ARAB REPUBIC OF EGYPT
EGYPTIAN ENVIRONMENTAL AFFAIRS AGENCY

SURVEY ON POLICY AND REGULATION ENVIRONMENT FOR EGYPTIAN BIOFUEL INDUSTRY DEVELOPMENT

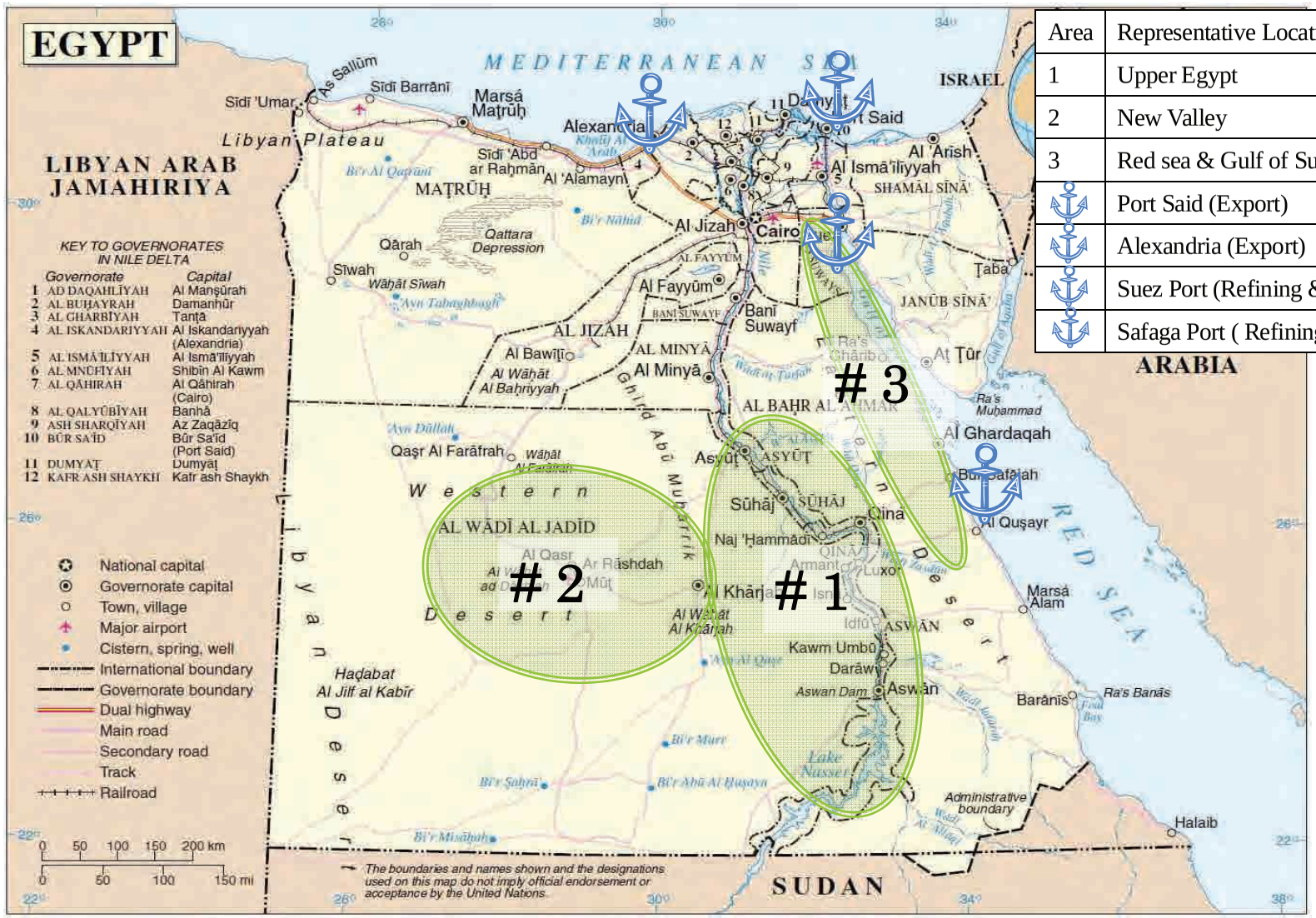
FINAL REPORT

JUNE 2012

Japan International Cooperation Agency (JICA)

Japan Development Institute (JDI)

Exchange Rate (As of June, 2012)
USD 1.0 = EGP 6.03
USD 1.0 = JPY 79.26
EGP 1.0 = JPY 13.155



Area	Representative Location
1	Upper Egypt
2	New Valley
3	Red sea & Gulf of Suez coast
⚓	Port Said (Export)
⚓	Alexandria (Export)
⚓	Suez Port (Refining & Export)
⚓	Safaga Port (Refining & Export)

Map. 1 Study Area and the Potential Focused Area for Jatropha Biofuel Industry Development

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ABBREVIATION

AGERI	Agricultural Genetic Engineering Research Institute
ARC	Agricultural Research Center
BDF	Bio Diesel Fuel
CAPMAS	Central Agency for Public Mobilization and Statistics
CAAQ	Central Administration of the Agricultural Quarantine
CAPQ	Central Administration of Plant Quarantine
CBD	Convention on Biological Diversity
CJO	Crude Jatropha Oil
COP	Conference of Parties, UNFCCC
DNA	Deoxyribonucleic Acid
EEAA	Egyptian Environmental Affairs Agency
ECHEM	Egyptian Petrochemicals Holding Company
EGAS	Egyptian Natural Gas Holding Company
EOJ	Embassy of Japan
EU	European Union
FAO	Food and Agricultural Organization of the United Nations
FAS	Foreign Agricultural Service, United States Department of Agriculture
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GMO	Genetically Modified Organism
GTZ	Gesellschaft für Technische Zusammenarbeit
HCWW	Holding Company for Water and wastewater
IATA	International Air Transport Association
IEA	International Energy Agency
ICAO	International Civil Aviation Organization
ICPM	Interim Commission for Phytosanitary Measures
IPCC	Intergovernmental Panel on Climate Change
IPPC	International Plant Protection Convention
ISPM	International Standards for Phytosanitary Measures
Jatropha	Jatropha curcus
ITPGR	International Treaty on Plant Genetic Resources for Food and Agriculture
JICA	Japan International Cooperation Agency
JDI	Japan Development Institute
JV	Joint Venture
LE	Egyptian Pound
MCA	Ministry of Civil Aviation
MTI	Ministry of Trade and Industry, Egypt
MALR	Ministry of Agriculture and Land Reclamation, Egypt
MALR/AE	Department of Afforestation and Environment, MALR
MHES	Ministry of Higher Education and State Ministry for Scientific Research
MOEE	Ministry of Electricity and Energy
MOF	Ministry of Finance, Egypt
MOH	Ministry of Housing, Utility and Urban Development, Egypt
MOP	Ministry of Petroleum

MOU	Memorandum of Understanding
MSEA	Ministry of State for Environment Affairs
MWRI	Ministry of Water Resource and Irrigation
NBC	National Biosafety Committee
NRC	Natural Research Center
NWRP	National Water Resources Plan
ODA	Official Development Assistance
O&M	Operation and Maintenance
OPVP	Office of Plant Variety Protection
PPP	Public and Private Partnership
RLC	Robbiki Leather City
PRA	Pest Risk Analysis
SBRC	Surfactant and Bio-energy Research Center, Bogor Agriculture University
SMTA	Standard Material Transfer Agreement
SUTSWA	Safe Use of Treated Sewage Water for Afforestation
UNDP	United Nation Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNIDO	United Nations Industrial Development Organization
USAID	United States Agency for International Development

Executive Summary and Recommendation for the Following Actions

In order to clarify the realistic threats and overcome the challenges for Egyptian biofuel industry development, this JICA study focused on following three focal points:

	Focal points	Remarks
1.	**Protection of Intellectual Property for New Plant Variety**	• Though Egypt has not joined international treaty of plant variety protection (UPOV), legal framework has already been developed and implemented for intellectual property by law 82 of 2002. • Due to the lack of infringement cases for plant variety protection, actual enforcement of the law shall be carefully monitored.
2.	**Three step scenarios for Jatropha industry's development**	I. Confirmation of productivity performance before the pilot project II. Confirmation of commercial viability, promotion of Jatropha biofuel industry development with PPP scheme, preparation of legal framework to facilitate private investments III. Commercialized large scale plantation with PPP scheme, possibly introduce agricultural investment zone strategy
3.	**Comparative field trial for productivity test**	• It is highly recommendable to evaluate "CLAIMED" productivities by suppliers before the second step of the pilot project (II.). • Without actual field tests environment in Egypt, it is hardly to meet the accountability of natural resources and funding allocation, especially under present circumstances in Egypt. • Result of fifteen (15) months monitoring program (June 2012-August 2013) for both local variety and imported varieties (tissue culture and seed) shall be one of the most important facts for further decision making.

Chapter I	Egyptian Potentiality for Biofuel Industry Development
Chapter II	Facts of Jatropha Biofuel Industry Development
Chapter III	Legal Framework and Practices of Intellectual Properties for Plant Varieties and High Yield Plant Registration and Field Application Procedure in Egypt
Chapter IV	Examination of Commercial Viability and Pilot Plantation Development
Chapter V	Challenges and Recommendations for the Egyptian Biofuel Industry

While Chapter I and II outline the background and facts of Jatropha industry in Egypt, Chapter III investigates the legal protection system of intellectual property rights of Jatropha and others. Based on these findings, Chapter IV proposes the three future scenarios and models of Jatropha industrial

development in Egypt, including the Pilot-phase project. Finally, Chapter V provides practical recommendations to materialize these scenarios. The summary of each Chapter is as follows:

Chapter I	Egyptian Potentiality for Biofuel Industry Development

Uniqueness of the Egyptian Jatropha biofuel industry development

The uniqueness lies in its renewable nature produced from the sun, wastewater and non-arable land and its inedible nature having no competition with other food production and its supply. It also has promising Bio-energy market in Europe having increasing demand and price of biodiesel feedstock by a set of policies encouraging renewable energy use and setting strict GHG cap regulations within the region.

A new industrial development is particularly important in current Egyptian political, economical and social settings. Especially considering the unemployment rate is rising to an alarming level of 12.4% (approx. 3.8 million people) recently in January 2012 increased after the Revolution of March 2011. Now Egypt is facing critical challenges to find sustainable and reliable economic engines for new Egypt expecting continuous population growth of over 2.0% for another decade. Under the critical economic condition, Biofuel industry development can be a great hope for the Egyptian economy.

Emergent Demand for Bio-Jet Fuel to Comply with EU Regulation on Carbon Capping

Great demand for the biofuel was identified in Europe with the Directive 2003/87/EC to establish a scheme for greenhouse gas emission allowance trading within the community regulating CO2 emission from selected business sectors having high influence in the Euro zone. Emergent demand for bio-jet fuel is now official with the Directive 2008/101/EC which includes Aviation Activities in the EU GHG Reduction Mechanism. The mandate stating that there are no exceptions even for off-EU international flight operators that bound for and from EU.

Egyptian Policies on Water Resource Management, Renewable Energy, and Foreign Investment and Public Private Partnership

Egyptian biofuel industry development is backed by several important policies in Egypt. Due to the lack of renewable water source, the government initiated a long-term strategy for water use in Egypt with the National Water Resources Plan-2017. As a part of national water resources, treated wastewater is accounted for safety discharge in afforestation or inedible crop production to avoid the Nile river contamination.

For the purpose of the safety wastewater management, Ministry of Housing, Utilities and Urban Development set ECP501 comprising main legislation and comprehensive guidelines for actual application of treated wastewater. In order to strictly ban on treated wastewater use for edible food cultivation, ECP501 only allows woods and inedible oil cultivation. Jatropha is classified under the industrial oil crops as below.

Table (5-1) Classification of plants and crops irrigable with treated wastewater (Extracted)

Grade	Agricultural group	Description
C	G 3.1 Industrial oil crops	Jojoba, castor, and Jatropha

Considering the reduction of public debts and attraction of private investments, current afforestation program with the utilization of wastewater shall fit to Public Private Partnership Scheme, initiated since 2007, by attracting private investments in producing commercially viable Inedible Oil Crop.

Advantage of Jatropha Biofuel and Its Supply Capacity

With the world's recognition for the importance of the sustainable biofuel production, the guideline for biofuel development was renewed, called Global Bioenergy Partnership's (GBEP) Sustainability Indicators for Bioenergy. According to the indicators, if Egypt can successfully produce Jatropha biofuel with treated wastewater, the environmental and sustainable value would be one of the most competitive biofuel in the world due to creation of new ecosystem, effective use of unused resources, technical transfer of new industry, and creation of sustainable jobs in remote communities.

The reality of Jatropha Biofuel and its supply capacity, however, is not as bright as once predicted during the Jatropha fever (2003-2010) under the influence of soaring petroleum price, growing environmental concerns, and attention to no competitive feedstock with the food production and its supply. The productivity of Jatropha is too low (less than 2.0 ton/ha) compared with the expected/profitable level (4.0 ton/ha) to be commercially viable.

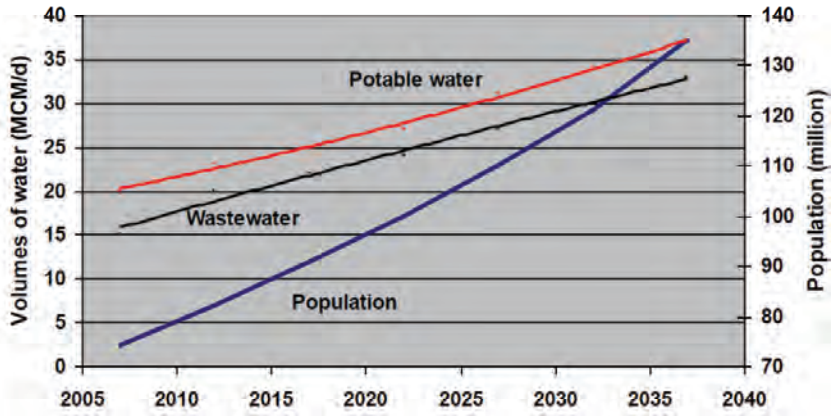
Now that the Jatropha Fever is over, public/privates' stakeholders are seriously looking for the REASONABLE and DEPENDABLE solutions for Jatropha development. The main activities include; development of practical cultivation techniques/technologies with best available agronomy, active research on yield improvement by developing new varieties, and efficient utilization of byproduct. Through series of scientific studies, the world is now confident to use Jatropha as biofuel feedstock.

Chapter II	Facts of Jatropha Biofuel Industry Development

Potentiality of Egyptian Jatropha Business Model

The current use of wastewater (696,000 CM/day or 0.25 BCM/year) for afforestation still represents only 36% of the capacity allocated for afforestation, 7% of the total treated wastewater (3.6 BCM/year) and 4 % of the total wastewater discharge (6.5 BCM/year). According to HCWW's 2009 Master Plan, the total wastewater discharge in Egypt is predicted up to 2037. By 2037, the wastewater discharge will increase up to about 32 million CM/day (11.7 BCM/year).

Figure 2-1 Wastewater Forecast based on HCWW Master Plan



* Original data from HCWW Master Plan up to 2037

(Source: CEDARE (2011) "Water use efficiency and economic approach")

In order to estimate the economic impact to the national economy, the nation-wide potential of inedible oil production is also estimated in the figure below.

Table 2-1 Nation Wide Potential of Inedible Oil Production in 2037

Wastewater discharge (BCM/yr)	Plantation Area (fed)	Oil Production (ton)
5.3	1,174,095	638,118

(Source: Study Team (2012))

Issues and Challenges on Jatropha Biofuel Supply Chain Development

This Section analyzes main issues and challenges for the commercialization of Jatropha biofuel development. (1) Cost of Plantation Development Management, (2) Productivities of Jatropha, (3) Import Procedures and Duration of Plant Quarantine, and (4) Seed Cake Applications and Marketing are main issues and challenges to be considered. Among them, productivities of Jatorpha are the most important one. JICA Study Team evaluated the current and potential productivity of Jatropha varieties.

Table 2-2 Possible Productivity Improvement Scenario of Jatropha

Year	2010	2015	2020	2030
Yield/ha	2.0	4.0	6.0	10.0

(Source: JICA Study Team)

Based on the future scenario of Jatropha productivity, a possible future Business Model for Jatropha is envisioned and shown below.

Table 2-3 Jatropha Business Model for 2011 to 2020

Model/Country		2010 (Actual)	2015 (Target)	2020 (Target)
Egyptian Model	Yield:	Less than 2.0	3.5-4.0 t/h	5.0 -6.0t/h
	Cost of CJO:	US$1,200/h	US$800/h	US$500/h
	Price of CJO:	US$1,000/t	US$1,000/t	US$1,000/t
	Seed Cake:	US$0/t	$100 to $200 for organic Fertilizer	$300/t Fertilizer or Animal Feed
A US Company Model*	Yield:	2.0-2.5 t/h	2.8 to 3.0 t/h	6.0 t/h
	Cost of Production:	$850/t	$700/t	$300/t
	Price of CJO:	$1,000	$1,000	$1,000
	Seed Cake:	$0	$200 Fertilizer	$300 Animal Feed

* The company is the biggest venture company working on Jatropha as a pioneer operating in India, Indonesia and Africa.

Advanced Agricultural Technologies and Its Application in Egypt

In order to achieve the “Commercially viable” Jatropha seed production, 1) traditional/common techniques such as selective breeding and multiplication by cutting have been tried, but most of the efforts have not achieved the commercially viable level at this moment. In order to effectively and efficiently accelerate such improvement efforts, 2) applied/advanced techniques such as productivity and oil quality improvement, genetic modification and multiplication by tissue culture have been studied in limited number of institutes in the world where governments have strong policy to promote Jatropha or privates have strong ambition to succeed in Jatropha business and successfully gather funding from public and/or privates.

In the case of Egypt, few efforts have been made to achieve the profitable business model. However, as one of the most advanced agricultural education centers in northern Africa and Middle East region, both traditional/common and applied/advanced techniques are available. Since AVAILABILITY of such techniques and PRACTICAL/COMMERCIAL APPLICABILITY of such techniques are different and the latter capacity is important to realize commercialized activities in Egypt, JICA experts evaluate the capability of some keen techniques in Egypt that have been applied or studied out of Egypt and seemingly promising to achieve the commercial viability in Jatropha business. This section summarizes some applied agricultural technologies mentioned in “Section 2: Reality of Jatropha Biofuel and Its Supply Capacity” and “section 4: New Jatropha Variety Development in the World”. Applicability of selected technologies in Egypt in the future is summarized in the following sections.

Chapter III	Legal Framework and Practices of Intellectual Properties for Plant Varieties and High Yield Plant Registration and Field Application Procedure in Egypt

After a decade of Jatropha investments all over the tropical and sub arid regions in the world, it is clear that the “Assurance of high productivity” is the focal point of Jatropha business. Not many research institutes under the governmental funding and privates could continue working on the mass production of high yield varieties, but there are some public and private organizations that have

achieved reliable production level for commercial production with plant protection. Egypt seems promising environment for highest productivities based on other edible tropical commodity production in agriculture. With assurance of said intellectually protected varieties, Egypt could introduce and may be able to prove one of the rare success business models in the world.

JICA study team confirmed reasonable legal frame for intellectual property (IP) including plant variety. However, there is no "Wood or shrub registration" in the past, so it would be the first case for Egypt to register the IP protected Jatropha. Even with other common commercial varieties, there are few cases of infringement cases. As a result, actual enforcement of Egyptian IP law is still uncertain, particularly for Jatropha variety protection.

Since genetically modified variety is most suitable application for inedible and isolated plantation like Jatropha, possibility of the genetically modified variety registration and protection of such variety was also studied. Though there are a couple of registration and on-going evaluation, it seemed still too early stage to register such varieties in Egypt. Legal framework shall be developed some time in the future after the stability of the new government.

Chapter IV	Examination of Commercial Viability and Pilot Plantation Development

Proposed Commercial Plantation Model and Its Commercial Viability

Developing a commercial plantation in desert environment involves a large initial investment for the construction of basic infrastructures such as irrigation system, road and power. In order to maximize the return from the investment, the size of the plantation needs to be large enough. In the desert area of Egypt, the normal size of commercial plantations ranges from 1,000 to 5,000 feddan. Therefore, it can be assumed that the minimum standard size of a commercial plantation is 1,000 feddan. The table below is the result of a financial analysis of a 1,000 feddan project.

Table 4-1 IRR and NPV of the Base Case with Existing Condition (LE 1,000)

	(USD, %)
Initial Investment	30,385
IRR	27%
Annual Income	2,518
NPV	8,360
Total Income (15 years)	56,074

(Source: Study Team (2012))

New high yield varieties of Jatropha are expected to reach 4 to 5 ton/y and the price of Jatropha oil is expected to be $1,200 even in present conditions. Also the seed cake is expected to be $96 as fertilizer in 2015. With the estimated IRR of 27% in the current prevailing conditions, Jatropha is likely to be a commercially viable inedible crop using the wastewater by 2015 -2017.

Objective and Profile of Proposed Pilot Project

The objective of the proposed Pilot Project is the testing of commercial viability of High Yield Varieties of Jatropha which shall be introduced from Asia as a main crop. JICA Study team recommends Luxor as the most favorable site for the pilot project at this preliminary evaluation stage. The selection of Luxor for the Pilot Project site is also supported the Egyptian stakeholders.

The proposed Pilot Project is expected to start in 2013 and last 3.5 year to 2016 with the following three (3) project components.

(1) 10 feddan (4 ha) pilot plantation with New varieties

(2) Oil Extraction factory/machine and supporting equipment's/tools,

(3) Evaluation of Commercial Feasibility as Bio Fuel and Organic Fertilizer

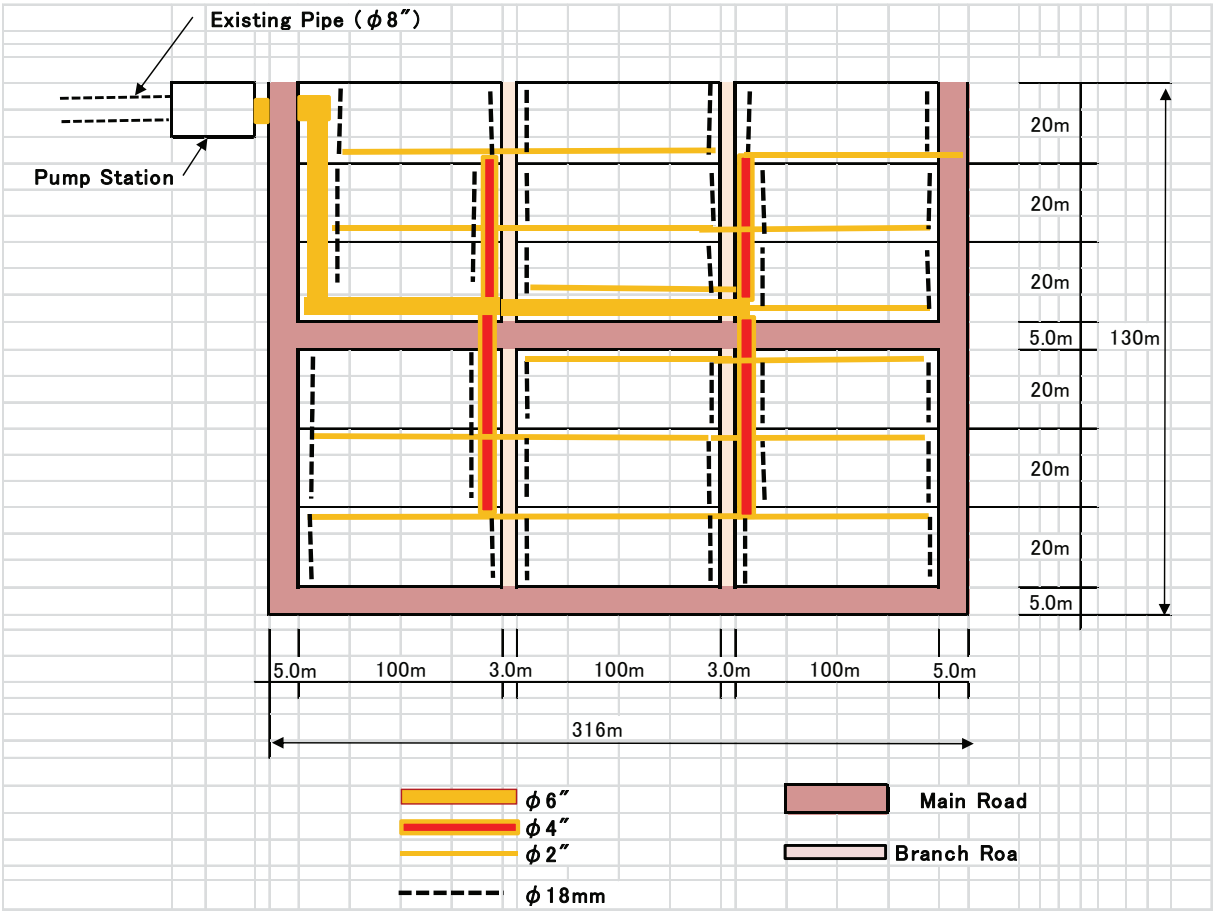
As a by-product from oil extraction, seed cake (75% by weight of the processed seeds) will be produced too. The Project Team will conduct an experiment to check if an organic fertilizer made from the seed cake is feasible in Upper Egypt or not.

Design Basis of the Show Case Model for Pilot Jatropha Plantation Development

To accomplish the aim of this Project three and half years will be needed. Implementation process will be 2 steps in general, i.e. 1st step is construction of the pilot plantation site and procurement of the equipment/the saplings of Jatropha for the operation/maintenance or plantation works. 2nd step is implementation of the pilot plantation work.

The productivity of Jatropha largely depends upon planting density, irrigation water, fertilizer application and variety. The agronomy of Jatropha cultivation in desert environment has not been studied well not only in Egypt but also in the world. Therefore, it is advisable to have cultivation experiments in the proposed pilot plantation in order to establish the best cultivation methods in the upper Egypt. The layout of the irrigation network as the general design of the pilot project is as follows.

Figure 4-1 Layout of the Irrigation Network



(Source: Study team (2012))

Expected Future Scenarios for Large-Scale Commercial Plantation Development

Upper Egypt Wide Inedible Oil Development Program: 2016-2037

Based on the HCWW's future projection up to 2037 of wastewater supply potential and oil production potential, we here propose an Upper Egypt-wide development program for Jatropha biofuel industry. We assume to start the program after the completion of the proposed Pilot Project around 2016/17.

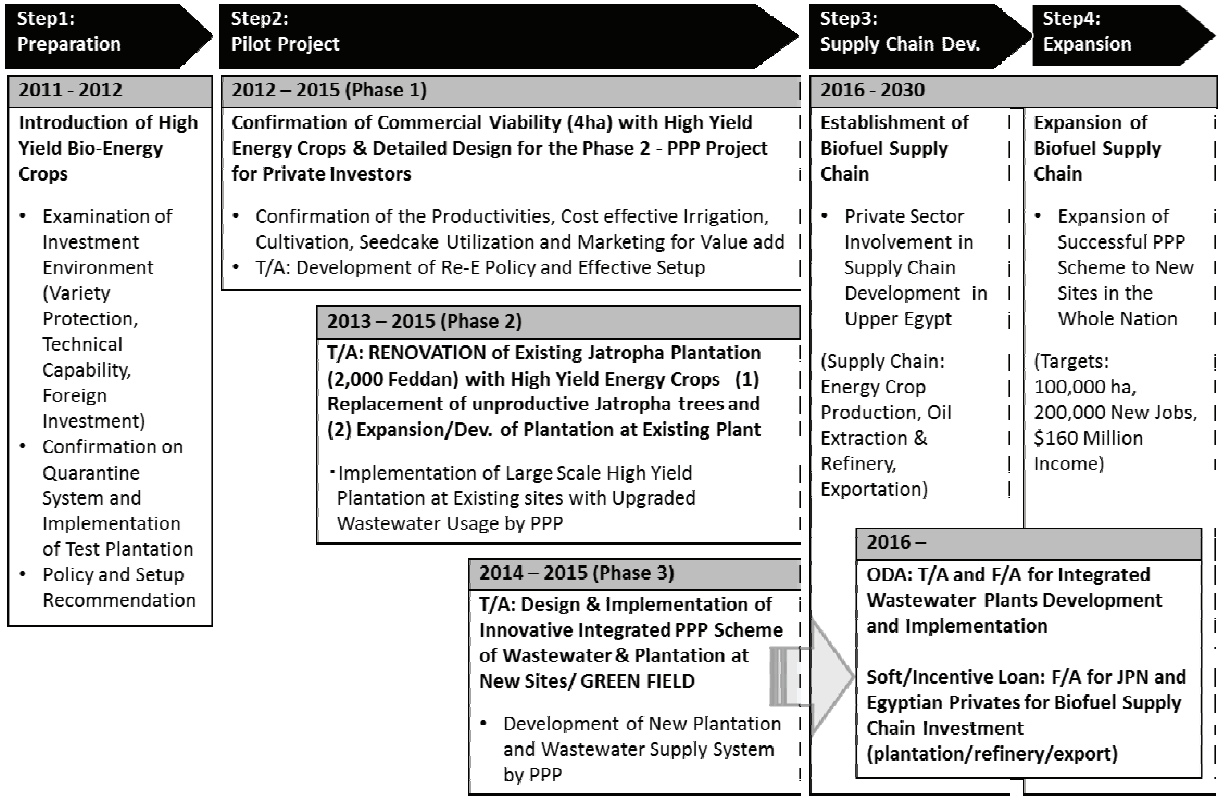
Vision of Upper Egypt Wide Inedible Oil Development Program

The program is to promote full utilization of the wastewater, unused desert land and under-employed human resources in Upper Egypt, in order to develop the overall supply chain of Inedible oil Industry (including Jatropha) in the Upper Egypt including Red Sea and New Valley, starting from large scale commercial plantations, to oil factories and export logistic channels.

Road Map of Upper Egypt Inedible Oil Development Program

A roadmap to achieve the above target is proposed in 4 steps including the preparation work between 2011 and 2012. The figure below summarizes the proposed roadmap in the following table.

Figure 4-2 Roadmap of Upper Egypt Inedible Oil Development Program



(Source: Study team (2012))

Chapter V	Challenges and Recommendations for the Egyptian Biofuel Industry

Study Team has confirmed that Egyptian Jatropha biofuel industry could directly benefit to new Egypt in particularly:

- Smart Use of Treated Wastewater for Sustainable and Safety Management,
- Potentially Major Contributor of Egyptian GDP by Competitive Exporting Commodity Short-Mid Term,
- Renewable Energy Source for Domestic Use, and
- Rural Development and Income Generation by new Jobs.

Successful implementation of inedible oil crop development program (IOCDP) and biofuel industry development (BID) require the following new policy & strategy

(1) Apply the PPP scheme for plantation portion of IOCDP/BID attracting Private investors and reducing public spending.
(2) Introduce a new Agricultural Investment Zone concept for IOCDP/BID and other Agricultural large scale developments
(3) Review of "Code 501" for more flexible and clear guidelines for use of treated wastewater and sludge
(4) Systematic arbitration mechanism (Trouble Solving Supreme Entity) for resolving problems arising from the IOCDP is also recommended.
(5) Role of PPP Unit, MOF and GAFI for the IOCDP/BID will be important to facilitate and ease privates hustle works.
(6) Role of Aid Agencies will be the Key for the successful implementation of IOCDP/BID especially in the Pilot Project stage:

- SHORT TERM ASISSTANCE

(i) Supporting the Pilot Project for Egyptian IOCDP/BID as a first step since the program is unique and may have a big impact on Egyptian Economy in terms of income generation and job creation.
(ii) Possible technical support for the Formulation of Agricultural Investment Zone Program may be needed, which is likely to increase private investment in OCIDP/BID and Agriculture sector in general.
(iii) Possible Technical support for Innovative Integrated Wastewater Treatment & Plantation PPP Scheme to HCWW, which is likely to allow more the PPP scheme and increase chance for JICA to participate in new green field integrated wastewater treatment plant and plantation combined project.

- MID-LONG TERM ASISSTANCE

(i) Financial and Technical Assistance for the Greenfield Integrated Wastewater Plant Development in Egypt by Yen loan will be ready for financing for the newly proposed integrated wastewater treatment plant & Agricultural Investment Zone together.
(ii) Financial and Technical Assistance for an Agricultural Investment Zone program for Agriculture sector and Inedible Oil crop Development Program if the Agricultural Investment Zone program will be read for financing mainly key infrastructure such as electric power, irrigation, roads and ports. If the projects are public, JICA use direct Yen loan and if projects are by private sector, the 2-step loan can be considered.
(iii) Financial and Technical Assistance for the Inedible Oil crop industry supply chain development and BID such as oil extraction factory and exporting facilities. If the projects are public, JICA use direct Yen loan and if projects are by private sector, the 2-step loan can be considered.

Finally, the below table describes 10 keywords as a gist and quick reference of this report.

1.	**One Stone Kills Four Birds**	Very unique golden opportunity to address 1) High Unemployment/Income Generation in rural areas 2) Safety & effective use of treated waste water with NON-Arable land 3) Sustainable industrial crop production with privates investments 4) New industry development (Inedible Oil Crop Industry)
2.	**Nation-Wide Inedible Oil Crop Production with Unconventional Water Sources**	Nation-wide Production of Inedible Oil Corp (IOC: cf. Jatropha for Upper Egypt, Castor, & Jojoba for Lower Egypt) for national strategies on renewable biofuel supply or competitive new commodities for new Egypt
3.	**PPP Scheme**	Shifting from public investments and operation to more effective and efficient privates' investments and/or operation
4.	**Agro-Investment Zone Scheme**	Facilitation of privet developers and investors to biofuel industry development by using smart and cost effective privileges for privates
5.	**Profit Sharing Scheme**	Encouragement for developers and investors to biofuel industry development program and reduction of INITIAL risks for investors
6.	**Integrated Wastewater Treatment Plant & IOC-Plantation**	More efficient & effective and cost reduction: Shifting from two separate development (urban area and plantation) to integrated development for higher efficiency of investment
7.	**Leverage of EG Code 501**	More flexible/wider applicability of treated wastewater and sludge with good treatment practices/technologies in EU and other reference countries
8.	**Leverage of Stakeholders for Commercialization**	(1) Present/Public Program: EEAA, MALR, HCWW (2) Next/Pilot Project Period: Ongoing stakeholders for afforestation (3) Next/PPP Framework Development: responsible and capable authorities for biofuel policy and PPP scheme development (4) Future/Eco-Park/Public Program: Ongoing stakeholders for afforestation (4') Commercial Plantation/PPP: Facilitation of privates by public authorities and competitive operation by privates
9.	**Vision and Goal (0.5 million new jobs & $7 billion income)**	Creation of New IOC Industry with wastewater Creation of 0.5 million new jobs and US$7.0 billion exporting commodity by 2030
10.	**Import & Test**	(1) Confirmation of productivities to achieve the commercial viabilities

of High Yield Variety	(2) Confirmation of accountability for the further steps of Jatropha project

CHAPTER I
Egyptian Potentiality for Biofuel Industry Development

Chapter I Egyptian Potentiality for Biofuel Industry Development

1. Objective of the Study and Background Information

1.2 Objective of the JICA Study

The grand objective of the study is to provide recommendations for necessary measures to attract private investments towards Jatropha industry development. The study addresses preferred policy and regulatory framework for new plant variety protection and organizational arrangements within Egypt. The study also examine an attractive pilot project and recommended action plans for the way forward as well as potential field of JICA assistant for government of Egypt. Followings are the summarized objectives.

(1) Legal framework and practices of Intellectual Properties for plant varieties and high yield plant registration and field application procedures in Egypt

(2) Potentiality of intergovernmental arrangement for Egyptian biofuel industry development

(3) Pilot Jatropha plantation project and design the show case model for attracting private investment.

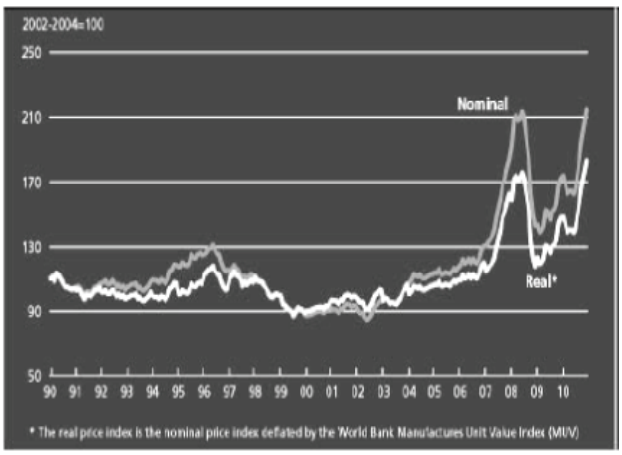
(4) Recommended development framework of Jatropha biofuel industry, action plan for Egyptian Government and support plan for JICA.

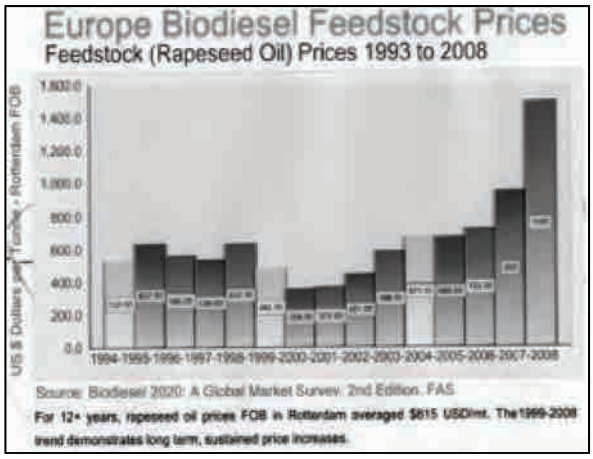
1.3 Summary of JICA Biofuel Industry Development Study in 2010

The principle objective of the previous JICA study was to examine the reality of treated wastewater used Jatropha production in Egypt and potential development strategies for Egyptian Jatropha biofuel industry development. The study identified a great potentiality and advantages of the Egyptian model as well as bottlenecks for the model to be commercially viable.

One of the unique advantages of the Egyptian Jatropha biofuel industry development is its renewable nature produced from the sun, wastewater and non-arable land. Another advantage is its inedible nature having no competition with other food production and its supply, which raised a world concern after the food price hyped in 2008. The promising Bio-energy market was identified in Europe having increasing demand and price of biodiesel feedstock by a set of policies encouraging renewable energy use and setting strict Greenhouse Gas (GHG) cap regulations within the region. Egypt also has a competitive access to European market compared to other biofuel production countries in Africa and Asia having geographical closeness and relatively well developed logistic networks.

Figure 0-1 Trend of Food Price Index and Europe Biodiesel Feedstock Price





(Source: FAO Food Price Index, 2011) (Source: Global market Survey, FAS, 2008)

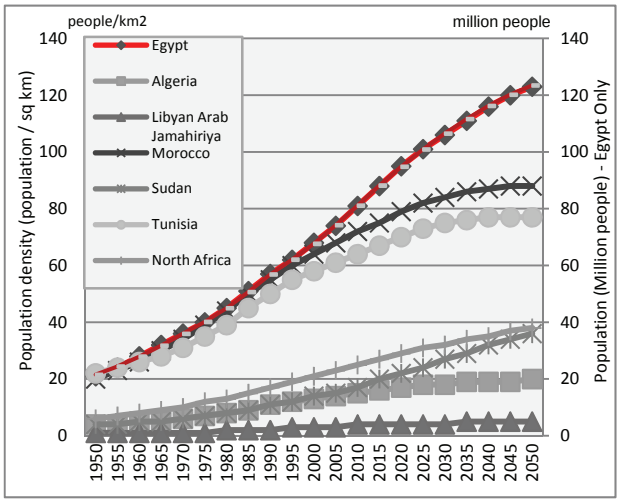
Economic impacts from the Bio-energy industry in Egypt are multifaceted. The industry contributes to environmental sustainability by ensuring fresh water and energy security with a smart use of wastewater. A new industrial development also brings financial contributions to the government, and its labor-intensive nature generates vast employment opportunities. Especially, Jatropha being suitable under constant sunlight and high temperature, it encourages the regional development of Upper Egypt where was being neglected by industrial activities. This addresses the issue and contributes to the mitigation of development disparity between the regions.

Although a significant potentiality and benefits were identified, the main challenge for a commercially viable Egyptian Jatropha biofuel development model is the low productivity of existing variety. Considering a definite need for the application of new high yield varieties and technologies, the necessity of further study was confirmed in order to invite private investors with the appropriate technology. In specific, investigation of the potentiality of new technology application in Egypt, confirmation of investor friendly policy environment and re-examination of the most viable business model with the sufficient Egyptian governmental support.

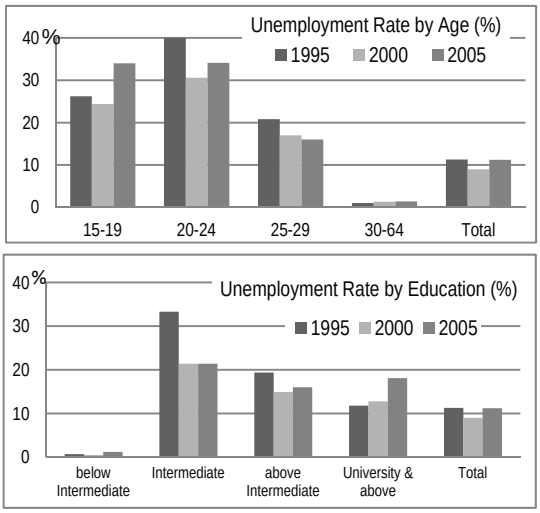
1.4 Call for Sustainable Development Strategy and Job Creation in Egypt

The recent social and political unrest started in January 2011 stemmed from a strong demand for the improvement of living condition and a reflection of underlying serious unemployment issues in Egypt. Despite a strong economic growth since 1990's, unemployment rate has remained stubbornly high in the range of 8-11% and especially it is serious among youth reaching the rate of 40%. Demographic is partly the issue that Egyptian economy is unable to absorb increasing number of job seekers entering into the job market every year. The mismatch of demand and supply within the labor market for skills and qualification has also hampered the employment opportunities for the well-educated young and future generation.

Figure.1-2: Population Growth and Employment Rate & Content



(Source: UN World Population Prospects, 2009)



(Source: CAPMAS, 1995, 2000, 2005)

The population of Egypt has been growing over 2.0% until now. The total population reached 81 million and the population growth rate was 2.2% for 2010/2011 (Table 1-1). As the population growth will remain average of 2.2% for the coming decades, the population of Egypt is expected to reach 100 million by 2020, facing with problems of how to provide necessary housing, education, and infrastructure. Above all, how to provide employment to rapidly growing young people is the biggest challenge.

Table 0-1 Population and Growth Rate of Egypt 2006 - 2021

Year	2006/07	2007/08	2008/09	2009/10	2010/2011	2020/21*
Population	73.6	75.2	76.8	78.7	80.4	99.9
Growth Rate (%)	2.3	2.1	2.2	2.4	2.2	(2.2)

*: estimates (Source: Ministry of Economic Development (2012))

Despite the government's numerous efforts in the past, the previous economic policies failed to utilize available resources to increase investment in traditional labor-intensive sectors but catering for capital-intensive sectors with an assumption that increase of investments is an automatic route to employment generation. The experiences have proved otherwise. A systematic strategy, detailed policies and realistic programs for the job creation should be coherent and integrated components of economic and investment policies, which overarches different ministerial responsibilities.

Now that the issue has surfaced in the form of revolution, Egyptian government is a centre of world's attention expecting to see changes in the existing political, economic and social structure. In order to achieve competitive and sustainable development, a strong, clear, and shared vision should be established among the relevant agencies with a set of strategic and realistic economic/investment/ industrial policies. The strategies should be market-driven and the policy

should be a package of effective use of local resources, essential infrastructure developments, required skill trainings, favorable investment environments directing towards the realization of the shared development vision.

Employment of Egypt has been depending on (1) Services (51%), (2) Agriculture (32%) and (3) Industry (17%). Service sector provides 51% of employment including (1) Tourism. (2) Wholesale/retail trade and (3) other services. Agriculture is still very important provider of employments (32%) with one of three workers engaged in agriculture. However, the agriculture sector has remained underdeveloped keeping the productivity level at 19.4% of that of the industry. Egyptian Government should be encouraged to modernize the sector in the future. Considering the abundant sunshine, land, water and labor, Egypt has a potentiality to expand the Agriculture sector as a major provider of employment by attracting FDI/DDI in Agriculture as is demonstrated by several modern large-scale Agro-Business companies operating already.

Table 0-2 GDP and Employment Share by Sectors 2011

Year	GDP Share (%)	Workforce Share (%)	Total Workers* (Million)	Productivity Per Worker
Agriculture	14.4	32.0	9.7	19.4
Industry	39.5	17.0	5.3	100
Service	45.8	51.0	15.8	39.0
Total			31.0	

(Source: World Bank and Central Bank of Egypt (2012))

Unemployment is rising to an alarming level of 12.4% recently in January 2012 especially after the Revolution of March 2011. About 3.8 million people out of 31 million labor force are out of jobs while the underemployment and/or self-employed informal sector were reported to be over 20% of total worker (6.2 million). The unemployment among the young people is reported to be especially high level of 25% to 30% according to Center Agency of Public Mobilization & Statistics (CAPMAS). CNN reported that 50% of college male graduates are not able to find jobs within two years and female graduates are in worse situations. Female college graduates of 90% are not able get a job within 2 years. Until the Arab Spring Revolution, the promising work places were finding jobs abroad in Gulf countries and Libya. However, job availability in other Arab countries is declining due to the Revolution and/or slowdown of the Global economy. As a result, Egypt is facing a very challenging task of providing jobs for rapidly growing young generation.

Table 0-3 Unemployment level in Egypt

Year	March 10	July 10	Oct. 10	Jan. 11	March 11	July 11	Oct 11	Jan 12
Unemployment Rate (%)	9.12	8.96	8.94	8.92	11.9	11.8	11.9	12.4

(Source: Central Agency for Public Mobilization & Statistics (2012))

1.5 Egyptian Economic Trends and Critical Factors

1.5.1 GDP, Growth Rate, Per capita Income and PC Income Growth Rate

The Egyptian GDP has been growing above 7.0 % until 2008/09 but GDP growth rate started to decline after 2008/09 and growth rate sharply declined for the 2010-11 and remain low for the current fiscal year of 2011-12 mainly due to the Arab Spring Revolution and the global economic decline. As GDP Growth has been declining but the population has been increasing, therefore, the per capita income remains below $3,000 until now. Per capita growth rate has been decline to below 3.0% for 2008-2010 and for the 2010/2011, the PC Income growth rate declined to -0.6 % in the first time in 10 years.

