rock crevices and in a variety of climates (i.e. tropical, subtropical, slightly cool, tolerant of light frost) and soils, i.e. gravelly, sandy, saline, stony, semi-arid, arid.There are other advantages as well: pest-resistancy; high absorbency rate of carbon dioxide (CO2) from the atmosphere.As for, exhibition of phyto-protective action against pests and pathogens, thusly providing additional protection to intercropped plants (Jones, 2004).

Meanwhile, the specific direct and indirect objectives could be summarized as follow:

Direct objectives

A.Protect the environment through using a treated wastewater instead of disposing into water stream.

B.Selecting the appropriate irrigation system, which is a suitable one under the prevailing conditions of such arid and hot region to ensure sustainable agricultural development.

C.Comparing jatropha plant under different climate conditions (Luxor &Ismailia governorates).

D.Elucidating soil productivity for cropping sequence of *Jatropha curcas* and the chemical composition of its seed oil in the light of the existing farming systems.

Indirect objectives:

A. Maximizing use of treated wastewater by cultivating an producing crops.

B. Find a sustainable energy and environmentally friendly alternative to today's fossil fuel.which reduce a CO2 emission that is considered a first culprit for global warming.

Generally, such study may be helpful for identifying the best soil management to achieve the highest biodiesel production. Moreover, such situation demands to do serious rethinking in the agricultural research and extension with a view to evolve a "New Agricultural Strategy" to reuse the low quality water as an irrigation water source on a large scale for both marginal desert soil cultivated with *Jatropha curcas* trees. Such New Agricultural Strategy alleviates the hazardous effects on the grown plants not in agriculture fields, but also on human health.

MATERIALS AND METHODS

Seedlings of Jatropha *curcas* plant were produced by planting its seeds in polyethylene black bags under greenhouse conditions. In a permanent field, seedlings were planting in a newly reclaimed sandy soil of desert outskirt at Luxor and Ismailia Governorate, in holes 3 x 3 m apart (466 seedling/fed ≈ 1260 seedling/ha), and directly irrigated with treated sewage effluent using a drip as well as surface irrigation system. The chemical characteristics of the used irrigation water as well as the physio-chemical properties and nutrients status of the experimental soils were determined according to the standard methods described by Jackson (1958), Klute (1965), Soltanpour and Schwab (1977), Page *et al.* (1982) and Gee and Bauder (1986), and the obtained data are presented in Tables (1 and 2). Method of Douglas and Paleg (1981) was used for extraction of total lipids. The weight of oil extracted from 10 g of seeds powder was measured to determine the lipid content. Result was expressed as the percentage of oil in the dry matter of seed powder. Acid value of seed oil was determined according to AOAC (1980) Method Cd 3a-63. Percentages of free fatty acids were calculated using oleic acid as a factor. As for, The fatty acids of the oil were converted to methyl esters using sodium methoxide according to the method of Chman *et al.* (1973) .

Table (1): Chemical and microbial characteristics of the treated sewage effluent as an irrigation source in the investigated areas .

Irrigation water	V1	V2	Irrigation water character	V1	V2
Available nutritive and un-nutritive elements (mg L^{-1}):			**pH**	**7.35**	**7.07**
NH_4^+	**3.800**	**2.45**	**Chemical analysis:**		
NO_3^-	6.500	5.89	ECe (dS m^{-1})	0.82	1.35
P	1.250	1.21	Soluble ions (m molc $^{L-}$1):		
K	32.74	28.5	Ca^{++}	3.10	2.4
Fe	0. 870	0.14	Mg^{++}	1.80	2.6
Mn	0.193	0.012	Na^+	2.60	5.4
Zn	0.215	0.01	K^+	0.58	0.73
Cu	0.076	0.01	CO_3^{--}	0.00	0.00
Cd	0.009	n.d	HCO_3^-	3.60	4.8
Co	0.021	0.002	Cl^-	2.40	6.6
Pb	0.210	n.d	SO_4^{--}	2.08	0.23
Ni	0.026	0.01	SAR	1.66	2.16
Cr	0.009	n.d	Boron (mg L^{-1})	0.37	0.34
Biological analysis:			Total coli bacteria (cell L^{-1})	1.4×10^4	1.1×10^4
COD (mg L^{-1})	85.00	35.00	Fecal coli bacteria (cell L^{-1})	1.6×10^3	1.9×10^3
BOD (mg L^{-1})	49..00	42	Salmonella (cell L^{-1})	2.8×10^3	1.1×10^3

V1: values of Luxor area V2: values of Ismailia area n.d: not detected

Table (2):Some characteristics of the experimental soil at initial state (as an average of three layers for a soil depth of 0-60 cm) in the investigated areas