Table 0-4 GDP, Growth Rate, Per capita Income and Per Capita Income Growth Rate

Year	2006/07	2007/08	2008/09	2009/10	2010/2011
GDP (LE Million)	744,800	895,500	1,042,200	1,206,600	1,371,800
Real G Rate (%)	7.1	7.2	4.7	5.1	1.8
Per Capita Income					
(LE)	10,211	12,030	13,702	15,514	17,233
(USD)	$1,789	$2,186	$2,486	$2,814	$2,966
Per Capita Growth Rate (%)	5.1	5.0	2.4	2.8	-0.6

(Source: Ministry of Finance and Central Bank)

1.5.2 Government Debt, Debt Service and Debt/GDP

The Government public debt has been also increasing rapidly due to slow down of GDP Growth and larger expenditure, which has been caused by the political/social turmoil started by the Spring Revolution of 2011. Due to increasing public debt in the recent years, the yield of Government security (364 days t-bill) rapidly increased from 6.0% before 2007 to 13.6% in September 2011 and may further increase in 2012.

Table 0-5 Government Debt, Debt Service and Debt/GDP

Year	Jan-07	Jan-08	Jan-09	Jan-10	Jan-11	Sept.11
Public Debt (LE Million)	591,001	599,603	699,667	808,384	967,290	1,175
Debt Service (LE Million)	54,725	60,004	71,123	98,856	117,251	---
Debt % of GDP	79.4%	67.0%	67.1%	67.0%	70.5%	75.0%
Interest Rate for Public Debt	6.0%	6.3%	11.6%	11.5%	12.4%	13.6%

(Source: Ministry of Finance and Central Bank of Egypt (2012))

1.5.3 Critically Declined Foreign Direct Investment

Until 2007/08, the Net Foreign Direct Investment (FDI) increased rapidly to the record high of USD13.2 billion. However, the FDI started to decline rapidly down wards to 2010/11 to mere USD 2.2 billion, back to a figure of one decade ago. The rapid decline of the net FDI is due to the political/economic turmoil coming from the Arab Spring Revolution started in March 2010. For the 2010/2011, the outflow of FDI reached to an alarming level of USD 7.39 billion, indicating many foreign investors are withdrawing their investments from Egypt.

Table 0-6 Net FDI in Egypt

Year	2003-04	04-05	05-06	06-07	07-08	08-09	09-10	10-11
Net FDI($Billion)	2.1	3.9	6.1	11.3	13.2	8.1	6.8	2.2
Inflow				13.09	17.80	12.84	11.00	9.57
Outflow				2.03	4.57	4.72	4.25	7.39

(Source: Ministry of Investment, GAFI (2012))

1.5.4 Major Export of Egypt (Goods and Services)

Export earnings for Egypt in 2010/11 mainly came from (1) Tourism ($10.6 Billion), (2) Oil Export ($10.3 Billion), (3) Suez Canal ($5.1 Billion) and (4) Remittance form Egyptian workers abroad ($9.8 billion) in 2009/10.

Table 0-7 Total Export, Tourism, Oil, Suez Canal and Remittance (Unit: USD Billion)

Year	2006-07	2007-08	2008/09	2009/10	2010/11	2011/12*
Total Export (Goods)	22,018	29,356	25,169	23,873	26,991	----
Tourism	8,183	10,827	10,488	11,591	10,589	10,022*
Oil	10,221	10,108	14,473	11,005	10,259	12,136*
Suez Canal	4,170	5,155	4,721	4,517	5,053	5,440*
Remittance abroad				9,800**		

* is preliminary estimates. ** is estimated by Central Bank of Egypt

(Source: Central Bank of Egypt (2012))

Severe Damage of Remittance from Egyptian Workers Abroad by Geopolitical and Global Economic Trend

The remittance from Egyptian workers abroad was reported by Central Bank for 2009-10 as $9.8 Billion, which is the third or second largest foreign currency earner in Egypt. The number of Egyptian workers abroad is estimated as many as 3-4 million workers working in Gulf countries of Saudi Arabia, UAE and Kuwait plus Libya until 2011. Libya alone was estimated to have 1.5 million Egyptian workers but the most of workers were forced to return back to Egypt by the Revolution which took place in 2011.

Due to the transitional governance period in Egypt, there are few chances for returned skilled and unskilled workers resulted in contributing to the sharp rise of unemployment rate and frustration in the society.

Furthermore, the economic crisis has gotten serious in Europe leading serious job cuts in all sectors including public services. Especially the foreign workers have been facing serious peer pressure from native nationality(ies). The trend of foreign workers' exclusion might get more serious in EU countries and especially skilled foreign workers might face difficulties to secure the work against native nationality(ies).

1.6 Creation of New Employment in Rural Communities

After the Egyptian revolution, Egypt has been facing critical challenges to find sustainable and reliable economic engines for new Egypt. However, unlike other developing and least developed countries in Arid areas in Africa and Middle East regions, Egypt still has tremendous potentialities of its sustainable and strong economic development by using its unused or inefficiently exploited resources, such as competitive and hardworking labors in rural communities, Nile river and ground water, arable land with irrigation.

Due to the lack of job opportunities in rural communities, many young people have needed to go to big cities in Egypt or overseas for survival. However, under present unfavorable circumstances, few investments in Egypt and prolonged Eurozone financial crisis, it has gotten harder for young generation day by day.

In general, it is not easy to create new employment in rural communities under globally competitive capitalism. However, unlike other countries, Egypt may have good potentiality to develop agribusinesses by:

1) leveraging and improving Nile river water application for higher value commodity production in existing farm land,
2) developing unused ground water resources for higher value commodity production with new farm land development in unused land,
3) applying "Treated wastewater" for inedible high value or strategic commodity (ex. biofuel feeds or industrial materials) production in NON-ARABLE land where there are little potentiality to utilize conventional farming activities with Nile river or ground water.

In any water resource application for further economic development in rural communities, it must be competitive enough not only in Egypt but also competitive in global markets for sustainable activities led by private sectors. Since the conventional agricultural sector development has been set as one of the most important priority sectors by the government after the revolution and possibly by the new government after the presidential election in June 2012, such conventional agribusiness sector shall likely take off with new government's strong commitments and privates' active participation.

On the contrary, there is no clear vision of the water resource exploitation, especially treated wastewater for new Egypt, though there are tremendous potentialities for rural development and job creation. This JICA study, therefore, focuses on the potentiality of the water resource application for sustainable and meaningful resource use for new Egypt.

2. Emergent Demand for Bio-Jet Fuel to Comply with EU Regulation on Carbon Capping

2.1 Directive 2003/87/EC to establish a scheme for greenhouse gas emission allowance trading within the community and DIRECTIVE 2008/101/EC to Include Aviation Activities in the EU GHG Reduction Mechanism

Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the community (Directive 2003/87/EC) regulates carbon dioxide (CO_2) emission from selected business sectors having high influence in the Euro zone. The primary objective of the Directive 2003/87/EC is to commit the international treaty-Kyoto Protocol of United Nations Framework Convention on Climate Change (UNFCCC) and reduce the greenhouse gas (GHG) emission within the Euro zone. Due to the technical difficulties, the civil aviation sector was excluded from the second EU ETS from 2009 to 2012 at the beginning.

After years of negotiation and technical feasibility studies and trials, civil aviation sectors finally agreed to surrender itself to the EU ETS. Directive 2008/101/EC to Include Aviation Activities in the EU GHG Reduction Mechanism (Directive 2008/101/EC) amended the Directive 2003/87/EC and civil aviation sectors are required to reduce GHG emission from 2012 based on the reference year of 2004-2006.

The Directive 2008/101/EC set following provisions:

- In order to avoid distortions of competition and improve environmental effectiveness, emissions from all flights arriving at and departing from EU airports shall be included into the scheme from 2012.
- For the period from 1 January 2012 to 31 December 2012, the total quantity of allowance to be allocated to aircraft operators shall be equivalent to 97% of the historical aviation emissions.
- For the period from 1 January 2013 and after, the total quantity of allowances to be allocated to the aircraft operators shall be 95% of the historical aviation emission,
- The Commission shall review the total quantity of allowances to be allocated to aircraft operators. The percentage of allowances to be allocated to aircraft operators may be changeable in the future.
- The total quantity of allowance allocated to aircraft operators, 15% of allowances shall be auctioned. This percentage may be increased as part of the general review of the Directive.
- If aircraft operators could not meet with the requirements, the excess mission penalty shall be EUR 100 for each tone of carbon dioxide emitted for which aircraft operators has not surrendered allowances.

2.2 Mandate Commitments by Aviation Operators

As shown in a quotation from the EU ETS policy website below, there are no exceptions even for off-EU international flight operators that bound for and from EU. It is serious thread for aviation sectors but the movement of CO_2 reduction in aviation sectors has been implemented as scheduled even though the aviation sectors have been facing severe profit reduction due to economic crisis in EU, excessive competition among conventional carriers and low cost carriers (LCC), and jet fuel increase 2010-2011.

EU reaffirms its commitment to tackling emissions from international aviation

On 21 December 2011, the European Court of Justice delivered its judgment in a legal case brought by some US airlines and their trade association against the inclusion of aviation in the EU ETS. The Court clearly upheld the 2009 legislation, stating that the extension of the EU ETS to aviation infringes neither the principle of territoriality, nor the sovereignty of third countries.

It also stated that the EU ETS does not constitute a tax, fee or charge on fuel, which could be in breach of the EU-US Air Transport Agreement. The Court concluded that the uniform application of the EU ETS to all flights which depart or arrive from the EU is consistent with provisions designed to prohibit discriminatory treatment between aircraft operators, on nationality grounds also covered by this agreement.

After the European Court of Justice's ruling in favour of the EU legislation, the Commission reaffirms its strong commitment to continue to work through the International Civil Aviation Organization (ICAO) with other countries to limit greenhouse gas emissions from international aviation.

< http://ec.europa.eu/clima/policies/transport/aviation/index_en.htm>

Table 2-1 EU ETS Mandates Commitments of Airline Operators

Key Factors	Remarks
The cap	Sizes the total quantity of allowances allocated to the aviation sector The cap is set a • 97% (2012) • 95% (2013-2020) of the baseline (2004-2006)
The baseline	Is the average of the annual aviation emission for the years 2004, 2005 and 2006 Baseline was published by the EC in March 2011 and is approx. 221 million tonnes of CO2
The benchmark	Is used to allocate the free of charge allowances to the operators Is calculated by dividing the total cap by the sum of tonne-km data provided by the operators in 2010 The benchmark is set at • 0.6797 allowances/1000 tonne-km (2012) • 0.6422 allowances/1000 tonne-km (2013-2020)
Free allocation	Operators had to report their tonne-km date for 2010 to get free allocation Amount of allowances for a certain operator is calculated by multiplying the benchmark with the 2010 tonne-km data of the operator The operators will receive • 85% of the calculated allowances in 2012 and • 83% in 2013-2020
Special reserve	In each period 3% of the cap will be set aside in a special reserve for operators • Who start performing aviation activity after the monitoring year • Whose tonne-km data increase by an average of more than 18% annually between the monitoring year and the second calendar year of the period
Offset use	Airline operators can use • 15% of their emissions (2012) • at least 1.5% of their verified emissions (2013-2020)
Fine and restriction	• 100 Euro shall be charged for Each exceeded CO2 tonne • Exceeded CO2 tonne shall be deducted from allowance in the following EU ETS periods • In the extreme case of no compliance, European Commission may impose the operation license of the incompetent operators

(Source: International Emissions Trading Association (IETA) <www.ieta.org>, Directive 2008/101/EC)

3. Egyptian Policies on Water Resource Management, Renewable Energy, and Foreign Investment and Public Private Partnership

Due to the extreme caution to access the public authorities' information after the revolution in 2011, JICA Study team had difficulties to access important policies and their updates for Egyptian biofuel industry development. Thus, this section summarized the published or previously acquired policy information.

3.1 National Water Resource Plan-2017

Due to the lack of renewable water source except the Nile river, water resource management is one of the highest priorities and bottleneck of sustainable development for Egypt. In order to develop the long-term strategy for water use in Egypt, Ministry of Water Resource and Irrigation (MWRI) initiated and took a lead of National Water Resources Plan-2017 (NWRP) with the collaboration of all relevant authorities in Egypt (http://www.mwri.gov.eg/En/plan46.html).

Though JICA Study team could not access the updated NWRP, the published NWRP (2005) still covers the comprehensive issues of Egyptian challenges to optimize the limited water resource management for sustainable development. NWRP presented the past status (up to 2004) of the nationwide water usage, problems and issues, and the proposal for solutions. The NWRP includes relevant policy decisions and measures that are to be implemented. All stakeholders were involved in NWRP implementation, and careful planning and coordination were conducted.

An implementation framework of NWRP-2017 was developed to assign clear responsibilities for the implementation of the varied plans. It also included the budgetary requirements for the implementation, including investments and recurrent costs. However, due to the development stage of new government after the revolution in 2011, few activities seemed taken into proceeding.

As a part of national water resources, treated wastewater is accounted for safety discharge in afforestation or inedible crop production to avoid the Nile river contamination.

3.2 Egyptian Code for Using the Treated Wastewater in the Field of Agriculture ECP501

For the purpose of the safety wastewater management, Ministry of Housing, Utilities and Urban Development set the Egyptian Code for Using the Treated Wastewater in the Field of Agriculture (ECP501). ECP501 comprises of main legislation and comprehensive guidelines for actual application of treated wastewater (Table 3-1).

Table 3-1 EU ETS Mandates Commitments of Airline Operators

Contents of the Code 501
Chapter 1: Introduction
Chapter 2: Domain of the code
Chapter 3: Definitions
Chapter 4: Criteria determining types of Treated Municipal Wastewater allowed to be reused for agricultural purposes
Chapter 5: Plants and crops prohibited or allowed to be irrigated by treated wastewater
Chapter 6: Regulations and Conditions related to irrigation methods
Chapter 7: Regulations related to Hygienic measures for protection against Hazards of direct exposure to Treated Municipal Wastewater used in agricultural purposes
Chapter 8: Institutional aspects related to applying the Code
Chapter 9: Self-Monitoring, Inspection & Corrective actions
Appendix (A): Tables summarizing the specific conditions related to utilization of Treated Municipal Wastewater in irrigating Plants & Crops
Appendix (B): Requirements and procedures for assessment of the environmental & health impacts of the Project of utilizing Treated Municipal Wastewater in agricultural purposes.
Appendix (C): Committees of the Egyptian Code for utilizing the Treated Municipal Wastewater and the resulting sludge in the field of Agriculture.

In order to strictly ban on treated wastewater use for edible food cultivation, ECP501 only allows woods and inedible oil cultivation (Colum below).

Colum: Extraction of Chapter 5 Plants and crops prohibited or allowed to be irrigated by treated wastewater

Plants and crops prohibited or irrigated by treated wastewater

5-1 This code defines the following prohibited uses of the treated wastewater:

5.1.1 The treated wastewater is prohibited to be used, whatever the treatment level is, in planting vegetables whether eaten raw or cooked.

5.1.2 The treated wastewater is prohibited to be used, whatever the treatment level is, in planting all kinds of fruit trees eaten raw without peel such as guava and grapes, etc.

5.1.3 In any event, the treated wastewater is prohibited to be used in irrigating export crops, including cotton, rice, onion, potatoes, medicinal plant, aromatic plants, citrus plants, and whatsoever included in the concerned administrative decisions of strategic crops to avoid the counter marketing advertising.

5.1.4 The treated wastewater is prohibited to be used in irrigating children gardens and schools.

5.2 The classification of plants and crops allowed to be irrigated by the treated wastewater:

According to this code, the plants and crops allowed to be irrigated by the treated wastewater is divided into 3 agricultural groups, which in turn are subdivided into 11 groups. This classification is based on the local conditions to cope with the reuse of treated wastewater with its three degrees.

Table (5.1) indicates the referred classification.

Table (5-1) Classification of plants and crops irrigable with treated wastewater*

Grade	Agricultural group	Description
A	G 1.1 Plants and trees grown for greenery at tourist villages and hotels	Grass, Saint Augustine grass, kinds of cactus, ornamental palm trees, climbi plants, fencing bushes and tree, wood and shade trees
	G 1.2 Plants and trees grown for greenery inside residential areas at the new cities	Grass, Saint Augustine grass, kinds of cactus, ornamental palm trees, climbi plants, fencing bushes and tree, wood and shade trees
B	G 2.1 Fodder / feed crops	Sorghum
	G 2.2 Trees producing fruits with peel	On conditions they are produced for c and manufacturing purposes such as l mango, olive trees, date palms, and nu such as almond and pecan
	G 2.3 Trees used for forestation of highways and green belts around cities	Casuarinas, camphor, Athol tamarix, oleander, fruit producing trees, date p and olive trees
	G 2.4 Nursery plants	Nursery plants of wood trees, orname plants, and fruit trees
	G 2.5 Roses and cut flowers	Local roses, eagle roses, bulbs (e.g. gladiolus, Bird of Paradise, etc.)
	G 2.6 Fiber crops	Flax, jute, hibiscus, and sisal
	G 2.7 Mulberry for producing silk	Japanese mulberry
C	G 3.1 Industrial oil crops	Jojoba, castor, and Jatropha
	G3.2 Wood trees	Kaya, camphor, and other wood trees

3.3 Egyptian Energy Policy and Renewable Energy Policy

As Egypt is one of the highest wind and solar energy density area in the world (Renewable Energy in Egypt 2008, PICO energy services), government of Egypt and aid agencies have intensively worked on renewable energy policy development in electricity sectors and implemented some promotion project funded by aid agencies.

As the result of such efforts, government of Egypt set the national strategy of electricity generation from renewable energy source in 2008 (http://www.nrea.gov.eg/english/page61e.htm). The strategy states “The strategy aims to Contribution of renewable energies by 20% of the total electricity generation by the year 2020. The share from the grid-connected wind power is 12% of the total electricity generation, and that represents about 7200 MW total capacities. Also, other renewable energy applications, led by hydropower and solar energy, will have a significant contribution.”

Table 3-2 Egyptian Renewable Energy Policy in Electricity Generation

Efforts is being exerted in order to reach total capacities of 7200 MW and this will be achieved through two main path:

1. State-owned projects implemented by the NREA with total capacities of 2375 MW (represents 33% of total installed capacities). These projects will be financed through governmental agreements.

2. Private sector projects with total capacities of 4825 MW (represents 76% of total installed capacities). Policy of increasing the participation of private sector will include two phases:

   - Phase I: Adopting Competitive Bids approach as the Egyptian Electricity Transmission Company will issue tenders internationally requesting private sector to supply power to build, own, operate wind farms and selling electricity for the company with price agreed upon between the company and the investor.

   - Phase II: Application of Feed-in-tariff system, taking into consideration the prices and experience achieved in phase I. In May 2009, investors were invited to submit their prequalification documents for the first competitive bid for 250 MW wind farm (BOO scheme). Through the few coming years, it is expected to launch some wind projects via competitive tenders.

(Source: New and Renewable Energy Authority (http://www.nrea.gov.eg/english1.html))

Due to the lack of concrete scientific proves, biomass energy, especially biofuel supply, had not been accounted for as a source of Egyptian renewable energy at this moment. Some Egyptian agencies and public organizations including EEAA, Egyptian Petro Chemicals Holding Company (ECHEM), Agricultural Research Center (ARC), and National Research Center (NRC) have studied technical feasibilities and economical feasibilities of biofuel supply by Jatropha curcus with treated wastewater application. However, except EEAA study known as USAID/LIFE program[1&2], studies are not made available for potential private investors in Egyptian Jatropha biofuel production and distribution. Though the published report gives positive results, neither public organizations nor privates have actively worked on Jatropha plantation for Jatropha biofuel production, except MALR HCWW, and EEAA' safety wastewater management afforestation program.

JICA study team have found and claimed that the productivity of the Jatropha is the key issues of Jatropha biofuel supply chain development in Egypt. Once the productivities meet the

[1] FEASIBILITY STUDY ON GROWING JATROPHA UTILIZING TREATED WASTEWATER IN LUXOR, LIFE Integrated Water Resources Management
Task Order No. 802, EPIQ II: Contract No. EPP-T-802-03-00013-00

[2] ECONOMIC FEASIBILITY OF ALTERNATIVE CROPS WITH POTENTIAL FOR THE REUSE OF TREATED WASTEWATER IN EGYPT, TASK 1.4 WASTEWATER REUSE, INTEGRATED WATER RESOURCE MANAGEMENT II REPORT NO. 3

commercially viable level, Jatropha biofuel could be accounted for Egyptian renewable energy source in the future.

The Detailed issue of the Jatropha cultivation is described in section 6 of this report. This JICA study aims to reevaluate the realistic facts of Jatropha biofuel production under present Egyptian circumstances and propose recommendable actions for the further consideration of effective use of treated wastewater and sustainable energy source development in Egypt.

3.4 Policy on Foreign Investment and Public Private Partnership Scheme

Egyptian Government have already initiated the PPP scheme supported by World Bank since 2007 for the purpose of reducing public debts, which has reached 9% of GDP by 2011. Now after the 2011 Revolution, a new government will be established in the near future (within 2012) and the new government is likely to promote the PPP Scheme more eagerly due to worsening of the public debt situation. The Afforestation program using wastewater can be shifted to a PPP Scheme attracting private investments by growing commercially viable Inedible Oil Crop (including Jatropha). Reasons for recommended shift to the PPP scheme are as follows:

(1) Growing oil crops or generally agriculture industry is suitable by private sector, not by public sector,

(2) Treatment of wastewater in Egypt is a very important responsibility of the public sector for protecting water resource of Nile River basin. Therefore, the public sector under the Code 501 of MoH will be responsible for wastewater treatment facilities and wastewater must be disposed in the desert land away from Nile River with a reasonable condition for providing wastewater to plantation operators and

(3) Unemployment is a serious problem in Egypt and New Government is likely to promote employment creation programs. And the Inedible Oil Crop Industry development by the PPP scheme is one of ways to creating employment.

In order to encourage the private sector to invest into the Inedible Oil Crop Industry development, application of Agro-SEZ Park concept just as Free Zone for Manufacturing is another scheme to be adopted by Egyptian Government. We strongly recommends the Agro-SEZ Park program in Egypt applying not only the Inedible Oil Crop Industry but also promoting agriculture sector in general.

4. Advantage of Jatropha Biofuel and Its Supply Capacity

4.1 Advantage of Jatropha Biofuel

Although both developed and developing countries are keen to the development of biofuel supply capacity as their energy security measures and contribution to the abatement of climate change, all countries are also highly cautioned and conservative to set national policy on biofuel promotion due to the severe food price rise caused by historically highest records of crude oil price and expectation of biofuel industry development, which led imbalance of food supply and damaged countries depending on low cost imported grains and vegetable oils.

As a result of such misleading, not only biofuel producing countries but also consuming countries consider “Sustainability” of biofuel production for the long term and have revised their ambitious biofuel policies to adjust present technical and physical infrastructure development for biofuel feed production without negative impacts on food supply.

One of the renown guidelines is Global Bioenergy Partnership’s (GBEP) Sustainability Indicators for Bioenergy. The initial concept of the GBEP was included in the “Gleneagles Plan of Action” of the G8 +5 in 2005 and its activities have been recognized at all G8 summit since 2006. At this moment, GBEP and its Partners comprise 23 countries and 13 international organizations and institutions including Japan and further 22 countries and 11 International Organizations and institutions are participating as Observers including Egypt (http://www.globalbioenergy.org/aboutgbep/partners-membership/en/).

The GBEP sustainability indicators comprise the set of twenty-four (24) GBEP bioenergy sustainability indicators under the three pillars, namely Environmental, Social and Economic Pillars. The order of the indicator has no significance. Based on the indicators, Egyptian Jatropha biofuel model shall give positive out puts (+) of 15/24, zero impacts (+/-) of 4/24, not applicable (N/A) of 3/24, and potentially negative impacts (-) of 2/24 that shall be addressed to reduce and mitigate the negative impacts (Table 4-1)

Table 4-1 Preliminary Evaluation of Egyptian Biofuel Model with GBEP Sustainability Indicators for Bioenergy

+: positive, +/-: neutral, -: negative, N/A: not applicable

GBEP Sustainable Indicator	Evaluation
ENVIRONMENTAL PILLAR	
1. Lifecycle GHG emissions	+
2. Soil quality	+
3. Harvest levels of wood resources	N/A
4. Emissions of non-GHG air pollutants, including air toxics	-
5. Water use and efficiency	+/-

Table 4-1 Preliminary Evaluation of Egyptian Biofuel Model with GBEP Sustainability Indicators for Bioenergy

+: positive, +/-: neutral, -: negative, N/A: not applicable

GBEP Sustainable Indicator	Evaluation
6. Water quality	+
7. Biological diversity in the landscape	+
8. Land use and land-use change related to bioenergy feedstock production	+
SOCIAL PILLAR	
9. Allocation and tenure of land for new bioenergy production	+/-
10. Price and supply of a national food basket	+/-
11. Change in income	+
12. Jobs in the bioenergy sector	+
13. Change in unpaid time spent by women and children collecting biomass	+/-
14. Bioenergy used to expand access to modern energy services	N/A
15. Change in mortality and burden of disease attributable to indoor smoke	N/A
16. Incidence of occupational injury, illness and fatalities	-
ECONOMIC PILLAR	
17. Productivity	+
18. Net energy balance	+
19. Gross value added	+
20. Change in the consumption of fossil fuels and traditional use of biomass	+
21. Training and re-qualification of the workforce	+
22. Energy diversity	+
23. Infrastructure and logistics for distribution of bioenergy	+
24. Capacity and flexibility of use of bioenergy	+

Source: GBEP Sustainability Indicators for Bioenergy (indicators) and JICA experts evaluation

If Egypt can successfully produce Jatropha biofuel with treated wastewater, the environmental and sustainable value of Egyptian biofuel would be one of the most competitive biofuel in the world due to creation of new ecosystem, effective use of unused resources, technical transfer of new industry, and creation of sustainable jobs in remote communities, which are mostly difficult in other potential countries of biofuel producers.

4.2 Reality of Jatropha Biofuel and Its Supply Capacity

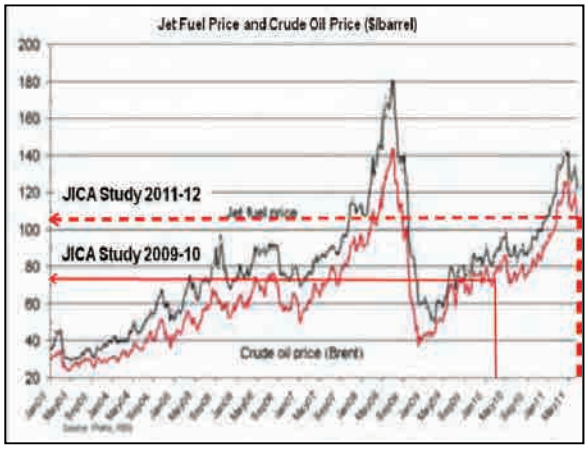
4.2.1 Historical Trend and Demand of Biofuel

Due to the soaring petroleum price since early 2000's (2003: $30, 2006: $60, 2008: $140) and growing environmental concerns, biofuel has become an important alternative fuel. However, an acceleration of demand and investments towards biofuel triggered historical record high food price in 2008, which led to high rise of the edible oil prices along with the crude oil price. Influenced by

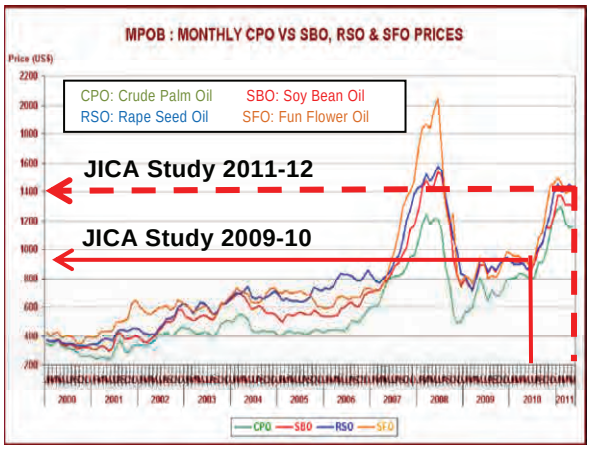
the economic financial crisis in 2008 and reflecting the world concern and criticism against the competition between food supply and biofuel production, an overall oil price has drastically dropped in late 2008. Recently however, the overall oil prices have been gradually increasing (crude oil: $100, rape seed oil: $ 1400) compared to the stagnant price range during 2009 to mid-2010.

An important implication of the international oil market and the recent rise of the oil price for the Jatropha biofuel is that the market is offering a great advantage and opportunity for the Egyptian Jatropha industrial business model compared to the last JICA study 2009-10.

Figure 4-1 Trend of Oil Price (Crude Oil, Jet Fuel and Vegetable Oil)



(Source: IATA, Jet Fuel Price Development, 2011)



(Source: Malaysia Palm Oil Board, 2011)

In addition to the favorable price in the international market, the demand side is also promising for biofuel feedstock in general and more so for Jatropha biofuel industry. Driven by advanced and aggressive biofuel policies and regulation with favorable governmental subsidies, the price of the biofuel feed stocks increased continuously in EU. Moreover, for the consideration of no-competition against food production, biofuel feedstock markets is in transition from expensive first generation edible feedstock to alternative and lower cost non-food feedstock. Under this circumstance, the recent focus is on the use of non-edible plant oil as a source of biodiesel production meeting the international standards.

4.2.2 Recent History of Jatropha in the world (First Jatropha Fever: 2003-2010)

Under the influence of international oil and fuel market, Jatropha Fever has swept the whole world since 2003. Since there were few INEDIBLE plant oils available, Jatropha became a star feedstock. Jatropha has been planted over 100 countries from Africa, Middle East, Asia and Latin American countries for the biofuel purpose. By 2008, the global Jatropha planted area reached over 1 million ha: about 0.8 million ha by Myanmar alone and India (0.4 million ha), Indonesia (0.2 million ha)

and others (about 0.2 million ha). Many experts predicted the future cultivation of Jatropha might reach over 4.5 million ha by 2010 and over 12 million ha by 2015 as shown below.

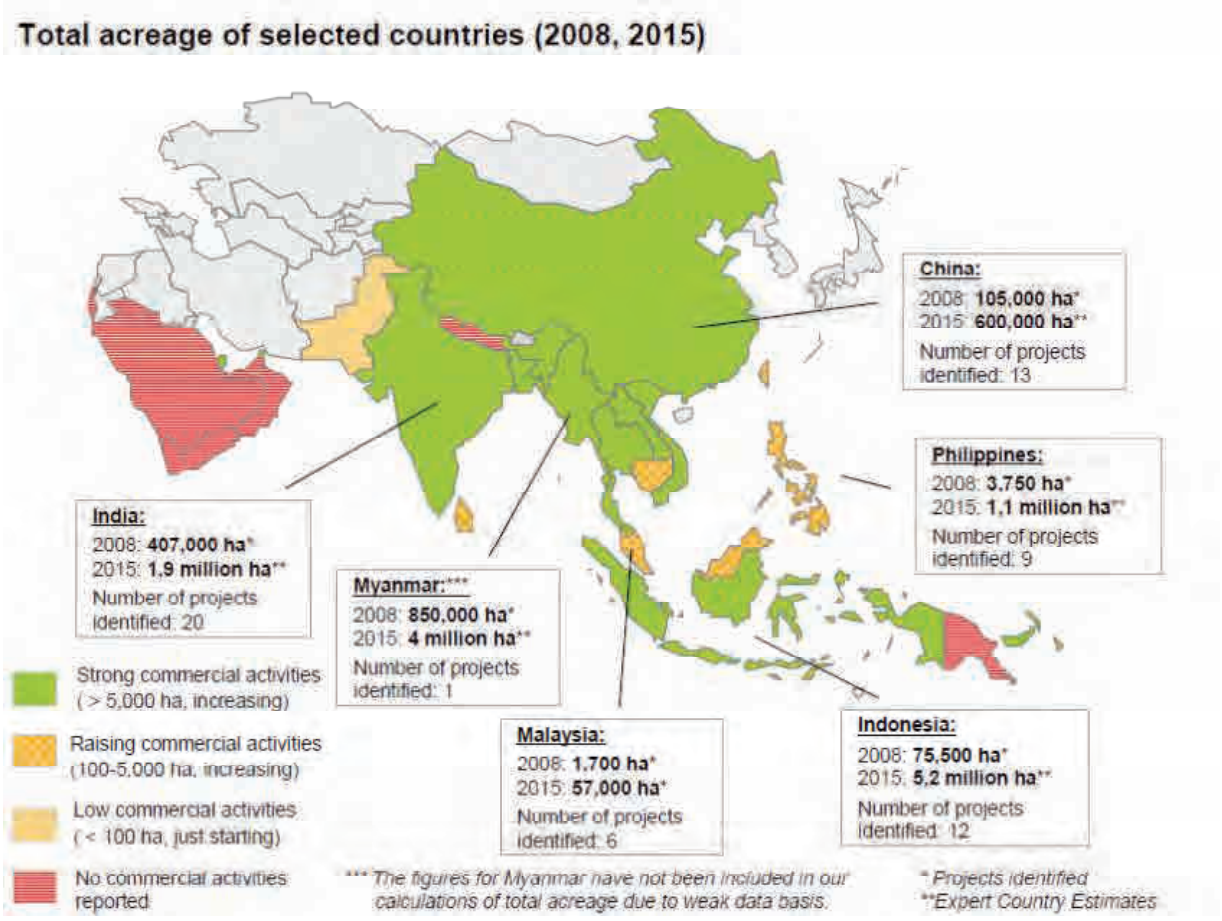
Table 4-2 Estimated production of Jatropha in the world for 2008 to 2015 (In ha)

Estimation	Latin America	Africa	Asia	Total
In 2008	27,000	73,000	911,000	1,011,000
No of Projects	41	97	104	242
For 2010	330,000	630,000	3,760,000	4,720,000
For 2015	1,600,000	2,000,000	9,200,000	12,800,000

(Source: GEXSI LLP supported by World Wild Fund for Nature (WWF), 2008)

Worldwide, renowned countries of Jatropha include Myanmar (850,000ha), India (407,000ha), China (105,000ha) and Indonesia (75,500ha). The commonalities of those countries are keen interests by the governments associated with their aggressive bio-fuel policies and/or support programs. For these four countries, Jatropha is cultivated in commercial scale plantations and contract farming in larger scale as shown below.

Figure 4-2 Jatropha Plantations in Selected Countries in 2008 (actual) and 2015 (plan)



(Source: GEXSI LLP supported by World Wild Fund for Nature (WWF), 2008)

Led by the governments' aggressive biofuel policies, private sectors involvement were encouraged and themselves were also interested in the MIRACLE BIOFUEL CROP promising a lucrative business without scientific and reasonable assessments. D1, one of the most famous companies working on Jatropha used to attract many investors including BP, has collected over US$100 million in venture capital and invested in Jatropha plantations in several countries since 2004. Well-known global companies such as Daimler (Mercedes), Boeing and Airbus have also been involved in growing or using Jatropha biofuel.

International Aid Agencies' such as UNDP, UNIDO, FAO, GTZ, USAID and many other international aid agencies have also been involved in research or experimental programs for rural development, renewable energy source development.

The end of Jatropha Fever came about during 2010 after series of field trials. Participants/investors recognized that Jatropha is not a Miracle Biofuel Feedstock without further yield improvement. In fact, the productivity of Jatropha is too low (less than 2.0 ton/ha) compared with the expected/profitable level (4.0 ton/ha) to be commercially viable. Presently, the productivities vary and depend on production environment, yet the most favorable practices could only reach up to 1.5-2.0 ton/ha at fertile soil with a good care. In the case of unfertile soil or/and less care, the productivity is less than 1.0 t/ha.

The estimation of actual Jatropha production in the world is difficult since many investors and farmers have left the Jatropha production after trials of two to three years for other higher income groups. Based on the discussions with experienced experts in this field and from available data and studies, JICA Study Team estimated a current total Jatropha cultivation area to be approximately 1.8 million ha. Of which Myanmar is by far the largest country with 1.1 million ha followed by India (200,000 ha), Indonesia (100,000 ha) and China (80,000 ha).

Table 4-3 Realistic estimation of Jatropha production in the world for 2008 to 2011 (ha)

Estimation	Latin America	Africa	Asia	Total
In 2008	27,000	73,000	911,000	1,011,000
For 2010	330,000	630,000	3,760,000	4,720,000
For 2011*	100,000	200,000	1,500,000	1,800,000

(Source: GEXSI LLP supported by World Wild Fund for Nature (WWF))
*By Study Team estimation.

Now that the Jatropha Fever is over, public/privates' stakeholders are seriously looking for the REASONABLE and DEPENDABLE solutions for Jatropha development engaging in activities as below. Through series of scientific studies, the world is now confident to use Jatropha as biofuel feedstock.

(1) SERIOUS high yield Jatropha variety development has been started since 2005
(2) Best available agronomy method has been tested in many countries and has already developed many practical cultivation techniques/technologies

(3) Many Jatropha related researches have been active for high yield varieties, agronomy, seed cake utilization and oil extraction.

(4) In addition to the yield improvement, the use of seed cake has seriously been considered. Few countries have started to use seed cake for Organic fertilizer and Bio-fuel for boiler and electric power.

Updated Jatropha market situation is that other than primary application for bio-diesel, there are strong demands in bio-jet fuel and other industrial usage such as bio-plastic. The Jatropha biofuel supply is very limited at this moment with less than 2,000 ton of crude Jatropha oil (CJO) marketed in 2010. However, in 2011, CJO is sold around US$1,000 to $1,100/ton mainly for experimental purposes.

Another demand is identified in Jatropha seed cake, which is used for 1) Organic fertilizer, 2) Biofuel substitute for coal or 3) Possible animal feed with detoxification in the future. Based on the experts' experiences in Myanmar, Jatropha seed cake could be sold with US$200-300/ton as an alternative oil seed cake of sesame or Castor oil for organic fertilizer production. The price of coal substitute purpose is about $80-$100/ton in Myanmar.

CHAPTER II
Facts of Jatropha Biofuel Industry Development

CHAPTER II Facts of Jatropha Biofuel Industry Development

5. Potentiality of Egyptian Jatropha Business Model

5.1 Advantage of Egyptian Model

Although the current model has yet reached an economically viable level, Egypt has a distinctive advantage in an advanced wastewater management through SUTSWA together with strong and constant year round sunlight, maximizing stable and high productivity and offering manageable and nutrient rich content of waste water supply to the Jatropha production. The large-scale availability of non-arable land is also an important component of realizing commercial based Jatropha industrial production which often a bottleneck for other countries, especially considering non-competition with other food production and its supply.

Three components; an availability of non-arable land, strong sunlight, and treated wastewater and their renewable nature are among the important advantages of Egyptian model unlike extractive nature of other natural resources. The followings are the lists of competitiveness of Egyptian model, having its ecological, physical and geographical advantages over other ecologically/potentially suitable Asia and African countries.

Table 5-1 List of Advantages of Egyptian Model

Category	Component	Advantages
Environmental	Safety discharge of treated wastewater	Effective use of treated wastewater prevents contamination of the Nile and ground water for drinking and edible agricultural purposes
Ecological	Availability of Sun	365 days available strong sunlight directly affect the yields of Jatropha
	Reliable availability of nutrient rich water	100% manageable water supply with nutrient rich content
	Abundant availability of large scale non arable land	Over 90% of the Egyptian land kept unused and the use of non-arable land causes no competition with other food production and its supply
Physical	Availability of skilled engineers	Availability of educated youth and elders seeking for the job opportunities
	Availability of competitive logistics network (road, rail, & waterway)	Relatively well developed logistic network is the basis of the low cost production and high profitability
Geographical	Competitive access to EU market	The most profitable market in terms of increasing demand and the closeness which enables low cost shipping and enjoying higher profitability

5.2 Potential Scale of the Commercialized Plantations in Upper Egypt

5.2.1 Potential Use of Wastewater for Inedible Oil Production

Presently, there are thirty eight (38) forests developed by government of Egypt and mostly irrigated by treated wastewater. However, none of those plantations have been operated as commercialized plantations. Such precious efforts and forests shall be continuously operated as the original purposes and be applied for a part of public services such as public parks. On the contrary, some existing oil crops and forests shall be converted to commercially viable practices to justify the public expenditure in such activities (Table 3-2 and Figure 3-1).

Table 5-2 List of Afforestation Under Safe Use of Treated Sewage Water for Afforestation

Governorate	Forest	Allocated Area (Feddan.)	Wastewater Treatment (m^3/day)	Irrigation System	Cultivated Plants
*1. Ismailia	Serapiom	500	90,000	Drip-Trickle	Cypress, pine, kaya, casuarina, camphor, sisal, berry, bamboo, concarpus, *Jatropha
2. Monoufeya	El-Sadat	500	18,000	Drip-Trickle	Cypress, pine, acacia, casuarina, camphor, sisal, berry, ornamental trees
*3. Luxor	Luxor	1700	30,000	Drip-Trickle & developed surface irrigation	Kaya, jatropha, camphor, acacia, berry trees, *jojoba
*4. Qena	Qena	500	23000	Drip-Trickle & developed surface irrigation	Camphor, kaya, *jatropha, *jojoba
5. South Sinai	AlToar	200	3,500	Drip-Trickle & developed surface irrigation	Casuarina, camphor, berry, botany, cancarpus
6. Aswan	Edf	300	8,000	Developed surface irrigation	Kaya
7. New Valley	AlKharg	400	1,300	Developed surface irrigation	Kaya, terminalia, tamarix, casuarina, camphor
8. New Valley	Paris	200	18,000	Drip-Trickle	Cypress, pine, acacia, casuarina, camphor
9. South Sinai	Sharm ElShiekh	60	3,000	Drip-Trickle	Casuarina, camphor, decorating tree
10. Daqahley	Gamass	150	1,500	Drip-Trickle	Cypress, pine concarpus
11. Giza	AlSaf	500	65,000	Drip-Trickle	Kaya, casuarinas
12. Aswan	Blanna	1,235	32,000	Drip-Trickle	Kaya
13. Aswan	Nasr AlNoba	100	14,000	Drip-Trickle	Camphor, kaya, terminalia
14. Beni Soueif	AlWasta	500	10,000	Drip-Trickle	Kaya, jatropha
*15. New Valley	Mut	700	10,000	Drip-Trickle	Kaya, terminalia, *Jatropha, *jojoba
16. North Sinai	AlAresh	200	15,000	Drip-Trickle	Kaya, jatropha
17. Assiut	Assiut	40	50,000	Drip-Trickle	Kaya, jatropha
18. Sohag	Gharb	1,000	28,000	Drip-Trickle & developed surface irrigation	Kaya, Jatropha
19. Sohag	Shark	1,000	28,000	Drip-Trickle & developed surface irrigation	Kaya, Jatropha
*20. Red Sea	Herghada	200	94	Drip-Trickle	Kaya, casurina, *jatropha
21. South Sinai	Newabaa	200	4,000	Drip-Trickle	Kaya, casuarinas

Governorate	Forest	Allocated Area (Feddan.)	Wastewater Treatment (m^3/day)	Irrigation System	Cultivated Plants
22. Suez	Atakka	400	30,000	Drip-Trickle	Jatropha
23. Aswan	Allaky Valley	550	8,000	Drip-Trickle	Camphor, kaya, terminalia
24. Alexandria	N9	60	10	Drip-Trickle	Kaya, casuarinas
*25.Ismailia	*Faid	*450	N/A	*Drip-Trickle	*Jatropha, *jojoba
*26.Marsa Matruh	*Marsa Matruh	*2,055	20,000	*Drip-Trickle	*Cypress, *pine, *casuarinas
Total		**13,245**	**490,404**		

item with "" implies added information by JICA study team
Source: EEAA Annual Report 2007 with updated information by JICA study team's field investigation in 2009

Figure 5-1 Forests under Safe Use of Treated Sewage Water for Afforestation Program

Source: EEAA Annual Report 2007

Considering the potential supply capacity of Jatropha biofuel, HCWW's afforestation plan throughout Egypt and Availability of treated wastewater and potentiality of Jatropha plantation development in Upper Egypt are summarized in Table 3-3 and 3-4.

Table 5-3 HCWW's Afforestation Plan throughout the Affiliate Companies

Affiliate Company	Capacity (1,000 m^3/day)		Forrest Allocation (Feddan)		
	design	actual	allocation	actual	future plan
G-Cairo and Surround					
Matruh	50	25	2,055	1,000	1,055
Monufia	35	33	1,200	1,200	-
Beni Suef	74	38	2,121	300	1,186
Faiyum	7	-	220	80	140
Eastern	100	100	4,681	-	4,681
Red Sea and Upper Egypt					
Red Sea	94	27	4,809	200	4,609
Minya	110	-	7,000	-	7,000
Asuit	472	57	12,907	400	12,507
Suhaj	292	76	14,758	2,143	12,615
Quina	325	158	17,240	900	16,340
Luxor	56	35	2,206	700	1,510
Aswan	153	106	4,464	1,105	3,359
New Valley	78	15	4,933	650	4,283
Sinai					
N-Sinai	39	18	2,400	250	1,950
S-Sinai	22	8	540	340	200
Total	1,908	696	81,534	9,268	71,435

(Source: HCWW)

Table 5-4 Potentiality of Jatropha Plantation Development in Upper Egypt based on the Treated Wastewater Availability

Availability of Treated Wastewater				
Location	Unit	Actual	Design Capacity	Condition
Fayum	1,000 m^3/d	NA	**68**	
Mniya	1,000 m^3/d	NA	**110**	
Asyut	1,000 m^3/d	57	**472**	
Suhaj	1,000 m^3/d	76	**292**	
Quina	1,000 m^3/d	158	**325**	
Luxor	1,000 m^3/d	35	**56**	
New Valley	1,000 m^3/d	15	**78**	
Aswan	1,000 m^3/d	106	**153**	
Total	million m^3/y	163	**567**	Annual wastewater availability
Potentiality of Jatropha Plantation Development				
	Unit	Actual	Design Capacity	Condition
Wastewater Available for Jatropha cultivation	million m3	82	**284**	50% of wastewater
Jatropha watering	litter/year	365	**365**	
Maximum Jatropha Trees	million trees	224	**777**	
Maximum Jatropha Plantation	Feddan (Ha)	487,500 (195,000)	**1,690,000 (676,000)**	2.5 feddan/ha

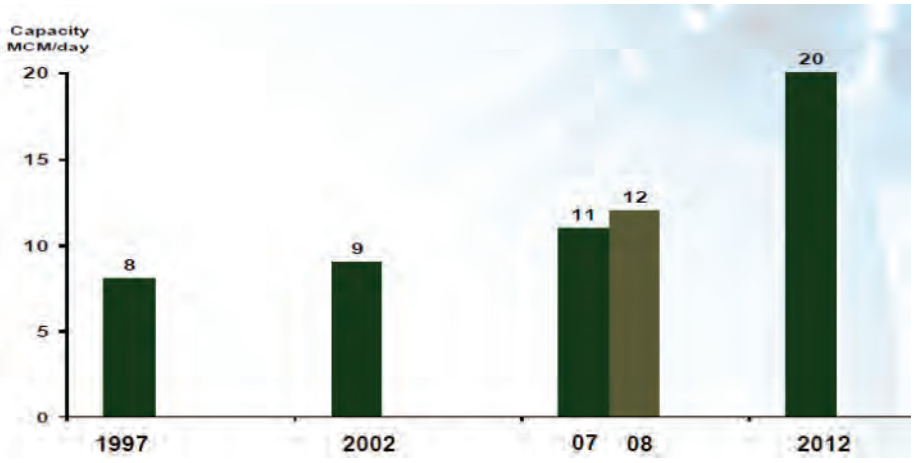
Source: HCWW 2008 (actual/design capacity), JDI (the rest of the calculation and assumption)

5.2.2 Potential Use of Wastewater for Inedible Oil Production

(1) Wastewater supply Potential for Inedible Oil Corp Cultivation

The national wastewater treatment capacity of Egypt was 12 million CM/day (4.4 billion CM/year) in 2008 and is estimated to increase up to 20 million CM/day (7.3 billion CM/year) in 2012.

Figure 5-2 National wastewater treatment capacity of Egypt



(Source: HCWW (2011) "Wastewater Reuse in Egypt: Opportunities and Challenges")

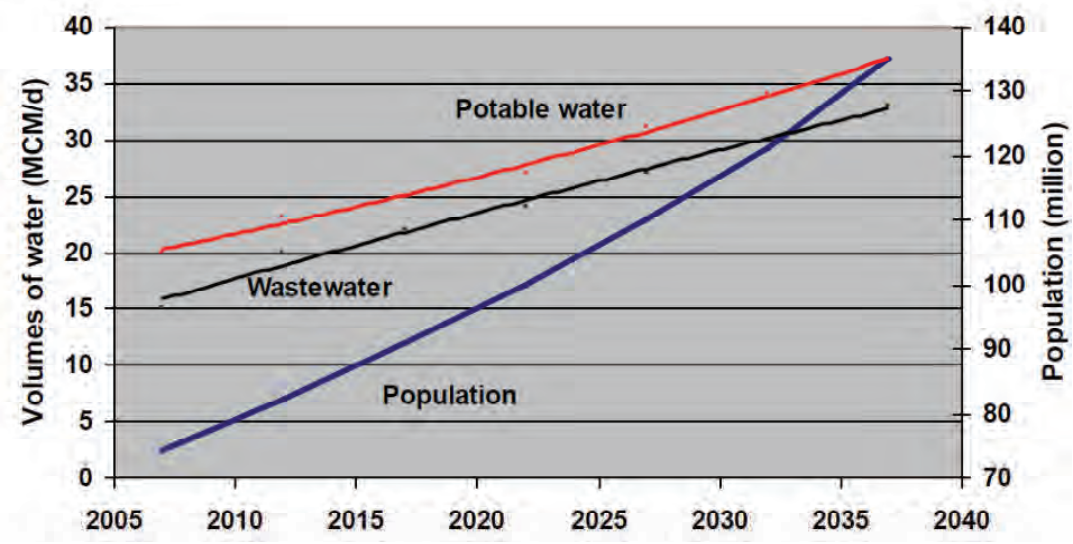
On the other hand, the present national discharge (the amount of collected wastewater) of wastewater of Egypt is estimated at 6.5 billion cubic meters (BCM/year) a year of wastewater in 2010. Of that amount, about 3.6 BCM/year is currently treated, and the treated wastewater supply capacity of 0.7 BCM/year is allocated for afforestation (0.26 BCM is undergoing secondary treatment and 0.44 BCM undergoing primary treatment).

Figure 5-3 Wastewater Supply and Treated Wastewater for Agroforestry (2010)

(Source: HCWW (2011) "Achieving the MDGs for Water and Sanitation Sector in Egypt")

Therefore, the current use of wastewater (696,000 CM/day or 0.25 BCM/year) for afforestation discussed above still represents only 36% of the capacity allocated for afforestation, 7% of the total treated wastewater (3.6 BCM/year) and 4 % of the total wastewater discharge (6.5 BCM/year). According to HCWW's 2009 Master Plan, the total wastewater discharge in Egypt is predicted up to 2037. By 2037, the wastewater discharge will increase up to about 32 million CM/day (11.7 BCM/year).

Figure 5-4 Wastewater Forecast based on HCWW Master Plan



* Original data from HCWW Master Plan up to 2037

(Source: CEDARE (2011) "Water use efficiency and economic approach")

The real potential of Jatropha/inedible oil production with treated wastewater can be estimated with the full use of the total available wastewater in Upper Egypt and the entire country. The share of the Upper Egypt in the national wastewater discharge is 8% as is shown in the table below.

Table 5-5 National Wastewater Discharge and Treatment Capacity (2000)

	Governorate	Installed Capacity (CM/day)	Actual Discharge (CM/day)	Treated Effluent Discharge (CM/day)
1	Alexandria	777,000	1,191,256	585,000
2	Aswan	53,500	87,654	46,594
3	Asyut	50,000	182,355	52,680
4	Beheira	184,592	295,055	71,236
5	Beni Suef	25,920	139,108	35,000
6	Cairo	1,711,880	2,650,365	1,378,880
7	Dakahlia	150,446	422,034	143,853
8	Damietta	143,800	137,965	89,945
9	Faiyum	108,500	188,704	71,868
10	Gharbia	294,000	287,443	156,920
11	Giza	1,030,000	995,676	794,000
12	Ismailia	100,000	150,227	79,500
13	Kafr el-Sheikh	18,500	250,906	18,500
14	Matruh	25,000	14,086	3,900
15	Minya	88,000	171,462	43,000
16	Monufia	143,250	187,258	111,150
17	New Valley	25,610	50,285	21,870
18	North Sinai	51,000	37,157	29,000
19	Port Said	190,000	136,231	124,190
20	Qalyubia	625,000	354,751	373,624
21	Qena (incl.Luxor)	38,000	213,271	48,000
22	Red Sea	0	46,286	0
23	Sharqia	81,000	430,991	68,900
24	Sohag	22,000	164,383	18,000
25	South Sinai	20,330	28,557	11,830
26	Suez	130,095	140,326	120,050
TOTAL		6,087,423	8,953,792	4,497,490
TOTAL (Upper Egypt)		189,110	744,234	187,144
SHARE (Upper Egypt)		3%	8%	4%

(Source: USAID (2010) “Integrated Water Resource Management 2”)

Assuming the 8% share of Upper Egypt in the national treated wastewater in 2037, we estimated the full potential of wastewater supply of both Upper Egypt and the whole country from 2010 to 2037 and summarized it in the following table. In this estimation, the water requirement of Jatropha is assumed at 5000 CM/fed/year. The planting density of 2.5 m x2.5 m is assumed.

Table 5-6 Potential Treated Wastewater Supply for Inedible Oil Production

	2010	2030	2037
National wastewater discharge (BCM)	6.5	10.6	11.7
National Treated Wastewater (BCM)	4.4	9.5	10.5
National treated wastewater (BCM)*	3.6	5.8	6.4
Upper Egypt Wastewater discharge (BCM)	0.52	0.85	0.9
Upper Egypt Treated wastewater (BCM)	0.47	0.76	0.8
Non-Upper Egypt area Wastewater discharge (BCM)	5.98	9.75	10.76
Non-Upper Egypt Treated wastewater (BCM)	3.93	8.78	9.69

(Source: CEDARE (2011) "Water use efficiency and economic approach", Study team (2012))

(2) Potential of Jatropha and Inedible Oil Production in Upper Egypt

Based on the above estimation, the potential of Jatropha oil production in upper Egypt are estimated in the table below.

Table 5-7 Potential Production of Jatropha Oil In Upper Egypt in 2037

	Wastewater discharge (BCM/yr)	Planation Area (fed)	Oil Production (ton)
Upper Egypt	0.4	84,240	105,300

(Source: Study Team (2012))

(3) Nation Wide Potential of Jatropha and Inedible Oil Production in Egypt

In order to estimate the economic impact to the national economy, the nation-wide potential of inedible oil production is also estimated in the figure below.

Table 5-8 Nation Wide Potential of Inedible Oil Production in 2037

	Wastewater discharge (BCM/yr)	Planation Area (fed)	Oil Production (ton)
Nationwide Total	5.3	1,174,095	638,118

(Source: Study Team (2012))

5.3 Potential Benefits on Egyptian Economy

The successfully developed Egyptian Jatropha industry has a great potential of bringing multiple benefits to the Egyptian economy. Adding new and competitive industry contributes to diversification of economic and development structure from the current vulnerable oil dependent economy. In respect of sustainable development strategies, renewable three components mentioned above provides sustainable energy security measures and also preservation of fresh water with an effective management of wastewater. Moreover, labor intensive industry development is in a strong need in traditional agriculture sector and other overarching related industrial sectors has potential of creating extensive skilled and unskilled jobs addressing high unemployment rate and poverty issue in Egypt.

As mentioned above, realization of Jatropha biofuel industry contributes to economic and social development in Egypt. The followings are the lists of potential benefits of Egyptian model on the economy addressing current important development challenges in Egypt for the sustainable development.

Table 5-9 List of Benefits of Egyptian Model

Category	Component	Benefits
Economical	New export industry as means of earning foreign currency	Diversification of Egyptian economic structure and new foreign earning source
	Perfect Investment opportunities for the PPP projects	Renewable energy industry is currently one of the most popular sectors for investment
Socio Economical	Technical transfer in agribusiness and biofuel industries	Strategic technology development for maintaining competitiveness in the global market
	Creation of skilled and unskilled jobs	Labor intensive nature provides a good opportunity for absorbing growing young people and unskilled elder persons heavily depending on governmental subsidies or supports
	Adjustment of unbalanced regional development	The use of unused rural agricultural land offers an effective distribution measure for substantial need creation outside of the Nile delta
Environmental	Fresh water preservation and renewable energy source production Safety wastewater management	Sustainable energy security with effective use of wastewater which prevents illegal dumping to freshwater sources

5.4 Suitability of Upper Egypt Development

Jatropha biofuel industry is most suitable for the development of Upper Egypt. Jatropha's tropical characteristics prefer year round sunlight and high temperature in vast unused rural land where

most of other industries avoid. In fact, current largest plantations have been developed in Upper Egypt with readily developed treated wastewater irrigation in the area proving its suitability in comparison with other regions in Egypt.

Since Jatropha biofuel industry requires permanent and seasonal labors, technicians/engineers and management staffs, substantial number of jobs and wage earning opportunities will be created in Upper Egypt. According to the World Bank report, agriculture is the main engine for poverty reduction, considering over one half of people out of poverty during 2005-2008 were accounted for by those employed in agriculture and the elasticity of poverty with respect to the growth of value added in agriculture is largest among all sectors of the Egyptian economy. This points out to the potential of urban rural population diversification and poverty alleviation potential of the sector contributing to integrated regional development. The followings are the lists of the advantages in Upper Egypt.

Table 5-10 List of Suitability to Upper Egypt Development

Category	Component	Advantages
Geographical	Stronger sunlight, higher temperature and warmer in winter	Favorable condition for the higher yield and stable annual seed production
	Availability of wastewater	Substantial amount of resources for the treated wastewater with a proper establishment of treatment system in the area
	Availability of large scale non arable land	Economical use for the unused land is available with minimal requirement to arrange the present stakeholders /land owners
Socio-economical	Extensive job creation and contribution to regional development	Permanent and temporary job creation for the plantation provides wage earning industry in the region
	Improvement of standard of living in the region	Basic infrastructure development along with the industrial development contributes to the improvement of access to services and basic infrastructure for the population in the region.
	Visible development impacts	Multiple benefits are expected in coordination with a number of existing projects implemented by international aid agencies

6. Issues and Challenges on Jatroha Biofuel Supply Chain Development

6.1 Cost of Plantation Development Management

The costs of plantation development and management need to be minimized for achieving its commercial viability. Basic strategies to achieve the commercial viability are listed below. Local large scale farms also adopt these principles to realize efficient plantations.

(1) Scale of economy
(2) Mechanization
(3) Minimum care and inputs for plantation management
(4) Selection of suitable lands
(5) Out-sourcing (of certain works/services)
(6) Utilization of existing infrastructures

6.1.2 Land Preparation

The candidate land should have at least 1,000 feddan or more for commercial plantation. A flat land is preferable because this can reduce the cost of land leveling. The actual works of land preparation for the plantation can be carried out by the farm management or by assigning a contractor. It may be advisable to contract out the whole or a part of the works because the work occurs only one time for the plantation development and needs high-cost machineries. The table below shows an estimation of typical land preparation works in relatively flat desert lands in case of evaluating the cost based on market prices. Depending on the farm's labor and assets (machineries) conditions, least cost method of land preparation should be chosen.

Table 6-1 Estimation of Land Preparation Cost (1,000 ha)

No.	Type of agricultural practice	Unit Cost	Quantity	Total/L.E
1	Loader operation	150LE	100 hours	15,000
2	Plough treatments	120 LE	100 hours	12,000
3	Labor for planting	70 LE	305 Man*Day	21,375
TOTAL				48,375

(Source: Study team (2012))

6.1.3 Irrigation System Cost

The existing irrigation systems for the afforestation under MALR uses minimal amount of water for growing forest trees in Egypt. However, this is not enough for commercial crop production. As will be discussed technically in Chapter 14, 10-40 liter/tree/day of irrigation water should be needed to

maximize the production. The cost of irrigation system development depends on the design of irrigation system including specifications of pump and pipes because there are many different grades of irrigation equipment available in the local market with a wide price range. Proper selection of pumps and pipes is important for cost minimization and long term success of plantation business.

6.1.4 Cost Effective Cultivation & Management

Because of the relatively low economic value of the produce (Jatropha seeds), too much input cost cannot be justified for maximizing the profit of the plantation. Therefore, minimum care and inputs are recommended for the day to day plantation management. Instead of applying expensive chemical fertilizers, low cost compost should be preferable.

6.1.5 Cost Effective Harvesting

The harvest labor cost is one of the largest cost items of Jatropha plantation operation. Therefore, the minimization of harvest cost is crucial for commercial viability of the plantation. The unit cost or efficiency of harvesting seeds or fruits depends on the tree maturity or the yield of the trees. If one tree gets to maturity and has high yield, a harvesting worker can pick up fruits more efficiently than he does before maturity. An estimation of harvesting labor for Jatropha is shown in the table below.

Table 6-2 Estimation of Harvest Labor Requirement for Different Tree Ages

	Unit	Expected Yield of Jatropha		
		0.2ton/fed (1st year)	1.0ton/fed (2nd year)	2.1ton/fed (3rd year)
Yield per fed	kg/fed	200	1,000	2,100
No of seeds per fed	seeds/fed	280,000	1,400,000	2,940,000
No of seeds per tree	seeds/tree	438	2,188	4,594
No of fruits per tree	fruits/tree	146	729	1,531
No of fruits per fed	fruits/fed	93,333	466,667	980,000
No of fruits harvested	fruits/person/day	16,000	24,000	40,000
Man*day per fed	MD/fed	6	19	25

(Source: Study Team (2012))

The mechanization of harvesting for Jatropha has been studied and tested in the United States, Brazil etc. However Study team assumes that it may take some more time to establish mechanization technology applicable on commercial plantations and that manual harvesting is more realistic in the initial stage.

6.2 Productivities of Jatropha

6.2.1 Existing Reality of Jatropha Productivities in the world

Based on the global experiments, the reality of the productivity of Jatropha is 1.5-2.0 ton/ha using wild variety seeds in fertile soil with a good care and less than 1.0 ton/ha for marginal land and/or without care. Although actual confirmation of the results was not yet officially reported, expected productivities by using POTENTIAL high yield seeds developed by research institutes and private companies in the world claim to be 3.0 to 4.0 tons/ha with a good condition. The details are studied in Chapter II.

Since none of the field trials tested 4-5 years to confirm the productivity of high yield matured Jatropha trees, the real performance and yield of these potential high yield seeds are unobtainable. However, based on the two years experiments in India, Indonesia and Philippines by a private company in Singapore partnering with several international companies, high yield variety is likely to yield up to 3.0 ton/ha minimum and hopefully to achieve 4.0 ton/ha.

In Egypt, inedible plants such as trees and oil crops has been cultivated using wastewater for more than 20 years. The Egyptian code (Egyptian Code 501) for utilizing the wastewater in agriculture field clearly indicates the treated Municipal water must be used for trees or inedible oil crops under the Safe Use of Treated Sewage Water for Afforestation program (SUTSWA). Jatropha has been experimented at Abrawash, Luxor and several other places, mainly in Upper Egypt. Up to now, about 2,000 Feddan have been planted with Jatropha.

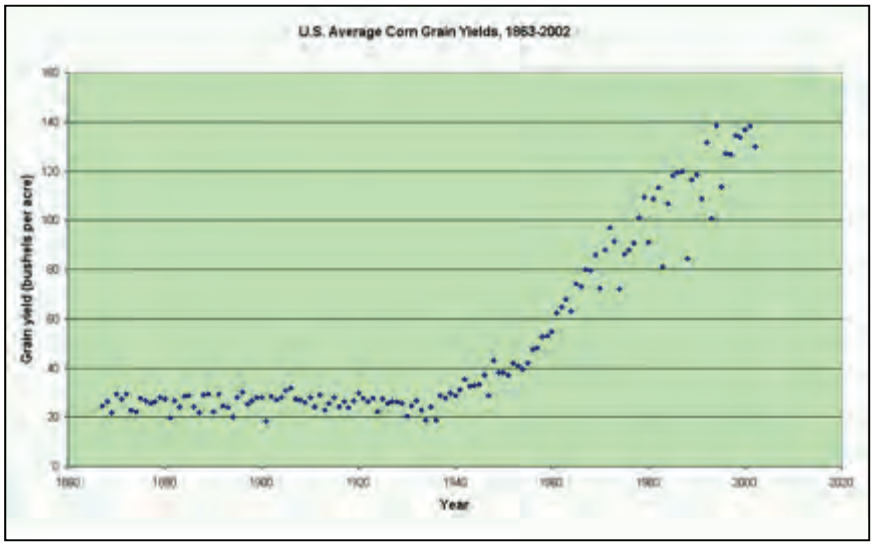
The results of the experiments claimed 2kg per tree (indicating 2.0 to 2.4 t/ha) during initial two to three years. However, the results might not reflect in case of larger scale production due to limited plantation area at this moment. Currently the entire planted field was not well taken care of and seeds are not harvested regularly. Based on the observation of JICA Study Team field investigation in June 2011, Jatropha trees are grown to 3-4m high with hardly no fruits. At Abrawash and Luxor Jatropha Plantation sites, the productivity of both sites are likely to be less than 1.0 ton/ha at this moment.

6.2.2 Future Prospect of Jatropha Productivity

In the past several decades, key crops such as maize, palm oil, cassava and rice have been improved in their yields on average 4 to 5 times of the original wild varieties. Jatropha is still a wild variety and the improvement process has just started in recent years. As for the prospects, Jatropha is expected to double its productivity in several years and within one to two decades, it is likely to improve to 4 to 5 time as any other key crops as shown below.

(1) Corn: 5 times from 25 Bushels/a to 140 Bushels/a (60 years)
(2) Palm Oil: 5 times from 7 ton/h to 35 ton/ha (50 years)
(3) Cassava : 5 times from 5-6 ton/h to 30 ton/ha (40 years)
(4) Jatropha: The target is 2 times from 2.0 to 4.0 ton/ha which can be achieved by 2015. 4 times by 2025-2030 just as other key crops.

Figure 6-1 US Average Corn Grain Yields



(Source: University of Nebraska-Lincoln, 2004)

Based on the productivity improvement of major crops, the possible productivity improvement scenario of Jatropha is shown below.

Table 6-3 Possible Productivity Improvement Scenario of Jatropha

Year	2010	2015	2020	2030
Yield/ha	2.0	4.0	6.0	10.0

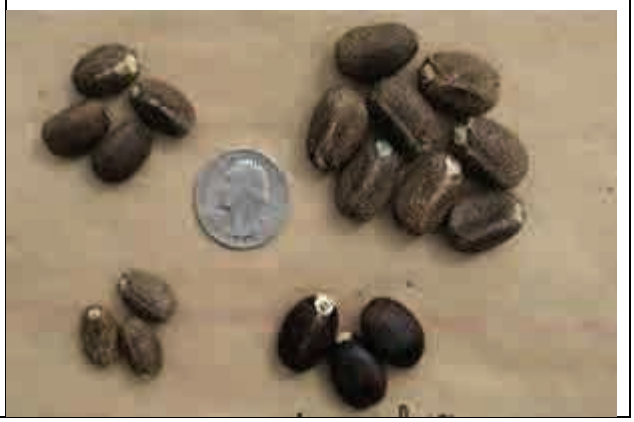
(Source: JICA Study Team)

6.2.3 High Yield Jatropha Variety Availability in the world

Since the global interest of Jatropha started in the late 1980s, several countries have been trying to develop high yield Jatropha varieties from the early 1990s. JICA Study Team investigated the latest high yield variety development in the world to explore suitable varieties to be introduced to Egypt for a Jatropha pilot project from 2013.

Technology-wise, currently, most of yield improvements are based on selection and cross breeding of selected varieties to increase number of bunches and number of fruits of each bunch. Researchers are also trying to increase the size of Jatropha seeds as shown the picture below. The size of seeds can be as small as 0.3 gm. per seed to 1.2 gm. per seed.

Figure 6-2 Example of Good Varieties and Differences

Increased number of fruits of each bunch	Increased size of Jatropha seeds
	

As a part of promoting renewable energy policy, governments are supporting public organizations and research institutes for their new breed Jatropha development efforts. Private sectors are also investing in developing high yield Jatropha variety for their business opportunities. Recognizing the two driving force for the development of high yield Jatropha variety, JICA Study Team targeted both public research institutions and private companies for their researches and development activities and identified reliable public institutions/private companies as listed in Table 6-4 based on the following criteria.

1) Scientific capability of new variety developers: Availability of breeding scientists or experts within public and private research institutes/laboratories or sufficient research/development funds is one of the essential criteria to evaluate their reliability.

2) Possessing already developed high yield Jatropha varieties: Availability of new variety is one of the key criteria to be able to introduce to Egypt for performance evaluation at the commencement of Pilot Project (proposed from 2013).

Table 6-4 High Yield Jatropha Varieties Developed or on-going in Selected Countries

Organization	Yield	Activities	Availability
1.Research Institute in the University in Indonesia partnering with Japanese Private companies • Japanese Research Institutes have been supporting research efforts.	3.0-4.0 ton/ha (Test result from many farms)	• High yield varieties are developed and next generation new variety is under development.	• Agreed to provide Egypt available varieties.
2. Private Company in USA	3.6-4.0 ton/ha average	• Breeding and biotechnology to develop elite seeds. • Launched Business operation in Brazil in 2011	• Joint Cultivation system with the minimum of $100,000 for the package service.
3. Research Institute in the University in Thailand	3.0 ton/ha	• First generation variety by selection	• Not able to provide the new variety yet. Development is still on the way.
4. JV Company in Singapore partnering with Japanese and Indian Private companies	3.5- 4.0 ton/ha (With best care)	• Selective breeding, Tissue culture • Test plantation in 8 countries in Asia and Latin America	• Only provide with Seedlings not seeds. • Their variety must be protected for the future use.
5.Private Company in England • High yield Jatropha development since 2004. Formed JV in 2008 with fuel company in England.	3.0-4.0 ton/ha (Claimed yield)	• Test plantation of Jatropha in over 15 countries but now concentrating in India, Indonesia and Zambia.	• Under investigation
6.Research Institutes in China • Partnering with other public research institutions, Chinese foundation, local botanical garden since 1990.	5.0 ton/ha (With Irrigation tested in China)	• Normal selection/cross breading/molecular modifications of original Jatropha varieties from Southern China, Vietnam, Laos, India and Malaysia and South Africa. • Experiments in Southern China (Yunnan and Guang Dong province)	• New varieties are only available to Chinese growers but not available to third countries.
7. Private Company in Belgium • New division from 6. specialized in a research and development of high	4.0-5.0 tons/ha (With Irrigation after 5 years)	• Normal selection/cross breading with a criteria of (1) Oil content, (2) No of fruits/branch and (3) No of bunches/y	• Under investigation of obtaining the latest new variety

Organization	Yield	Activities	Availability
yield variety		• Experiments in India, Indonesia, Zambia and Malawi.	
8. Private Company in Brazil	3.5 ton/ha (The best yield tested and targeting 7.0 ton/ha	• Original varieties corrected in Latin America and 10 years breeding program since 2003.	• New varieties are expected in 2012/2013.

(Source: JICA Study Team)

6.2.4 High Yield Jatropha Variety Availability in Japan

Japanese public organizations/private companies are also investing in high yield Jatropha variety development. Japanese government is promoting the renewable energy development reflecting growing concerns for the global warming and the international responsibility to contribute to the reduction of CO_2 emission. From another angle, renewable energy source development was also encouraged for the purpose of sustainable energy security. Responding to the global interest and needs towards renewable energy source, Japanese private sectors are also investing in developing high yield Jatropha variety to explore their business opportunities.

JICA Study Team investigated the research and development activities of public organizations and private companies for high yield Jatropha variety development and its feasibility and readiness of applying its technology for the Pilot Jatropha Plantation in Egypt. Based on the preliminary interviews and discussions, there are few organizations/companies which are active on and aiming for the commercialization of the technology. So far, none of Japanese companies has developed its own new Jatropha varieties but in cooperation with research institutions/private companies abroad for their research and field trials as shown in Table 6-5 and 6-6. Since Japanese climate is not suitable for Jatropha production, their commercialization model is to grow Jatropha abroad and export to the international market or have a sales target in the domestic market.

Table 6-5 Japanese Companies' Activities on Jatropha Business Development (1 of 2)

Type of Organization: Capital (JPY):	Feasibility to Apply its Solution/Technology for the Pilot Jatropha Plantation in Egypt Shortly	Achievement & Activities	Approaches to Achieve High Productivities
1. Private Company A • ¥64,936 million	• Seemingly reliable and applicable • Knowledgeable and well experienced in commercial activities	• Selective breeding • Application of tissue culture • Field trial in 8 countries • Test production of seedling by tissue culture • Preparation for commercial distribution centre	• Elite variety selection and selective breeding • Mass-multiplication by tissue culture
2. Private Company B • ¥210 million	• Well recognized in Japanese biofuel society but uncertain	• Selective breeding, currently finished 2nd stage of elite variety	• Elite variety selection and selective breeding

Type of Organization: Capital (JPY):	Feasibility to Apply its Solution/Technology for the Pilot Jatropha Plantation in Egypt Shortly	Achievement & Activities	Approaches to Achieve High Productivities
	applicability • Further communication is required.	breeding • Field trial in 5 countries • Test plantation with cutting • Study on detoxification	• Cutting method to secure unified performance • Detoxification
3. A Venture Company of a Japanese University C • ¥7.5 million	• Not in the stage of business application • Focusing more on research • Overseas Business in not in the scope at this moment	• Study on the enhancement of Jatropha lipid production • Field trail in Okinawa, Japan	• Strengthening the molecular mechanism of photosynthesis and capacity of environmental adaptation
4. Private Company D • ¥12 million	• Not in the stage of business application	• Study on cold-resistant breed • Field trail in the Philippines and Japan • Study on the oil application to value added products other than fuel use	• Cold-resistant breed for the application to cold region in Japan
5. Private research Institute E • ¥4,818 million	• Not applicable: DNA analysis Only	• Deciphering of Genomes determining lipid synthesis and disease resistance • Identified the structure of over 40,000 genes (approx. 95% of all genes)	• Genomic analysis on the mechanism of Environmental tolerance and oil production
6. A Research Group of a Japanese University F • ¥ Unknown	• Not in the stage of business application due to the early stage of the efforts • Not applicable: tolerance for drought rather than productivities at this moment	• Study on drought-resistant breed • Identified 3 drought resilient genomes ready to develop new breed	• Drought-resistant breed for the application to dry and unsuitable lands
7. Semi-public foundation G • ¥ 33,910 million	• Not in the stage of business application due to the early stage of the efforts	• Study on the strategy and production method for enhancing lipid production • Selective breeding in Indonesia	• Method of selective breeding • Strengthening the molecular mechanism of photosynthesis and lipid production
8. Private Company H • ¥15.4 million	• Probably not applicable due to little technical improvement	• Semi-commercial plantation in China • Test plot in Cambodia	• Selection of applicable variety for the client/investors' lands

Table 6-6 Japanese Companies' Activities on Jatropha Business Development (2 of 2)

Name of Organization:	Research Partners (Their Role)	On-Going Activity Location	Claimed Productivities
1. Private Company A	• JV Company in Singapore (Selective breeding, Tissue culture)	• 8 countries in Asia and Latin America	• 4-5 ton seed/ha-year with rain-fed
2. Private Company B	• Various partners including private, research institute, universities (Productivity Improvement in general) • Research Institute in Japanese University and Private research institute (Detoxification)	• 5 countries in Asia and Africa	• 4 ton seed/ha-year with rain-fed
3. A Venture Company of a Japanese University C	• Research Institute in Japanese University (Productivity Improvement in general) • Another Research Institute in Japanese University (Plantation) Past: • Research Institute in the University in Indonesia (Unknown) • Ministry in Botswana (Unknown)	• Okinawa, Japan	• Uncertain/No clear goal • Still in the stage of research
4. Company D	• Venture from Research Institute in Japanese University (Unknown) • Research Institute in the University in Indonesia (Tissue culture)	• Miyagi, Japan • Philippines • Indonesia	• Confidential due to exclusive joint project with partners
5. Private research Institute E	• Various partners including Japanese Private Companies, Public Research Institute and Research institute in University in Japan (Genomic analysis)	• Japan (Research Only)	• Genomic analysis Only
6. Research Group of a Japanese University F	• Private Research Institute in Japan (Genomic Analysis) • University in the Philippines (Plantation) • Private Company in Japan (Possible Involvement)	• The Philippines	• Unknown • Not directly aiming for increasing productivity
7. Semi-public foundation G	• Various partners (Confidential) • Research Institute in the University in Indonesia (Selective Breeding)	• Indonesia	• Confidential due to exclusive joint project with partners
8. Private Company H	• Various partners (Plantation Owners/Investors)	• Cambodia	• 3-6kg/tree

6.2.5 Recommendable High Yield Jatropha Varieties for Egyptian Biofuel Industry Development

JICA Study Team confirmed the necessity of Jatropha yield improvement for the Egyptian business model, which is quite different form rain-fed based practices in the world. Based on the previous preliminary study and its review by JICA Study Team, it is clear that improvement of Jatropha yield is necessary to commercialize the Jatropha plantations in Egypt. As same as other agribusiness commodities, it is essential to choose the "Most profitable" varieties for the investors/producers' environment. Based on the JICA Study Team's observation and information from the responsible

agencies developing and managing the existing plantations, the present varieties were introduced from India without careful selection and comparable performance tests. In addition, after the introduction of Jatropha from India, there have not been consistent variety improvement efforts in Egypt except inconsistent or limited research activities by relevant institutes such as Agricultural Research Institute (ARC), MALR.

In order to achieve the commercial viability in Egyptian environment, JICA Study Team recommend introduction of the higher yield varieties that have been institutionally or commercially developed for last 10 to 20years in the world. Those varieties have improved 1) seed yields by conventional breeding or/and 2) fraction of each tree's productivity by using cutting or tissue culture multiplication technique. Since none of those varieties has been developed with treated wastewater irrigation, it is highly recommendable to compare the performance of the existing varieties and confirm their productivities that enable the commercial viabilities before the implementation of the large-scale plantations.

In order to recommend the most suitable varieties, JICA Study Team evaluated possible candidates with essential criteria such as reliability of the supplier/breeder and possibility to supply the variety(ies) in Egypt. Description of the criteria including other additional conditions are given below.

1) Reliability of supplier/breeder:
   Reliability is evaluated by the availability of high level/experienced breeding experts and the utilization of well-equipped laboratories. Since there are numbers of UNREALISTIC claims for Jatropha productivities that have mislead lots of investors and ended enormous losses in the past, it is essential to evaluate the reliability of the supplier/breeder to avoid such failures.
   In case of public/private research institutes/universities: (a) having at least 5 breeding scientists/experts and (b) having at least one research laboratory and at least 1 hector of Jatropha plantation.
   In case of private organization: (c) having equity capital of over US$1 million and/or (d) having research collaboration with publicly notable research institutes/universities that have confirmed the claimed performance of new varieties by the private organization.
   JICA Study Team only selected suppliers/breeders that fulfill the said criteria.

2) Availability of improved varieties with minimum yield of 3.5 ton/ha:
   Based on the realistic achievement in the world, minimum productivities of 3.5 ton/ha at matured stage is reasonable performance compared to the wide varieties with 0.1 – 2.0 ton/ha. The performance requires the historical records of total yield in the "Area" rather than the "Sum or multiplication" of selected high yield trees.

3) Duration of actual field experiences out-of-laboratory test plots and number of applied regions/countries (longer and varied field records):

Jatropha requires 3-5 years to achieve the maturity for the commercial yields. In general, the productivities of the improved varieties are less than the initial performance test in the institutes/breeders' laboratory test plots. Thus, it is necessary to evaluate the performances of the field trials for minimum of 3-4years. Since the breeding efforts are continuous activities, it is not always available to confirm a variety's performance with certain scale and duration. However, even such cases, expected performance of a new variety could be considered by comparison of previous varieties' performances during juvenile stages.

Since the performance heavily depends on environmental condition (soil, sun, water), confirmation of a variety's performance in many regions or countries shall be considered as higher reliability and wider applicability of the variety.

4) Accessibility of the new varieties for Egyptian business model:

Since the improved variety shall be imported to Egypt for the initial performance test followed by the commercial projects, it is one of two critical factors to evaluate the accessibility of such improved varieties. Due to the Jatropha's enormous possibilities in privates' businesses opportunities or a nation's alternative fuel/renewable energy source development, a wide variety of public and private sectors have been actively working on the variety improvement globally. As a result, some varieties are not accessible for a performance test in Egypt due to the origin's national policies or simply confidentiality of the varieties. Since some private suppliers do not sell the improved varieties only but also require "Consulting fees or profit sharing", expected costs of such expenditures were also considered.

Table 6-7 Evaluation of High Yield Jatropha Varieties

Candidate	1.Reliability	2. Yield (ton/ha)	3.Field Plantation/ Experience	4. Accessibility	Recommendable
1. Research Institute in the University in Indonesia/ Japanese Involvement	OK	3.5 - 4.0	Over 10 countries in Asia	OK	○
2. Private Company in USA	OK	3.5 - 4.0	4 countries in Latin America	Conditionally OK*	○
3. Research Institute in the University in Thailand	OK	3.0	Only in Thailand	No	
4.JV Company in Singapore/ Japanese Involvement	OK	3.5 - 4.0	4 countries in Asia	OK	○
5. Private Company in England	OK	2.5 - 3.0	Over 7 countries in Asian and Africa	OK	
6. Research Institutes in China	OK	5.0	Only in China	No	
7. Private Company in Belgium	OK	4.0 - 5.0	Over 10 countries in Asia and Africa	Conditionally OK *	○
8. Private Company in Brazil	OK	3.5	Only in Brazil	OK	
9. Private Company in Japan	OK	4.0	5 countries in Asia and Africa	OK	○

*With a condition of joint research investment minimum of US$100,000.

(JICA Study Team)

Based on the evaluation above, the JICA Study Team recommend five (5) candidates (3 for government led project and 2 for private investment project) for the recommended performance test in Egypt. Summary of the recommendable varieties and expected costs to acquire those varieties is shown below (Table 6-8).

Table 6-8 Details of Short Listed High Yield Jatropha Varieties

Suppliers	Expected Yield	Conditions of Supply	Expected Costs
1. Research Institute in the University in Indonesia with a Japanese public institute's research program (terminated)	3.0-4.0 ton/ha (results of elite varieties in the world and cross breeding)	• EG/Government - IDN/Government Permission to import/expert • EG/Government - IDN/Government Trial Test Agreement • Elite variety cutting	Less than US$1,000 for the trial
2. Private Company in USA	3.6-4.0 ton/ha average	• US/Government – EG/Government Permission to import/expert • Private – EG/Government Trial Test Agreement • Seeds are only available by Joint Cultivation	Joint Cultivation system with minimum of US$100,000*
3. JV Company in Singapore partnering with Japanese and Indian Private companies	3.5- 4.0 ton/ha (result of elite breeding and modern multiplication technique)	• SG/Government – EG/Government Permission to import/expert • Private – EG/Government Trial Test Agreement • Elite variety seedlings	Less than US$1,000 for the trial
4. Private Company in Belgium	4.0-5.0 tons/ha (result of elite breeding over last 10years)	• Belgium/Government – EG/Government Permission to import/expert • Private – EG/Government Trial Test Agreement • Seeds are membership exclusive.	Membership fee of over $100,000 with 3 years commitment*
5. Private Company in Japan (breeding facilities in Philippines)	4 ton/ha(result of elite breeding over 5years in Philippines)	• Philippines/Government – EG/Government Permission to import/expert • Private – EG/Government Trial Test Agreement • Elite variety cutting	Less than US$1,000 for the trial

*New varieties are only available through packaged services including improved variety supply, cultivation and harvesting technology transfer, and consulting service. The varieties will be accessible by either entering into a joint research project or being a member of the program with a long-term commitment.

(Source: JICA Study Team)

1) For ODA projects, 1) a research institute in Indonesia (#1 Table 4-5), 2) a private supplier in Singapore (#4 Table 4-5), and 3) a private supplier in Japan (#9 Table 4-5) are suitable candidates for the initial performance tests with ODA due to the reasonable procurement cost and no requirement of long term commitments. According to the discussion with the relevant authorities/personnel of the candidate institutes/companies, recommended new varieties would be able to transfer to Egypt when the required documentations are properly in place between the supplying and procuring governments for plant quarantine and supplier and Egyptian receiving authorities for the variety protection.

2) For private investment projects, all candidates recommended for ODA projects are suitable. In addition to those suppliers, two private suppliers (#2 and #7 Table 4-5) might be suitable for private investors if the private investors are willing to work with those suppliers with long-term commitments for the joint investment projects. Those candidates may also be possible to apply in the recommended scheme of Phase 3 - Integrated New Plantation & Wastewater Development with PPP scheme.

In order to support the decision making before the proposed pilot Jatropha plantation (4ha test plantation to confirm the commercial viability), JICA Study Team recommend a "Initial performance test" with three recommended varieties for ODA project above (#1, 4, 9 Table 4-5) within this JICA survey period. Due to the limited time to evaluate the performance within the JICA survey, the results of the initial performance shall be limited. However, such results are invaluable to confirm the initial performance by comparing the "Records" of improved/introduced varieties with NON irrigation/rain-fed condition.

Since it is likely to take several months to evaluate the final recommendation from the JICA Study Team and make the decision for the next phases by Egyptian authorities, a follow-up performance tests continuously followed by the initial test would be able to confirm the claimed performance and reduce the risk of introducing those improved varieties that are not suitable enough for a commercially viable plantation in Egypt. Such performance tests are necessary procedures for any commercial afforestation project during the preparation period. As same as commercialized investment projects, such performance tests would greatly support the final decision-making. Therefore, it is highly recommendable to proceed an initial performance test with improved varieties from overseas as well as best performance trees in Egypt.

In terms of protection of the breeders' rights – intellectual property (IP) of the improved varieties introduced in Egypt, JICA Study Team has confirmed the effective legal framework to ensure the breeders' rights as similar condition as most of industrial countries. Although there are limited practices for IP related conflicts in Egypt, JICA Study Team has confirmed the Egyptian authorities' strong intentions to properly enforce the "Law on the Protection of Intellectual Property Rights." The details of legal framework and practices of IP protection are described in Chapter IV.

6.2.6 Potential Improved Jatropha Varieties for Commercial Plantations in Egypt

Assuming the condition below, Egypt is expected to reach commercially viable Jatropha biofuel production during the Pilot Project period (2013-2015).

- Successful outcome of high yield varieties
- Crude Jatropha Oil (CJO) price will remain around US$1,000/ton (Implying the crude petroleum oil price will remain around $100/barrel or higher)
- The use of Jatropha seed cake either for Organic fertilizer or Bio-fuel for boiler or power generation as substitute for coal

The Pilot Project (2013-2015) is targeting to achieve 3.5 to 4.0 ton/ha by 2015 and 5.0 to 6.0 ton/ha by 2020, which can be achievable based on the past improvement experiences of key crops. The possible future Business Model is shown below.

Table 6-9 Jatropha Business Model for 2011 to 2020

Model/Country		2010 (Actual)	2015 (Target)	2020 (Target)
Egyptian Model	Yield:	Less than 2.0	3.5-4.0 t/h	5.0 -6.0t/h
	Cost of CJO:	US$1,200/h	US$800/h	US$500/h
	Price of CJO:	US$1,000/t	US$1,000/t	US$1,000/t
	Seed Cake:	US$0/t	$100 to $200 for organic Fertilizer	$300/t Fertilizer or Animal Feed
A US Company Model*	Yield:	2.0-2.5 t/h	2.8 to 3.0 t/h	6.0 t/h
	Cost of Production:	$850/t	$700/t	$300/t
	Price of CJO:	$1,000	$1,000	$1,000
	Seed Cake:	$0	$200 Fertilizer	$300 Animal Feed

* The company is the biggest venture company working on Jatropha as a pioneer operating in India, Indonesia and Africa.

The use of by-products, Jatropha Seed Cake is another way to make Jatropha commercially viable. Seed cake industry is commercially established in Myanmar, which is the largest producer of Jatropha in the world. Cashing the Jatropha Cake: 70% to 75% of Jatropha seeds by weight ends up with the Jatropha seed Cake and cashing the Cake is one of the key factors for the project to be viable.

(1) Use as organic fertilizer :

Already an organic fertilizer company in Myanmar is developed a commercial organic fertilizer product using the Jatropha cake mixed with other organic materials. Currently the company is paying $300 per ton of the Cake, which is high price above our expectation.

(2) Use as biomass fuel:

Jatropha Cake with about 5,000 kcal/kg can be used to substitute wood or coal, or sometime converted as bio gas. The market price of Jatropha Cake for this use depends on the price of woods and coal.

(3) Use as Animal feed:

Use for animal feed is not possible at this time due to toxic substances of Jatropha cake. However, several studies were made and some studies are on-going for reducing and eliminating the toxic substances from the Jatropha Cake. It is worth continuing to study the possibility.

Examples of Jatropha Seed Cake for actual Use

(1) Case of A US Company

According to the company, the process has developed to produce animal feed from Jatropha Cake in 2010 (patented until 2020: anti-nutritional factor removed) with expected sales value of $300 ton. The business plan is to gain revenues both from CJO and animal feed. Based on the implied productivity of 2.8 ton/ha (Used to be 3.5 tons to 4.0 ton/ha), and sales cost of CJO as $1,100/ton and Cake as $300/ton, total Revenue will be $1,400/ha. In 2010, CJO Production cost is $850 and now trying to reduce the cost of $700 per ton and further to $300 ton in the future to be competitive with crude petroleum oil.

(2) Case in Myanmar:

Jatropha Cake is used for organic fertilizer. Contents of Jatropha Cake are 6.84% Oil, Nitrogen 3.42%, and around 1% of Potassium and Phosphate.

JICA Study Team will produce Jatropha Oil and seed cake during the Pilot Project and try to develop Organic Fertilizer from Jatropha seed cake just as is already commercialized in Myanmar.

6.3 Import Procedures and Duration of Plant Quarantine

6.3.1 Plant Quarantine Procedures

Any activities involved in plant import in Egypt must comply with the Ministerial Decree No.3007 of 201 Concerning the Egyptian Plant Quarantine Rules and Regulations (MALR). Throughout the JICA study team's experiences of importing improved Jatropha varieties, the JICA study team found it difficult for most of international Jatropha seedling suppliers. One of two difficulties is complex approval structures of approval and applications of such consideration.

Although the Central Administration of Plant Quarantine (CAPQ) is responsible for all the administrative work related to plant import, CAPQ is required to get final approval of plant import by another committee, namely Seedling Committee under ARC, MALR. Once the CAPQ completes the pest risk assessment of import varieties, suppliers of the Jatropha seedling must apply the committee's approval by itself or precipitant or consignee. All documents necessary for the approval must be written in Arabic and there are few formal application forms for each application, where takes lots of time and makes foreign suppliers impossible.

It is highly recommendable to hire local consultants/experts to get the import permit, but it may take a few months to clear all paper work, which is up to a few weeks work in most of countries. In addition to the Egyptian side processes, seed suppliers shall also consider the time to acquire "Strict" pest risk assessment report from authorities of plants' origin, National Plant Protection Organization (NPPO)

6.3.2 Duration of Plant Quarantine

Although Jatropha is common species throughout MALR, EEAA, HCWW's afforestation in Upper Egypt and Red seas, Egyptian authorities are likely to ask maximum monitoring period of plant quarantine – twelve months. Even tissue culture plants internationally known as free from pests and pathogen could be required to stay under the plant quarantine area for one year.