Soil character	V1	V2	Soil character	V1	V2
Particle size distribution %:			**pH (1: 2.5, soil-water suspension)**	**7.84**	**7.33**
Sand	93.47	92.5	Chemical analysis of soil paste extract:		
Silt	3.19	3.28	ECe (dS m^{-1})	2.94	1.37
Clay	3.34	4.22	Soluble cations (m molc $^{L-}$L):		
Textural class	Sandy	Sandy	Ca^{2+}	11.70	5.3
$CaCO_3$ content %	0.78	5.6	Mg^{2+}	7.30	2.6
Organic matter content %	0.31	0.39	Na^{+}	10.60	4.6
Gypsum %	0.12	0.89	K^{+}	0.37	0.73
CEC (c molc kg^{-1} soil)	5.09	7.22	Soluble anions (m molc $^{L-}$1):		
Bulk density (Mg m^{-3})	1.68	1.62	CO_3^{2-}	0.00	0.00
Hydraulic conductivity (cm h^{-1})	18.70	36.9	HCO_3^{-}	2.50	5.2
Field capacity %	11.20	10.76	Cl^{-}	14.95	7.2
Wilting point %	3.17	3.21	SO_4^{2-}	12.52	0.36
Available water %	8.03	7.5			

V1: values of Luxor area V2: values of Ismailia area

Botanical feature:

A Prunning:

The plants need to produce side shoots for either maximum sprouting or maximum flowers and seed. Between 90 and 120 days top of all plants at 25 cm. Cut the top off cleanly and cut top to produce 8-12 side branches. It is considered good practice. In order to facilitate the harvesting, it is suggested to keep the tree less than 2 meters.

The fruits were produced in (December and /or summer) under enough soil and sufficiently temperatures high. The seeds became mature when the capsule changes from green to yellow, after six to eight months from plantation. The blackish, thin shelled seeds are oblong and resemble small castor seeds. After collection, the fruits were transported in open bags to the processing site where they were dried in the shade until all the fruits have opened. When the seeds were dry they were separated from the fruits and cleaned. Pressing of the drying seeds was carried out by a mechanical seed press. The produced *Jatropha curcas* oil was transformed to biofuel as will be discussed thereafter.

Biodiesel pilot plant:

The biodiesel pilot plant consists of a transesterification reactor with heater, a stirrer, chemical mixing tank, three glycerol settling tanks and washing tank. The capacity of pilot biodiesel plant is 250 litres/day. The process flowchart for biodiesel production and pilot biodiesel plant are shown in Fig. 1. *Jatropha curcas* seeds oil extraction unit, *Jatropha curcas* oil pure biodiesel, refined glycerol, washing tank, alcohol & catalyst crude glycerol Transesterification reactor, diesel engine crude biodiesel, water washed oil cake, manure detoxification, animal feed lamp/stove.

Fig.1. Process flowchart for biodiesel production from *Jatropha* seeds and the resulted by products

RESULTS AND DISCUSSION

Soil is reliable for several modifications through various environmental conditions. So, to identify the adverse effective roles of soil productivity limitations and their intensity in the area under consideration, the obtained results and their discussions will be based on the prevailing soil characteristics as affected by its origins and the environmental conditions. The later conditions include the available water resources and their suitability for the agricultural irrigation purposes, particularly under arid and semi arid features.

A general view on the irrigation water and experimental soils:

a. Treated sewage effluent as an irrigation source:

According to the water salinity and sodicity classes undertaken by Ayers and Westcot (1985), data in Table (1) indicate that the used treated sewage effluent, i.e. the an irrigation source, is of no saline or sodice problem This is due to the ECiw and SAR values lay within the range of < 0.75 dS/m and < 6.00, respectively in both investigated areas., Concerning, the available heavy metal contents of Fe, Mn, Zn, Cu, B, Cd, Co, Pb, Ni and Cr in the used treated sewage effluent as an irrigation source are relatively high as compared with the fresh irrigation water, yet their values are still within the permissible limits yet, it is suitable for irrigation because their values are still within the permissible limits for irrigation according to (FAO, 1985). However, the criteria of COD, BOD and number of microbial species (Total Coli, Fecal Coli and salmonella) values exceeded the permissible limits, and then they are laying within the secondary category for agricultural reuse in Egypt (Decree No. 16 of Law 93/1962 recommended by Committee, 1995).