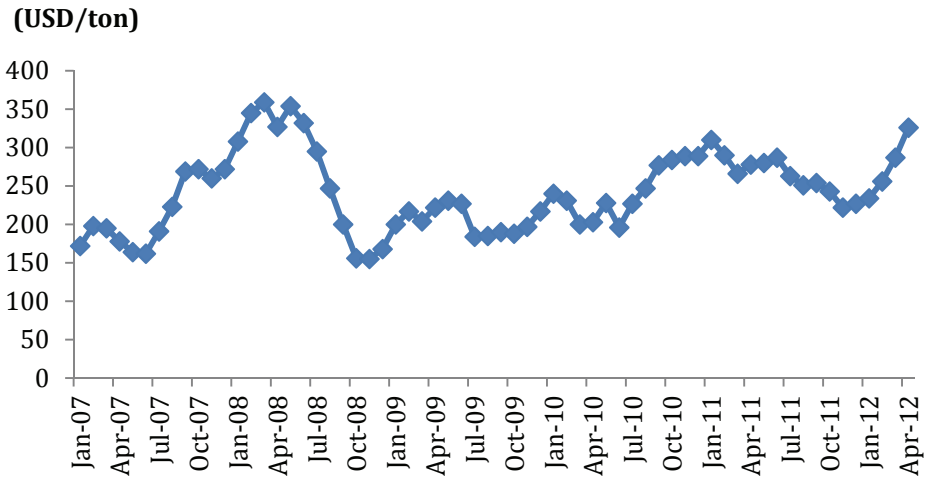
As initial root development is very important for the commercial stage production after three (3) years, one year quarantine with small pots adversely affects healthy growth of root system development. It would be acceptable for the first time, but it will not be acceptable for commercial activities. MALR shall address this issue to meet the needs of actual plantation activities on the ground.

6.4 Seed Cake Applications and Marketing

6.4.1 Organic Fertilizer

From the viewpoint of a vegetable oil producer, the sale of the seed cake is an important revenue source in addition to oil sale. The main use of seed cakes of oil seeds is animal feeds because of its high economic value. However, some seed cakes like Jatropha cake and Castor cake contain toxic substances and so cannot be used for animal feeds. These inedible seed cakes are often used for organic fertilizer, because they have a certain level of nutrients such as nitrogen and phosphorus, which are essential of plant growth. The price of Jatropha cake can ne estimated at around 60-80% of the price of rapeseed meal based on their comparative nutrients content. The recent price trend of rapeseed meal in EU is shown in the figure below. As of 2012, a Jatropha cake product has been already registered as a specially designated fertilizer in some prefectures of Japan.

Figure 6-3 Rapeseed Meal Price (34%, Hamburg, fob ex-mill)



Source: FAO (2007-2012)

If one grows Jatropha in Egypt with treated wastewater, there will be two issues concerning the sales of Jatropha cake as organic fertilizer. The first issue would be one of pollution of cake because of possible pollutants in the wastewater and soil. The main pollutants of the wastewater are heavy metals originated from local factories and hazardous microbial organisms. It is recommendable for the Jatropha seed cake to be analyzed to check whether it includes heavy metals or not before selling as organic fertilizers. In case of the upper Egypt, heavy metal pollution in water and soil are rarely observed because there are few factories which could give out heavy metals. On the other hand, the Jatropha cake is not likely to contain any hazardous microbial organisms because seeds are stored in fruits shell up until harvesting and also because seeds are pressed in an oil factory at relatively high temperature (nearly 100 degrees Celsius), killing most of the microbial organisms.

The second issue would be cultural one. Even if the Jatropha cake are analyzed in a laboratory and proven to be safe in terms of heavy metal and microbial pollutions, local people may not be happy to use the cake for organic fertilizer for food crop production due to cultural or religious belief. Because there is no regulation to prohibit the use of oil seed cakes which are produced with treated wastewater, it needs to be tested whether local people can accept it or not. If the marketing of the Jatropha cake is difficult in the local market, the plantation owner should re-use the cake as organic fertilizer in their own plantation or export to foreign countries which do not have cultural obstacles.

6.4.2 Animal Meal

If the toxic substances (especially phorbol esters) in the Jatropha cake are successfully removed by de-toxification processes in an economic manner, the cake can be sold for animal feeds, which will improve the economic feasibility of the Jatropha business, though it is needed to prove safe just like the use of the cake for organic fertilizer. Technically the phorbol esters can be removed with present technology but the cost of de-toxification process are too high to apply. Therefore, the cost must be reduced through further research and development.

7. Advanced Agricultural Technologies and Its Application in Egypt

7.1 Applied Agricultural Technologies for Commercialized Jatropha Cultivation in Egypt

In order to achieve the “Commercially viable” Jatropha seed production, 1) traditional/common techniques such as selective breeding and multiplication by cutting have been tried, but most of the efforts have not achieved the commercially viable level at this moment. In order to effectively and efficiently accelerate such improvement efforts, 2) applied/advanced techniques such as productivity and oil quality improvement, genetic modification and multiplication by tissue culture have been studied in limited number of institutes in the world where governments have strong policy to promote Jatropha or privates have strong ambition to succeed in Jatropha business and successfully gather funding from public and/or privates.

In the case of Egypt, few efforts have been made to achieve the profitable business model. However, as one of the most advanced agricultural education centers in northern Africa and Middle East region, both traditional/common and applied/advanced techniques are available. Since AVAILABILITY of such techniques and PRACTICAL/COMMERCIAL APPLICABILITY of such techniques are different and the latter capacity is important to realize commercialized activities in Egypt, JICA experts evaluate the capability of some keen techniques in Egypt that have been applied or studied out of Egypt and seemingly promising to achieve the commercial viability in Jatropha business. This section summarizes some applied agricultural technologies mentioned in “Section 2: Reality of Jatropha Biofuel and Its Supply Capacity” and “section 4: New Jatropha Variety Development in the World”. Applicability of selected technologies in Egypt in the future is summarized in the following sections.

7.2 Tissue Culture Technologies in Egypt

The tissue culture is one of the key technologies for the pilot trial. Pilot trial needs a quite large number of Jatropha seedlings, when new varieties of Jatropha imported from overseas show their productivities in a comparative trial. It is the key of success to secure the technology of making callus tissue from intact plants or leaves and cultivate and regenerate it to intact plants again. Many of the major universities have their own tissue culture laboratories or training courses in Egypt as shown in the table below.

Table 7-1 Universities and Institutes with Tissue Culture Laboratories

	Universities/Institutes	Laboratories/Department/Course
1	Cairo	Department of Biotechnology, Faculty of Agriculture and Plant Biology Research Lab
2	Ain Shams	tissue culture course for post-graduate students at Faculty of Science
3	Alexandria	Tissue Culture Laboratory, Department of Crop Science, Faculty of Agriculture
4	Zagazig	plant tissue culture laboratory, Horticulture Department
5	Minufiya	Genetic Engineering and Tissue Culture Center
6	Assiut	tissue culture laboratory of Agronomy Department, College of Agriculture
7	Desert Research Center	Genetic Resources Department, Tissue Culture Lab.
8	AGERI/ARC	MicroPropagation Technology (MPT) Lab etc.
9	American university in Cairo (Sadat)	Tissue culture lab

(Source: Study team (2012))

Current situation of tissue culture technique level and good candidates to collaborate with in Egypt are described as follows.

7.2.1 Primary Institutions and Academic Programs for the Biotechnology and Tissue Culture Technology in Egypt

1) Cairo University

The studies on tissue culture are conducted at Department of Biotechnology, Faculty of Agriculture and Plant Biology Research Lab. The Lab has 5 autoclaves (25liter x 3, small x 2) and 3 clean benches. According to the staff, the main research target plants were jojoba, banana, dates, fruits, and foliage plants. However, in case of jojoba culture, it was not real tissue culture. The cut small stems, not callus, of jojoba were transplanted as cutting into culture media in sterile glass bottles. The laboratory training is provided for one month period based on the request by company.

(Source: Interview with Mr. Osama Konsowa Ahmed, Prof. Assistant, Dept. of Biochemistry, Faculty of Agriculture, Cairo University)

2) Agricultural Genetic Engineering Research Institute

One of the major targets for biotechnology in Egypt is the production of transgenic plants conferring resistance to biotic stresses resulting from pathogenic viruses, bacteria, fungi, and insect pests, and abiotic stresses such as salinity, drought, and high temperature. These biotic and abiotic constrains are major agricultural problems leading to serious yield losses in many economical important crops in Egypt. Agricultural Genetic Engineering Research Institute (AGERI) was established in 1989 at the Agriculture Research Center (ARC), Ministry of Agriculture and Land Reclamation. ARC is the most respectable center in agriculture in Egypt as described in Chapter II, 6.3 of the final report of "Egyptian Biofuel Industry Development Study" by JICA and JDI in March 2010 and has 16 institutes including AGERI and 13 laboratories.

The functional laboratories at AGERI are specialized and targeted for representing a spectrum of increasingly complex scientific challenges ranging from tissue culture technology to the transfer of genes controlling biotic and abiotic stress, growth, maturity and quality. Gene manipulation techniques such as cloning, sequencing, modifications, construction of genomic and cDNA libraries, plant regeneration in tissue culture are just a few examples of the cellular and molecular biology methodologies that are utilized for production of transgenic plants.

Target plants are potato, tomato, cotton, maize, rice, wheat, melon, zucchini, sorghum, banana, fava bean, and cut flowers including virus free ones such as potato and banana. There is no own gene in Egypt. AGERI collaborates with Monsanto and Pioneer in conducting research and training. AGERI has Scientific Collaboration with University of Arizona, University of Minnesota, Michigan State University, Cornell University, University of Maryland, USDA Maryland, and Scripps Research Institute. There is no commercialized GMO product in Egypt.

AGERI has basic technology and facilities on tissue culture and experience of study on tissue culture of Jatropha and spent 5-6 months to make the Jatropha tissue culture from its leaves. Some laboratories conduct studied using tissue culture.

The following is a representation of research involvement within the institute:

- BioComputing & Networks Unit (BCNU)
- Bio-Molecular Engineering (BME) Laboratory
- Gene Expression & Regulation Technology (GERT) Laboratory
- Gene Transfer & Insect Control (GTIC) Laboratory
- Microbial Molecular Biology (MMB) Laboratory
- MicroPropagation Technology (MPT) Laboratory
- Molecular Genetics & Genome Mapping (MGGM) Laboratory
- Molecular Manipulation & Gene Transfer (MMGT) Laboratory

- Molecular Plant Pathogenesis (MPP) Laboratory
- Molecular Plant Virology (MPV) Laboratory
- Plant Cellular & Molecular Genetics (PCMG) Laboratory
- Plant Gene Transfer (PGT) Laboratory
- Protein Structure & Biochemistry (PSB) Laboratory

As an example of the curriculum of universities providing tissue culture training, the curriculum of the Plant Biotechnology Department of Minufiya University is presented in the table below.

Table 7-2 Curriculum of Plant Biotechnology Department of Minufiya University

Advanced guide to hydroponics	Methods of plant breeding
Advanced plant breeding I	Micropropagation
Advanced plant breeding II	Mineral plant nutrition
Advanced plant physiology	Mist propagation and automatic watering
Agriculture biotechnology	Morphology and evolution of plants
Analysis of horticultural problems	Mushroom propagation
Analysis of natural products	Mutation breeding
Biology of weeds	Natural products from plants
Biotechnology of medical and aromatic plants	Plant biotechnology
Biotechnology of ornamental plants	Plant breeding for pest and disease resistance
Biotechnology of secondary metabolites	Plant breeding for stresses
Biotechnology of trees	Plant cell culture
Biotechnology of vegetable crops	Plant diseases
Breeding plants resistant to insects	Plant ecology
Crop breeding	Plant ecophysiology
Diagnosis and control of plant diseases	Plant gene technology
Diversity and evolution of land plants	Plant genetic protection
Evolution of crop plants	Plant hormones and regulators
Evolutionary biology of plants	Plant molecular biology methods
Field crop biotechnology I	Plant population biology
Field crop biotechnology II	Plant protoplast and genetic engineering
Field crop biotechnology III	Seed biotechnology
Field performance of transgenic plants	Somaclonal variation
Fruit biotechnology	Somatic embryogenesis and synthetic seeds
Gene manipulation in plants	Somatic hybridization in crop improvement
Genetics and cytogenetics in crops	Special topics in plant morphology & anatomy
Greenhouse and nursery crop production	Tissue and cell culture practices in plants
Haploids in plant breeding	Tissue culture of horticultural crops
Higher plant cell walls	Transgenic plants
Horticultural breeding	Tree biotechnology

Hydroponics	Vegetable crop biotechnology
Light and plant growth	Weed control
Seminar	Special topics

(Source: Minufiya University (2012))

7.2.2 Agribusinesses Incorporated with Tissue Culture in Egypt

As described above, Egypt has competitive and high level education systems and good capacities to supply high skilled technicians in the market and research institutes. In addition to the skill development capacities, Egypt also has quite numbers of public and private research institutes incorporated with tissue culture technologies. Though most of the research laboratories sometimes work for privates to propagate some plants up on requests, they are not competitive and cost effective production. As Jatropha is not a high value commodity, low cost propagation of “high quality seedlings” is desirable.

Based on the hearing at schools and research institutes and commercial laboratory visits, JICA study team found that commercial applications of tissue culture technologies are limited in Egypt. Due to the high cost investments and high cost operation costs including maintenance of facilities and labor costs, applicable plants are limited to “High value” plants such as orchid and flowers for European markets or “seedless” profitable fruits such as banana. Banana is the most common tissue culture application in Egypt. Banana is known to one of the easiest plants to propagate so that its protocols and practices are well published and common in the world.

Considering the technical difficulties of Jatropha tissue culture propagation, it is not as easy as banana or orchid. In general, the commercial tissue culture factories are very restricted access to secure the clean environment and protect licensed techniques. With introduction by university professors and research institutes, JICA study team could be able to visit four commercial laboratories within greater Cairo and Alexandria area. With present facilities, all factory could handle the Jatropha propagation, but three of them may require some additional training for technicians due to the limited capability. Only one company showed full capability to handle the Jatropha propagation. Since the facilities are well equipped for massive commercial production, competitive low cost production could be achievable once technicians get use to the high level tissue culture work.

7.3 Genetically Modified Organism (GMO) Technology and Agribusinesses Incorporated with GMO in Egypt

Although there is no commercialized GMO application in Egypt at this moment due to the confirmation of its hazardous effects on natural environment and potential impacts on human health, its application shall be reasonable for Jatropha biofuel feed production due to isolated desert cultivation and none human consumption – energy or industrial application only. NON-GMO Jatropha may be applicable for some selected sites in Upper Egypt where productive

meteorological environment, soil, and topographical features are commercially suitable. However, it would be required to introduce GMO to produce Jatropha biofuel feeds in further wider area, effectively utilize treated wastewater and increase the supply capacity of the biofuel, and increase profitability and encourage more privates' investment in Egyptian biofuel industries.

CHAPTER III
Legal Framework and Practices of Intellectual Properties for Plant Varieties and High Yield Plant Registration and Field Application Procedures in Egypt

CHAPTER III Legal Framework and Practices of Intellectual Properties for Plant Varieties and High Yield Plant Registration and Field Application Procedures in Egypt

8. Protection of plant varieties

Legal framework and practices of intellectual properties for plant varieties are very important matters for persons or investors who have high yield plant varieties. Whether some investors take high interests in transferring Jatropha with high yield into Egypt depends on the legal framework and her actual conditions. This chapter contributes to clarify such important subjects. In addition, it also contributes to show the registration and field application procedures of high yield plants in Egypt.

8.1 Euro-Mediterranean Agreement

The European and Mediterranean Plant Protection Organization (EPPO) is an intergovernmental organization responsible for European cooperation in plant protection in the European and Mediterranean region. Under the International Plant Protection Convention (IPPC), EPPO is the regional plant protection organization for Europe.

Euro-Mediterranean Agreement established an association between the European Communities and their Member States of 17 countries, of the one part, and the Kingdom of Morocco, of the other part on 18, March 2000. Egypt has not joined yet directly with this agreement, but the agreement indirectly affects to Egypt, because it focuses in the part on cooperation of renewable energy, development of energy networks, and diversifying outputs of agriculture. Therefore, Egypt and Japan International Cooperation Agency (JICA) should have much interest in indirect effects on the project.

8.2 TRIPs Agreement of WTO

As well known in World Trade Organization (WTO), World Intellectual Property Organization (WIPO), etc., the starting point of the intellectual property agreement is the basic principles, i.e., non-discrimination features prominently: national treatment (treating one’s own nationals and foreigners equally), and most-favored-nation treatment (equal treatment for nationals of all trading partners in the WTO). The Agreement on Trade Related Aspects of Intellectual Property Rights (TRIPS) has an additional important principle: intellectual property protection should contribute to technical innovation and the transfer of technology. The Agreement says that both producers and users should benefit, and that economic and social welfare should be enhanced,

TRIPS is an international agreement administered by WTO that sets down minimum standards for many forms of intellectual property right regulation as applied to nationals of other WTO Members.

Article 27 3(b) in Section 5 of Part II of this Agreement said that "Members may also exclude from patentability:(b) plants and animals other than micro-organisms, and essentially biological processes for the production of plants or animals other than non-biological and microbiological processes. However, Members shall provide for the protection of plant varieties by patents, either by an effective *sui generis* system or by any combination thereof. The provisions of this subparagraph shall be reviewed four years after the date of entry into force of the WTO Agreement."

Egypt has been a member of WTO since 30 June 1995. Egypt updated its Intellectual Property (IP) law in 2002 in order to comply with the 1994's World Trade Organization Agreement on TRIPS. It is updating again to conform to the terms of bilateral deals with Europe. It should be noticed that there have not been disputed with other countries about the intellectual property protection in 2011.

8.3 UPOV and other protection

The International Union for the Protection of New Varieties of Plants (UPOV) is an international organization to protect new plant varieties by intellectual property right. The International Convention established UPOV for the Protection of New Varieties of Plants. After the revision in 1991, the protection areas have enlarged to all plant species.

Although several countries including the United States have different legal systems to protect plant varieties, UPOV has been accepted as an effective *sui generis* system proposed in the TRIPS Agreement and many developing countries have entered recently into UPOV. Egypt has not been yet a member of UPOV, but Egypt has contacted with UPOV and accepted as an observer now.

UPOV has a big mission to provide and promote an effective protection system of plant varieties, with the aim of encouraging the development of new varieties of plants, for the benefit of society. It is housed in the World Intellectual Property Organization (WIPO) headquarters in Geneva. Egypt had shown much interest in UPOV system and had initiated the procedure for becoming UPOV members on 15 Sep. 2005 with the Council of UPOV. Then, Egypt would perhaps lift the longstanding safeguard that had been put on her own genetic resources in order to comply with UPOV. Egypt also would remove an exception in law that allows farmers to freely exchange, save, and re-sow propagating materials.

In addition, Egyptian law on exhaustion of the right changed, complied with UPOV 1991, so that now the right's holder retains his/her rights until he/she agrees to sell or market his/her plant variety.

8.4 Protection of plant varieties in Egypt (Egyptian IPR Law Book Four)

The government of Egypt fulfilled the conditions of the WIPO Convention on April 21, 1975. The new Protection of Intellectual Property Rights Law: Law No. 82 of 2002 granted formally protection of plant varieties, derived inside or outside Egypt, whether developed through biological or non-biological means, when registered in the special register of protected plant varieties (A-189), on its BOOK FOUR titled with PLANT VARIETIES.

According to the said Law, the Office of Plant Variety Protection (OPVP) is a competent authority to receive, examine and decide on applications submitted for the protection of plant varieties, in accordance with the rules and procedures stipulated in the establishment decision (A-190). The holder of a breeder's right certificate has an exclusive right to the commercial exploitation of the protected variety in any form whatsoever. The production, propagation, circulation, sale, marketing, importing, exporting of propagation material are not allowed without the written consent of the variety breeder (A-194). The breeder is entitled to fair compensation for the use and exploitation, by third parties, during the non-voluntary license period. The assessment of such compensation shall take into consideration the economic value of the variety (A-196). These articles are formal procedures for the protection of intellectual property rights of plant varieties.

The Book Four of Law No. 82 of 2002 on the Protection of Intellectual Property Rights (Egyptian IPR Law) defines the protection of the new plant varieties. Though Egypt has not adapted UPOV, the definitions and the principal philosophy of Egyptian IPR Law are compatible with UPOV.

Thus, legal framework for the protection of plant varieties in Egypt is seemingly as reliable and reasonable as other UPOV adapted countries. In addition, Government of Egypt has been preparing for adapting UPOV and final decision shall be made quickly under the new cabinet after the election in fall, 2011, based on comments by authorized officers of OPVP.

Although there are not many practical cases in Egypt, the breeders' right to protect the plant varieties, and to claim and recover the damage for the infringing activities is secured by the law. Once an individual or a company starts the registration process, the breeders' right shall be given and the damage can be claimed from the application date when the application of the plant registration is approved later.

The remaining subjects should be checked off actual procedures and whether the protection will be practiced well for the breeders or not.

8.5 Protocols and procedures for registration and protection in Egypt

In order to protect a new plant variety in Egypt, registration of such variety at the Office of Plant Variety Protection is the first step for the applicant or breeder to protect. The protocols and procedures are similar to EU and other developed countries.

In order to protect a new plant variety in Egypt, registration of such variety at the Office of Plant Variety Protection is the first step for the applicant or breeder to protect. The protocols and procedures are similar to EU and other developed countries.

The registration system for the new plant variety plays a central role in the process leading to its commercialization. In briefing, the registration in Egypt follows a well-established procedure controlled by several organizations under the umbrella of the Ministry of Agriculture and Land Reclamation (MALR). The Central Administration for Seed Testing and Certification (CASC), an under-secretariat of MALR, has the overall authority for policy and procedures regarding registration and release of all seed in Egypt.

Once confined field tests have been conducted, applicants submit a set of forms to the National Biosafety Committee to support a finding of low or negligible environmental risk. Upon review and approval, the application is forwarded to the Seed Registration Committee, which grants approval to begin three year (or three season) quality and performance evaluation. That is standard for all new varieties. Only upon successful completion of these trials, a new plant variety will be approved for commercial sale. Thus, seed registration is the final step in commercial release of new plant varieties.

Latest detailed protocols and procedures is described as followings. The sample form of the application is shown in Appendix 5: Application Form for New Plant Variety Registration with Technical Questionnaire Form.

8.5.1 Ministerial Decrees for Registration and Release of Plant Varieties

According to the ISNAR Country Report 62, during the period 1997–99, a number of Ministerial Decrees were issued to accommodate changes in the roles of the Ministry of Agriculture in plant breeders' rights and liberalization of the agricultural sector.

(1) Decree No. 242/1997, Ministry of Health: This decree prohibits importing any foodstuff produced through GMOs, unless its safety is confirmed. The decree also necessitates that any imported seeds should be accompanied with a certificate from the country of origin, confirming that these seeds were not produced from untested genetically modified (GM) plants. GM plants or seeds can be imported, only if previously approved for use in the country of origin and deemed safe.

(2) Decree No. 82/1998, Ministry of Agriculture: This decree establishes policy and provides guidance on procedures for the release of crop varieties developed by the ARC. It makes no distinction between varieties developed through conventional breeding and those derived by genetic engineering. Variety identification, or Distinctness, Uniformity and Stability (DUS) tests are conducted in one location during seed multiplication. Model descriptors issued by UPOV are used for a comparative evaluation against standard varieties as defined by the relevant Crop Seed technical committee, which are grown in parallel with the new variety. Variety performance or Value of Cultivation and Use (VCU) tests examine the agricultural, industrial, and economic value of the new subject variety as compared with other superior varieties in use. Such tests are conducted in more than one location to ensure that the variety tolerates a diversity of local environmental conditions. The candidate variety is recommended to register only when all required tests have been satisfactorily completed.

(3) Decree No. 1648/1998, Ministry of Agriculture: This decree confirms the authority and responsibility of CASC for releasing GM as well as conventional seeds. It describes procedures for obtaining a small-scale release permit for a new genetically engineered crop variety, registering it, and releasing it for commercial use. It outlines important steps to be followed by government or private sector applicants, as well as other local or foreign organizations seeking to commercialize their products. The decree specifies the roles and responsibilities of the NBC, the Seed Registration Committee, and the Committee for Food Safety. The final document was approved by Deputy Prime Minister and Minister of Agriculture in July 1999.

(4) Decree No. 702/1999, Ministry of Agriculture : This decree adds DNA fingerprinting to the required protocol for registration of all new agriculture crop varieties in order to confirm identity during the registration process and for subsequent use as a reference, if required. The decree stipulates that: DNA fingerprints of the new hybrid variety and its parents are a prerequisite for registration. One copy of the fingerprint is to be kept in the secretariat of the Seed Registration Committee and another copy is to be kept in the management office of the applicant’s institution.

The relevant crop technical committee should verify the fingerprint and its specifics through a laboratory certified to have the required scientific and technical capabilities. The applicant is to pay all costs required for the finger printing process, as determined by the registration committee for agricultural varieties. Sample material is to be submitted to the SRC secretariat, which will pass it to the relevant certified laboratory.

***Important Note**:*
It is worth to mention that all protocols, regulations & procedures for protection and/or registering a new plant variety in Egypt are governed by the:

* **Egyptian Intellectual Property Law No. 82/2002 - Book 4** *(appendix 2).*

In addition to:
* **The Council of Ministers Resolution No. 1366 of 2003** issuing Implementing regulations for Law No. 82 of 2002 on the Protection of Intellectual Property Rights Books 1, 2 and 4 *(appendix 2)*.

Treaties & Agreements
Egypt is already a member state in many IP related agreements & protocols. However, in respect to the Plant Breeder's rights and related issued, Egypt is a member at the following:

Table 8-1 List of Enforced Treaties and Agreement for Plant Breeder's Rights in Egypt

Treaty - Protocol	In Force Since
* International Plant Protection Convention	Oct 02, 2005
* Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS)	Jan 01, 2005
* International Treaty on Plant Genetic Resources for Food and Agriculture	Jun 29, 2004
* Cartagena Protocol on Biosafety to the Convention on Biological Diversity	Mar 21, 2004
* Convention on Biological Diversity	Dec 29, 1993
* Paris Convention for the Protection of Industrial property	Jul 01, 1951

Requirements
- A duly filled in ***Technical Questionnaire*** form (Appendix *5*).
- A duly filed in Application form (Appendix *6*).
- Power of Attorney of the applicant legalized up to the Egyptian Consulate (Appendix *7*)
- **Distinct, Uniform & Stable and Value for Cultivation & Use (DUS & VCU)** Reports for the subject species (*original certified certificates*) if any.
- An Importation Permission from the ***Seed Crops Committee*** (in order to allow the new variety to be circulated and commercialized in the Egyptian local market).

8.5.2 Seed Industry in Egypt

Seed Industry and its organizations

For one's information, the followings show the seed industry and its organization in Egypt, then, present the latest ministerial decrees relevant to the registration and release of plant varieties.

In 1993, the Ministry of Agriculture initiated the implementation of a market economy policy for agriculture by issuing a decree reorganizing the seed sector. The Decree separated seed certification, quality control, marketing control, and law enforcement activities from seed production activities. This change continues to give a strong push for complete privatization of the seed sector and improved performance in quality control and seed certification organizations, leading ultimately to improved seed quality.

Agencies of Seed sector

According to the ISNAR Country Report 62, the following agencies play a key role in Egypt's seed sector:

The Agricultural Research Center (ARC): ARC has 17 research institutes and support organizations. It has the primary responsibility for crop improvement research, cultivar development and testing throughout the country. ARC supervises national field crop breeding programs for cereals, fiber materials, oils, legumes, fodder, and sugar. The ARC research institutes have developed the majority of field crop varieties.

The Central Administration for Seed Testing and Certification (CASC): CASC, established in 1995, is the agency responsible for seed quality control, seed legislation and policy enforcement. CASC reviews all relevant legislation, updates and prepares rules required to control all seed activities, and works to integrate and harmonize the seed legislative framework. CASC is the designated seed certification authority and performs lab- and field-testing for certified seed and lab testing for the uncertified seed.

The Central Administration for Seed Production (CASP): CASP administers and advises ARC on requirements for foundation and registered classes of seeds and plants. The agency supervises and contracts with seed growers to multiply seed. CASP is headquartered in Giza with offices in the governorates.

Seed companies: There are 66 registered seed production companies, which are specialized mainly in seed of hybrid maize, sorghum, Sudan-grass forages, sunflower, some vegetable seeds, and seeds of clover and alfalfa. In addition, 53 companies are registered for seed import and 148 for seed export.

Seed Industry Regulation

The Egyptian Seed Industry started in 1922, when a unit of cottonseed production and distribution was established in the Ministry of Agriculture. Later, this unit expanded its activities to include seed production of other crops. This unit was progressively upgraded until being designated as an Under Secretariat of MALR in 1980. The Ministry has started to liberalize this vital economic sector and to encourage private sector participation, especially in hybrid seed production.

8.6 Protocols of cultivation tests and their costs in Egypt

All nations shall check the phenotypes of new plant varieties with cultivation tests.
Once confined field tests have been conducted, applicants submit a set of forms to the National Biosafety Committee to support a finding of low or negligible environmental risk. Upon review and approval, the application is forwarded to the Seed Registration Committee, which grants approval to begin three year (or three season) quality and performance evaluation, which is standard for all new varieties. Only upon successful completion of these trials a new plant variety will be approved for commercial sale. Thus seed registration is the final step in commercial release of new plant varieties.

***Important Note**:*
In case the plant variety has not been examined yet anywhere worldwide, and there are no foreign DUS & VCU reports for the same; the ***Egyptian Central Administration for Seed Testing & Certification (CASC)*** will conduct the relevant tests & issue their reports within (2) years from the application's filing date.

Technical Requirements

The Egyptian IP Law stipulates that a protection shall be granted to the breeder when the variety is Distinct, Uniform, Sable & Novel; and shall be subject to a denomination.

Distinct:
Means that the applied variety is distinguishable from other known plant varieties, by one or more obvious characteristics, on condition that the applied variety keeps these characteristics after propagation.

Uniform:
Means that the applied variety remains within permissible limits among its class.

Stable:

Means that the applied variety when being replanted, it maintains its essential characteristics unchanged after repeat propagation for a certain period as stated in the relevant provisions (i.e. 2-3 years based on the type of variety).

Novel:

Means that the applied variety is considered new; and in order to fulfill this novelty requirement, the vegetation propagation of the subject variety (at the time of filing the application request) has not been sold or transmitted to third parties either by the breeder himself or with his consent for the purpose of exploitation of that variety.

However, a variety shall **not** lose its novelty in case of the following:

- If it was exposed or circulated Inside Egypt for NOT more than **One Year** from the application's filing date**.**
- If it was exposed or circulated Outside Egypt for NOT more than:
  *** Six Years** from the application's filing date (for trees & Vines).
  *** Four Years** from the application's filing date (for other crops).
- Or in case the variety has been sold or disposed to others, with the consent of the breeder, prior to the granting of protection to the subject variety.

Protection Period

If the plant variety fulfills the (4) technical requirements of:

1- Distinct 2- Uniform 3- Stable 4- Novel

A Plant breeder will be granted a total protection period for his variety as follows:

- for Trees & Vines: **25 years**
- for other crops: **20 years**

(the Period starts as of the date of grant protection, not as of the date of filing application)

Official Costs for protection

❖ **In case the breeder/applicant is a Company:**

▪ Filing an application (*including examination fees*)	EGP 100.00
▪ Publication fees for the variety	EGP 50.00
▪ Obtaining a certified protection certificate of the PV	EGP 750.00

	Total Costs: EGP 900.00

❖ **In case the breeder/applicant is a Scientific or Research Institution:**

▪ Filing an application (*including examination fees*)	EGP 25.00
▪ Publication fees for the variety	EGP 50.00

- Obtaining a certified protection certificate of the PV EGP 100.00

Total Costs: EGP 175.00

Important Notes:

- In case the applicant/breeder acquires DUS & VCU tests that have been conducted at any of the **UPOV** member states (*69 members till this moment*), the subject reports will be submitted at the ***Egyptian Central Administration for Seed Testing & Certification (CASC);*** which will conduct local tests in order to verify the revealed results mentioned in the foreign reports. Such local tests will be conducted for a period of only one year, for an official cost of **EGP 5000.00**

- While, if the breeder/applicant has no DUS & VCU reports certified by any other Country, he will need to **register** his new variety in Egypt, parallel with the protection procedures.

(*This is applied for both: Companies & Scientific or Research Institutions*)

Registration Procedures & Costs

In case the plant breeder would like to protect his variety in Egypt, however, he is still unable to furnish a duly certified certificates for the DUS & VCU reports from his country of origin or any other country. The ***Egyptian Ministry of Agriculture & Land Reclamation*** will conduct the required tests LOCALLY in order to examine the varieties' novelty, uniformity, distinction & Stability. Such local tests will be conducted within **3 years** as of the request filing date.

Costs of which are listed as follows:

Table 8-2 Costs Related to the Plant Registration for Crops in Egypt

* **For Crops (*costs are in EGP*):**

Item	Official Fees
Cultivation for the 1st year	6000.00
Cultivation for the 2nd year	6000.00
Cultivation for the 3rd year	4000.00
DNA Test for the P. variety	500.00
P.V. National Registration	2500.00
Agricultural Economy Research Institution's report	6000.00
Plant Disease Research Institution's report	6000.00
Total in EGP	**31250.00**

Table 8-3 Costs Related to the Plant Registration for Vegetables in Egypt

* **For Vegetables (*costs are in EGP*):**

Item	Official Fees
Cultivation for the 1st year	3500.00
Cultivation for the 2nd year	3500.00
Cultivation for the 3rd year	2000.00
DNA Test for the variety	500.00
PV National Registration	2500.00
Agricultural Economy Research Institution's report	6000.00
Plant Disease Research Institution's report	6000.00
Total in EGP	**24250.00**

Note:
For **Corn** only, the cultivation is only two years (*no need for the 3rd year*); pursuant to the Ministerial Decree No. **1298 of 2007**

Official Authorities
The competent authority responsible for issuing the DUS & VCU tests is the:

*** Egyptian Central Administration for Seed Testing & Certification (CASC)**

Including the supplementary Reports conducted and issued by the following authorities:

Agricultural Economy Research Institution
Genetic Engineering Research Institution
Plant Preservation Research Institution
Plant Disease Research Institution
Agricultural Research Center

After completion of the subject reports, a final & complied report is to be raised to the "***Plant Varieties Registration Committee***" which will revise all these relevant reports, and issue the final decision, as whether to register this plant variety in Egypt or not.

8.7 List of plant varieties registered and/or protected in Egypt

As long as the initial communication with OPVP representatives, Jatropha would be the “First wood/tree” to be registered in Egypt, while registration of common commodities and fruits such as strawberry and Mango has been increasing. The updated list of plant varieties protected in Egypt is attached with appendix 3 and of plant varieties registered in Egypt with appendix 4.

8.8 Transfer of cultivation test data from other countries in Egypt

Egypt is currently seeking a membership at the UPOV agreement; however, there have been a number of amendments on the subject agreement that the Egyptian Government had requested to be affected in order to match with the provisions of the Egyptian IP Law no. 82 of 2002 / Book (4).

Accordingly, within the next few months, a final decision will be held by the WIPO indicating whether to accept these amendments with regard to Egypt or not.

Nevertheless, at present, Egypt is dealt as a member state in the UPOV, which means that any VCU & DUS tests issued in Egypt will be accepted by any member state in the UPOV (*a total of 69 members as yet; 68 Countries in addition to the European Union*); and vice versa.

Thus, any VCU & DUS issued by any of the UPOV member states will be accepted in Egypt.

1) Cases in which foreign tests have been validated in Egypt:

The ***Egyptian Central Administration for Seed Testing & Certification (CASC)*** had already accepted the VCU & DUS tests issued by other foreign Countries (*UPOV member states*), namely:

Table 8-4 DUS & VCU Tests issued by the "European Union & France Office"

1	Sugra Thirteen	Grapes	Jan 04, 2010	Sun World International LLC (USA)
2	Camino Real	Strawberry	Jan 04, 2010	The Regents of the University of California (USA)
3	Albion	Strawberry	Jan 04, 2010	The Regents of the University of California (USA)
4	Ventana	Strawberry	Jan 04, 2010	The Regents of the University of California (USA)
5	Grapaes	Grapes	May 02, 2010	Grapa Company Ltd. (Israel)
6	Palomar	Strawberry	May 05, 2010	The Regents of the University of California (USA)
7	Driscoll Eldorado	Strawberry	May 05, 2010	Driscoll Strawberry Associates, Inc. (USA)
8	Driscoll Atlantis	Strawberry	May 05, 2010	Driscoll Strawberry Associates, Inc. (USA)
9	Driscoll Bonair	Strawberry	May 05, 2010	Driscoll Strawberry Associates, Inc. (USA)

Table 8-5 DUS & VCU Tests issued by "South Africa"

1	Merensky 2	Avocado	Dec 02, 2010	Westfalia Limited (South Africa)
2	Mendez no 1	Avocado	Dec 02, 2010	Westfalia Limited (South Africa)
3	TFEO2	Mango	Dec 02, 2010	Westfalia Limited (South Africa)
4	HGO1	Mango	Dec 02, 2010	Westfalia Limited (South Africa)

2) Cases in which Egyptian tests have been validated in other foreign countries:

Till this moment, **NO such cases** have occurred in Egypt; since no VCU & DUS tests conducted in Egypt have been requested to be used abroad.

Important Note:

Currently there is a ***pending protocol*** between Egypt & KSA (*not in force as yet*), whereby the DUS & VCU test reports that are:

* **Conducted & Issued in Egypt:**
Will be IMMIDIATELY accepted in KSA (*without any further validations).*

*** Required for registration in KSA:**
Will be conducted in Egypt (*i.e. there are no measures to conduct the subject tests as yet in KSA*).

8.9 Conflicts and infringements on plant varieties or related IPR in Egypt

Based on the initial communication with authorized officers in OPVP, there have not been any official cases to solve the infringements for the registered plants in Egypt. Since the number of plant registration mostly by foreign investors or breeders has been increasing, the cases shall be carefully monitored to see the actual Egyptian practices and avoid meaningless losses

Upon checking the official records at the:

* Egyptian Ministry of Agriculture and Land Reclamation.
* Egyptian Committee for Agricultural Crops Registration.
* Egyptian Office of Plant Varieties Protection.

We have been confirmed that till this moment (October 2011):

- **NO infringement cases** have been recorded against registered and/or protected Plant Varieties in Egypt, either by an Egyptian party or any foreign parties.

8.9.1 Regulations & Provisions

With regard to infringement actions on plant varieties in Egypt, the governing law controlling such actions is the:

*** Egyptian Law No. 82 of 2002 Pertaining to the Protection of Intellectual Property Rights.**
(Please refer to annex 1 to review its full text)

* Concerned Articles: Article Nos. **193, 194, 204 & 206**; which stipulate the following:

Article 193

Nevertheless, a variety, for which a breeder's right is requested, shall be granted a temporary protection starting from the date of the filing of the application and expires on the date of the publication of the grant of the title. During this period, the breeder's right as stipulated in Article 194, shall be limited to a fair compensation as soon as such protection is granted, provided that the breeder has notified his application to the party that has been exploiting the plant variety prior to granting the protection.

Comment: This article applies in case the variety is just filed in Egypt (i.e. not protected as yet).

Article 194

The holder of a breeder's right certificate shall have an exclusive right to the commercial exploitation of the protected variety in any form whatsoever. The production, propagation, circulation, sale, marketing, importing, exporting of propagation material shall not be allowed without the written consent of the variety breeder.

Comment: This article applies in case the variety is already protected in Egypt & the official certificate is already issued.

Article 204

Upon the request of any concerned party, the president of the competent court considering the merits of the case, may issue a decision, by petition, to order one or more of the appropriate conservatory measures, and in particular:

(1) Establishing infringement of a protected right.
(2) Drawing a detailed inventory and detailed description of the infringing products and the implements used or may be used in the infringement.
(3) Seizure of all articles stated in item 2.

In all cases, the president may designate one or more experts to assist the bailiff in charge of the execution of such measures. He may require the applicant to deposit an appropriate financial security.

Where the applicant fails to submit the merits of the case to the competent court, within 15 days following the date of the order, such order shall cease to have effect.

Article 206

The Minister of Justice, in agreement with the Minister of Agriculture, shall issue a decision designating law enforcement officers for the purpose of implementing the provisions contained in this Book.

8.9.2 Competent Authority

All infringement complains with regard to any IP right in Egypt is to be raised at the:

* **Ministry of Agriculture & Land Reclamation** (for receiving Complains)
* **Egyptian Economic Court** (for issuing a court Judgment)
* **Egyptian Court of Appeal** (for appealing judgments)

8.9.3 Infringement Complain Procedures

1) Case Study

An assumed applicant called "**Genetics Inc.**" is already a holder of an IP right for a specific plant variety in Egypt called "X"; he has been seeking for protecting his new variety in Egypt by means of registration and protection.

Thus, he filed an application at the Egyptian Office for Plant Varieties Protection (OPVP) requesting to protect his variety "X" in Egypt and at the same to register the same in order to be allowed to cultivate, trade, and market the subject variety in Egypt legally and legitimately.

And while the variety is pending for registration in Egypt (un-registered yet), he recognized another Egyptian party called "SKK" are cultivating his variety without registering the same at the competent authorities, and without seeking his consent or agreed license to use the same in Egypt.

Thus, he has now decided to stop this infringing action by legal means and before the proper authorities, seeking a protection for his IP right & business in Egypt which will be in harm in case this infringer continues to violate his variety in such form.

2) Analysis

First, we need to advise "**Genetics Inc.**" that according to the IP law no. 82/2002, being the owner of this variety "X" (proved by a filing certificate evidencing that his variety is temporarily protected in Egypt) he is granted an <u>exclusive</u> right on her protected material, preserving his rights as follows:

<u>Economically</u>: by preventing others from doing the following without his authorization:

- Reproduction of his variety or cultivating the same in any form.
- Selling or marketing the same for his interest in Egypt.
- Making any kind of profit based on the subject variety in any way.
-

<u>Morally</u>: by ensuring the following two rights:

- A convenient recognition of his name as being the legitimate owner of this variety.
- To object to any act leads to distorting the integrity of his variety or adversely affects his honor or reputation.

Let's discuss the deed of the infringing party "SKK":

He had committed the following infringement actions:

- He violated an IP right of "**Using"** the variety "X" without a clear consent of agreed license from the owner "Genetics Inc."

- He violated an IP right of "**Cultivating"** the variety "X" and trying to gain profits on the same illegally without an authorization from the owner of the subject variety.

Findings

1- The imitated variety (illegally cultivated in Egypt) is identical or at least similar to the genuine variety owned by "**Genetics Inc**."

2- The opposed party "**SKK**" (i.e. the infringer) has no legitimate right (i.e. written consent or a license agreement)allowing him to use, cultivate or trade in the variety "X" being owned totally to "Genetics Inc."

3- The cultivation, trade or use has been conducted in bad faith.

3) Legal Procedures

1- The opponent (i.e. Genetics Inc.) can raise a formal complaint before the ***Minister of Agriculture & Land Reclamation***, mentioning clearly and in detail the infringing act that has been conducted by the opposed party "SKK".

2- The Minister (*pursuant to the Law*) shall call for a legal & technical committee to investigate this matter immediately and make sudden visits (accompanied with police officers) to the location in which the infringement action is taking place (e.g. cultivation field).

3- Such legal & technical committee is mainly composed of agricultural experts & legal professionals, who are asked to prepare an official report based on the consequences and findings of their investigations and visits.

4- And accordingly, the committee shall declare their testimony with regard to the infringement compliant, as whether:

5- The opponent "**Genetics Inc**" acquires a legitimate right on the subject variety "X" in Egypt; and

6- Whether the defendant "**SKK**" has conducted a violation to the economic, moral and legal rights of the opponent.

7- In case their report findings do confirm an infringement action conducted by the defendant "SKK", their report shall be raised to the ***Egyptian Economic Court***, which will review the documents, evidences and relevant report; and subsequently call for a hearing

session, in the presence of both parties (the opponent & the defendant) in order to allow each party to furnish his defensive basis clearly and fairly.

8- Upon hearing each party, and reviewing the papers and evidences; the Economic Court shall issue their executive decision as either to:

A) Accept the complaint in form and subject; and accordingly:
* The infringing crop shall be immediately stopped & confiscated.
* The infringer "SKK" shall be accused by conducting a criminal action.
* The infringer "SKK" shall pay a legal fine, payable to the Court.
* The opponent "Genetic Inc." has a lawful right to file a lawsuit at the Criminal Court asking for a suitable compensation from "SKK" due to the economic & moral loses he faced by this infringement action.

B) Reject the complaint in subject; and accordingly:
* The defendant's (SKK) crops will not be confiscated.
* The defendant (SKK) will not be accused of an infringement action.

4) Legal Remedy for (B) case

In case of rejecting an infringement complaint by the Economic Court; the opponent "Genetics Inc" has the right to nullify this judgment at the **Egyptian Court of Appeal**.

5) Deliberation Time frame

Actually there is no fixed time line to be estimated for such cases; however the normal time frame for such issues to be resolved may be around **(one) year**.

6) Complain Official Costs

Till this moment, there are no official costs for raising such infringement complains (i.e. free of charge), excluding some ordinary stamp duties (*worthless mentioning*).

9. Plant Quarantine

9.1 International framework on plant quarantine

The Uruguay Round of trade negotiations of the GATT has developed its Agreement on Sanitary and Phytosanitary Measures (SPS Agreement) established in 1995 whose main aim, in the phytosanitary section, is to ensure that any phytosanitary measures, which act as non-tariff barriers to trade, can be technically justified.

International Standards for Phytosanitary Measures (ISPMs) are adopted by contracting parties to The International Plant Protection Convention (IPPC) through the Commission on Phytosanitary Measures. ISPMs are the standards, guidelines and recommendations recognized as the basis for phytosanitary measures applied by Members of the World Trade Organization under the Agreement on the Application of Sanitary and Phytosanitary Measures. Non-contracting parties to the IPPC are encouraged to observe these standards.