B. The Experimental soil:

The chosen soil site is occupying the desert formations that are adjacent to the western portion of the Nile Valley region at Luxor and Ismialia Governorate. Field studies as illustrated in Table (2), indicate that the studied soils were developed on the aeolian deposits, which are characterized by topographic features of almost flat that devoid natural vegetation in few scattered small patches. The representative soil site, is morphologically, characterized by deep and well drainage soil condition. As for, the representative soils site were lacking for any evidence of soil development, and are mainly characterized by loose sandy texture. In general, soil structure are single grain, and in turn it more related to its low capacity to retain either soil moisture or nutrients to the grown plants.

The obtained data in Table (2) reveal that the values of bulk density were relatively high due to the relatively coarse nature of soils. Moreover, the distinct pattern of saturated hydraulic conductivity was controlled by soil texture and the soil conductive pores, so it exhibits a relatively high value (13.92-20.70 cm h-1). As a general view, data in Table (2) indicate also that the values of organic matter, CEC and ECe as the studied soils were relatively low. Therefore, these soils are classified as poor in the inorganic and organic colloids, and it is non-saline and non-alkaline soils (ECe < 4 dS/m and ESP < 15). The investigated soils are suitable for jatropha planting according to (Gour, 2006) who describe the best soils for jatropha, are aerated sands of at least 45cm depth. As for, jatropha is often described as having a low nutrients requirement because it is adapted to grown in poor soils.

Table (3): Some indices for cultivated *Jatropha*.

No	Details	Range 1	Range 2
1	No. of bunches per plant	750 bunches	600
2	No. of fruits per bunch	10 fruits	10
3	No. of fruits per plant	7500	6000
4	On an average 5 fruits per bunch 750 x 5	3750 fruits	3000
5	No. of seeds per fruit	3 seeds	3
6	No. of seeds out of 3750 fruits 3750 x 3	11.250 seeds	18000
7	No. of seeds per kg	1200 seeds/kg	1400
8	No. of plants per acre	466	466
9	Average yield of oil per kg of seeds	350 g	260g

Range 1: Luxor area Range 2: Ismailia area

Data in Table (3) concluded that, Luxor are suitable climate for jatropha plantation which is well adapted to conditions of high light intensity, Also, jatropha flowered twice a year in Luxor (May and December) compared to jatropha in Ismailia governorate which flowered once a year in may.

Chemical and physical analysis of the seed oil:
a. Oil content and acid value as percent of free fatty acids:

The data collected from studying the physical and chemical properties of the tested samples (Table 4) showed that oil content of *Jatropha* was determined in seeds from Luxor and Ismailia area under drip and surface irrigation systems. the jatropha oil seed content in Luxor was higher (32.2%) than the oil content in Ismailia area (26%). This is may be due to the suitable climate in Luxor which is well adapted to conditions of high light intensity (Jongschaap, 2007).This results also obtained that, using a drip irrigation offer a viable alternative to conventional irrigation practice in two areas. As the content of jatropha seed oil results are almost similar in two investigated irrigation system. In this system water is fed drop by drop near the root of plant. This is effective in both dry and humid atmospheres. 1.5 to 2.5 times more soil can be provided with water, using this system, compared to conventional irrigation Satish (2011). Generally, The jatropha water need various with the location and age of plant as well as there is little quantitative data available on the exactly water needs, water productivity and water use efficiency of jatropha.

Jatropha curcas indicated that it was suitable as non-edible vegetable oil feedstock in oleochemical industries (biodiesel, fatty acids, soap, fatty nitrogenous derivatives, surfactants and detergents,etc). Currently, Jatropha curcas can produce 2000 liter/ha oil per annual (Azam *et al*., 2005).

Table (4): Chemical and physical properties of *Jatropha* seeds.

Seeds properties	**V1**	**V2**
Bulk density (g cm^{-3})	0.459	0.431
Solid density (g cm^{-3})	0.814	0.822
Porosity %	43.60	43.0
Equivalent diameter (mm)	11.77	10.7
Sphericity (mm^2)	0.673	0.633
Moisture content %	9.94	9.85
Cross section area (mm^2)	73.19	72.9
Slender ratio	1.58	1.57
Oil content %	32.20	26.0
Density at 20 °C (g mL^{-1})	1.92	1.89
Viscosity at room temperature (cp)	41.99	40.13
Physical state at room temperature	Liquid	Liquid

V1: values of Luxor area V2: values of Ismailia area

Viscosity defined as resistance liquid to flow, as it increased with molecular weight, but it decreased with increasing unsaturated level and temperature (Nouredini *et al*., 1992). At room temperature kinematic viscosity of the sample was detected at 42.88 cp. The viscosity of *Jatropha* oil seed must be reduced for biodiesel application since the kinematic viscosity of biodiesel was very low compared to vegetable oils. High viscosity of the *Jatropha* oil seed are not suitable if its use directly as engine fuel, often results in operational problems such as carbon deposits, oil ring sticking, and thickening and gelling of lubricating oil as a result of contamination by the vegetable oils. Different methods such as preheating, blending, ultrasonically assisted methanol transesterification and supercritical methanol transesterification are being used to reduce the viscosity and make them suitable for engine applications (Pramanik, 2003 and Banapurmath, 2008).