ISPMs were originally produced as separate booklets. The current book was produced by the IPPC Secretariat according to the decision made by the Interim Commission for Phytosanitary Measures at its Seventh session in 2005 (ICPM-7). It compiles all ISPMs without modification to their content, except in relation to the section Definitions, as decided by ICPM-7.

9.2 Plant Quarantine in Egypt

The IPPC has been revised according to the SPS Agreement for setting the standards, guidelines and recommendations recognized as the basis for phytosanitary measures applied by Members of the WTO. The new revised text was approved by FAO Conference in 1997 and came into force in October 2005. It puts particular emphasis on ISPMs and their technical justification by Pest Risk Analysis (PRA).

Since legal framework of Plant Quarantine in Egypt was established by Agriculture Law No. 53/1966, Part VI. Chapter III , no amendments have been introduced onto the tables used inspection and treatment of the imported and/or exported agricultural products (The Egyptian Plant Quarantine Rules & Regulations: Ministerial Decree, No.3007 of 2001). Ministerial Decree No. 951 of 1991 defined the fees on consignments liable to the Plant Quarantine Provisions. MALR's Ministerial Decree No. 3007 of 2001 defines the protocols and procedures of plant quarantine in Egypt. Articles (1) to (3) are defined to decline entry into Egypt with related lists of insects and pests by plant and crop in each table. Jatropha, however, cannot be found in those tables. In practice, Central Administration of Plant Quarantine (CAPQ) under MALR is fully responsible for importation and exportation of any plants in Egypt except custom duty so as to ensure compliance with the international agreements and streamline its operation. This is also intended to increase transparency to all the stakeholders in the import/export businesses. It should be clarified what

inspection will be done to imported Jatropha.

In addition, the article (22) of the Ministerial Decree No.3007/2001 says that 'A phytosanitary certificate must accompany every shipment of plants imported for cultivation or propagation. The said certificate must be issued by the competent authority in the country of origin, attesting to its being free from pests and referring to the scientific name of the plant and area where it was grown.

The Plant Quarantine in Egypt is regulated and governed by:

* **The Ministerial Decree No. 3007 of 2001**

Where, the subject decree has discussed the procedures and legislation to be applied by the Egyptian agricultural quarantine on imports of agricultural communications on the basis of scientific risk assessments.

Competent Authority

The competent authority that is concerned with the Plant Quarantine in Egypt is the:

*** Central Administration of the Agricultural Quarantine (CAAQ)**
Ministry of Agriculture & Land Reclamation

With an assistant-committee composed of the following authorities:
* Horticultural Research Institution
* Plant Preservation Research Institution
* Plant Disease Research Institution

Main Function

The Plant Quarantine is considered the **First Defensive Line** protecting the Agricultural Wealth in Egypt from the entry of any potential agricultural pests, insects, mites, bacteria, or plant diseases accompanied with foreign plants or agricultural products imported into Egypt.

Procedural Stages

The plant quarantine tests & examinations must be fulfilled before registering a new variety in Egypt. Thus, registration cannot be processed without an official permission from the CAAQ that the subject variety is clean and void of any harmful pests.

In case the CAAQ issued its report allowing the variety to be entered safely into Egypt, the applicant/breeder will also need to obtain an **Importation Permission** from the:

*** Egyptian Crop Seeds Committee**

At the Egyptian Central Administration for Seed Testing & Certification (CASC)

The main function of the **Crop Seeds Committee** is to revise the report issued by the CAAQ and to verify the same (*theoretically & analytically*) in order to decide whether the subject plant or agricultural product is allowed to be imported into Egypt or not.

However, and based on the current practices in Egypt, once the CAAQ issues its report confirming that the subject plant variety is clean and void of any harmful pests (*based on the regulations and conditions stipulated in the Law provisions)*, **the Crop Seeds Committee** will certainly issue their approval, and allow the subject variety to be safely imported into Egypt.

Accordingly, the order of procedures for registering and importing a new variety in Egypt is as follows:

First Step

Issuance of the Plant Quarantine's Approval Test Report from the "CAAQ"

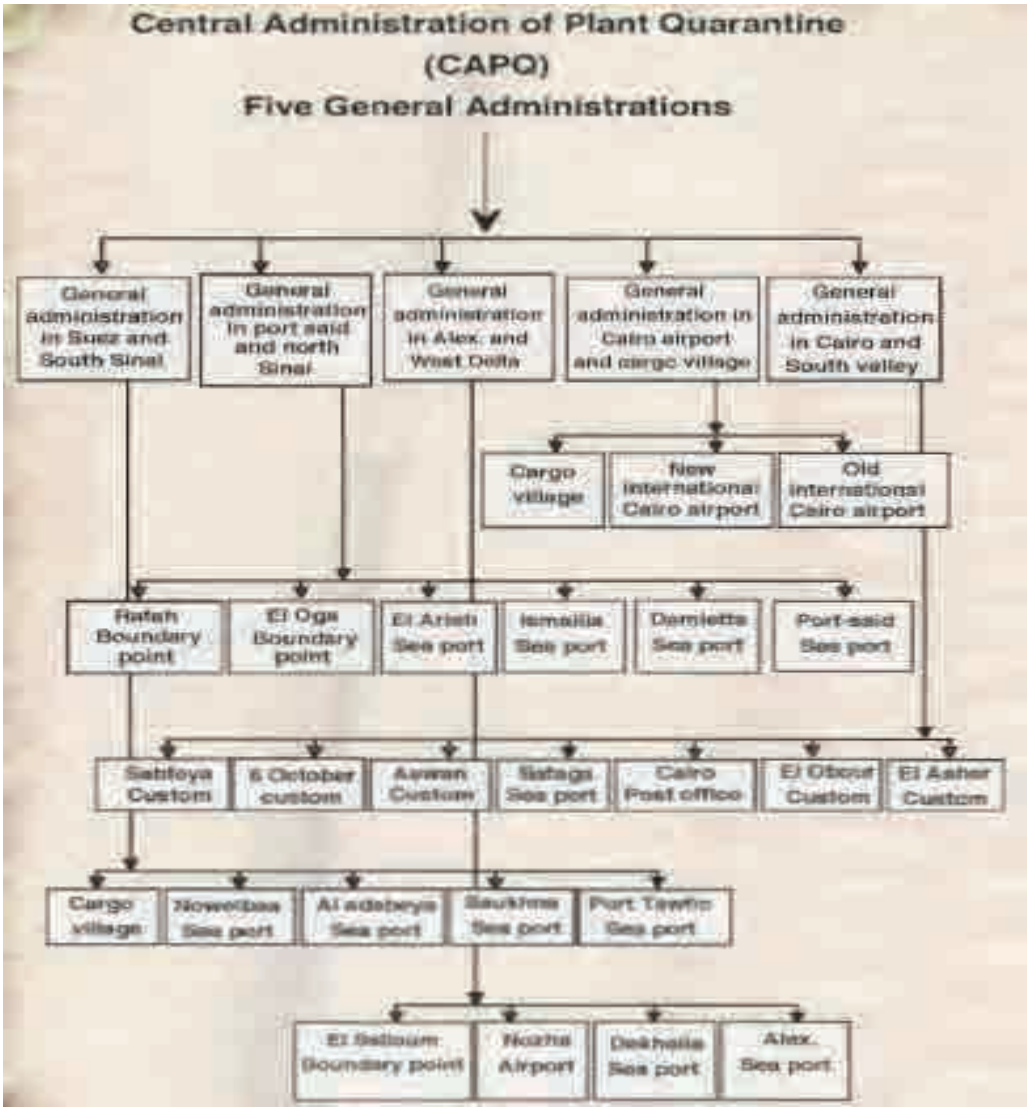
Second Step

Issuance of the Importation Permission from the Crop Seeds Committee

Third Step

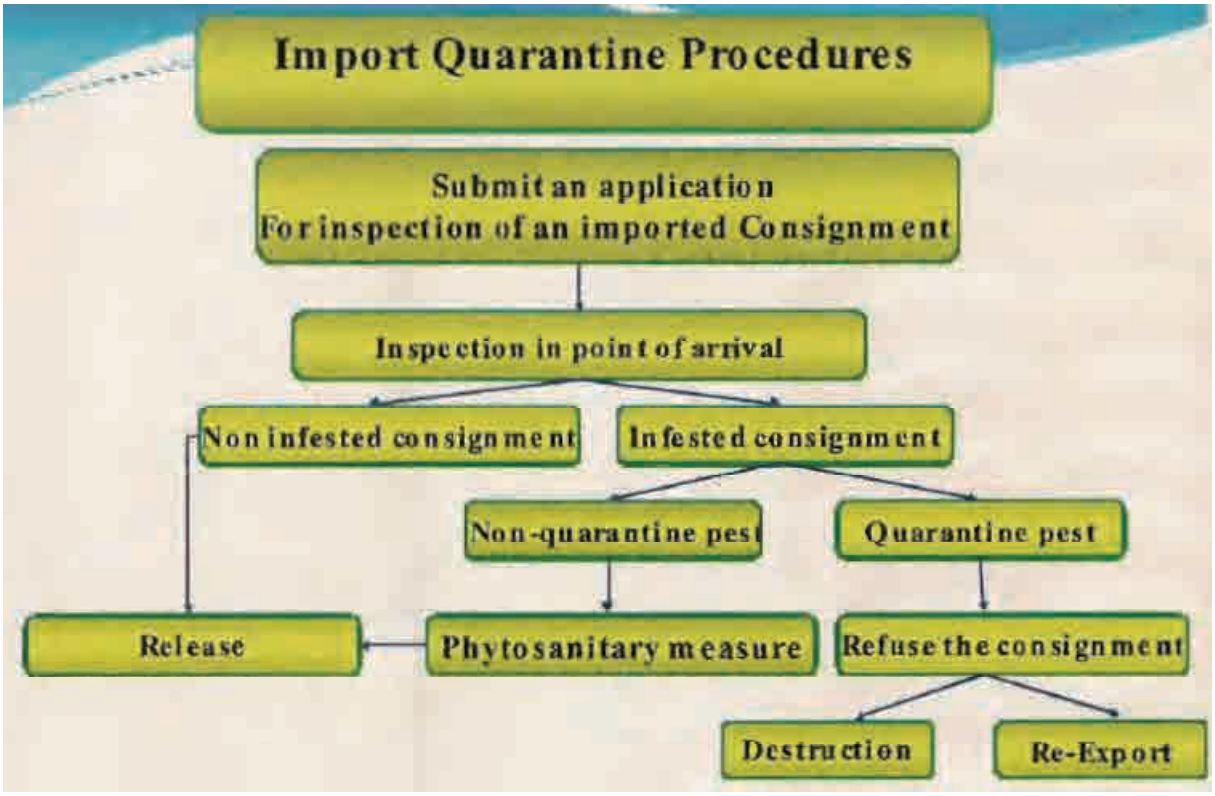
Applying for registering the new plant variety at the "CASC"

Source: CAPQ 2008 brochure



Source: CAPQ 2008 brochure

9.3 Protocols and procedures for plant quarantine in Egypt



Source: CAPQ 2008 brochure

The application of plant quarantine for import is shown in Appendix 4 Pest Risk Analysis Questionnaire.

Ministerial Decree No. 3007 of 2011 full text

* The subject decree was issued in the EG. Official Gazette dated May 19, 2002 (**issue no. 112**)

For reviewing the ***full text*** of the cited decree (*Articles 1~ 86*), along with the relevant procedures, regulations, protocols and official costs, please find the enclosed document that has been prepared, revised and approved by the ***Central Administration of the Agricultural Quarantine (CAAQ)*** in Egypt (*attachment 4 ~ total of 85 pages*).

Full list of Pests Harmful to Plants and Agri-Products

Also please find the same attachment (*attachment 4*) for reviewing the full list of:

- Unrecorded pests to be declined entry into Egypt (Insect pests, fungal diseases, Bacterial diseases, Nematodes, Viral Diseases, and mites) - Table (1)

- Recorded pests to be declined entry into Egypt (Insect pests, fungal diseases, Bacterial diseases, Nematodes, Viral Diseases, and mites) - Table (2)
- Recorded pests that will only be admitted after disinfection (Insect pests, fungal diseases, Bacterial diseases, Nematodes, Viral Diseases, and mites) - Table (3)
- Plants and Agricultural Products to be permitted entry into Egypt if they were infected with the recorded and/or unrecorded pests opposite to each, following application of eradication techniques - Table (4)
- Plants and Agricultural Products to be permitted entry into Egypt without disinfection if they were infected with the pests defined opposite to each - Table (5)
- Conditions for the entry of imported Plant and Agricultural Products infested with quarantine pests which can be fully eradicated during processing or manufacturing Table (6)

9.4 Cultivation tests for plant quarantine in Egypt

Pursuant to the IP Law no. 82 of 2002 and the Mistrial Decree no. 3007 of 2001; NO cultivation tests are to be conducted by the ***Central Administration of the Agricultural Quarantine (CAAQ)*.**

Rather:
When the agricultural products, new varieties, or samples of any plant arrive to Egypt via Airports, Land ports, or Seaports (harbors), the applicant/breeder shall fill in an application for "***Inspecting an Imported Consignment***".

Upon submitting the application, the **CAAQ** technicians at the port will:

- ❖ Conduct a prompt inspection to the consignment as a whole (i.e. samples of the same) in order to allow the shipment to enter safely into Egypt. Noting that if they found even one insect or pest in the selected sample, they will consider the consignment infested.

  Time frame: normally takes 2-3 hours on average to issue the Passage Permission.

Where:

- In case the subject plant variety (*or agricultural product*) is proved to be clear and free of any harmful pests (***non-Infested Consignment***):

  The consignment will be **safely released.**

  Consequently, a report of this clear inspection test and release of consignment will be raised immediately to the "**Crop Seeds Committee**" in order to issue within 3-5 working

days their "**Importation Permission**"; which is considered the main requirement for seeking protection for new plant varieties in Egypt.

- While in case the subject plant variety (*or agricultural product*) is proved to be infected with harmful pests (***Infested Consignment***):

The CAAQ technicians will decide (*based on the law provisions*) whether the pest is:

*** Non-Quarantine Pest** or *** A Quarantine Pest**

❖ In case it is a Non-Quarantine Pest:

The CAAQ officers will take a sample of the subject plant variety (*or the agricultural product*) for being tested, in order to ascertain its clearness of any quarantine pests.

The concerned examination test (***Phytosanitary Measure***) is conducted at:

* The CAAQ's analytical laboratory
* Horticultural Research Institution
* Plant Preservation Research Institution
* Plant Disease Research Institution.

Time frame: normally takes 3-5 days on average to issue their Test Reports

❖ While in case it is a Quarantine Pest:

The whole consignment will be **refused** and prevented from entering Egypt; as either will be

Destructed	**or**	**Returned back (re-exported)**

9.5 Laws in other countries to export to Egypt (CBD)

Convention on Biological Diversity (CBD) is an international legally binding treaty. CBD Article3 said that each country has the sovereign right for their own natural resources. Therefore, all parties which want to export natural resources and relative materials to other countries should acquire the permission from the authorized governmental office. If an export country has not determined domestic laws, it will request the similar procedure with Bonn Guidelines.

Most of CBD members request a benefit-sharing contract to export wild plant varieties. In the case of a newly inbred variety, a benefit-sharing contract is necessary, if that new variety contains genes from another variety which the export country has the sovereign right.

The recommended procedures have not determined yet, but International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGR) in FAO has determined the Standard Material Transfer Agreement (SMTA).

9.6 Recommendation protocols for easier introduction of new Jatropha varieties from other countries

Steps & Protocols:

The Procedures for introducing a new Jatropha variety in Egypt are as follows:

Step I:
The Jatropha consignment (seeds or plants) will arrive at the Port, where the officials of the CAAQ will request the applicant/breeder to complete an application form for "***Inspecting an Imported Consignment***".

Upon submitting the application, the **CAAQ** technicians at the port will conduct an inspection to the consignment to decide whether the same is clean or infested.

Noting that if they found even one insect or pest in the selected sample, they will consider the consignment infested.

Time frame: normally takes 2-3 hours on average to issue the Passage Permission.

Smooth Course:

- In case the subject plant variety (*or agricultural product*) is proved to be clear and free of any harmful pests, the consignment will be **considered *non Infested Consignment***.

  Consequently, a report of this clear inspection test and release of consignment will be raised immediately to the "**Crop Seeds Committee**" in order to issue within 3-5 working days their "**Importation Permission**"; which is considered the main requirement for seeking protection for new plant varieties in Egypt.

Un-smooth Course:

- While in case the subject plant variety (*or agricultural product*) is proved to be infected with harmful pests (***Infested Consignment***):

The CAAQ technicians will decide (*based on the law provisions*) whether the pest is:

❖ A Non-Quarantine Pest:

In such case the CAAQ officers will take a sample of the subject plant variety (*or the agricultural product*) for being tested, in order to ascertain its clearness of any quarantine pests.

The concerned examination test (***Phytosanitary Measure***) is conducted at:
* The CAAQ's analytical labs.
* Horticultural Research Institution Laps
* Plant Preservation Research Institution Laps
* Plant Disease Research Institution Laps.

Time frame: normally takes 3-5 days on average to issue their Test Reports

❖ Or A Quarantine Pest:

In such case the whole consignment will be **refused** and prevented from entering Egypt; as either will be:

*** Destructed; or**
*** Returned back (re-exported)**.

Step II:
In case the CAAQ issued their permission to release the shipment as a non-infested consignment, the ***Crop Seeds Committee*** will issue their **Importation Permission.**

Step III:
After allowing the consignment to enter into Egypt, it is now applicable and highly recommended to start the registration proceed for the new Jatropha variety in Egypt.

Where the variety breeder (or applicant) will apply for registering and protecting the new plant variety at the:

For Protection
(Recordal as an IP value to its holder)
At: Office of Plant Variety Protection
Egyptian Central Administration for Seed Testing & Certification *(CASC)*

For Registration

(Allowing the variety to be marketed and circulated)

At: Egyptian Central Administration for Seed Testing & Certification *(CASC)*

Ministry of Agriculture and Land Reclamation

N.B: Both recordal (*protection & registration*) are extremely important and much advisable to be proceeded together in parallel lines.

PROCEDUAL RECCOMENDATIONS

Based on recommendations collected from the following authorities:

- *Desert Plants Department, MALR*
- Gene bank, ARC/MALR
- Central Administration for Foreign Agricultural Relations (FAR), MALR

And also based on recommendations collected from different authorities and qualified officials; the following points are recommended for best introduction of a New Jatropha variety in Egypt:

1- It is recommended to introduce Jatropha as seeds (*not plants*); since official and technical procedures to accept introduction of Jatropha seeds in Egypt are much easier and smoother compared to Jatropha plants.

2- In case Jatropha is intended to be exported to Egypt in form of seeds and plants; it is highly recommended to introduce each type in a separate application (i.e. separate bill of lading for Jatropha seeds and another bill of lading for Jatropha plants); in order to save time and costs, and in order to avoid any procedural inconveniences.

3- Also in order to save time and costs, it is highly recommended to coordinate with the **Department of Afforestation & Environment** *(directed by Mr. Ali O. Asal)* and inform them with the consignment arrival port and exact arrival date, in order to arrange their schedule and be able to coordinate with the professionals of CAAQ to attend the arrival port timely and receive the consignment carefully without any delays.

4- With regard to the costs for this coordination that will be undertaken by the **Department of Afforestation & Environment** (which is very important), unfortunately there are no fixed costs for this assignment; rather it will be scaled on case by case basis.

5- Also for the sake of accuracy and time saving, it is much advisable to furnish a certified **certificate** proving that the consignment is free of harmful pests (*non-infested consignment*) issued by any foreign reputable analytical authority. Such certificate will ease the procedures and assist the CAAQ to issue their permission to release the shipment promptly.

6- The introduced Jatropha seeds or plants are highly recommended to be of **high productivity** and **low cultivation costs**; as based on the experience of the desert cultivation engineers in Egypt, a single Jatropha tree in Egypt is mainly producing around **one Kilogram** of oil, which is considered low productive and costly compared to other alternatives in the same field.

7- In general, Jatropha plant types that are currently cultivated in Egypt (namely: Jatropha curcas & Jatropha Integerrima) are taking around **(3) years** to produce their yields; and in normal cases the net amount of oil extracted is around 35% to 45% only from the overall yield; which means that more than half of the yield is **in vain**.

8- These Jatropha seeds currently developed in Egypt are capable to be reserved in special refrigerators for around **(4) years** at most, to be re-cultivated once again.

9- In Egypt, Jatropha is not cultivated in wide areas; rather in small fields. However, we have been informed by **Dr. Al Muafy Abdo** that Jatropha is currently cultivated in Sinai; under the supervision of the Egyptian Armed Forces.

Table 9-1 Necessary Period of ordinary procedures for Quarantine, Protection and Registration of a New Plant Variety

Corresponding Organization	case	CAAQ	CSC	OPVP	CASC	CACR	MALR
Agricultural Quarantine and Importation Permission	With a report of exported consignment inspection	2-3 hours	3-5 working days	-	-	-	-
	Without a report of exported consignment inspection	1-3 days	3-5 working days	-	-	-	-
Protection of a New Plant Variety	With Certificate of DUS tests	-	-	2-3 month	-	-	-
	Without Certificate of DUS tests	-	-	Temporary Protection (*)	-	-	-
Registration of a New Plant Variety	With Certificate of DUS tests	-	-	-	2 year	-	-
	Without of VCU tests	-	-	-	3 years	-	-

(*)where the filing receipt will be the official evidence of protection

Table 9-2 Necessary Period of ordinary procedures for Quarantine, Protection and Registration of GMO(**)

Corresponding Organization	case	CAAQ	CSC	OPVP	CASC	CACR	MALR
Agricultural Quarantine and Importation Permission	With a report of exported consignment inspection	2-3 hours	3-5 working days	-	-	-	-
	Without a report of exported consignment inspection	1-3 days	3-5 working days	-	-	-	-
Protection of GMO	With Certificate of DUS tests	-	-	1 month	-	-	-
	Without Certificate of DUS tests	-	-	Temporary Protection (*)	-	-	-
Registration of GMO	With Certificate of DUS tests	-	-	-	1 year	-	-
	Without of VCU tests	-	-	-	3 years	-	-

(*):where the filing receipt will be the official evidence of protection

(**) Necessary period depends on any social or political occasions

10. Genetically-Modified Plants

10.1 Cartagena Protocol and Nagoya-Kuala Lumpur Supplementary Protocol in CBD

The *Cartagena Protocol on Biosafety to the Convention on Biological Diversity* is an international treaty governing the movements of living modified organisms (LMOs) resulting from modern biotechnology from one country to another. It was adopted on 29 January 2000 as a supplementary agreement to the Convention on Biological Diversity and entered into force on 11 September 2003

The *Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization to the Convention on Biological Diversity* is an international agreement under the *Cartagena Protocol.* It aims at sharing the benefits arising from the utilization of genetic resources in a fair and equitable way, including by appropriate access to genetic resources and by appropriate transfer of relevant technologies, taking into account all rights over those resources and to technologies, and by appropriate funding, thereby contributing to the conservation of biological diversity and the sustainable use of its components. It was adopted by the Conference of the Parties to the Convention on Biological Diversity at its tenth meeting on 29 October 2010 in Nagoya, Japan, and would enter into force 90 days after the fiftieth instrument of ratification. Its objective is the fair and equitable sharing of benefits arising from the utilization of genetic resources, thereby contributing to the conservation and sustainable use of biodiversity.

The Nagoya Protocol applies to genetic resources that are covered by the CBD, and to the benefits arising from their utilization. The Nagoya Protocol also covers traditional knowledge (TK) associated with genetic resources that are covered by the CBD and the benefits arising from its utilization.

On the introduction of GM Jatropha to Egypt concerning to the Nagoya Protocol, stakeholders who will share benefits arising from the utilization of GM Jatropha will be the developer and cultivators. Because Jatropha plants are a very ordinary plant and its genetic resources have been developed and owned by a Japanese company.

10.2 Egyptian laws and decrees on the introduction of Genetically-Modified Plants

Competent Authority

The competent authorities concerned with the Genetically Modified Plants in Egypt are the:

***Gene Bank (National Program for Plant Genetic Resources)**
*** Central Administration of the Agricultural Quarantine (CAAQ)**

With the assistance of:
* Horticultural Research Institution.
* Plant Preservation Research Institution.
* Plant Disease Research Institution Laps.

Main Function

The Gene Bank is considered the competent administrative authority for approving manipulation of Egyptian genetic resources in order to derive new varieties. An applicant for a breeder's right certificate shall -at first- furnish an attestation to the approval of the said authority for such manipulation.

Note: The Gene Bank is only concerned with the Egyptian Genetic Resources, which means that any foreign genetic resources (*imported GM plants or seeds*) will not be under the supervision of the Gene Bank.

However, the Gene Bank will always keep a sample of any foreign genetic Resource in its possession for scientific & research purposes.

Regulating Provisions

- **Articles no. 179, 180, 181 & 182 of the *Council of Ministers' Resolution No. 1366 of 2003,* stipulating the following:**

Article 179:

A register shall be established with the Ministry of Agriculture, in which Egyptian plant genetic resource, whether wild or domesticated, are recorded.

Article 180:

The breeder shall be under the obligation to disclose, in the form established to that effect, the genetic source of the new plant variety in respect of which protection is applied for. Such obligation shall extend to any traditional knowledge or indigenous know-how used as a basis for developing the new variety.

Article 181:

The Plant Genetic Resources National Program shall be the competent administrative authority for approving manipulation of Egyptian genetic resources in order to derive new varieties. In order to be granted a breeder's right certificate, the applicant shall be required to furnish evidence of the approval by the said authority of such manipulation.

Article 182:

The Minister of Agriculture, upon a proposal by the President of the Plant Genetic Resources National Program, shall issue, in application of Article 200 of the Law, a decision determining the contribution to be made by the plant variety breeder to research efforts, share in the income resulting from the use made by the breeder of the Egyptian wild or domesticated genetic resource, and uses of such share income.

In such determination, the following shall be taken, particularly, into account:

1. Technical precedent set by the new plant variety.
2. Egyptian traditional knowledge used in the production of the new plant variety
3. Commercial income resulting from the exploitation of the new plant variety.

❖ Article no. 200 of the Egyptian IP Law no. 82 of 2002, stipulating the following:

Article 200

The breeder shall disclose the genetic source relied on to develop the new plant variety. The protection of the new plant variety requires that the breeder has acquired that source by legitimate means under the Egyptian law.

Such a requirement extends to traditional knowledge and experience accumulated among local communities the breeder could have relied on in his efforts to develop the new plant variety.

Likewise, the breeder who deals with Egyptian genetic sources, with a view to develop new varieties derived therefrom shall undertake to obtain the approval of the relevant competent administrative authorities. He shall also undertake to acknowledge the Egyptian traditional knowledge as sources to what he could have achieved using such knowledge and experience, through the disclosure of the Egyptian source the breeder benefited from, and by sharing the profits gained with the interested party, as prescribed in the Regulations of this Law.

A register shall be established in the Ministry of Agriculture to include the genetic Egyptian plants, both wild and domesticated.

Special Regulating Provisions

Upon checking with the Supreme officials at the Gene Bank, namely:

** Dr. Al Muafy Abdo (Chief of Desert Plants Department)*.

* *Mr. Ali O. Asal (Director General, Under-secretary for Afforestation & Environment).*
* *Mr. Mohamed M. Ebreheem Adel (Senior Agricultural Engineer at the Gene Bank)*

We have been confirmed that **no** special legislations or law provisions were issued for regulating the Genetic Resources issues, or even for introducing genetically modified plants into Egypt.

Only the above mentioned articles are the regulating provisions for such cases in Egypt.

10.3 Egyptian regulations on the research and development of GM plants

Due to the following points:

a) Absence of detailed & clear law provisions and ministerial decrees managing the introduction of new GM plants into Egypt.
b) Lake of valuable technical support provided to agricultural researchers and plant scientists in Egypt (i.e. low funds & weak subsidizations).
c) Absence of reliable official labs (*i.e. related to the Egyptian Government*) supported with good experiences and reasonable funding, specialized in analyzing plant genetic modifications.

Unfortunately, the Search & Development of GM Plants in Egypt is still below acceptable levels.

Procedural Steps

There are no fixed special steps for examining or analyzing **non-food** Genetically Modified plants in Egypt.

Rather, the relevant tests and lab analysis will be conducted jointly by the following authorities so as to ascertain whether or not these new seeds or plant products are safe for cultivation and circulation in Egypt:

* The Agricultural Genetic Engineering Research Institute (AGERI)
* The CAAQ's analytical labs.
* Horticultural Research Institution Laps.
* Plant Preservation Research Institution Laps.
* Plant Disease Research Institution Laps.

Thus, the **Test Reports** issued by the mentioned authorities for Plant **Quarantine** purposes are **inclusively** the same reports for the purposes of introduction of new GM plants into Egypt.

In other words, safety measures (*which is the main concern*) are applied for both purposes, and once being approved by the Central Administration of the Agricultural Quarantine (**CAAQ**) & the Crop Seeds Committee, the GM plant will be approved to be entered into Egypt safely.

Official Costs

As mentioned in the last point, the procedures are the same for Plant Quarantine purposes and genetic Modification analysis, and accordingly, the fees are **inclusive** (i.e. no separate fees for GM plant analysis and approvals).

10.4 Egyptian regulations on the Cultivation of GM plants in Open Fields

As mentioned in the item of "Special Regulating Provisions" **no** special legislations or law provisions were issued for regulating the Genetic Resources issues, or even for introducing genetically modified plants into Egypt.

It is worth to mention that ***the National Program for Plant Genetic Resources*** is just a regulative program focusing on administrative issues that are mainly addressed to the Officials, Engineers & Scientists at the Egyptian Gene Bank.

In general, the available regulations (*mentioned in the following topic*) and protocols are:

* Directly related to the Environmental Safety of the plant variety; and

* Indirectly related to the Genetic Resources.

Where the **safety** -*as previously mentioned*- is the main concern to the Egyptian Government; and once the plant, seeds, or agricultural product is confirmed to be:

- Free of any harmful pests.
- Has no negative impact on the national agricultural wealth, safety of biological diversity, agricultural sector, and life or health of humans, animals or plants in Egypt.
- Has no harmful economic or social effects, does not hamper local agricultural activities, or it appears that its use is compatible with the values and beliefs of the community.

Its cultivation process will be smoothly **approved** with no official or legal obstacles.

Related Regulating Provisions

- **Article no. 199 of the Egyptian IP Law no. 82 of 2002, stipulating the following:**

Article 199:

The Minister of Agriculture may, on the recommendation of the ministerial committee referred to in Article 196, limit the exercise of the breeder of all or some of his rights provided for in this Law in any manner with the aim of safeguarding the public interest, and in particular if it appears that the protected plant variety:

(a) has harmful effects on the natural environment, the safety of biological diversity, the agricultural sector, the life or health of humans, animals or plants, in Egypt;

(b) has harmful economic or social effects, hampers local agricultural activities, or it appears that its use is incompatible with the values and beliefs of the community.

- **Article no. 38 / Part Two: "Protection of Air Environment from Pollution" of the Environmental Law no. 4 of 1994, stipulating the following:**

Article 38:

It is prohibited to spray or use pesticides or any other chemical compound for agriculture, public health or other purpose except after observing the conditions, regulations and safety measures laid down in the executive regulations of this Law and in a manner that will not expose humans, animals, plants, waterways and other components of the environment, directly or indirectly, now or in future, to the harmful effects of such pesticides or chemical compounds.

10.5 Egyptian regulations on the cultivation of GM plants in open fields

As mentioned in the item of "Special Regulating Provisions" **no** special legislations or law provisions were issued for regulating the Genetic Resources issues, or even for introducing genetically modified plants into Egypt.

It is worth to mention that ***the National Program for Plant Genetic Resources*** is just a regulative program focusing on administrative issues that are mainly addressed to the Officials, Engineers & Scientists at the Egyptian Gene Bank.

In general, the available regulations (*mentioned in the following topic*) and protocols are:

* Directly related to the Environmental Safety of the plant variety; and

* Indirectly related to the Genetic Resources.

Where the **safety** -*as previously mentioned*- is the main concern to the Egyptian Government; and once the plant, seeds, or agricultural product is confirmed to be:

- Free of any harmful pests.
- Has no negative impact on the national agricultural wealth, safety of biological diversity, agricultural sector, and life or health of humans, animals or plants in Egypt.
- Has no harmful economic or social effects, does not hamper local agricultural activities, or it appears that its use is compatible with the values and beliefs of the community.

Its cultivation process will be smoothly **approved** with no official or legal obstacles.

Related Regulating Provisions

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(a) has harmful effects on the natural environment, the safety of biological diversity, the agricultural sector, the life or health of humans, animals or plants, in Egypt;

(b) has harmful economic or social effects, hampers local agricultural activities, or it appears that its use is incompatible with the values and beliefs of the community.

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It is prohibited to spray or use pesticides or any other chemical compound for agriculture, public health or other purpose except after observing the conditions, regulations and safety measures laid down in the executive regulations of this Law and in a manner that will not expose humans, animals, plants, waterways and other components of the environment, directly or indirectly, now or in future, to the harmful effects of such pesticides or chemical compounds.

10.6 List of GM Plants approved to introduce in Egypt

We have been confirmed that till this moment, one genetically modified (GM) plant: GM maize for feed has been registered and protected in Egypt. GM cotton has been continuing on field tests towards commercialization. It means that not many but a few plants have been recorded in which the public authorities are requested to approve the introduction of GM plants in Egypt.

According to the interview to the director and staff of The Agricultural Genetic Engineering Research Institute (AGERI), it has not produced any commercial biotechnology crops for food, but Egypt leads the Middle East and North Africa region in the development and acceptance of agricultural biotechnology. The Ministry of Agriculture is a strong supporter of biotechnology. Egypt is a large consumer of agricultural products derived through modern biotechnology and imported from the United States and Argentine. The government continues to maintain a general import policy that allows imports so long as the product imported is also consumed in the countries of origin.

The AGERI has been developing a number of GM products for commercialization by working with leading biotechnology companies and universities in the United States, but still need to resolve some issues to commercialize potatoes and squash; including IPR issues and conducting risk assessment and **food biosafety** analysis. GMO products that AGERI has considered in research are: tuber moth and fungal -resistant potatoes, virus-resistant squash, sugar cane, figs, and tomatoes, corn borer-resistant, drought resistant, fungal resistant maize, and drought-tolerant rice and wheat. However, through collaboration with Monsanto, Cotton Research Institute (CRI) has developed an insect-resistant long-staple GM cotton strain, which is considered the crop #1 for commercialization.

Despite the relatively advanced research and development, Egypt has made in agricultural biotechnology, public awareness about biotechnology is very limited. Egyptian government leaders recognize the importance of biotechnology as a tool for national development. They have set excellence in biotechnology and genetic engineering as a national goal.

In that sense the Egyptian Ministry of Agriculture and Land Reclamation (*Desert Plants Department)* has taken effective steps in cultivating and developing two types of Jatropha varieties in Egypt, namely:

*** Jatropha Curcas** *** Jatropha Integerrima**

Biotechnology Trade and Production:

In referable information depending on GRAIN report Number EG9012 at USDA, genetic engineering programs in Egypt started in 1990. In 1992 a cooperative research agreement was reached between AGERI and ABSP (Agricultural Biotechnology for Sustainability Productivity Project) to develop Egypt's agricultural system and made it more friendly working environment. In 2008, U.S. has decided a comprehensive program to help Egypt to establish a competent authority and to set a system for practical biotechnology applications. Teams of scientists from both Egypt and the United States were established to address specific commodity constraints and policy issues such as biosafety and intellectual property rights, and management and networking within the program.

To date, Egypt has not produced any commercial biotechnology crops for food. Research is conducted on the following crops, which have not yet reached the stage of commercial release:

Yellow varieties of maize, modified for resistance to borers, applying technology produced by two international companies (Monsanto and Pioneer). AGERI has no gene to work with. These were the first GMOs BT maize to be imported into Egypt by the private sector for the purpose of field trials. In April 2007 and after receiving the necessary approvals, Monsanto– through a local company- has planted a variety called Ageeb yellow grain, which is GM corn with Mon 810 to resist corn borers. The GM corn had been planted in four sites (Sids in Kafr El-Sheikh, Nubaria (new reclaimed lands), army farm at Cairo-Alexandria desert road, and El-Gharbia governorate). The company used 960 kilograms of GM imported seeds. The areas cultivated with these varieties varied from 4-80 acres. The small areas were allocated in the old land and the large areas in the newly reclaimed land. The area left around each farm ranges between 15-20 meters. In year 2008 Ageeb yg was the first GM crop to be commercialized in the country. The Egyptian government allowed the importation of about 28 tons of the transgenic corn seeds in to the Egyptian market for the purpose of the use as silage, but in the year 2009 the NBC stopped any more importation of any more transgenic corn seeds from outside the country (mainly south Africa) with the intension of completing the Biosafety framework in the country; yet they allowed the company to plant all the seeds (GM) that was produced locally to be planted in the new reclaimed areas.

The National Biosafety Committee (NBC) was approached by another private sector company in Egypt with the intention of commercializing three corn varieties carrying the same Bt genes as the already approved version (Bt corn-Mon810) for feed in 2009.

Cotton, Egypt may be on the verge of launching the country's first commercially grown genetically modified crop, a strain of cotton that could save the industry millions of pounds every year by boosting output and virtually eliminating chemical crop spraying. AGERI and CRI- both under Agriculture Research Center (ARC)- has found a commercial partner in the Monsanto Company, the US-based producer of the world No. 1 herbicide. The new cotton crop will contain a gene purchased from Monsanto that makes the plants resistant to certain insects, but it will retain its unique Egyptian characteristics in every other respect. The new plants produce the sought-after long staple fibers for which Egypt known. The selection was done by the breeders, making the collaboration a multi-disciplinary approach. The new cottonseeds contain a patented gene. Any future user of the gene must pay a royalty to Monsanto, but advocates say that increased output, along with the amount farmers will save on chemical fertilizers, will cover more than the price of the switchover. In May 2007 and for the first time, field trials of the new long staple cotton varieties namely Giza 86, 89, 90, 91, 96 - had been cultivated under the supervision of AGERI. The mount used is 22 kilograms of cottonseeds planted in two areas: Bani Suief and El-Gemaiza, both are demonstrated plots at ARC working stations, one is 2 acres and the other is 6 acres.

The process for securing commercial release approval for crops genetically engineered outside of Egypt has an added step. The applicant must first obtain a permit for importing the initial seed material from the Supreme Committee for Food Safety (SCFS), Ministry of Health. The permit is then presented to the National Biosafety Committee (NBC) and the Seed Registration Committee (SRC), after which the seed is imported into the country. From this point forward, the remaining steps in the approval are exactly the same as for GMOs developed within Egypt.

Procedures for commercializing GMO crops were established in 1998 by Ministerial decree No. 1648. For varieties produced within Egypt, the process is as follows:

The applicant completes a permit application form providing details of the genetic material introduced, the process used for inserting it, and other relevant information. The applicant also provides data from food and feed safety studies and evidence supporting a determination of low or negligible environment risk. Where applicable, the applicant provides documents indicating approved of similar GMO's for release in their country of origin.

The application is submitted to the NBC, which, after examination and approval, forwards it to the SRC for their preliminary approval to proceed with standard field trials conducted at several locations. The SRC assigns a team of qualified inspectors drawn from relevant ARC units and/or private certified laboratories to supervise cultivation, ensure adherence to any biosafety

requirements, confirm the new phenotype, and evaluate agronomic performance.

The NBC has the right to confirm the nature of the genetic modification by taking samples from the field for molecular analysis.

After successful completion of the field trials and submission of a report to the NBC, the NBC authorizes the applicant to submit an application to the SRC for final approval to commercially release the new variety. Pending this, three-year seasons of agronomic performance trails are conducted under the supervision of the SRC.

Biotechnology Policy:

Responsible government ministries and their role

The Ministry of Agriculture is a strong supporter of biotechnology. An inter-ministerial committee chaired by the Minister of Agriculture is responsible for formulating policy on biotechnology.

AGERI is the main research body of agricultural biotechnology in Egypt. It is a part of the Agricultural Research Center (ARC), which is directed by the Ministry of Agriculture. Although there has been some collaboration with international firms in the private sector, AGERI has relied primarily on its own scientific resources. This explains the relatively slow progress of biotechnology in Egypt. AGERI has been working on a wide range of species, primarily on developing pest and disease resistance and drought tolerance. Species being worked on have included potato, tomato, cotton, corn, fava bean, cucurbits, wheat, banana, and date palm. It has received assistance from USAID in the past and this has encouraged some joint research with U.S. agricultural institutions.

Although Egypt has ratified the Cartagena Protocol, it does not have national legislation on biotech. It has a general government policy regarding the importation of genetically modified crops into Egypt based on law # 53 for 1966. At present, there is no requirement to label GM food products but labeling will be required in the law. AGERI has high creditability with countries of the region in explaining the benefits of biotechnology, and officials from all over the region have been astonished and pleased to learn about Egyptian advances in biotechnology. Egypt is a convincing example of how developing countries will benefit from biotechnology.

The Ministries of Health, Agriculture, and Higher Education and Scientific Research control almost all food policy decisions in Egypt. In addition, the Ministries of Foreign Trade and Industry, Supply and Home Trade, and Finance control the flow of food imports and exports through Egypt.

Ministry of Agriculture: The Ministry of Agriculture is responsible for arranging events and seminars that would explain biotechnology to farmers and to the public. It works closely with the Ministry of Health and is the main authority responsible for food cultivation issues. Within the Ministry, the Central Administration for Seed Testing and Certification (CASC) controls, tests, and registers new plant varieties.

Ministry of Health: The Ministry of Health has different specialized departments and is charged with maintaining and improving the overall health of the population. Its responsibilities include: approving all food products for sale in Egypt, supervising food quality, regulating the use of preservatives in foods, and ensuring that products are labeled properly with expiration dates.

The ministry has mainly the following committees and organizations:

The Supreme Committee for Food Safety ensures the safety of food production and consumption and controls food import permitting.

Ministry of Foreign Trade and Industry (MOFTI): The ministry executes its activities through the following organizations:

The Egyptian Organization for Standardization and Quality Control (EOS) sets the standards for food and industrial products whether imported or locally produced.

The General Organization for Export and Import Control Authority (GOEIC)

Ministry of Environment: The Egyptian Environmental Affairs Agency ensures implementation of the Environmental Protection Law in Egypt. MOE is the focal point for the implementation of Cartagena protocol.

Ministry of Higher Education and Scientific Research: The ministry plays a complementary role to the Ministry of Agriculture. They both feed information to the Ministry of Health. If technology appears to be harmful, the ministry would oppose it. The main research body of the ministry is the National Research Center (NRC). The center arranges regular seminars that are attended by officials in government agencies.

Ministry of Supply and Home Trade: Controls the flow of imports and exports through Egypt, and has significant influence on the movement of GM food and agricultural products.

Role and membership of biosafety committee

Egypt has a fairly advanced biosafety system, and it has ratified the Cartagena Protocol. In 1995, the Ministry of Agriculture formally instituted Egypt’s national biosafety system. A National

Biosafety Committee (NBC) was established and includes representatives from the ministries of agriculture, education, industry, health, environmental affairs, private sector, policy makers, and consultants knowledgeable in policy and applicable laws, and non-technical members. The initial committee consisted of 10 members. Subsequent appointments expanded membership to 30. Current members include seven representatives from the ministries of Agriculture, Health, Environment, Industry, and Commerce; one representative from the Egyptian Academy of Science and Technology; 12 members from academic institutions; one attorney, eight people from government research institutes, and one seed expert. Based on area of expertise, members are appointed to one of three subcommittees that specialize in agriculture (crops), environment (biopesticides, biofertilzers, agents for bioremediation), and health (pharmaceuticals, human, and veterinary vaccines).

The committee is responsible for ensuring the safe use of biotechnology products and facilitating access to modern biotechnology generated abroad. The system involves several ministries, organizations, and government agencies involved with the importation, exportation, and local production of natural products. The committee establishes policies and procedures to govern the use of modern biotechnology. This includes publishing the National Biosafety Committee guidelines (NBC guidelines) to be followed at the national level. The committee also provides technical advice to the regulatory authorities and institutions responsible for the development of biotechnology in Egypt. The guidelines describe the modalities of use, handling, transfer, and testing of GMOs. They address laboratory practices, greenhouse containment, and small-scale field-testing.

Duties of the committee include formulating, implementing and updating biosafety guidelines, conducting risk assessment, issuing permits for field trials, coordinating with national and international organizations. The biosafety guidelines are not legally binding. They have only advisory status. There are no details regarding review, decision making, and reporting processes, and they have not been well publicized within the country. Nevertheless, the guidelines have functioned since 1995, with 56 approval and renewal (about 50% each) for small-scale field trials issued and several GM crops moving toward placing on the market.

There is also an Institutional Biosafety Committee (IBC). The NBC requires that all institutions conducting R-DNA research assemble an IBC. The IBC is responsible for insuring that the R-DNA is carried out in full conformity with the provision of the NBC guidelines. The IBC may establish additional procedures as deemed necessary to govern its institution’s activities. The IBC designates a biologic safety officer (BSO) that meets the requirements of NBC and who should be familiar with biosafety.

Political factors that may influence regulatory decisions

Egyptian government leaders recognize the importance of biotechnology and have set excellence in biotechnology and genetic engineering as a national goal. The Egyptian government made a strategic decision that the first commercialized GMOs would be products of Egypt's AGERI/NRC, rather than imported products grown commercially in their country of origin. In this way, the public's introduction to biotechnology intends to be in the form of preferred local varieties engineered to overcome local diseases or pests problems-products developed at home to benefit Egyptian farmers, growers and consumers.

Problems cited for the slow passage of GM crops to commercial stage include the lack of capacity to negotiate licenses to use genes and research techniques patented by others, especially for crops with export potential. In addition, there are difficulties in meeting regulatory requirements and a lack of effective public commercialization modalities and working extension networks. One of the problems is the lack of a dynamic private sector to take technologies to the farmer. It has also been estimated that regulatory costs might exceed the costs of research and experimentation needed to develop a given GM crop, which is the major problem in releasing such crops to the market.

Comparing with GM crops or feed, GM Jatropha is able to be plant with low cost under the Egypt –JICA project, because plantation of GH Jatropha would not target many individual small farmers, but a few relatively big companies.

Environmental requirements

Egypt has no required environmental tests for GMO products. In addition to field testing, an environmental risk assessment in the country is required by NBC for any ready to be commercialized crops or plants.

Field-testing of biotechnology crops

A standard permit application form is used to request NBC approval of a proposed greenhouse study or field test. Upon submission of the application, all members of the appropriate subcommittee are given copies, and one member is designated the principal investigator. The principal investigator, who may consult with other subcommittee members, is assigned to thoroughly review the application, visit the field test location, inspect the facilities, and submit a report to the NBC. The proposed release is then discussed at a meeting of the full NBC, where a decision is made to issue or deny the requested permit. When a committee member is the applicant or had been involved in the research leading to the GMO to be considered, that member does not vote on the application.

Applications for field-testing genetically modified plant material are submitted to the chair of the NBC. Genetically modified material to be imported requires an import permit that must be obtained in advance from the Supreme Committee on Food Safety, Ministry of Health and Population.

Requests should be made a minimum of eight weeks prior to the proposed initiation of the importation or field test.

The NBC, as the lead agency, sends duplicate copies to secondary agencies for their assessment (i.e. Supreme Committee on Food Safety), as applicable. Reviews from the secondary agencies are returned to the NBC, and a final assessment is performed. From this, a decision is made whether to authorize the field test. Mitigation procedures are taken to protect confidential information, such as exact trial sites, plasmid maps, and exact genetic change. Other information may initially be designated confidential; however its confidentiality is subject to provisions in the Access to Information and Privacy Act. Field-test permit applications must describe the plant species modified to exhibit a specific trait, to be tested at a specific location in a specific year.

In Egypt, approval by the NBC to conduct a field test does not require the applicant to submit a report at its conclusion. During seed registration trials, an appointed team of inspectors carries out monitoring. As the purpose of the trial is to evaluate variety performance, monitoring is conducted primarily to ensure compliance with biosafety requirements, not to collect biosafety data.

The biosafety system was developed in a way in which components are added only as they become necessary. For example, testing requirements for GMO seed certification were not clarified until the first applications for commercial release were submitted to SRC.

Table 10-1 shows the names of crops which are under field trials.

Table 10-1 GMO Crops Under Isolated Field Trials

Cotton	Banana
Wheat	Sugar Cane
Maize	Squash
Potato	Cucumber
Melon	Tomato
Water melon	Recombinant DNA construct

10.7 Possibility and recommendation on the introduction of GM Jatropha to Egypt

Based on our survey for the possibility of introducing a new GM Jatropha to Egypt supported with the technical opinions raised by highly qualified professionals in this field; the following result is being concluded:

Overall Result		
Possibility of Introduction in Egypt	**Possible**	**Not possible**
Detailed Results	√	

❖ **Registrability**:

The Jatropha seeds or plants are registerable according to the IP Law no. 82 of 2002, and based on the current regulations adopted at the Egyptian Ministry of Agriculture and Land Reclamation, which clearly stipulate that **any new** plant variety is introduced to Egypt and an application for registering or protecting the same has been filed at the competent authority (*even not listed in the table of plant species whose varieties are protectable under Law No. 82 of 2002 and the Executive Regulations thereof – Article II of the* ***Ministerial Decree No (807) of 2005***). An official request is being raised to the Minster in order to issue a fresh Ministerial Decree approving the same and to be added in the aforementioned table of species (*i.e. this case had happened for Raspberry which was not listed in the table, thus a Ministerial decree was issued approving the same immediately*)**.**

Thus, Registerability of GM Jatropha in Egypt is acceptable and guaranteed by the Law.

❖ **Acceptance of Entry**:

As mentioned in our previous chapter, the **safety** is the main concern to the Egyptian Government; and once the plant, seeds, or agricultural product is confirmed to be:

- Free of any harmful pests.

- Has no negative impact on the national agricultural wealth, safety of biological diversity, agricultural sector, and life or health of humans, animals or plants in Egypt.

- Has no harmful economic or social effects, does not hamper local agricultural activities, or it appears that its use is compatible with the values and beliefs of the community.

Its entry and cultivation process will be smoothly **approved** with no official or legal obstacles.

❖ **Governmental Tests and Examinations**:

Also as mentioned in our previous chapter, there are no special steps for examining or analyzing the Genetically Modified plants in Egypt.

Rather, the relevant tests and laboratory analysis will be conducted jointly by the following authorities so as to ascertain whether or not these new seeds or plant products are safe for cultivation and circulation in Egypt:

* The CAAQ's analytical laboratories
* Horticultural Research Institution
* Plant Preservation Research Institution
* Plant Disease Research Institution

Thus, the **Test Reports** issued by the mentioned authorities for Plant **Quarantine** purposes are **inclusively** the same reports for the purposes of introduction of new GM plants into Egypt.

In other words, safety measures (*which is the main concern*) are applied for both purposes, and once being approved by the Central Administration of the Agricultural Quarantine (**CAAQ**) & the Crop Seeds Committee, the GM plant will be approved to be entered into Egypt safely.

The committee is responsible for ensuring the safe use of biotechnology products and facilitating access to modern biotechnology generated abroad. The committee establishes policies and procedures to govern the use of modern biotechnology. The committee also provides technical advice to the regulatory authorities and institutions responsible for the development of biotechnology in Egypt.

Applications for field-testing genetically modified plant material are submitted to the chair of the NBC. The NBC sends duplicate copies to secondary agencies for their assessment (i.e. Supreme Committee on Food Safety), as applicable. Reviews from the secondary agencies are returned to the NBC, and a final assessment is performed. From this, a decision is made whether to authorize the field test.

❖ **Governmental Support:**

We have been confirmed by **Dr. Al Muafy Abdo** that the Egyptian Government will highly support any Jatropha variety introduced in Egypt (especially from the JICA & JDI) with all available resources:

a) Human resources – e.g. engineers, pilots, farmers, etc…
b) Scientific resources – e.g. laboratories, researches, etc…
c) Equipment – e.g. refrigerators, coolers, stores, etc…

It is worth mentioning that **Dr. Al Muafy Abdo** has expressed his ultimate pleasure to share your valuable research and assist JDI and Nagoya University on this project, and to further assist the introduction of any new Jatropha seeds or plants to Egypt; he declared his full pleasure and consent to grant all his support, experience and time for this esteemed project in Egypt.

10.8 Recommendations

A. Generally, it is recommended to introduce **already genetically modified** Jatropha seeds (*i.e. whose genetic modifications have been processed and examined abroad*), and not to undertake the genetic modifications inside Egypt. The technical reason for this recommendation is that the Egyptian scientific laps for testing and analyzing such type of genetic modifications are still developing, though AGERI has been developing some GM crops.

B. It is advisable to share the Egyptian Government with the available scientific points related to the development of Jatropha varieties; since it is a highly strategic product and the best we can launch a fruitful cooperation with the Egyptian Government the smoothest course will be adopted to approve and support introductory of the Jatropha varieties in Egypt (*e.g. such as providing the Gene Bank continually with samples of the Jatropha GM seeds*).

C. It is also much advisable to build an excellent relation with the "**Central Administration for Foreign Agricultural Relations**." That committee is dedicated to build good relations with foreign governments & foreign scientific institutions with respect to relevant agricultural issues (www.far.malr.gov.eg).

Address: Dokki, Giza, Egypt
Tel: (+202) 33373616
(+202) 37625913
(+202) 37603155
Fax: (+202) 33374195
E-mail: info@far-malr.gov.eg

D. It is also **recommended** to build a good relation with the "**DNA Research Institution**" in order to ease the procedures of introducing a GM plant in Egypt; since it will be the first recorded case to introduce a foreign GM seed or plant into Egypt (www.arc.sci.eg).
Address: 9 Gamaa St., Giza 12619, Egypt
Tel: (+202) 35734424
(+202) 35727831
(+202) 01001435990
Fax: (+202) 35731574

E. Also a business contact is advisable with the National Biosafety Committee (NBC.

CHAPTER IV
Examination of Commercial Viability and Pilot Plantation Development

CHAPTER IV Examination of Commercial Viability and Pilot Plantation Development

11. Proposed Commercial Plantation Model and Its Commercial Viability

11.1 Conceptual Design of Commercial Plantation and Its Costs

11.1.1 Productivity of Jatropha

For the economic viability of a commercial Jatropha plantation, the productivity of Jatropha cultivation is a crucial factor since it directly influences the revenue of the plantation project. Therefore, it is recommendable to use newly developed high-yield varieties to achieve one of the highest yields. Currently the world average productivity of Jatropha is estimated at around 1ton/ha, while new varieties are estimated to reach 3.0 to 5.0 tons/ha. The table below shows one of the high yield variety recently developed in Singapore.

Table 11-1 Estimated Productivity of Jatropha New Variety

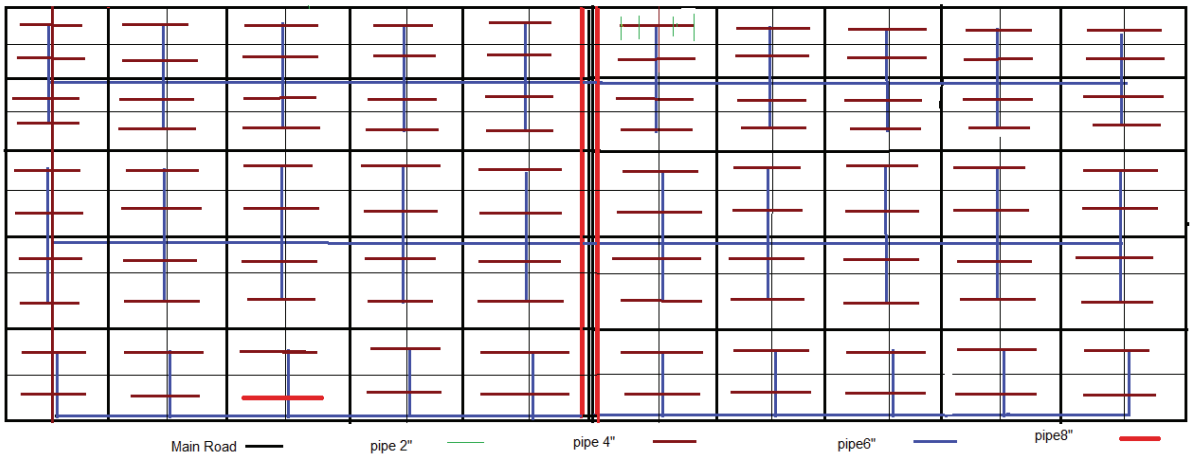
	year1	year2	year3	year4	Year 5- 15
Productivity (ton/ha)	0.5	2.4	5.2	5.2	5.2

(Source: JOIL (2012) “Improving Jatropha Plantation”, Study team (2012))

11.1.2 Scale of Commercial Plantation

Developing a commercial plantation in desert environment involves a large initial investment for the construction of basic infrastructures such as irrigation system, road and power. In order to maximize the return from the investment, the size of the plantation needs to be large enough. In the desert area of Egypt, the normal size of commercial plantations ranges from 1,000 to 5,000 feddan. Therefore, it can be assumed that the minimum standard size of a commercial plantation is 1,000 Feddan. The study team proposes a conceptual design of the irrigation infrastructure for a 1,000 fed commercial Jatropha plantation as below.

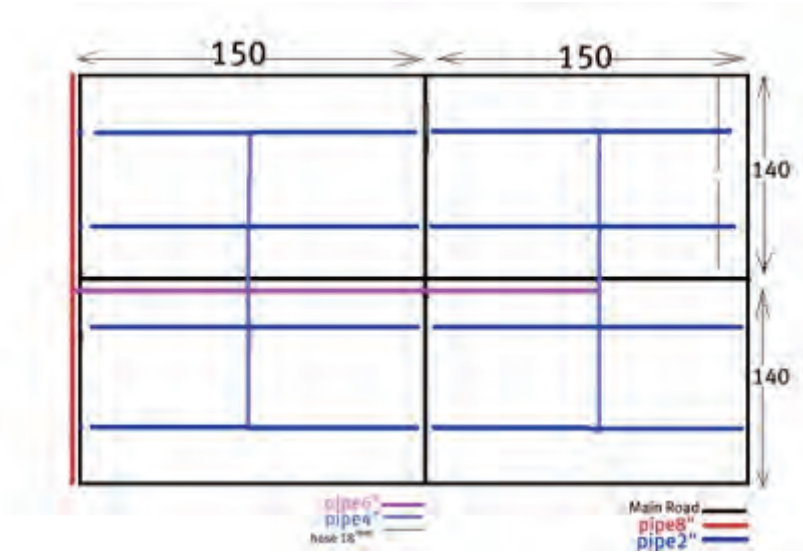
Figure 11-1 Conceptual design of 1000 feddan Jatropha Plantation (Overall)



(Source: Study Team (2012))

One basic unit (20 feddan) of the irrigation infrastructure for the 1,000 fed plantation is shown below.

Figure 11-2 Conceptual design of 1000 feddan Jatropha Plantation (Unit Plot)



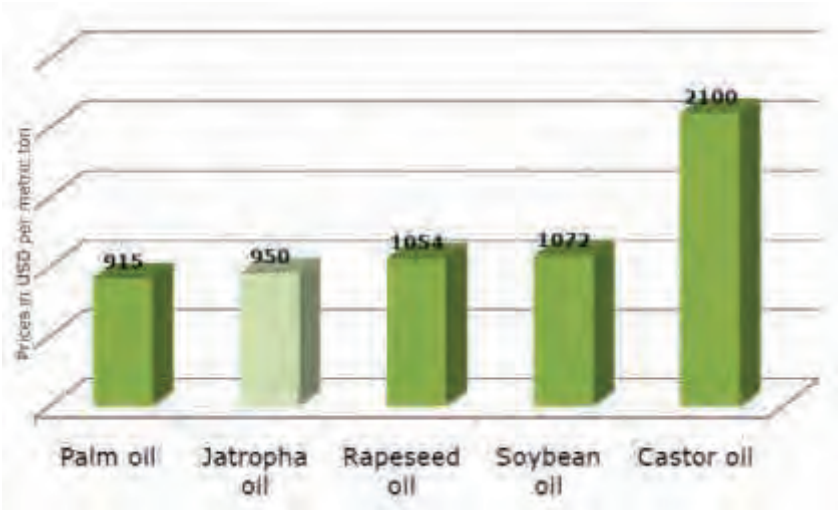
(Source: Study Team (2012))

11.2 Potential Sales Value of Jatropha Biofuel

The global Jatropha market is still in the early developmental stage. There is no stable and globally recognized price indicators at present. According to sources of Jatropha oil industry, the price range of Jatropha crude oil in recent years is USD800-1,500/ton. One indicative price provided by an trading company based in Rotterdam, which is an international trading center of vegetable oils for EU countries, is shown in the figure below.

According to this figure, a Jatropha price was between palm oil price and rapeseed price in September 2010.

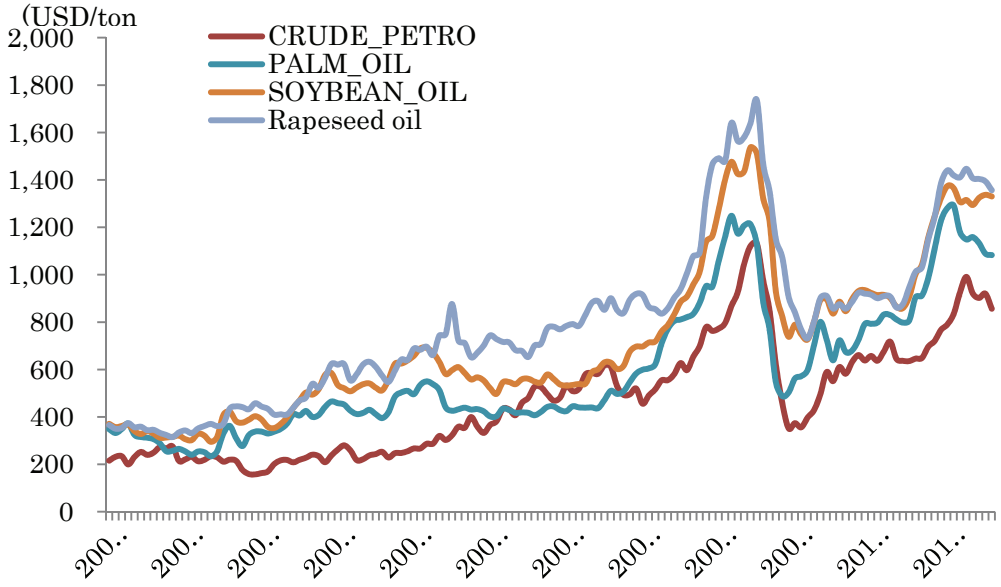
Figure 11-3 Vegetable Oil Price Indications (CIF or Ex-Work)(Sep. 2010)



(Source: BFP International B.V. (2010) “International trade and logistics of Jatropha oil”)

As of February 2012, the price of Palm oil was USD 1,106/ton (CIF, Europe) according to World Bank, while the price of Rapeseed oil was USD 1,299/ton (FOB Rotterdam) according to IMF. Therefore, an estimation of the present Jatropha crude oil price can be made at around USD 1,200/ton, assuming that the Jatropha oil price is in the middle of the two oil prices. For the future price trend of Jaropha oil, we estimate it based on a future projection of the petroleum crude oil price as most of the prices of the vegetable oils have historically correlated closely with the petroleum crude oil price, as is shown in the figure below.

Figure 11-4 Price trend of Vegetable Oil and Petroleum Crude Oil



(Source: World Bank, IMF (various years))

Based on an IEA's projection of future petroleum crude oil price up to 2030, a future price of Jatropha oil is estimated as in the table below.

Table 11-2 Expected Jatropha Cake Price as Fertilizer (USD/Mt)

	2010	2015	2020	2025	2030
Jatropha oil Price	950	1,065	1,314	1,554	1,829
Jatropha seed Price	190	213	263	311	366

(Source: IEA (2008) "World Energy Outlook", BFP International B.V. (2010) "International trade and logistics of Jatropha oil", Study Team (2012))

11.3 Potential Sales Value of Seed Cake

11.3.1 Potential Sales Value of Seed Cake

(1) Global Seed Cake Trend

Oil seed cakes (meals) can be classified in to two groups. One group is edible oil seed cakes and the other group is inedible oil seeds cakes. The edible oil seed cakes are normally utilized as ingredients of animal feeds and their price mainly depends upon their protein content. The inedible oil seed cakes are mainly utilized directly as organic fertilizers or as ingredients of compost and their prices mainly depend upon the nutrient contents such nitrogen, phosphorus etc. Jatropha cakes are not edible and the nutritional values are similar to those of castor seed cakes. The table below

shows the nutrient contents of different oil seed cakes. At present, the market of Jatropha cakes are not well established in the world due to its limitation in supply and therefore there is no publicly announced price information. This study assumes that castor cake price is a benchmark of Jatropha cake price.

Table 11-3 Nutrient contents of oil seed cakes

Oil cakes	Nitrogen	Phosphorus	Potassium
(a) Non edible cakes			
Jatropha cake	3.2-4.4	1.4-2.1	1.2-1.7
Castor cake	5.5-5.8	1.8-1.9	1.0-1.1
Mahua cake	2.5-2.6	0.1-0.9	1.8-1.9
Karanj cake	3.9-4.0	0.9-1.0	1.3-1.4
Neem cake	5.2-5.3	1.0-1.1	1.4-1.5
Safflower cake	4.8-4.9	1.4-1.5	1.2-1.3
(b) Edible cakes			
Coconut cake	3.0-3.2	1.8-1.9	1.6-1.7
Cotton seed	6.4-6.5	2.8-2.9	2.1-2.2
Groundnut cake	7.0-7.2	1.5-1.6	1.3-1.4
Linseed	5.5-5.6	1.4-1.5	1.2-1.3
Sesame cake	6.2-6.3	2.0-2.1	1.2-1.3

(Source: www.inseda.org, http://etd.uasd.edu/ft/th9732.pdf)

(2) Egyptian Seed Cake Trend

The oil seed cake markets in Egypt are dominated by cotton cakes and soybean cake, which are used for animal feeds. The markets of cotton and soybean cakes are well established and it is easy to collect their price information from local cake producers. However, the supply of inedible oil seed cakes is still quite limited in Egypt and their referable prices are difficult to obtain in Egypt. Therefore, we collected some example prices for castor cake and Jojoba cakes from a few local industry sources based on their past selling record.

Table 11-4 Local Prices of Oil Seed Cakes

	Inedible		Edible		
	Castor	Jojoba	Sesame	Cotton	Soybean
Local Price (LE/ton)	700	500-700	1700	1800-2200	2000-2500
USD/ton	117	83-117	283	300-367	333-417

(Source: Local oil producers (2012))

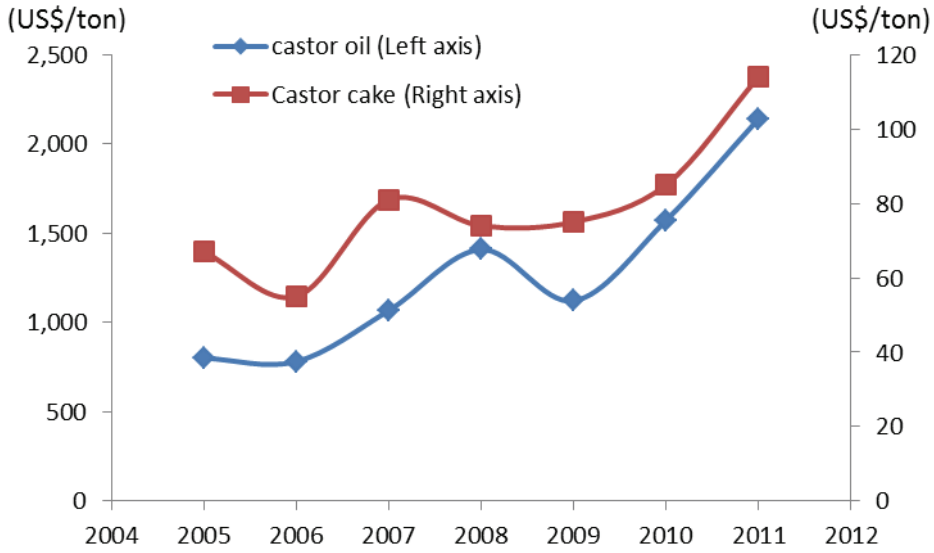
11.3.2 Possible future Jatropha Seed Cake sales price

(1) Use as Organic Fertilizer

For this study, the future price of Jatropha cake is estimated based on the correlation between castor cake price and crude petroleum price as is shown below.

Firstly, the castor cake price is closely correlated to the price of castor oil.

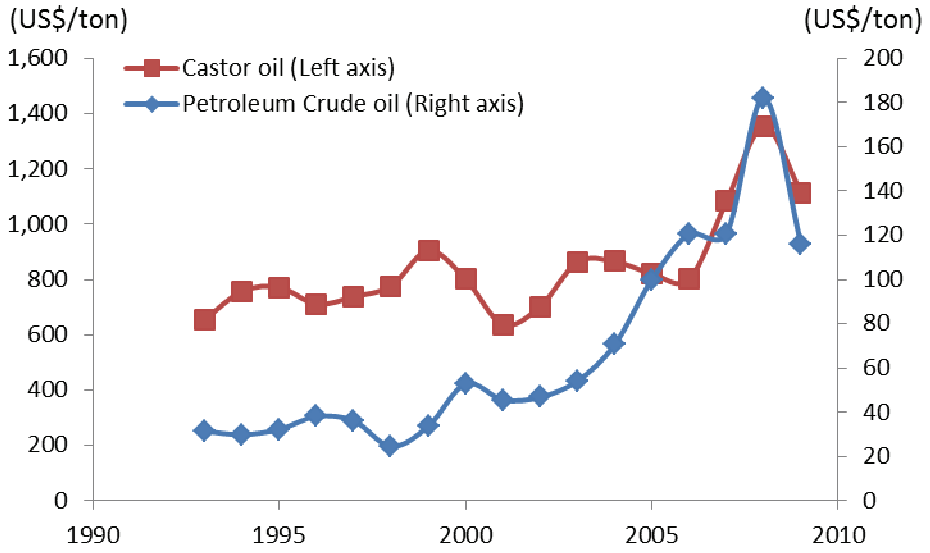
Figure 11-5 Correlation between Castor cake and oil prices



(Source: Solvent Extractors' Association of India (2012))

Secondly, the castor oil price is correlated to the international price of crude petroleum oil price through fertilizer markets.

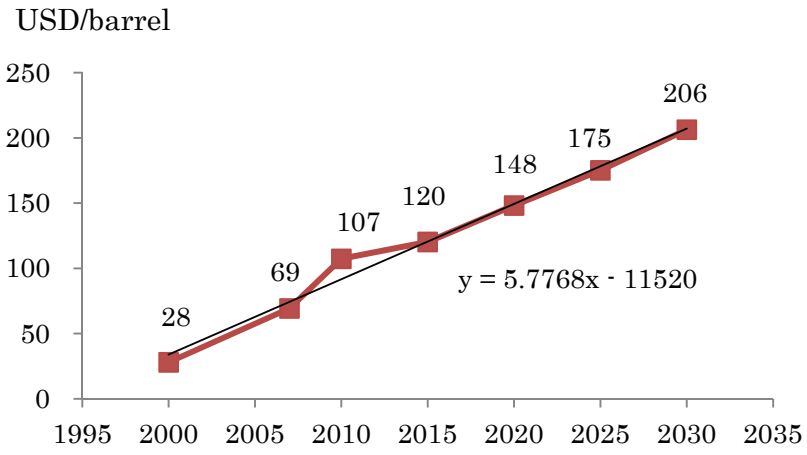
Figure 11-6 Correlation between Crude Oil Price and Castor Oil Price



(Source: FAOSTAT, IMF (various years))

According to the World Energy Outlook of IEA, the crude oil price is estimated to increase gradually up to USD 206 in 2030.

Figure 11-7 Forecast of Crude Petroleum Oil Price up to 2030



(Source: IEA (2008) “World Energy Outlook”)

Based on the above correlations, the future Jatropha cake price as organic fertilizer was estimated as below.

Table 11-5 Expected Jatropha Cake Price as Fertilizer (USD/Mt)

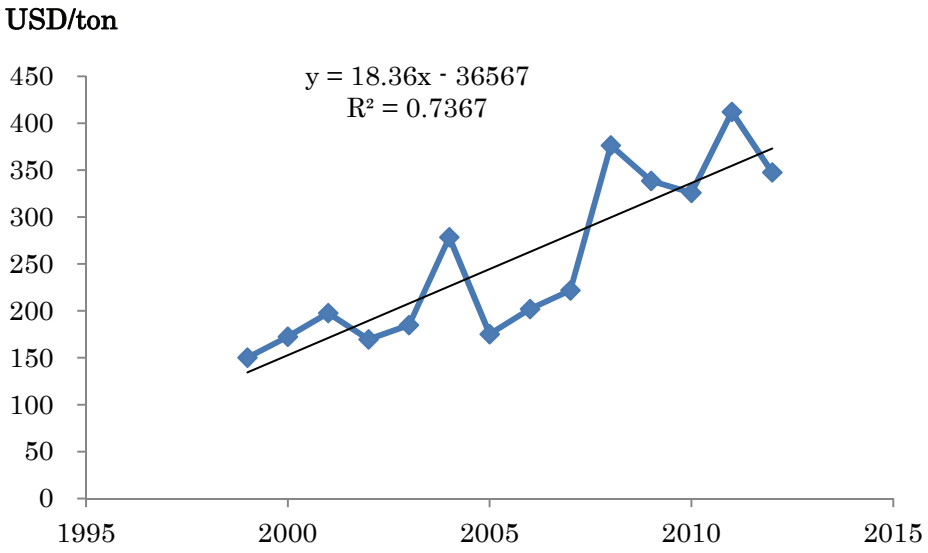
	2015	2020	2025
Jatropha Cake Price	96	119	141

(Source: Study Team (2012))

(2) Use as Animal Feed

Due to its toxicities, especially phorbol esters, Jatropha cake has not been used for animal feeds. However, research activities on de-toxification of Jatropha cakes have been actively conducted globally in the past decade and new technologies have been being developed. Already one patent for the detoxification has been registered in UK. Therefore, it can be reasonably assumed that the practical application of Jatropha cake for animal feeds may start from 2020. The protein content of Jatropha cake is 22-24 % while that of soybean cake, which is the most typical seed cake commodity in the international market, is 48%. Soybean cake price in the past 5 years is USD200-400/ton. Therefore, the Jatropha cake price is estimated based on the protein content and soybean cake price trend. The past price trend of soybean cake is shown in the figure and approximate equation below.

Figure 11-8 Soybean cake price trend in international market



(Source: IMF (various years))

For this study, the price of Jatropha cake as animal feeds is estimated by halving the price of soybean cake. Using the approximate equation above, the estimated Jatropha cake price was calculated as below.

Table 11-6 Expected Jatropha Cake Price as Feeds (USD/Mt)

	2020	2025	2030	2035
Jatropha Cake Price	260	306	352	398

(Source: Local oil producers (2012))

11.4 Financial Analysis of Proposed Plantation Model

In order to analyze the financial feasibility of a commercial scale Jatropha plantation project, which is expected in near future, we calculated the internal rate of return (IRR), a commonly used cash flow analysis to clarify whether a project is profitable enough compared to a conservative interest benchmarks such as long-term public interest rates. Theoretically, it is worth to invest if the IRR is higher than such benchmarks. In general, the benchmark is higher in developing countries and lower in developed countries. However, the benchmarks are commonly set between 10 and 20 % depending on the countries' situation. In Egypt case, based on the discussion with private business representatives, benchmarks would be between 15 and 20% depending on the type of the project and location, etc. If the risk of a project is lower, the benchmark is also lower. For the Jatropha plantation, there are few good practices so that it would be considered as a higher risk project. Since the IRR does not consider the cost of borrowing money and inflation to exclude the uncertainties, the actual profits are usually lower than IRR cash flows. Thus, we consider 20% as the bench mark of an Egyptian Jatropha biofuel plantation project. The table below is the basic assumptions for the analysis.

Table 11-7 Basic Assumptions for Commercial Scale Plantation in 2020

Item	Value	Remarks
Initial year	2020	With technical improvement and policy development as well as the commercially viable price of crude oil price
Project Life	15 year	Considering internal rate of return (IRR) for 15years
Size of the Plantation	1,000 feddan (400ha)	Due to the MALR's experiences, 1,000 feddan would be the minimum scale of the plantation to cost effectively develop the plantation 1 ha = 2.5 feddan
Seed Productivity	2.1 t/feddan-y (5.2t/ha-y)	Present Luxor level, without high yield breading
Jatropha Trees	640 tree/feddan (1,600 tree/ha)	Planting density: 2.5m x 2.5m
Oil Recovery Rate (ORR)	25%	Percentage of recoverable/convertible weight of Jatropha oil:
Land Lease	0 LE/feddan-y (US$0/ha-y)	Profit sharing scheme is assumed.
Treated Wastewater	0 LE/m^3 (US$0/$m^3$)	Profit sharing scheme is assumed.
Corporate Tax	0%	20year exemption, due to Law No. 8 of Investment

Item	Value	Remarks
		Incentives, renewable energy or Upper Egypt development related project shall be applicable
Jatropha Oil Price in 2020	LE 7,236/t (US$1,200/t)	Price of biofuel feeds for refinery = Value of extracted vegetable oil price including Jatropha oil + CO_2 premium
Jatropha Seed Sales	1,440 LE/t (US$240/t)	80%* of Jatropha vegetable oil price x ORR(25%) * 100 - 80% = 20% profits is typically feasible for oil extraction business

11.4.1 Cash Out

(1) Initial Investment

Based on the latest cost information collected from local suppliers and contractors, we examined expected costs for initial investment for a 1,000 fed plantation. The main part of the initial investment is the cost of the construction of an irrigation system for the plantation.

Table 11-8 Irrigation Infrastructure Cost for 1000 fed

Item	Quantity	Unit rate (LE)	Cost (LE)
Pipe 12"	5000 m	115	575000
Pipe 8"	3000 m	37	111000
Pipe 6"	18450 m	26	479700
Pipe 4"	10500 m	15	157500
Pipe 2"	28000 m	4.8	134400
T 8/6"	10	85	850
Elbow 6"	120	73	8760
Valve 6"	50	90	4500
T 6"	50	64	3200
Push 6"	100	35	3500
T 6/4"	50	20	1000
Cross 6/4	50	25	1250
Cross 4/2	200	15	3000
T 4/2	200	17	3400
Elbow 45/2"	800	4.25	3400
Male 63/2"	800	4.25	3400
Elbow 2"	800	10	8000
Elbow 18mm	300	7	2100
Starter 18mm	300	8.5	2550
Rubber 18 mm	300	7	2100
Pipe closure 18mm	300	6	1800

Item	Quantity	Unit rate (LE)	Cost (LE)
Connection 18mm	150	6	900
Glutinous	150 k	45	20250
Teflon	50	25	1250
Hose 18 mm	850000 M	0.36	306000
Digging	60000 m	2	120000
Work Manship	1000 Feddan	250	250000
Pump + Motor	2	24590	49180
Filter Station			80000
TOTAL		25,587	2,337,990

(Source: Local suppliers (2012))

The total initial investment cost including the irrigation system is summarized in the table below and is LE 6,513/fed (1,080USD/fed).

Table 11-9 Initial Investment for 1000 fed plantation

	Quantity (for 1000fed)	Unit cost (LE/unit)	Cost (LE/1000fed)
Seedlings (tree)	538,080	3	1,614,240
Land preparation (fed)	1,000	1,816	1,271,215
Planting(fed)	1,000	1,080	756,000
Irrigation system (fed)	1,000	2,338	2,338,000
Agricultural instruments (set)	200	272	54,400
Dehulling machine	10	12,000	120,000
Tractor (Romania, 80HP)	2	80,000	160,000
Warehouse (Storing seeds)	200	1,000	200,000
Total			6,513,855

(Source: Local suppliers (2012), Study team (2012))

(2) Operation and Management

Based on the latest cost information collected from local suppliers and contractors, we estimated the operation and maintenance (O&M) cost of the 1,000 fed Jatropha planation as below. The O&M cost is LE 2,118/fed (USD351/fed).

Table 11-10 Operation and Management Cost Per Fed (LE/fed)

Per Fed Cost (LE/fed)	Year 1	Year 2	Year 3 and after
Labor for fertilizer application(MD)	29	29	29
Labor for weeding(MD)	29	29	29
Labor for irrigation	29	29	29
Labor for harvesting	420	1,140	1,225
Labor for dehulling and drying seeds (LE/ton)	5	23	49
Cost of Fuel for Dehulling (LE)	2	8	18
Cost of chemical fertilizer(Urea)	240	240	240
Cost of chemical fertilizer(SP)	132	132	132
Cost of chemical fertilizer(K2SO4)	140	140	140
Cost of chemical fertilizer(Micro-elements)(kg)	45	45	45
Sub-total	1,070	1,815	1,935

(Source: Study Team (2012), Local suppliers (2012))

(3) Cost of Treated Wastewater and Land Lease

The price of treated wastewater (to be set by HCWW) and the government's land lease fee for Jatropha and inedible oil development projects should be set at low levels in order to attract private investors into this sector. At present, investors would be reluctant to invest in this new sector due to uncertainties of the new industry such as future productivity. In this situation, the investment will not go smoothly if the Egyptian government wishes to enjoy upfront profits from the beginning. In the Petroleum and gas industry in the world, the concept of "profit sharing" can be applicable. Likewise this concept can be applied in this new inedible oil industry development so that the land and wastewater will not be charged until the profit of a new project comes up and the profit will be shared between private investors and the local government. Under the assumption of the profit sharing scheme, we set the cost of land and water at zero. For example, the price of treated wastewater is currently set at zero LE/ton for MALR's "Man Made Forest" Project.

11.4.2 Cash In

Seed sales is the only cash in for this simplified analysis. Sales price of the Jatropha seed in 2020 would be 1440 LE/t (US$240/t) so that the expected income would be as follow.

Table 11-11 Cash In

Project Year	2020	2021	2022	2023-34
Cash In (1,000 LE/y)	**634**	**1,901**	**4,118**	**4,118**
Seed Sales (1,000 LE/y)	634	1,901	4,118	4,118
Seed Sales (1,000 US$/y)	105	315	683	683

(Source: Study Team (2012))

11.4.3 Cash Flow and IRR

The balance of the cash-in and cash-out is shown below. An annual income of LE 2,518,000 will be obtained from Year 3.

Table 11-12 Cash Flow of the Base Case with Existing Condition (LE 1,000)

Project Year	Year 1	Year 2	Year 3	Year 4-15
Cash Flow/Balance	**-7,229**	**178**	**2,518**	**2,518**
Cash Out	7,863	1,723	1,600	1,600
Cash In	**634**	**1,901**	**4,118**	**4,118**

(Source: Study Team (2012))

As a result, a financial IRR of 27% is calculated while the net present value (NPV) is calculated at LE 56,074,000.

Table 11-13 IRR and NPV of the Base Case with Existing Condition (LE 1,000)

	(USD, %)
Initial Investment	**30,385**
IRR	27%
Annual Income	2,518
NPV	8,360
Total Income (15 years)	56,074

(Source: Study Team (2012))

11.4.4 Sensitivity Analysis

A result of the sensitivity analysis is shown below, allowing plus and minus 50% change in revenue and cost. As we have seen above, the price of Jatropha oil and cake are most likely to increase due to the expected increase in petroleum oil price in the global market. Even in the case of a 15% deceased revenue (seed sales), the IRR will be over the long term Egyptian Treasury Bond (5-7years interest rate) of 16-17%, which is considered as the minimum requirement for long term

investment for both public and private sectors (http://www.cbe.org.eg/treasury_bonds.htm). Likewise, the IRR will be over the benchmark in the case of the 20% cost increase.

Table 11-14 Sensitive Analysis of the Seed Sales Price and Cost for Option 2

										Seed Sales			1,440		LE/t			
26.7%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	100%	105%	110%	115%	120%	130%	140%	150%
150%	#NUM!	#NUM!	-23.9%	-13.3%	-7.9%	-4.0%	-0.8%	2.0%	4.6%	6.9%	9.0%	11.1%	13.0%	14.9%	16.7%	20.2%	23.5%	26.7%
140%	#NUM!	#NUM!	-14.3%	-8.2%	-4.0%	-0.5%	2.4%	5.1%	7.5%	9.8%	11.9%	14.0%	15.9%	17.8%	19.7%	23.3%	26.7%	30.1%
130%	#NUM!	-15.6%	-8.6%	-4.0%	-0.3%	2.8%	5.6%	8.2%	10.6%	12.9%	15.0%	17.1%	19.1%	21.1%	23.0%	26.7%	30.4%	33.9%
120%	-17.3%	-9.1%	-4.0%	0.0%	3.3%	6.3%	9.0%	11.6%	14.0%	16.2%	18.5%	20.6%	22.7%	24.7%	26.7%	30.7%	34.5%	38.3%
110%	-9.6%	-4.0%	0.3%	3.9%	7.1%	10.0%	12.7%	15.2%	17.7%	20.0%	22.3%	24.6%	26.7%	28.9%	31.0%	35.2%	39.3%	43.4%
100%	-4.0%	0.7%	4.6%	8.0%	11.1%	14.0%	16.7%	19.3%	21.9%	24.3%	**26.7%**	29.1%	31.4%	33.8%	36.0%	40.6%	45.0%	49.5%
90%	1.1%	5.3%	9.0%	12.4%	15.5%	18.5%	21.3%	24.1%	26.7%	29.4%	32.0%	34.5%	37.0%	39.6%	42.1%	47.0%	51.9%	56.9%
80%	6.3%	10.3%	14.0%	17.4%	20.6%	23.7%	26.7%	29.7%	32.6%	35.5%	38.3%	41.1%	43.9%	46.7%	49.5%	55.0%	60.6%	66.1%
70%	11.9%	15.9%	19.7%	23.3%	26.7%	30.1%	33.4%	36.7%	39.9%	43.1%	46.3%	49.5%	52.6%	55.8%	59.0%	65.3%	71.7%	78.2%
60%	18.5%	22.7%	26.7%	30.7%	34.5%	38.3%	42.1%	45.8%	49.5%	53.2%	56.9%	60.6%	64.3%	68.0%	71.7%	79.2%	86.9%	94.6%
50%	26.7%	31.4%	36.0%	40.6%	45.0%	49.5%	53.9%	58.3%	62.8%	67.2%	71.7%	76.2%	80.8%	85.3%	90.0%	99.3%	108.9%	118.7%

(Source: Study team (2012))

Although the IRRs estimated here are conservative, it should be noted that we set assumptions of (1) free water and land, (2) no bank borrowing (own capital only). Therefore, it is still needed to promote public intervention and support for the development of the Jatropha biofuels.

11.5 Recommendation of Pilot Project and Commercial Viability Test for the PPP Project Development

- New high yield varieties of Jatropha are expected to reach 4 to 5 ton/y and the price of Jatropha oil is expected to be $1,200 even in present conditions. Also the seed cake is expected to be $96 as fertilizer in 2015. With the estimated IRR of 27% in the current prevailing conditions, Jatropha is likely to be a commercially viable inedible crop using the wastewater by 2015 -2017.

- Therefore, we recommend to implement a Pilot Project for (1) testing of new high-yield varieties, (2) improving the Jatropha agronomy and (3) proving the optimal irrigation with treated wastewater and optimal fertilizer use in consideration of nutrients contained in the treated wastewater. The pilot project should have a size of minimum of 10 Feddan (4 hector) to check the commercial viability.

- Since private plantations are normally more efficient, compared to government-operated plantations, we recommend to use PPP schemes attracting private investors for inedible oil crop development using the treated wastewater.

- In order to attract the private investment, guaranteeing safe and attractive investment conditions are essential for Inedible Oil Crop development, which can be created by launching an Agro-SEZ Program supported by a new decree (described later).

12. Objective and Profile of Proposed Pilot Project

12.1 Objective

The objective of the proposed Pilot Project is the testing of commercial viability of High Yield Varieties of Jatropha which shall be introduced from Asia as a main crop.

12.2 Selection of Pilot Project Site within MoA Afforestation Area

12.2.1 Selection of Pilot Project Site

The selection of the Pilot Project site is one of the most critical factors to achieve the commercial viability of the Egyptian biofuel model. The JICA Study team examined several candidate locations for selecting one site for the proposed pilot project (4ha) based on critical criteria, in order to prove the commercial viability not only for the 4ha pilot project but also the following commercial scale supply chain development.

Due to the limitation in time and information, the evaluation was carefully conducted and confirmed among JICA study team, relevant authorities and technical experts. Several candidate locations for the future commercial projects were proposed after the collection of most updated information such as land availability (physical and jurisdiction), wastewater supply (supply capacity, cost, long term reliability), logistic costs, and natural disaster (flooding and storm). The following map shows the 4 candidate sites (Asyut, Qena, Luxor and Aswan) in the upper Egypt.

Figure 12-1 Four Candidate Sites for Proposed Pilot Project

(Source: Study Team (2012))

The details of the selection criteria are as follows:

1) Plant Quarantine Availability:
   Existence of the plant quarantine is a favorable condition to introducing new varieties to the pilot project.

2) Greenhouse Facility Availability:
   Existence of the greenhouse facility, which is required for the quarantine procedure, is a favorable condition for introducing new varieties to the pilot project.

3) International Airport Availability:
   Existence of international airport (frequency of the flight and distance from the site) is evaluated as a favorable condition as it secures easy access for JICA Study Staffs and Egyptian Research staffs to implement the project.

4) Distance from Sea Port:
Distance and closeness to a sea port is a criteria for possible export of CJO to EU and other overseas markets.

5) Land Availability:
Land requirement for the Pilot Project is 4 hector (10 Feddan). The evaluation will be based on whether the site satisfies the requirement.

6) Soil Conditions:
Soil sampling was conducted and the soil samples were analyzed in the laboratory including chemical and physical properties of the soil in February and March, 2012.

7) Existing Jatropha Plantation with irrigation for RENOVATION:
After the implementation of the proposed pilot project, the next target should be the renovation of existing plantations. Therefore, the existence of already developed Jatropha plantations with irrigation is a factor for identifying candidate sites.

8) Wastewater Availability:
The wastewater requirement for the 4 ha Pilot Project is 20,000 CM /year (= 5,000 CM/ha x 4 ha). The evaluation is based on whether the site satisfies the requirement.

9) Waste water Quality:
According to HCWW, the quality of wastewater is very similar for all sites due to guidelines set by HCWW and Jatropha trees are grown by using existing wastewater.

10) Project Building Availability: Existence of a building (within 1km), which can be used for the proposed pilot project as the project office, is favorable for economical and speedy implementation of pilot project in terms of avoiding extra construction cost of building and basic infrastructure (water, electricity, etc.).

12.2.2 Evaluation Criteria

Each site is evaluated in three measurements: Good/Preferable:○, O.K/Available:▲ and Not Available:× and each Good/Preferable is given one point. In terms of accessibility to sea port, since the proposed business model is focusing on the biofuel market in EU for the initial stage, distance from the seaport is very critical factor for the COST of fuel transport. In other words, the logistic cost must be competitive enough for the final market. Due to the JICA experts' experiences, the criteria for the distance were set as shown in the table below.

Table 12-1 Evaluation Base for Distance to International Ports

Distance to Port (Km)	Less than 100	101-250	251-500	Over 500
Evaluation Point	○	▲	▲	×

(Source: Study Team (2012))

12.2.3 Result of Site Evaluation

Based on the evaluation table shown below, JICA Study team recommends Luxor as the most favorable site for the pilot project at this preliminary evaluation stage. The selection of Luxor for the Pilot Project site is also supported the Egyptian stakeholders.