The density of a material is a defined as the measured of its mass per unit volume (*i.e.,* g/mL). The density vegetable oil lower than of water and the differences between vegetables oil are quite small, particularly amongst the common vegetable oils. Generally, the density of oil decreases with molecular weight, yet increase with unsaturation level (Gunstone, 2004). From the experiment was conducted, the density of *Jatropha* seed oil were 1.93g/mL.

b. Fatty acid components:

Fatty acid components determination were another important characteristic carried out on this study (Table 5). The properties of the triglyceride and the biodiesel fuel are determined by the amounts of each fatty acid that are present in the molecules. Chain length and number of double bonds determine the physical characteristics of both fatty acids and triglycerides (Mittelbach and Remschmidt, 2004). Transesterification does not alter the fatty acid components of the feedstocks and such acids play an important role in some critical parameters of the biodiesel, as cetane number and cold flow properties (Ramos *et al*., 2008).

Table (5): Fatty acid components %.

Fatty Acid	*Jatropha curcas* oil seed
Oleic 18:1 %	57.8
Linoleic 18:2	34.5
Palmitic 16:0	12.5
Stearic 18:0	4.67
Palmitoliec 16:1	0.68
Linolenic 18:3	0.3
Arachidic 20:0	0.66
Myristic 14:0	0.3

Fatty acid components of studied oil are shown in Table (5) indicate that there are three main types of fatty acids that can be present in a triglyceride, which is saturated (Cn:0), monounsaturated (Cn:1) and polyunsaturated with two or three double bonds (Cn:2,3). Various vegetable oil is a potential feedstock for the production of a fatty acid methyl ester or biodiesel but the quality of the fuel will be effect by the oil composition. Ideally, the vegetable oil should have low saturation and low polyunsaturation, *i.e.,* be high in monounsaturated fatty acids. *Jatroha* oils that rich in polyunsaturated such as linoleic and linolenic (Table 5), tend to give methyl ester fuels with poor oxidation stability. Vegetable with high degree unsaturation tend to have high freezing point. This oil have poor flow characteristic and may become solid (*i.e.* palm oil) at low temperatures though they may perform satisfactorily in hot climates (Gunstone, 2004).

The predominant fatty acids in studied oil consist of monounsaturated (42.89%), followed by polyunsaturated fatty acid (30.17%) and saturated fatty acid (23.71%). Monounsaturation of *Jatropha* seed oil. The major fatty acids in *Jatropha* seed oil were the oleic, linoleic, palmitic and the stearic fatty acid. Oleic acid showed the highest percentage (42.4%), followed by linoleic acid (29.8%) . Thus, *Jatropha* seed oil can be classified as oleic–linoleic oil. The major fatty acids in *Jatropha seed* oil were the oleic, linoleic, palmitic and the stearic acids, which are exhibited good physicochemical properties and could be useful as biodiesel feedstock and industrial application. Feedstock costs account for a large percent of the direct biodiesel production costs, including capital cost and return.

The way of reducing the biodiesel production costs is to use the less expensive feedstock containing fatty acids such as inedible oils, animal fats, food oil wastes and by products of the refining vegetables oils. With no competing food uses, this characteristic turns attention to *Jatropha curcas*, which grows in tropical and subtropical climates across the developing world.

V. Pilot biodiesel plant operation:

In the pilot biodiesel plant, *Jatropha* oil is blended with alcohol and catalyst mixture in transesterification reactor. The reactor is kept at reaction temperature for specific duration with vigorous agitation. After reaction, the biodiesel and glycerol mixture is sent to the glycerol settling tank. The crude biodiesel is collected and washed to get pure biodiesel. Depending upon the need, the size of the unit can be scaled up to get higher production capacity. The fuel properties of *Jatropha* biodiesel produced in the pilot plant are given in the Table (6).

Jatropha oil + Alcohol Catalyst ⟶ *Jatropha* biodiesel + Glycerol

Table (6): Properties of *Jatropha* oil and standard specifications of diesel oil.