Table 12-2 Evaluation of Candidate Sites

Location/Criteria	Luxor	Mark	Aswan	Mark	Qena	Mark	Assiut	Mark
1. Plant Quarantine Availability	Yes	○	Yes	○	No	×	Yes	○
2. Greenhouse Facility Availability	Yes	○	No	×	No	×	No	×
3. International Airport Availability	Yes	○	Yes	○	No	×	No	×
4. Distance from Sea Port	220km	▲	700 km	×	200 km	▲	230 km	▲
5. Land Availability (4 ha)	1,500ha	○	3,300 ha	○	16,000 ha	○	12,500 ha	○
6. Soil Condition	Good	○	Good	○	Good	○	Good	○
7. Existing Jatropha Plantation with irrigation for RENOVATION	800 Fd	○	No	×	400 Fd	○	200 Fd	○
8. Wastewater Availability (1,000cm^3/10days)	30,000 cm^3	○	8,000 cm^3	○	23,000cm^3	○	50,000cm^3	○
9. Wastewater Quality	Good	○	Good	○	Good	○	Good	○
10. Project Building Availability	Yes (200 m2)	○	No	×	No	×	No	×
Total Score		9		6		5		6

(Source: Study Team (2012))

12.3 Afforestation and Irrigation System in Luxor

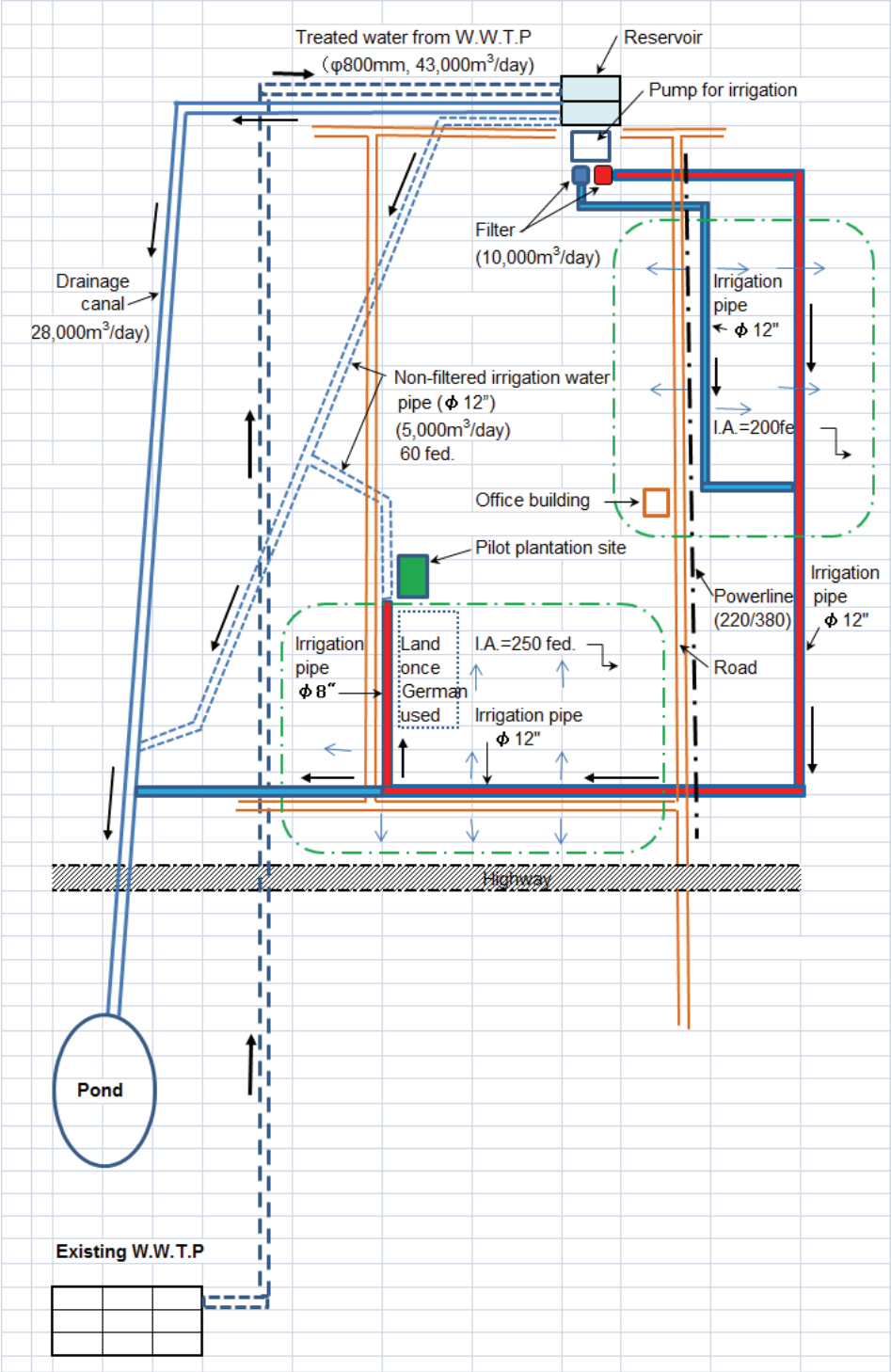
There are 3 wastewater plants in Luxor. El Hebiel Plant is the by far the largest plant. Therefore, Study team examined the afforestation site adjacent to the treatment plant. This wastewater treatment plant in Luxor is on the eastern side of Nile River, as shown in the map below. It is operated by Luxor Company of Water and Wastewater.

Figure 12-2 Location of Luxor Wastewater Treatment Plant (El Hebiel)

(Source: Study Team (2012))

A general location map of the afforestation and irrigation system in the area under MALR in Luxor is as shown in the Figure 13-3.

Figure 12-3 Location of the Facilities for Afforestation and Irrigation



(Source: Study Team (2012))

12.3.1 Afforestation in Luxor

The present situation of the afforestation in Luxor (El Hebiel) is summarized in the table below. The majority of the existing forest is Khaya senegalensis. They are planted with Jatropha is 121 fed.

Table 12-3 Present Situation of Afforestation in Luxor

No.	Scientific Name	English name	Cultured area (fed)
1	Nursery		2
2	Planted area		745
	(1) Khaya senegalensis	Mahogany	608
	(2) Jatropha curcas	Jatropha	121
	(3) Dalbergia sisso	Dalbergia	10
	(4) Morus spp	Mulberries	4
	(5) Simmondsia chinensis	Jojoba	1
3	Non-planted area		996
Total Area Allocated for Afforestation			1,741

(Source: MALR(2012))

12.3.2 Supply of Treated Waste Water

The treated waste water (TWW) is conveyed from the existing waste water treatment plant to the reservoir by HCWW in Luxor. TWW is conveyed through the conveyance pipeline (800mm diameter, approximately 5km in length) to the reservoir in total 43,000m^3 per day.

The Study team collected a TWW sample from the site and conducted chemical analyses at ARC of MALR. The analysis result is presented in the table below. The most influential water quality criteria on crop productivity is the water salinity as measured by electrical conductivity (EC). The EC result of 1.0 mmho/cm indicates slight salinity compared to the safety level of < 0.7 mmho/cm, but is lower than the level of moderate salinity hazard level (1.5-3.0 mmho/cm) and much lower than severe level (> 3.0). Therefore, this level is usually no harm to crops. The sodium imbalance (sodicity), which is normally indicated as Sodium Absorption Ratio (SAR), of 3.5 of the sample water does not suggest the risk of water infiltration problem unless the EC is lower than 0.4 mmho/cm. The pH of water is in the normal range of 6.5 to 8.4. No heavy metal pollution was detected. As a conclusion, the treated water from the Luxor treatment plant can be used for crop cultivation.

Table 12-4 Analysis Result of Treated Wastewater from Proposed Project Site

		Concentration (mg/l)	
EC (mmohs/cm)	1.02	(NH_4^+)	31.8
ppm	653	(NO_3^-)	0.000
pH	6.71	(P)	4.060
Soluble Anions (meq./L)		(Fe)	0.098
CO_3^-	-	(Mn)	0.105
HCO_3^-	0.90	(Zn)	0.046
Cl	4.11	(Cu)	0.000
$SO_4^=$	4.58	(Co)	0.000
Soluble Cations (meq./L)		(Ni)	0.000
Ca^{++}	1.50	(Pb)	0.000
Mg^{++}	2.50	(Cr)	0.000
Na^+	5.03	(Cd)	0.000
K^+	0.56	(Mo)	0.000
RSC	-	(Se)	0.000
SAR	3.57		

(Source: Study Team (2012))

12.3.3 Distribution of TWW

A part of TWW flowed into the reservoir is supplied through the sand filter to the irrigation area in total 10,000m^3/day. Another part of TWW is supplied without filter to the irrigation area by the pipe (12 inch diameter) in total 5,000m^3/day and irrigated 60 feddan of afforestation area. Remaining part of TWW is overflowed from the reservoir and flowing down to the pond adjacent to the highway in total 28,000m^3/day through the natural canal of 7km in length.

12.3.4 Supplied Filtered TWW

Adjoining to the reservoir, pump station is located in which 5 number of pumps (3 pumps: diameter is 8inch/10inch, discharge capacity is 400m^3 per hour each, and 2 pumps: diameter is 6inch/8inch, discharge capacity is 200m^3 per hour each) are installed, and is supplying the water to the irrigation area. These pumps once send the TWW to the sand filter plant, filtered water is delivered to the irrigation area.

There are two sand filter systems (painted in blue color and red color each). The water filtered by blue colored system is supplied to the 200 feddan irrigation area and filtered water by red color system is supplied to the 250 feddan irrigation area.

At present, only 15 % of TWW (43,000m^3/day) is filtered and send to the irrigation area. Therefore, the big amount of water is available to use the irrigation of the Jatropha or afforestation purpose.

12.4 Selected Land and Facilities for Pilot Project

Selection of the land for the Pilot Plantation Project is carried out considering spread of the area, topographical condition, land ownership, possibility of water supply, existence of building to minimize the cost to arrange the plantation. JICA study team selected three (3) candidates of the area which are shown in the Figure 13-5. Each candidate site conditions are as follows.

・Site-1
- Topographic condition: very wide and flat.
- Land Allocation: Governorate of Luxor for Land Fill Site
- Water supply: Pipe from the pump station locates nearby
- Existence of building: MALR's building is located nearby

・Site-2
- Topographic condition: land is long shape, but fairly flat
- Land Allocation: Luxor Water and Wastewater Company under HCWW
- Water supply: Pipe-end from the pump station is located beside the site
- Existence of building: MALR's building is located nearby

・Site-3
- Topographic condition: land is undulating and soil seems to be hard
- Land Allocation: Luxor Water and Wastewater Company under HCWW
- Water supply: WWTP locates adjacent to the site
- Existence of building: Not exist the building to use easily

As each site has merit and demerit, it should be mainly considered on the land ownership. Because, it is essential for obtaining the land to this Project in early time to implement this Pilot Plantation Project. Site-2 seems to have a predominant to others on this point of view. Additionally, water source and building are available nearby, so that Site-2 should be selected to the Pilot Plantation Project Site.

Figure 12-4 Location of Three Candidate Sites for Pilot Plantation Site

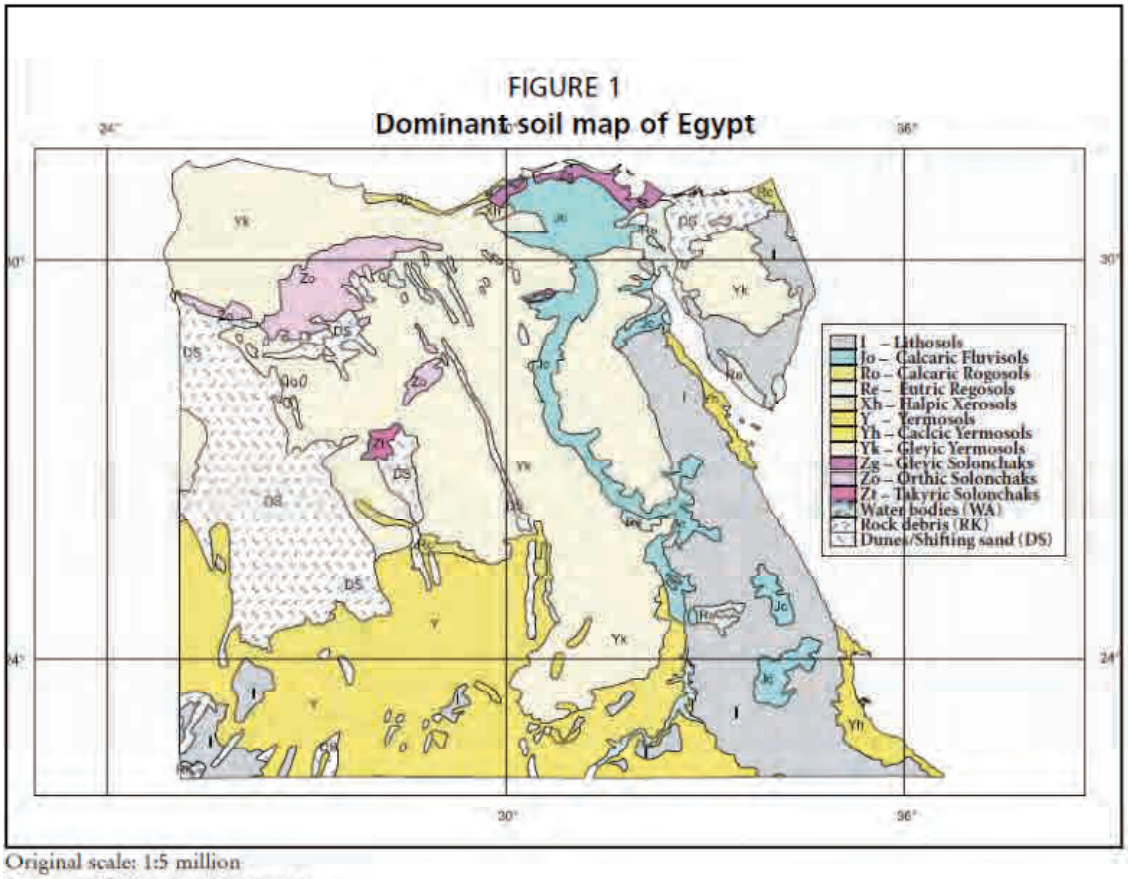
(Source: Study Team (Year 2012))

12.5 Climatic and Soil Condition of Project Site

(1) Soil conditions

The dominant soil types on the east side of Nile river in Luxor are Lithosols or Calcaric fluvisols according to the Soil Map of Egypt.

Figure 12-5 Soil Map of Egypt



Original scale: 1:5 million
Source: DSMW-FAO-UNESCO.

The soil in the 10 fed site is sandy soil and the land is fairly flat. The study team collected 10 soil samples (10-30 cm depth and 60 cm depth) from the site. The results of the samples were summarized in the table below. The pH of the soil is slightly alkaline (8.2-8.6). The contents of heavy metals in soil are in the safe range. The organic matter in the soil is quite low. However, nitrogen and Potassium contents in the soil is relatively high, while phosphorus is low. A criteria for evaluating macro and micro nutrients and heavy metals in soil, water, plants are attached in the Appendix.

Table 12-5 Result of Soil Analysis

Chemical Analysis of soil samples

Sample No.	pH 1:2.5	EC	SP	Anions (meq. / L)				Cations (meq. / L)				CaCO3 %
				CO_3^{--}	HCO_3^-	Cl^-	SO_4^{--}	Ca^{++}	Mg^{++}	Na^+	K^+	
1	8.40	2.82	28.0	-	5.0	19.05	2.95	5.0	6.10	15.50	0.40	5.40
1'	8.20	2.56	25.0	-	4.11	18.01	2.62	4.01	5.21	15.21	0.31	4.45
2	8.30	2.63	26.0	-	4.75	19.02	0.84	5.65	6.02	12.56	0.38	6.30
2'	8.30	2.30	24.5	-	3.09	17.02	0.36	3.11	4.93	12.11	0.32	6.9
3	8.30	2.29	25.0	-	2.98	12.82	4.73	5.01	3.36	11.86	0.30	5.20
3'	8.41	2.08	25.0	-	2.01	11.12	5.64	4.11	3.15	11.21	0.30	4.31
4	8.50	1.98	26.0	-	2.80	12.99	2.95	3.18	5.11	10.13	0.32	8.20
4'	8.30	2.04	27.0	-	3.0	13.02	2.87	3.16	5.21	10.11	0.41	7.76
5	8.40	1.78	25.50	-	2.45	7.92	5.39	3.89	3.66	7.91	0.30	5.40
5'	8.60	1.55	27.0	-	2.11	8.01	3.65	3.12	3.18	7.21	0.26	5.17
6	8.40	1.43	24.0	-	2.62	8.72	1.24	2.69	3.17	6.42	0.3	6.20
6'	8.30	1.31	25.0	-	2.12	7.12	2.55	2.29	3.01	6.21	0.28	6.90
7	8.50	1.23	25.0	-	3.0	8.89	0.08	2.20	3.75	5.62	0.24	6.20
7'	8.45	1.36	24.0	-	3.21	9.21	0.21	2.40	3.99	5.99	0.25	5.17
8	8.20	1.02	24.0	-	2.75	5.30	1.70	1.45	2.78	5.27	0.25	5.30
8'	8.35	0.88	25.0	-	2.15	4.3	1.24	1.22	2.11	4.21	0.15	4.45
9	8.40	1.98	25.0	-	2.10	13.55	2.91	2.43	4.36	11.52	0.25	5.40
9'	8.30	2.50	25.0	-	3.0	15.2	4.3	4.21	5.22	12.66	0.41	5.17
10	8.40	1.49	26.0	-	3.06	8.12	2.39	2.63	3.64	7.0	0.3	6.20
10'	8.41	1.36	24.5	-	3.0	7.3	1.79	2.33	3.51	6.0	0.25	6.90

Elements content of soil samples

Sample No.	(mg/kg)						
	N	K	P	Fe	Zn	Mn	Cu
1	101.35	384.2	0.802	3.15	0.55	0.39	0.21
1'	95.55	421.8	1.24	2.65	0.38	0.22	0.13
2	98.12	336.12	2.82	2.94	0.68	0.81	0.12
2'	95.55	365.6	3.60	2.95	0.69	0.79	0.23
3	77.59	563.16	1.26	3.48	0.68	0.43	0.13
3'	88.2	555.8	0.96	3.07	0.44	0.31	0.18
4	82.16	522.17	1.43	3.59	0.72	0.49	0.35
4'	88.2	517.2	1.57	3.86	0.56	0.45	0.24
5	86.06	291.16	2.18	4.83	0.39	0.45	0.35
5'	88.2	292.2	2.11	3.20	0.48	0.47	0.19
6	83.21	232.17	2.65	3.96	0.42	0.39	0.39
6'	88.2	220.60	2.33	3.19	0.55	0.33	0.17
7	89.62	545.12	1.12	3.15	0.68	0.49	0.20
7'	88.2	536.4	0.99	3.40	0.69	0.33	0.21
8	40.60	145.16	1.66	3.86	0.68	1.19	0.41
8'	36.75	151.40	1.89	4.04	0.62	0.68	0.23
9	106.35	371.12	2.0	3.95	1.09	0.44	0.18
9'	110.25	365.6	1.92	3.36	0.91	0.52	0.21
10	80.16	281.12	17.22	3.01	0.44	0.55	0.16
10'	73.5	274.0	15.68	2.82	0.39	0.31	0.14

Organic matter content

Sample No.	Organic matter %
1	0.1
1'	0.1
2	0.2
2'	0.1
3	0.1
3'	0.06
4	0.05
4'	0.06
5	0.2
5'	0.1
6	0.1
6'	0.06
7	0.08
7'	0.06
8	0.1
8'	0.1
9	0.16
9'	0.1
10	0.07
10'	0.06

*Sample 1 represent the soil depth of 10-30cm, while Sample 1' represents the soil depth of 60cm.

Table 12-6 Soil Analysis Result (Mechanical)

Sample No.	Soil particle size distribution (%)				Texture
	Clay	Silt	Fine sand	Coarse sand	
1	4.1	9.5	43.9	42.5	Sandy
2	4.5	7.4	44.5	43.6	Sandy
3	4.4	9.3	43.7	42.6	Sandy
4	4.4	7.5	44.6	43.5	Sandy
5	5.4	8.2	40.7	45.7	Sandy
6	3.6	9.3	40.5	46.6	Sandy
7	5.4	9.7	41.6	43.3	Sandy
8	7.25	6.05	79.15	7.55	Sandy
9	4.0	10.5	46.0	39.5	Sandy
10	3.7	9.2	48.8	38.3	Sandy

*Soil samples from all the depths at one sampling location are pooled and analyzed.
(Source: Study Team (2012))

According the mechanical analysis of the soil samples, sand constitutes 87% of the soil, rendering sandy texture. As is evident from the photo below, the soil in the site does not have soil layers, being typical desert soil.

Photo: Hole for Soil Sampling

(2) Climate conditions

The climatic conditions of Luxor are summarized in the following table. The average temperature is about 32 degrees Celsius and can reach more than 40 degrees Celsius in summer time. During the noontime in summer, agricultural workers cannot normally work due to high temperature. The rainfall is practically zero. Therefore, continuous irrigation water must be supplied to the pilot project field throughout a year.

Table 12-7 Climatic Data of Luxor

month no.	Avg. Temperature (°C)	Max. Temperature (°C)	Min. Temperature (°C)	Relative Humidity (%)	Wind Speed (Knot)	Avg. Sun shine (Hours)	Avg. Radiation (MJ/M^2)	Total Rain (mm)	Avg. Et_0 (mm)
1	14	23	5.4	52	3.2	9.1	16	0.1	2.6
2	16	25.5	7	42	3.6	9.7	19.1	0.2	3.5
3	20.2	29.5	10.6	34	4.3	10.1	22.4	0	5
4	26	34.8	15.7	26	4	10.8	25.3	0	6.4
5	30	38.7	20	22	3.7	11.6	27.4	0.3	7.3
6	32.4	41.1	23	23	3.5	13.1	29.7	0	7.9
7	32.9	40.6	23.6	26	3.2	13	29.3	0	7.7
8	32.5	40.7	23.4	27	3	12.2	27.7	0	7.1
9	30	38.6	21.5	32	2.6	11.8	25.4	0	6.1
10	25.4	35.3	17.5	40	2.8	10.8	21.3	0	4.8
11	20	29.6	12.1	47	3	9.6	17.2	0	3.5
12	15	24.6	7.2	53	3	9	15.2	0	2.6

(Source: Central Laboratory for Agricultural Climate (2004))

12.6 Profile of Pilot Project

12.6.1 Period of Pilot Project

The proposed Pilot Project is expected to start in 2013 and last 3.5 year to 2016.

12.6.2 Scale of Pilot Plantation

The Site area is 10 Feddan (4 hector) to be testing Jatropha.

12.6.3 Components of Pilot project

(1) 10 feddan (4 ha) pilot plantation with New varieties

The first component of the pilot project is the 10 feddan Pilot Plantation with new Jatropha varieties. The Pilot Project shall test all available new Jatropha varieties shortlisted in Chapter V. Other alternative oil crops may also be in the scope of pilot project based on the further investigation of their commercial viability.

Photo: Example of Jatropha Plantation

Photo: Jatropha seeds

(2) Oil Extraction factory/machine and supporting equipment's/tools,

the second component of the pilot project is the Pilot Oil Factory. In order to demonstrate the use of Jatropha Oil for practical use in Egypt, the Pilot Project introduces an Oil Extraction facility and a Degumming facility.

Photo: Example of Expeller

Photo: Example of oil extraction facility

(3) Evaluation of Commercial Feasibility as Bio Fuel and Organic Fertilizer

The produced Jatropha oil (Strait Vegetable Oil: SVO) will be analyzed for quality evaluation at laboratories of local and international inspection organizations. The project team will check whether the product(s) meet the of the market needs. Once satisfactory quality of SVO is produced, it will be sold or offered as a sample to bio-jet fuel producers for quality evaluation.

As a by-product from oil extraction, seed cake (75% by weight of the processed seeds) will be produced too. The Project Team will conduct an experiment to check an organic fertilizer made from the seed cake is feasible in Upper Egypt or not.

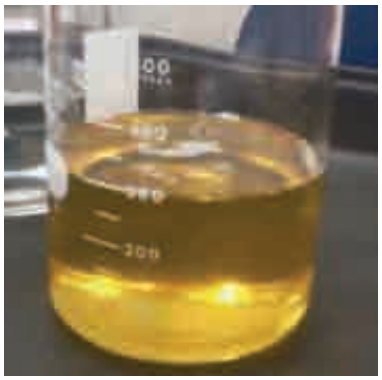


Photo: Example of Jatropha SVO

(4) Necessary Conditions for Proposed Pilot Project Implementation in Luxor

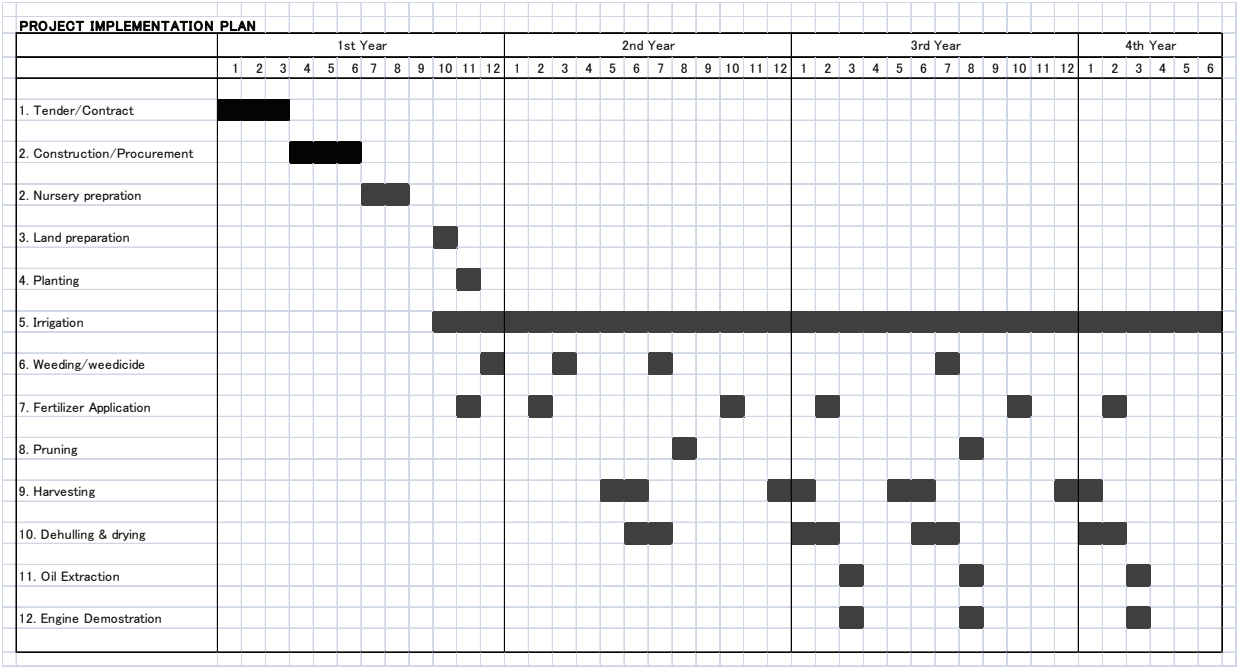
- 4 ha (10 Feddan) land will be provided by Ministry of Agriculture, Forestry Department at identified and agreed site.
- Wastewater will be supplied from the existing facilities of HCWW using the Ministry of Agriculture owned pumping/piping system.
- Project site office & factory/laboratory building shall be provided by the Ministry of Agriculture (Existing 5 room building of about 150 sq meters).
- Assisting Institutions/Agencies shall provide all other irrigation, equipment, cars, and office building improvement, oil-extraction machine and necessary experts and manpower for the Pilot Project.

13. Design Basis of the Show Case Model for Pilot Jatropha Plantation Development

13.1 Overall Pilot Plantation Implementation Plan

To accomplish the aim of this Project three and half years will be needed. Implementation process will be 2 steps in general, i.e. 1st step is construction of the pilot plantation site and procurement of the equipment/the sapling of Jatropha for the operation/maintenance or plantation works. 2nd step is implementation of the pilot plantation work. Overall implementation plan is as follows:

Figure 13-1 Overall Project Implementation Plan



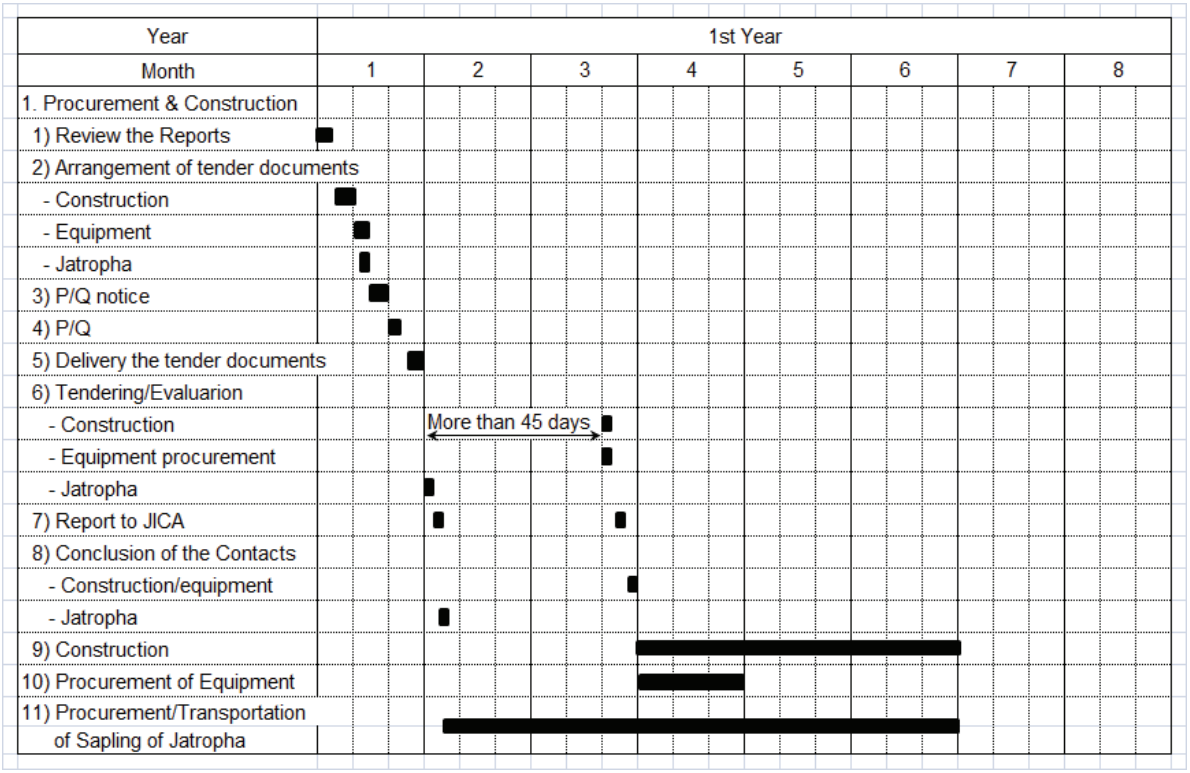
(Source: Study team (2012))

13.1.1 Construction Stage

For the implementation of pilot examination of Jatropha cultivation, arrangement of the plantation field is required before hand. The local contractor for construction of the experimental field, a supplier(s) for necessary equipment, and other supplier (s) for sapling of Jatropha are lined-up. In this case, tendering is divided into 3 lots, because procurement items are fairly different. Specifically Lot-1 is for construction work, Lot-2 is procurement work of equipment and Lot-3 is procurement work of the sapling of Jatropha. In the case of JICA's expected process procurement through the tendering and bidding is as follows.

After the contract with the firms by the bidding, construction of the experimental field and the procurement of the equipment and the sapling of Jatropha are to be implemented. The construction of the experimental field will need about 3 months. Procurement of the equipment and the sapling of Jatropha will not need more time than construction.
Expected implementation of the construction stage is as shown below.

Figure 13-2 Project Implementation Plan on Construction Stage



(Source: Study team (2012))

13.2 Design of Pilot Plantation

13.2.1 Cultivation Design

The productivity of Jatropha largely depends upon planting density, irrigation water, fertilizer application and variety. The agronomy of Jatropha cultivation in desert environment has not been studied well not only in Egypt but also in the world. Therefore, it is advisable to have cultivation experiments in the proposed pilot plantation in order to establish the best cultivation methods in the upper Egypt. The following experimental design is suggested by Study team in consultation with Egyptian local experts that are specialized in agriculture in desert environment.

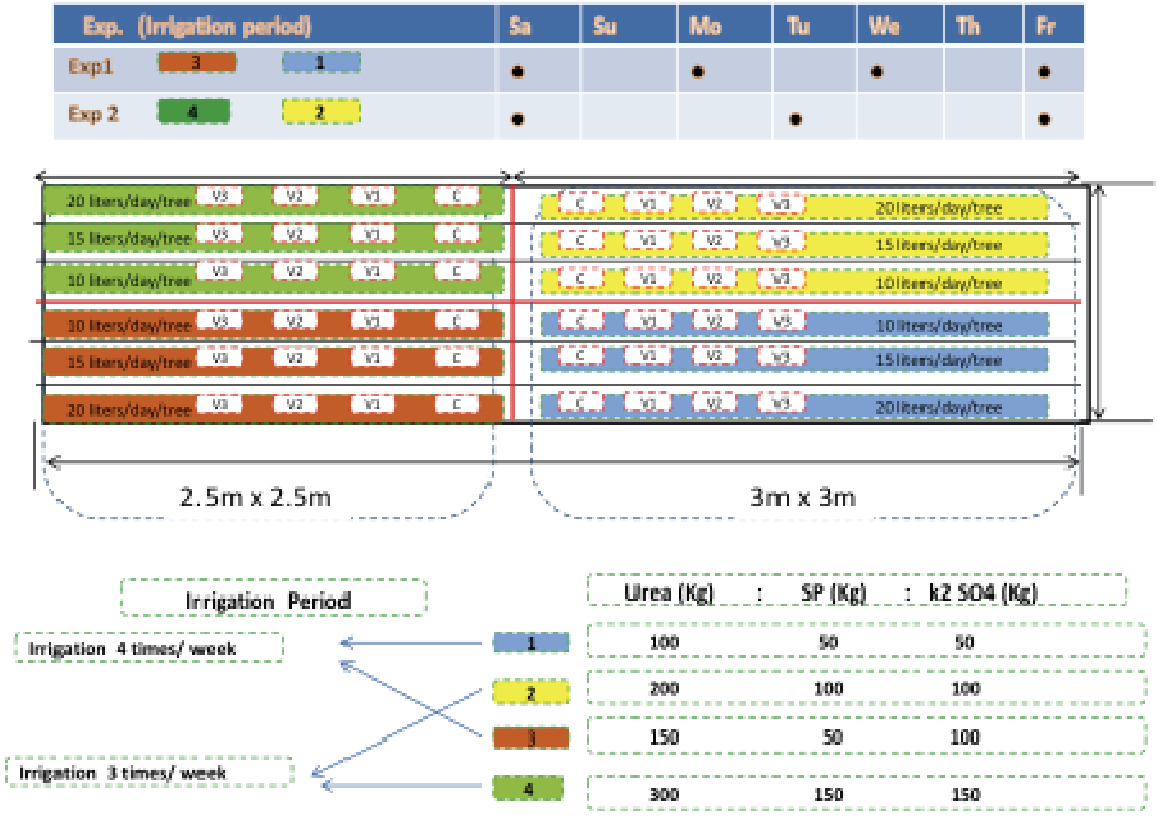
(1) Planting Density
- 3m x 3m (466/fed) : 12 fed
- 2.5m x 2.5m (640/fed): 12 fed

(2) Irrigation water (liter/day/tree)
- 10 (1st year), 15 (2nd year), 20 (3rd year)
- 15 (1st year), 20 (2nd year), 30 (3rd year)
- 20 (1st year), 25 (2nd year), 40 (3rd year)

(3) Fertilizer dose (kg/fed)
- Urea: 100kg, SP:50kg, K_2SO_4: 50kg
- Urea: 150kg, SP:50kg, K_2SO_4: 100kg
- Urea: 200kg, SP:100kg, K_2SO_4: 100kg
- Urea: 300kg, SP:150kg, K_2SO_4: 150kg

(4) Varieties
- Local variety (Control: C)
- Singapore variety (V1)
- Philippine variety (V2)
- Indonesia variety (V3)

Figure 13-3 Design of Jatropha Cultivation



(Source: Study team (2012))

13.2.2 Main Irrigation Pipe

(1) Hydraulic Condition

As shown on the Figure 12-3, the irrigation pipe to the Pilot Plantation site is divided into two parts i.e. 12 inch (300mm) diameter pipe portion between Point-A and Point –B (L=2,800m) and 8 inch

(200mm) diameter pipe portion (L=750m) between Point-B and Point-C. The hydraulic features of those pipes are as follows:
There is 22m difference in elevation between Point-A and Point-B from the topographic condition of this area. There is no difference in elevation between Point-B and Point-C. Elevations of Point-B and Point-C are lower than Point-A.

At present, the pump is operating principally 9hrs and supplying the 15% of conveyed water (43,000m3/day) to the irrigation area. This means that about 720m3/hr of water is sending to the both of filter. Considering the ratio of each irrigation area of two filters, the red color filter will filter about 400m3/hr of water. The filtered water is flowing down to the irrigation area through the irrigation pipe as shown in the Figure 12-3.

As the water to the Pilot Plantation is supplied utilizing the existing irrigation pipe, hydraulic analysis to this pipe is done as follows.

Water requirement of the Pilot Plantation is 50m3/hr. Then flow volume of water each point at the design stage is as follows:

- Point-A : V=400m3/hr + 50m3/hr = 450m3/hr
- Point-B : V=400m3/hr + 50m3/hr = 450m3/hr
- Point-C : V=50 m3/hr

Above water is able to supply by the operation of two existing small pumps (250m3/hr x 2nos.) .

(2) Friction Head Loss

There are many formulas for the calculation of head loss by friction of the pipeline. It is said that Hazen-Williams Formula is more suitable to design the pipeline considering the kind of pipe, diameter of pipe, design water velocity, etc. Therefore, friction head loss of the pipe is calculated using the Hazen-Williams Formula and results are as follows.

$$h = 10.666 \times C^{-1.85} \times D^{-4.87} \times Q^{1.85} \times L$$

- h：Friction loss head of pipe (m)
- C：Coefficient of discharge
  In case of PVC pipe, C=140
- D：Diameter of pipe（mm）
- Q：Discharge volume (litter/min)
- L：Length of pipe（m）

Results of the calculation are as follows/

- Between Point-A and Point –B, h_1:24.0m
- Between Point B and Point-C, h_2:0.8m
- Total head loss: 24.8m

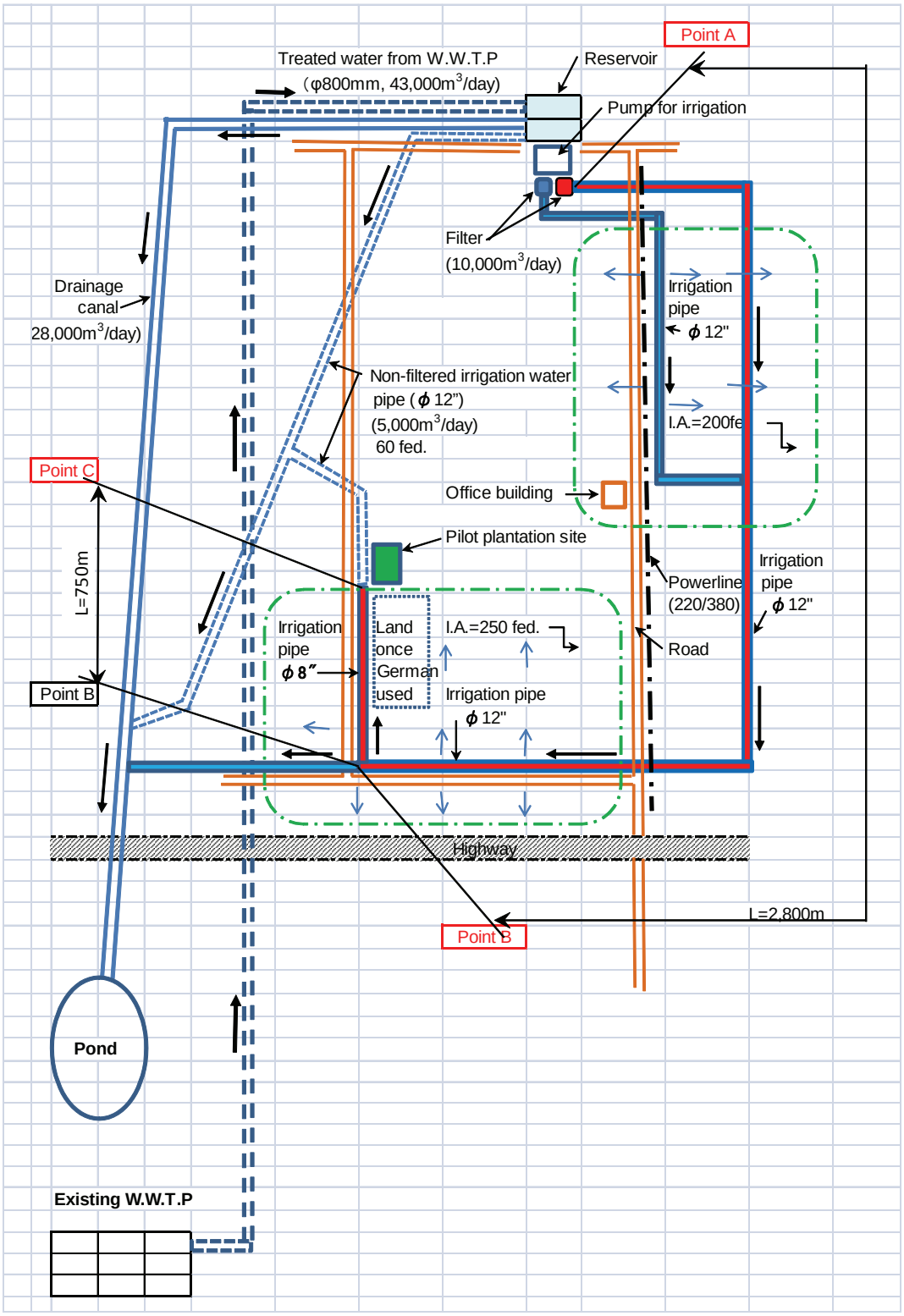
In addition to these results, head losses by the valve, bent pipe, divergence, etc. should be considered. Then, total head loss between Point-A and Point-C is about to 27m.

(3) Water Head of the Main Irrigation Pipe at the Pilot Plantation Site

Regarding the water head of the pump station, out-put of the small pump is 50m (5.0 bars) and water pressure of 1.5bars is lost by sand filter, so that water head at the outlet of the filter will be 3.5 bars.

The main irrigation pipe descends to the Pilot Plantation Site by 22m. This means, that water head at the Pilot Plantation Site will be 5.7 bar and friction loss during this portion is 27m (2.7 bars), then water head at the Point C is 3.0bars (30m) is assumed. This seems higher pressure than the necessary pressure to the irrigation system of the Pilot Plantation as mentioned later. Therefore, it is supposed that the irrigation pipe and main pipe of the Pilot Plantation would be connected together directly. However, this result should be judged carefully with consideration of hydraulic analysis of the Pilot Plantation.

Figure 13-4 Layout of the Irrigation Facilities

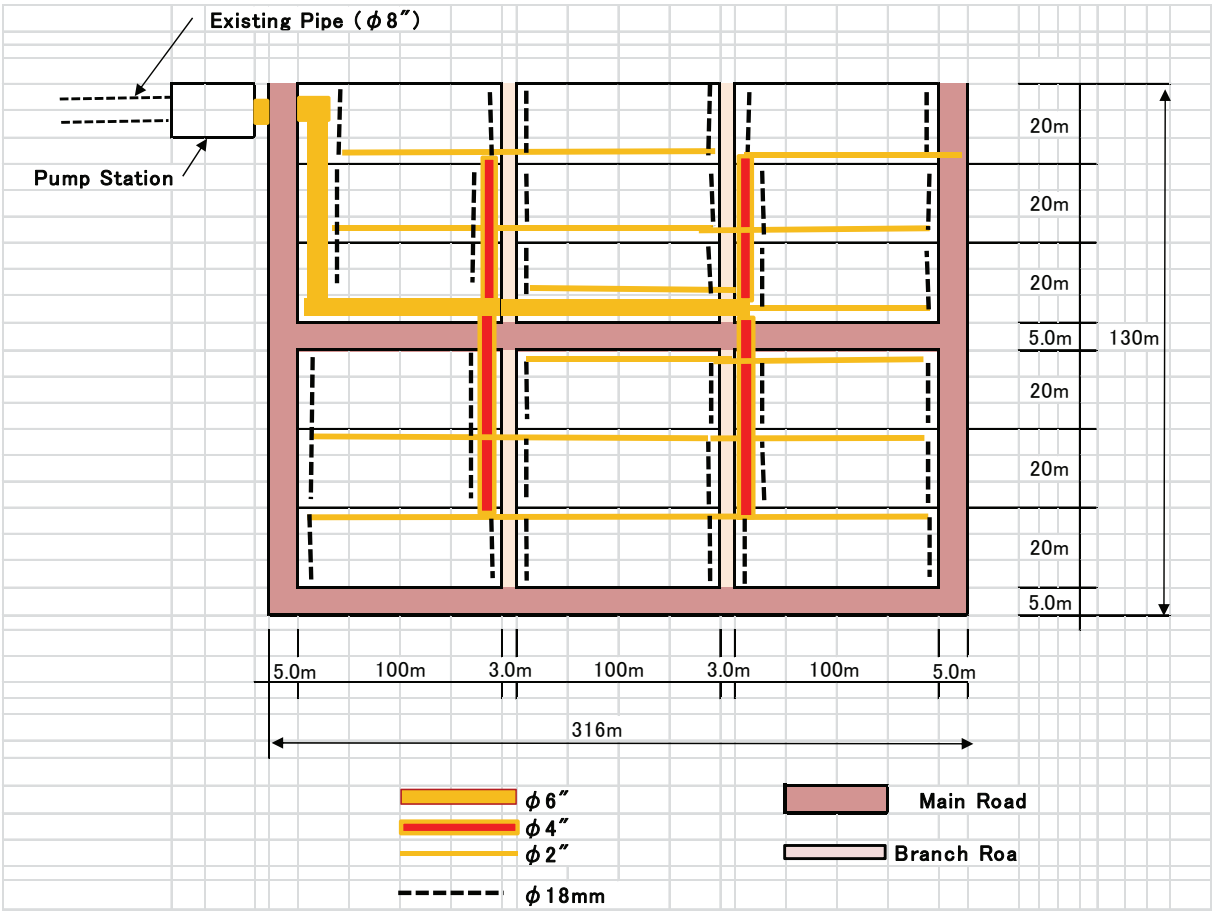


(Source: Study team (2012))

13.2.3 Irrigation Network on the Pilot Plantation

As shown in the Figure 12.4, the selected land (Site-2) has rectangular shape. When using the drip pipe for water supply at the end portion of irrigation network, it said that the optimum length of drip pipe is 25m. Considering these conditions, layout of the irrigation network as the general design is as follows.