Specification	Standard specification of *Jatropha* oil	Standard specification of diesel
Specific gravity	0.917	0.846
Flash point, °C	240	34
Cetane value	51	47.80
Kinematics viscosity@30 °C	52	3.60
Sulphur %	0.14	< 1.0-1.2
Calorific value kcal/kg	9056	9865
Pour point	8.00	3.00
Colour	4	4
Acid value	25.60	25.60
Saponification value	162	192
Iodine value[3]	104	104
Water and sediment %	0.00	0.075

Conclusion:

From the previous results, Jatropha curcus are more successful in Luxor governorate under drip irrigation system which is a suitable under the prevailing conditions of such arid and hot region to ensure sustainable agriculture development. As for, The potential benefits to society of the spread of Biodiesel Crops are far more than just reduced environmental damage but also improves economic growth as well as generate extremely healthy returns. The investigated research is just a background to understand the nature of Jatropha curcus under Egyptian conditions. We need a lot of researches to obtain a maximum yield especially throw genetic engineering (to increase the ratio of female to male flowers). As well as beneficial safety use of jatropha cake by composting or /and animal feed which contribute in decreasing the cost of the biofuel.

ACKNOWLEDGEMENT

The authors thank Prof. Dr. Mosa, A.I.prof.in Engineering Res.Inst.,Agric. Res. Center, Giza-Egypt for helpful comments regarding a chemical and physical analysis of seed oil.

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تعظيم الفائدة من إعادة إستخدام مياه الصرف الصحى المعالج فى رى الأراضى الصحراوية المستصلحة حديثا لإنتاج الوقود الحيوى من أشجار الجاتروفا

سيد أحمد التهامي ومحمد محسن الخولى و طه عبد الخالق المغربى و سميه احمد حسانين
معهد بحوث الأراضي والمياه والبيئة -مركز البحوث الزراعية-الجيزه -مصر

تعتبر هذه الدراسة من الاستراتيجيات الهامة للاستفادة من الأراضى الهامشية واستغلال مياه الصرف الصحى كبديل للموارد المائية للاستخدام الزراعى وهذا يمثل تحديا كبير للاستفادة من مياه الصرف الصحى كمصدر بديل لرى هذه الأراضى لصحراء محافظة الاقصر والاسماعيلية – مصر وتحويلها إلى أراضى منتجة لذا كانت الاهداف المباشرة لهذه الدراسه هي حماية البيئة من خلال أستخدام مياه الصرف الصحي المعالجة بدلا من التخلص منها في مجاري المياه . وأختيار نظام الري المناسب أما الاهداف الغير مباشرة هي تعظيم أستخدام المياه العادمه المعالجه من خلال زراعة المحاصيل المنتجة للطاقة البديلة والصديقة للبيئة مما يقلل من انبعاث CO_2 الذي يعتبر السبب الاول لظاهرة الاحتباس الحراري. لذا كان التوجه بالاهتمام لزراعة أشجار الجاتروفا والتى تنمو فى المناطق الاستوائية وشبه الاستوائية وهى مصدر للوقود الحيوى وذات النمو سريع.

والتكامل بين مياه الصرف الصحي كمصدر لرى الأراضى الصحرواية والجاتروفا كمصدر وقود حيوى يمثل استراتيجية للزراعة الجديدة وتأثيرها على اقتصاد البلاد ومواجهة ارتفاع الواردات من زيت الديزل وترجع الأهمية المتزايدة لزراعة نبات الجاتروفا لتضائل احتياطات النفط والآثار البيئية الناجمة عن انبعاثات غاز ثانى أكسيد الكربون من محركات الديزل والحد من الآثار الضارة للأراضى الرملية وهذا يأتى من تطبيق استخدام الرى بالتنقيط بدلا عن الرى بالغمر عن طريق اعطاء الاحتياجات المائية المطلوبة للنباتات المنزرعة ومن النتائج المتحصل عليها تشير إلى أن التربة غير ملحية غير صودية ومصدر المياه يشير إلى أنها غير ملحية وغير صودية ومحتواها من العناصر(N, P, K, Fe, Mn, Zn, Cu, Cd, Co, Pb, Ni, Cr) والمحتوى البيولوجى (COD,BOD) والسالمونيلا والشيجلا تقع ضمن الحدود المسموح بها حيث تم إستخدام هذه المياه فى رى نباتات الجاتروفا وأظهرت النتائج ارتفاع فى محصول البذور ومحصول الزيت ونمو النباتات ومن التحليل العنصرى لزيت بذور الجاتروفا وجد أنها تحتوى على نسبة عالية من الأحماض الدهنية.

قام بتحكيم البحث

أ.د / السيد محمود الحديدى	**كلية الزراعة – جامعة المنصورة**
أ.د / حسن حمزه عباس	**كلية الزراعة بمشتهر – جامعة بنها**