Figure 13-5 Layout of the Irrigation Network



(Source: Study team (2012))

13.2.4 Hydraulic Analysis of the Pipes in the Pilot Plantation

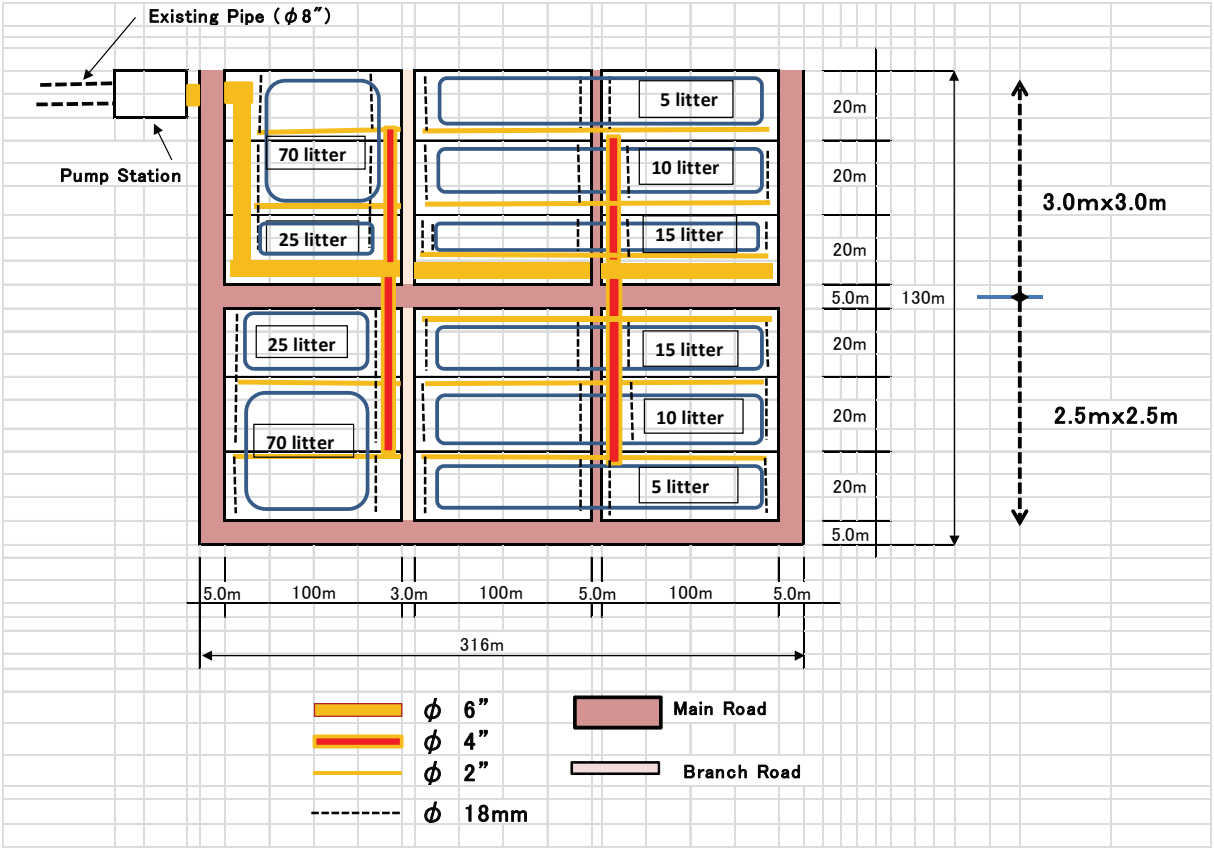
1) Plan of Jatropha Plantation

Whole area of the Plantation divided into two areas considering the plantation interval of Jatropha i.e. 2.5m x 2.5m and 3.0m x 3.0m, and considering the pipe network too. It is shown in the Figure 13-6.

2) Verification for Capacity of the Irrigation Facilities

There are many ways of supply the water to Jatropha. It seems, however, that the purpose of such water supply would be the obtaining of stable but normal yielding of Jatropha. On the other hand, it is said that minimum water requirement for commercial production of Jatropha is 1,400m3/hr/1,000Feddan or 4,000m3/year/ Feddan, which is roughly 10 to 25 times higher than that of MALR's Jatropha watering practices in Luxor - one litter/day/tree. The aim of this Project is to search the commercial viability on the Jatropha cultivation, however, such water requirements of Jatropha are acceptable to the designed or the existing irrigation facility or not, now for three cases of water requirement 70, 25 and 15,10,5litter/day/tree, those irrigation facilities are to be verified.

Figure 13-6 Plan of Jatropha Plantation



(Source: Study team (2012))

3) Friction Head Loss of Drip Pipe

Flow volume of water (Q) at the beginning point of drip pipe is calculated as below for only 70 litter as a maximum case, with 9 hrs pump operation per day and considering the number of planting Jatropha along the drip pipe of 25m in length.

Table 13-1 Water Flow Volume of Drip Pipe

Plantation Interval	Water Requirement	No. of Jatropha	Liter/day	Liter/min
2.5mx2.5m	70	10	700	1.30
	25	10	250	0.46
	15	10	150	0.28
	10	10	100	0.19
	5	10	50	0.09
3.0mx3.0m	70	8	560	1.04
	25	8	200	0.37
	15	8	120	0.22
	10	8	80	0.15
	5	8	40	0.07

(Source: Study Team (2012))

Friction head loss on the above is calculated as follows using the Hazen-Williams formula same as 14.2.2 (2).

$$Hf = F_1 [10.666 \times C^{-1.85} \times D^{-4.87} \times Q^{1.85} \times L]$$

F_1: Reduction coefficient on frictional head loss in the drip pipe
(F value is obtained by the experiment in Japan)

In case of 2.5mx2.5m, $F_1=4.02x10^{-1}$, and in case of 3.0mx3.0m, $F_1=4.16x10^{-1}$.
Each Hf in maximum case of 70litter/litter/day is as follows;

$$Hf(2.5 \times 2.5) = 4.02x10^{-1} \times 0.021 = 0.001m$$
$$Hf(3.0 \times 3.0) = 4.16x10^{-1} \times 0.014 = 0.001m$$

These results mean the friction head losses through the drip pipes are very small and negligible.

4) Friction Head Loss on the Main Pipeline

Friction head loss (⊿h) of each pipe portion is calculated also using Hazen-Williams formula and the results are as shown below. Target pipes for analysis are from the pipe located most remote block to the pipe of entrance of the Pilot Plantation.

Table 13-2 Results of the Calculation of Friction Head Loss

Pipe portion		Flow water (litter/min)	Pipe length (m)	⊿h (m)	Velocity (m/sec)	Remarks
(1)	2”(50mm)	34	100	0.01	0.29	
(2)-1	4”(100mm)	69	25	0.01	0.15	
(2)-2	4”(100mm)	206	25	0.04	0.44	
(3)-1	6”(150mm)	279	203	0.12	0.26	
(3)-2	6”(150mm)	635	208	0.54	0.60	
(3)-3	6”(150mm)	812	178	0.73	0.77	
		812litter/min =0.81m3/min =50m3/hr	-	1.45 (Total)	-	

(Source: Study team (2012))

When it is supposed to give 2 bars (20m) of water pressure at beginning point of the drip pipe on the most remote block, necessary water pressure of the entrance point of the pilot plantation is estimated about 22m.

The water pressure at the endpoint (Point C) of the irrigation pipeline is 30m as the results of calculation in the 14.2.2 (3). There is namely some higher water pressure at the endpoint of the irrigation pipe, so that both pipes of the irrigation pipe and the pipe of Pilot Plantation are able to directly connected. This means that this irrigation system has some ability to supply the minimum water requirement for commercial production of Jatropha as mentioned before. However, to prevent the fall of water supply pressure due to the unexpected causes on the irrigation pipe, booster pump (Q: about 50m3/hr, Hm: 30m) to stable water supply to the Pilot Plantation is recommendable to set as reserve.

13.3 Utilization of existing building as JICA office

To develop a commercially viable Jatropha Plantation with effective utilization of the wastewater, it is essential not only Pilot Plantation field but also operation and maintenance facilities. There is a vacant building in the afforestation area which belongs to MALR as shown in photos below and MALR agrees to offer it for this Project.

13.3.1 Present Conditions

- The building itself seems to be firm and no problem to use as it is.
- kinds of voltaic electricity i.e. 220/380 volt are supplied up to the building. This is useful not only supply electricity to the office building but also supply to the oil extraction factory which is intending to build ajecent to the office building.
- Water supply facility is existing in the building. However those facility semms to be decayed, so that replacement of those seems be needed.

(Building)

(Electricity)

(Water tank)

13.3.2 Necessity Provision

The following measures are to be taken for use of the building for the purpose of implementing the necessary activities smoothly and effectively.

・Painting the wall of inside
・Replace the electric supply system and install the lighting and air conditioners etc.
  - 8 single florescent lights in the rooms, kitchen, etc.
  - 5 double florescent lights in the meeting room, entrance hall
  - 1 mercury and 2 florescent light at outside for safety
  - 1 air conditioner in each room and 2 in the meeting room
・Replace the water supply system and install the necessary facilities
  - 2 water receiving tank outside on the ground
  - 1 delivery tank on the roof
  - Delivery pipe, taps, showerhead, etc.
・Arrangement of desks and chairs
  - 5 sets of desk and chair for Japanese experts
  - 3 sets of desk and chair for Egyptian experts

- 1 set of desk and chair for Egyptian clerk/assistant
- 6 long tables and 12 pipe chairs in the meeting room.

・Arrangement of office equipment
- 1 desktop computer
- 10 laptop computers for the experts
- Copy machine (A3 size printing available)
- -ditto- (Color printing available)
- Telephone/internet system

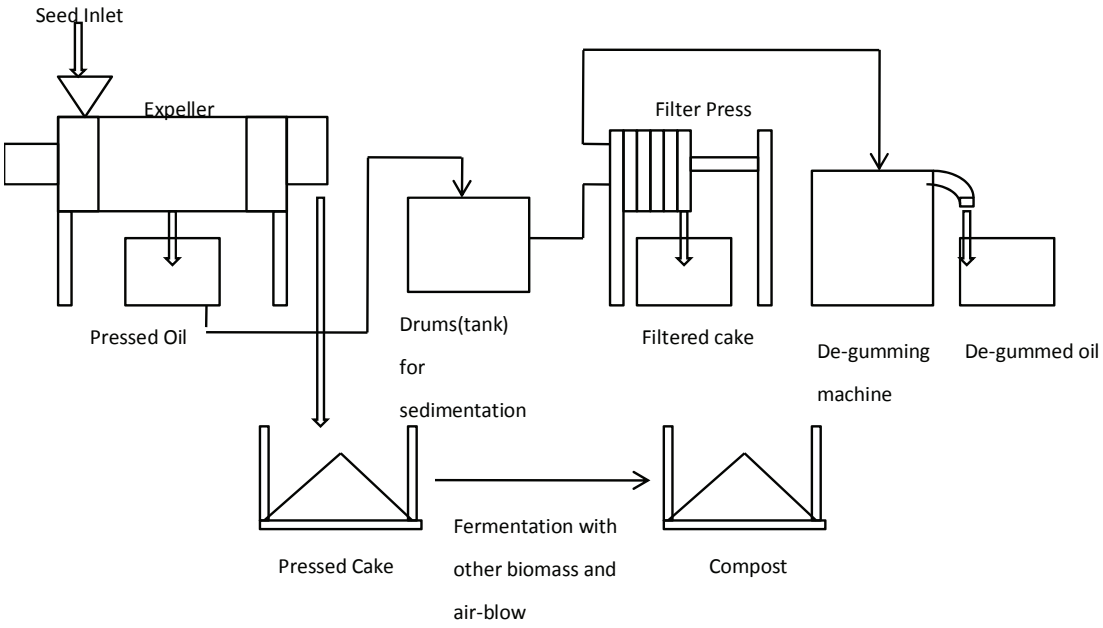
・Arrangement of necessary cooking equipment in the kitchen for preparing light meal or serving tea, etc.

・Arrangement of office car
- 1 sedan-type 4 wheel driven car

13.4 Arrangement Oil Extraction Factory

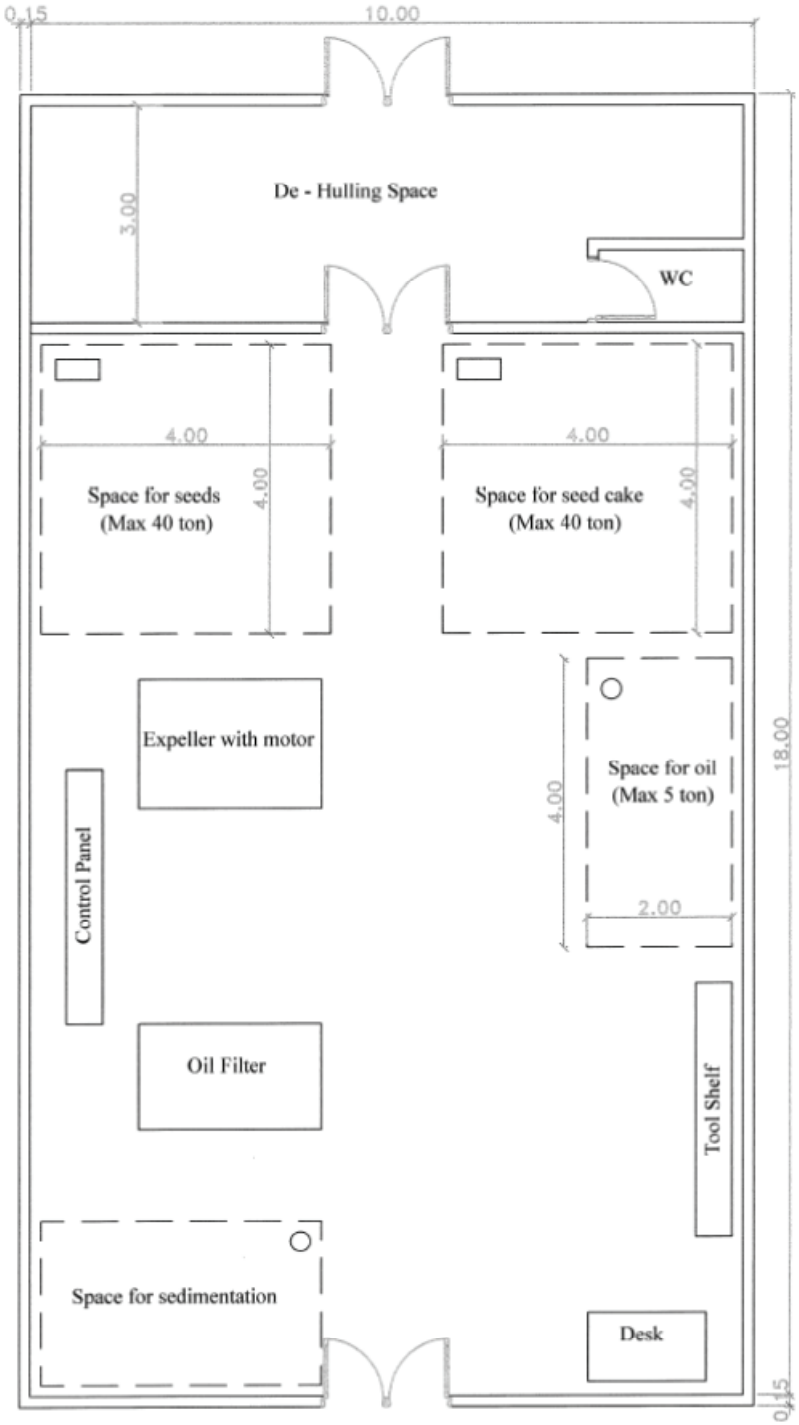
Jatropha seeds are normally extracted by screw press machine. The operation is run continuously, and seeds need no pre-treatment. There are two types of press namely single screw press and twin screw press. The oil content produced by the single screw press is 21-24%, while twin screw press gives 24-27%. The advantage of screw press is high capacity due to the process can be continuously and waste can be separated and flow out from the end of the screw. Also size of screw press can be from just 0.3 ton/day capacity to 100 ton/day capacity to choose from based on the need. Extracted Jatropha crude oil (CJO) still contains gum, free fatty acid and other organic matters. In order to use CJO for SVO or BDF, degumming and neutralization will be needed.

Figure 13-7 Normal Jatropha Oil Extracting System and Flow Chart



(Source: Study team (2012))

Figure 13-8 Jatropha Oil Factory for Proposed Pilot Project



(Source: Study team (2012))

The following shows a specification of the tentative Jatropha Oil Extraction Plant to be introduced in the Pilot Project.

Table 13-3 Specification of the Jatropha Oil Extraction Plant

Items		Capacities and Functions
1	Expeller	A mechanical pressing machine for extracting oil from oil seeds. Processing capacity is 150-200kg of seed per hour. Products made in China or India is readily available at a reasonable price in the Egypt local market. The oil content of pressed cake is 6-10%.
2	Motor for Expeller	A three-phase induction motor for running an expeller. 25HP (Horse Power). 1470RPM (Rotation per minute).
3	Steel Foundation for Expeller	A steel framework to which an expeller is fixed so that the expeller can run stably. Available at a local mechanical workshop within a few days based on the expeller design.
4	Electric Accessories for Expeller	All necessary electric items such as switch board, breaker, electric wire, pulley etc.
5	Drums/tanks for sedimentation	Containers for temporarily keeping crude oil still so that small particles and gum shall be sedimented at the bottom. After some time of sedimentation, the crude oil shall be transferred to a filter press machine.
6	Filter Press	A filtering machine equipped with a small pump for removing all impurities of crude oil by sending and forcing the oil to go through layers of cotton sheets fixed in the machine.
7	Motor for Filter Press	A three-phase induction motor for running an electric pump for a filter press. 1HP . 1390RPM.
8	Steel Foundation for Filter Press	A steel framework to which a filter machine is fixed.
9	Drums or a tank	For storing final products.

13.5 Manning Schedule for Implementation of Pilot Plantation Project

For the implementation of this Project, following qualifications and tasks for candidate person are required.

13.5.1 International Experts

(1) Project Manager (PM)

Good experience in project management is required (at least 20 years). PM is responsible for overall project management and negotiation/communication with the local government and JICA.

(2) Deputy Project Manager (DPM)

Good experience and knowledge of biofuel and inedible oil development is required (at least 7 years). DPM is to assist PM and responsible for overall project management in the absence of PM.

(3) Agronomist

Good experience in plantation development and management of oil crops is required and production of inedible oil (5 years). This expert is responsible of the pilot plantation management and to supervise the agronomist from 3rd country.

(4) Agricultural Engineer

Good experience in irrigation system development and management is required (at least 20 years). This expert is to train and supervise the local irrigation engineer in the 1st year.

(5) Agronomist (3rd country)

Good experience in cultivation of Jatropha and other inedible oil crops is required (at least 5 years). An expert from Thailand, India or Indonesia, which have long experience in Jatropha cultivation, are assumed. The expert is to train and supervise the local agronomist.

(6) Oil extraction expert

Good experience and technical know-how of oil extraction is required. The expert is to provide advices on the efficient production oil and quality control of oil products.

(7) Project Coordinator

Good experience of project coordination is required (at least 3 years). The coordinator is in charge of accounting and financial management of the pilot project.

13.5.2 Egyptian Experts (Full-time)

(1) Construction supervisor

Good experience in construction supervision is required (at least 20 years).

(2) Agronomist-1

The expert is required to have at least 10 years of agronomic research experience, especially fertilizer application under drip irrigation and to have a bachelor degree in agricultural science. High level of English proficiency in speaking and writing is necessary.

(3) Agronomist-2

The expert is required to have at least 10 years of agronomic research experience, especially pruning techniques of tree crops and to have a bachelor degree in agricultural science. High level of English proficiency in speaking and writing is necessary.

(4) Irrigation Engineer

Good experience in irrigation management of drip irrigation is required (5-10 years).

(5) Agricultural worker

Good experience in agricultural works in upper Egypt is necessary (at least 5 years). The worker is responsible for day to day works in all aspects of plantation operation.

(6) Irrigation worker-1

Good experience in irrigation works in upper Egypt is necessary (at least 1 year). The worker is responsible for day to day irrigation system operation in all aspects of plantation operation.

(7) Irrigation worker-2

Good experience in irrigation works in upper Egypt is necessary (at least 1 years). The worker is responsible for day to day irrigation system operation in all aspects of plantation operation.

(8) Driver-1

The driver is responsible for driving a 4 WD car.

(9) Driver-2

The driver is responsible for driving a pick-up truck.

13.5.3 Egyptian Workers (Seasonal and daily hired)

(1) Workers for harvesting

Agricultural laborers are to be hired in harvest season (twice a year) for harvesting of Jatropha fruits.

(2) Workers for weeding

Agricultural laborers are to be hired for weeding.

These international/Egyptian experts and Egyptian workers will be stationed in consideration of the growth of Jatropha. The manning schedule to this plan is shown in the following Table.

Table 13-4 Manning Schedule of the Project

	Year 1												Year 2												Year 3												Year 4						TOTAL
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	(M*M)
JICA Experts																																										
1. Project Manager	1	1	1	1							1				1				1					1						1					1					1		11
2. Deputy Project Manager				1	1	1	1					1	1	1	1	1	1	1					1	1	1	1	1	1					1	1	1	1	1	1	1	1	1	27
3. Agronomist							1	1	1	1										1	1	1								1	1	1								1	1	12
4. Agricultural Engineer	1	1	1	1	1	1																																		1		7
5. Agronomist (3rd country)									1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	34
6. Oil extraction expert																							1												1								2
7. Project Cordinator	1				1							#											#												#						#		4
Sub-total																																										
Local experts																																										(M*M)
1. Construction supervisor	1	1	1	1	1	1																																				6
1. Agronomist 1 (Fertilizer)						1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	37
2. Agronomist 2 (Pruning)						1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	37
3. Agri worker 1						1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	37
4. Engineer (Irrigation)				1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	39
5. Irrigation worker1							1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	36
6. Irrigation worker2							1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	36
7. Driver 1							1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	36
8. Driver 2							1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	36
Sub-total																																										
Workers																																										(M*D)
1. Workers for Harvest																				170												360										530
2. Workers for Weeding							#	#	#	#	#	#						#					#						#						#						#		220
Sub-total																																										
Total																																										

(Source: Study team (2012))

13.6 Expected cost of Pilot Plantation Implementation

The projected cost of the Pilot Project is approximately 2.9million US$ (230 million Yen) for the three and half years period including both development & operation of the Pilot Project. Detailed cost is shown below.

Table 13-5 Expected Cost of Pilot Plantation Implementation

Item	Unit	Unit cost (US$)	Quantity	Amount (US$)
1. Cost of Facilities/Equipments for Pilot Project				
(1) Irrigation system for 4ha plantation	Set	23,200	1	23,200
(2) Oil extraction machine	$/set	1,500	1	1,500
(3) Diesel engine for demonstration	$/set	10,000	1	10,000
(4) Office renewal	$/set	2,500	1	2,500
(5) Office equipments	$/set	12,000	1	12,000
(6) Pickup truck	$/set	25,000	1	25,000
(7) 4 wheel-driven car	$/set	33,000	1	33,000
(8) Buggy and carrier	$/set	8,000	2	16,000
(9) Telephone/mobile phone	$/set	50	4	200
(10) Oil Extraction Factory	$/set	40,000	1	40,000
(11) Agricultural tools (cutter, hoe etc)	$/set	500	20	10,000
(12) Dehulling machine	$/no.	2,500	1	2,500
(13)Testing of jatropha oil	$/set	10,000	1	10,000
Sub total				185,900
2. Cost of Operation for Pilot Project				
(1) Farming cost (4ha x 3 years)	$/ha	1,091	12	13,092
(2) Construction supervisor (local)	M*M	850	6	5,100
(3) Agronomist (2 locals)	M*M	850	74	62,900
(4) Agri worker (local)	M*M	150	37	5,550
(5) Engineer (irrigation, local)	M*M	330	39	12,870
(6) Irrigation workes (2 locals)	M*M	150	72	10,800
(7) Driver of pickup truck	$/month	165	36	5,940
(8) Driver of 4 wheel car	$/month	165	36	5,940
(9) Utilities (electricity etc) for office	$/month	300	36	10,800
(10) Planting materials	$/tree	2	6,000	12,000
(11) Fuels for pickup and 4WD	$/month	800	36	28,800
(12) Communication (mobile, internet service)	$/month	50	36	1,800
(13) Rental car	$/day	150	180	27,000
Sub total				202,592
3. Cost of Experts				
(1) PM	M*M	38,700	11	425,700
(2) DPM	M*M	34,600	27	934,200
(3) Agronomist	M*M	34,600	12	415,200
(4) Agricultural engineer	M*M	34,600	7	242,200
(5) Agronomist (from 3rd contry)	M*M	4,000	34	136,000
(6) Oil extraction expert	M*M	34,600	2	69,200
(7) Project coodinator	M*M	24,800	4	99,200
Sub total				2,321,700
4. Cost of Travel				
Flights (Tokyo- Cairo -Tokyo)(Business Class)	Time	8,600	20	172,000
Flights (Tokyo- Cairo -Tokyo)(Economy Class)	Tme	2,500	7	17,500
Flights (Cairo -Luxor- Cairo)	Time	300	27	8,100
Sub total				197,600
Total Cost				2,907,792

Source: JICA Study Team (Year 2012)

14. Expected Future Scenarios for Large-Scale Commercial Plantation Development

14.1 Upper Egypt Wide Inedible Oil Development Program: 2016-2037

Based on the HCWW's future projection up to 2037 of wastewater supply potential and oil production potential, which were discussed in Section 5.2, we here propose an Upper Egypt-wide development program for Jatropha biofuel industry. We assume to start the program after the completion of the proposed Pilot Project around 2016/17.

14.2 Vision of Upper Egypt Wide Inedible Oil Development Program

The program is to promote full utilization of the wastewater, unused desert land and under-employed human resources in Upper Egypt, in order to develop the overall supply chain of Inedible oil Industry (including Jatropha) in the Upper Egypt including Red Sea and New Valley, starting from large scale commercial plantations, to oil factories and export logistic channels.

14.3 Concept of Upper Egypt Wide Development Program

14.3.1 Phase 1: Promotion of Private Investment in Plantation Development

Private investments in large-scale plantations (minimum 1,000 fed) will be promoted in the entire Upper Egypt, targeting 100,000 Feddan in total. In order to encourage private investments for Inedible Oil Crop Industry, an Agro-SEZ Park Program will be initiated form 2016 (The Agro-SEZ Park Concept shall be explained in the next Section). In this stage, the products of the plantations will mainly be sold as Jatropha Seeds (JS) and exported through the Alexandria port.

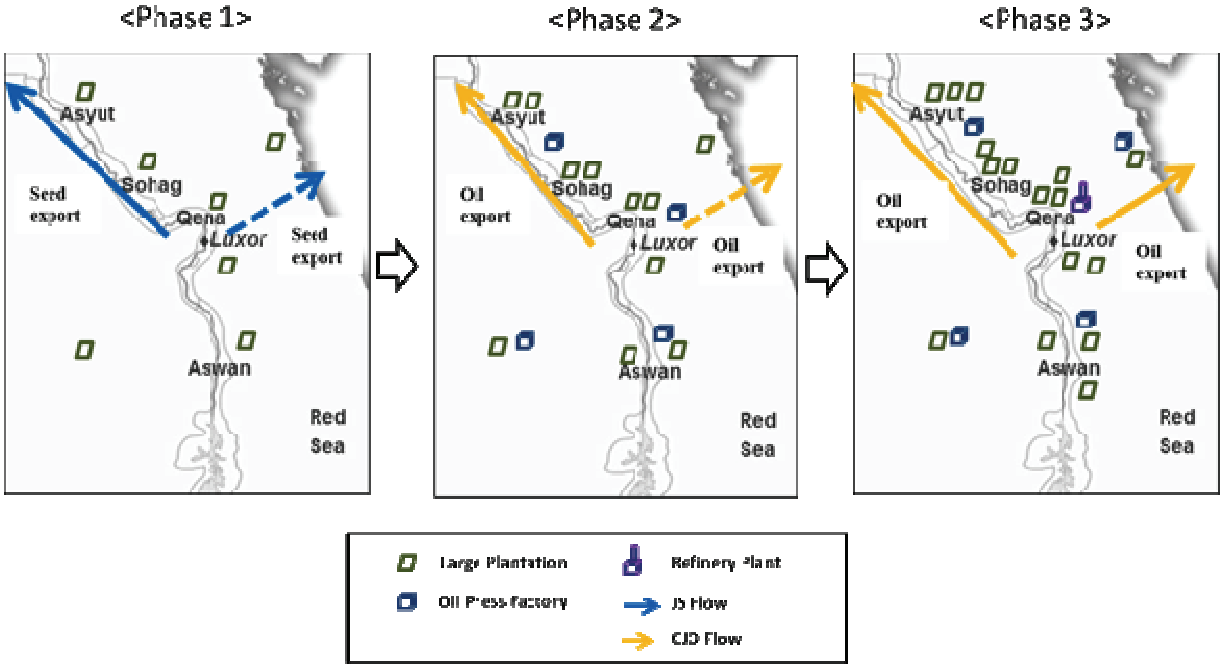
14.3.2 Phase 2: Construction of Large Scale Oil Factories

Once the seed production increases to a certain level (5,000 - 10,000 ton) in each plantation or each production area, oil extraction factories will be constructed at strategic five or six locations. The entire supply chain of Jatropha Biofuel industry will be developed step by step from a plantation, warehouse, factory up to seaport to export Jatropha crude oil (CJO) to EU.

14.3.3 Phase 3: Construction of Refinery Plants

As the production quantity of Jatropha and inedible oil increases, investors shall be encouraged to construct a refinery plant (secondary processing such as bio jet fuel) for further value-addition in Upper Egypt.

Figure 14-1 Concept of Upper Egypt Inedible Oil Development Program



(Source: Study team (2012))

14.4 Logistics of Upper Egypt Wide Development Program

14.4.1 Transportation from Upper Egypt to Sea Ports

The main target market of Jatropha and inedible oils from the Upper Egypt are assumed to be EU countries in this study and Rotterdam is the main import port in EU. In order to formulate the Upper Egypt Inedible Oil Development Program, the study team studied three logistic modes: road (by truck), railway and river (barge/tanker). We can consider two different packaging methods for a large quantity of liquid cargos. In case of seeds transportation, the products will be transported in bulk. In case of oil, the products will be transported in flexitanks/tanker trucks or in bulk by tanker ship. A Felxitank/tanker truck is suitable for a relatively small quantity (100-5,000 ton), while the tanker ship is for a large quantity (1,000 to 50,000 ton). A standard flexitank can carry 20ton of vegetable oil and can be accommodated in a 20ft dry container.

The actual cost information of the above three transportation modes are summarized in the table below, based on the hearings with local logistic companies.

Table 14-1 Summary of Transportation costs from Upper Egypt

Origin	Destination	Distance (km)	Transportation Charge (LE/ton)	Time	Availability
1. Truck transportation (loading 20ton cargo)					
(1) Seeds transportation (20 ton/truck)					
Luxor	Quena	60	75(every day)	4hr	7/Week
Quena	Safaga	195	75(every day)	6hr	7/Week
Quena	Sohag	120	75(every day)	6hr	7/Week
Asyut	Cairo	300	200	6hr	7/Week
Aswan	Alexandria	1,075	200	1-2 days	7/Week
Quena	Alexandria	745	140-214	1-2 days	7/Week
Luxor	Alexandria	805	160	1-2 days	7/Week
(2) Oil transportation by 20 ft container (20ton/container)					
Aswan	Alexandria	1,075	244	1-2 days	7/Week
Quena	Alexandria	745	214	1-2 days	7/Week
2. Railway Transportation of oil by 20ft container (20ton/container)					
Aswan	Port Said	1,115	100	4 days	7/Week
Aswan	Alexandria	1,075	96	4 days	7/Week
Luxor	Port Said	905	81	3 days	7/Week
Luxor	Alexandria	870	78	3 days	7/Week
Asyut	Port Said	610	55	3 days	7/Week
Asyut	Alexandria	575	51	3 days	7/Week
3. River transportation of Oil by 20ft container (20ton/container)					
Aswan	Alexandria	1,075	40	15 Days	3 trip/month
Luxor	Alexandria	870	33	12 days	3 trip/month
Asyut	Alexandria	575	27	10 days	3 trip/month

* Seed transportation cost is almost double of oil in case of railway and waterway

(Source: Local logistics companies (2012))

(1) River transportation

As generally perceived, the river transportation is the cheapest mode of transportation from Upper Egypt to Alexandria. For example, the transportation cost from Luxor to Alexandria is 33 LE/ton (5.6 USD/ton) in containers. However, the time of transportation is quite long (12 days from Luxor to Alexandria) and the frequency of shipping per month (only 3 times per month) is also quite low. Therefore, river transportation may not always be a reliable means of transportation. Besides, one needs to take it into consideration that one travel of a ship can accommodate 15 containers (20 ft) only.

(2) Railway

Railway is the second cheapest means of transportation from Upper Egypt to Alexandria. In case of Luxor, it will cost 78 LE/ton (USD13/ton) to transport oil in 20 feet containers. This is also much cheaper than the cost of transportation by trucks. Compared to river transportation, the transportation time and the frequency of transportation are fairly advantageous. The minimum lot for the railway is 40 containers (20ft), which will be about 800ton of Jatropha oil.

(3) Trucking

The transportation by truck is more costly than the other modes of transportation. In case of transportation from Luxor to Alexandria, it will cost 160LE /ton (USD27/ton). In case of transportation from Luxor to Safaga, it may cost 100-150LE/ton(13-20USD/ton).

Figure 14-2 Logistic cost of Inedible Oil Export from Upper Egypt (Case of Luxor)

(Source: Study Team (2012))

As export ports, the Alexandria port (and Safaga port in later stage) are assumed to be best options in this study.

14.4.2 Transportation from Seaport to EU (Rotterdam port)

(1) Alexandria port to Rotterdam port (about 6000km)

Alexandria port is the principal port in Egypt. According to local logistic companies, the ocean freight charge from Alexandria to Rotterdam is about USD12.5/ton or less in 20ft container.

(2) Safaga port to Rotterdam (About 7000km)

Safaga is located on the western shore of the Red Sea and it is an important phosphate export port. To sail to Rotterdam from Safaga, the ship needs to pass the Suez Canal and therefore to pay the transit charge of around USD 0.3 million/passing, according to the Suez Canal Authority. This high charge suggests that the passing of the Suez Canal by small sized tankers are not economical and the ship size of over 50,000 DWT will be necessary. Therefore, it is advisable to use Safaga port as a port of loading after the inedible oil industry develop to a certain level in Upper Egypt and to use the Alexandria port instead for the initial stage.

Figure 14-3 Safaga Port

(Source: http://www.emdb.gov.eg/)

Table 14-2 Summary of Safaga

Summary :	
Port Position Long :	033 56 E
Port Position Lat :	26 45 N
Terminal Type :	General Cargo, Dry Bulk Cargo & Passangers
Time Zone :	GMT +2 (+/- hours)
Nearest Airport :	Hourghada
Authority :	Safaga Port Authority
Leth Agencies Contact :	Richard Skogheim (Oslo office)
Max Draft Excl Tide :	12,83 m
Max Length :	m
Max DWT :	Max Grt 70.327 tons mt
Main Import :	Aluminum Bowder, Coal, Grain, Florid, Cars.
Main Export :	Phosphate, Food
Night Navigation :	
Tides :	Between 1,2m and 2,1m
Weather :	Prevailing Winds are North west and South East
Working Hours:	24 Hours

(Source: http://www.lethagencies.com/)

14.5 Inedible Oil Production Plan

Based on the transportation information discussed above, an inedible oil production plan in Upper is analyzed. On the one hand, if a large quantity of seeds, which is bulky and low-density, are collected from remote areas before the extraction, the buying price of seeds at an oil factory will increase due to the transportation cost of seeds and this in turn shall increase the cost of the final product (oil) significantly. If a small oil factory is constructed in each of Jatropha plantation, the transportation cost of seeds (just from field to factory) shall be minimal. On the other hand, if a large quantity of seeds are collected to one place and a single large-scale oil factory is constructed there, the scale of economy shall be exploited, compensating for or exceeding the increased transportation cost of seeds. Thus, the locations and number of oil factories shall be determined based on the logistic costs and scale economy.

In the table below, an attempt was made to compare the case (Case 1) of one big oil factory in once place (in this case, Quena city) with the case (Case 2) of establishing several smaller scale factories in each seed production area (Quena, Aswan, Luxor, Sohag, Asyut). As a result, the latter case was favored in terms of oil production cost per ton without considering the land lease cost and other minor costs. This result supports the proposed concept, which was presented in 15.3.

Table 14-3 Oil Production Cost and logistic cost

Unit Cost	Case1 **Oil mill in each area (5,000ton)**	Case2 **Oil mill in Quena (50,000)**
Seed buying price (USD/ton seeds)	200	228
Oil recovery rate	25%	25%
Cake recovery rate	75%	75%
Feedstock cost (USD/ton oil)	800	912
Processing cost: Operator salary (USD/ton oil)	9.6	1.9
Processing cost: Electricity (USD/ton oil)	12	12
Transportation (Factory to Safag)(USD/ton oil)	43	8
Depreciation (20years)(USD/ton oil)	40	10
Other costs omitted (customs, tax, land etc.)	0	0
Production Cost(USD/ton oil)	905	944

(Source: Study team (2012), Local logistics companies and expeller supplier (2012))

If the main market of Jatropha oil is the EU biojet fuel, the produced oil need to meet the quality criteria of the buyers, who produce bio jet fuel for the EU market. One example of the oil quality requirement is shown in the table below. Most of the criteria will be easily achieved without secondary processing. Only free fatty acid (FFA) may be a technical issue to be carefully addressed in the proposed pilot project. If the produced oil in the pilot project is out of the FFA criteria, the acidification (neutralization) process will be needed.

Table 14-4 Example of Jatropha Oil Quality Requirement for Biojet Fuel

Item	Criteria
Free Fatty acid (expressed as oleic; molecular weight 282)	max 1 wt-%
Moisture & Volatile matter	max 0.2 wt-%
Impurities (insoluble in petroleum ether)	max 0.1 wt-%
Phosphorus	max 300 ppm-wt
Sulfur	max 10 ppm-wt
Flash point	min 120°C

(Source: A biojet fuel producer (2012))

14.6 Future Road Map Scenarios for the Biofuel Industry Development

The Study Team suggests a target of the proposed Upper Egypt Wide Inedible Oil Development Program as presented in the table below.

Table 14-5 Target for the Biofuel Industry Development

	Wastewater discharge (BCM/yr)	Plantation Area (fed)	Oil Production (ton)	Oil Income (Sales: USD)	Employment (Person)
Upper Egypt	0.4	84,240	105,300	105,300,000	20,218

(Source: Study Team (2012))

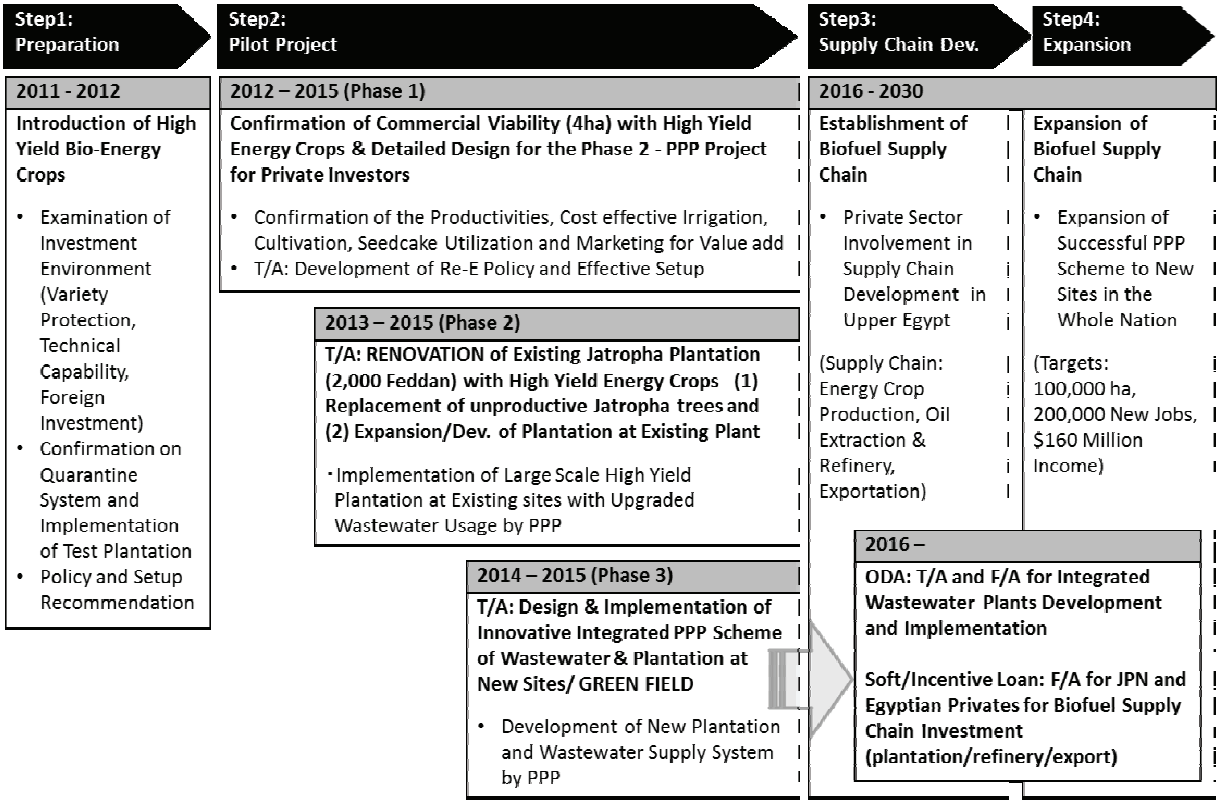
14.7 Road Map of Upper Egypt Inedible Oil Development Program

A roadmap to achieve the above target is proposed in 4 steps including the preparation work between 2011 and 2012.

1) The next step is the implementation of the proposed Pilot Project.
2) After the Pilot Project, a first Commercial plantation is expected to be developed by HCWW with an attractive condition for the private sector by 2016/17 using the Agro-SEZ Concept. As the plantation is progressing, the oil extraction factory should be constructed as the Jatropha seeds will be produced.
3) This first successful Agro-SEZ Program should be applied to other area and region.

The figure below summarizes the proposed roadmap in the following table.

Figure 14-4 **Roadmap of Upper Egypt Inedible Oil Development Program**



(Source: Study team (2012))

In the initial stage of plantation development, we recommend to replace the existing Jatropha plantation with new high-yield varieties. There are more than 1,000 feddan of planted area in Egypt and these plantation are not productive with high cost irrigation infrastructure and operations. Therefore, if the soil is free from salts and heavy metal accumulation and the cost of replacement is low enough, it is advisable to start the Jatropha plantation development with these exiting plantations in order to save the initial investment and revitalize the unproductive plantation.

We collected soil samples from the existing Jatropha plantation in Luxor and analyzed it. The result shows that there was no harmful accumulation of heavy metal or salts. The following table summarizes the cost of replacing the existing Jaropha plantation, assuming that only some part of the irrigation system is renewed before the replanting with new high-yield varieties. The replacement cost is low, compared to the initial investment cost of an irrigation system for a completely new site (LE 2,338/fed).

Table 14-6 Cost of Replacing Existing Jatropha Plantations with New Varieties

No.	Item	Cost (LE/fed)
1	Pulled old trees out	---------
2	Replacement the hose 18 m	522
3	Labors for replacement	50
4	Culture new trees labor work	300
5	Fungicide	50
6	Compost	233
TOTAL		1,154

(Source: Study team (2012), local supplier (2012))

CHAPTER V
Challenges and Recommendations for the Egyptian Biofuel Industry Development

CHAPTER V Challenges and Recommendations for the Egyptian Biofuel Industry Development

15. Critical Challenges for the Proposed Egyptian Biofuel Industry Development Program

15.1 Development Stage of Seed Productivities and Nature of Biofuel Market

As described in section 6.4, Jatropha curcus is a relatively new industrial oil crop and its variety improvement is ongoing processes by limited public organizations or private breeders in the world. Though some selected trees have proved profitable production levels, it is hardly possible to multiply “Same productivity” seedlings in commercial scale and plant in the large scale plantations.

One of key issues is “Fluctuation” of the each tree’s productivity. Traditionally, elite breeding programs had been taken for several decades or longer to achieve stable and reliable productivities. Though recent technologies enable faster elite variety development, there are few reliable elite Jatropha suppliers that are capable of “Reliable seedling supply” on the market at this moment.

For last ten years, there have been many large scale Jatropha plantation projects in developing countries mostly led by developed countries’ investors or biofuel producers to meet such developed countries aggressive polices on biofuel promotion. However, almost no large scale project have achieved “Profitable and sustainable” business model due to the imbalance of investment costs and profits.

Low profit is not only led by low productivities but also by nature of low commodity market. Unlike other high quantity commodities, benchmark or comparative commodity of Jatropha biofuel is one of the lowest value commodities – fossil fuel products. Even with “Environmental” additive value of biofuels, price of fossil fuels are too low to compete with labor and resource intensive biofuels compared to the fossil fuels.

Not only developed countries but also developing countries such as Thailand and Brazil have successfully lead privates’ investments into biofuel industries with governments’ strong policies on biofuel promotion for the purpose of long term energy security, commitment of climate change abatement, and/or sustainable development in new industries. Jatropha has been one of the key elements for the inedible biofuel feeds for those countries with little success.

Considering the sustainability of Jatropha biofuel model in Egypt, it is hardly to tell its potentiality without “Actual field trial under Egyptian climate treated with treated wastewater.” None of the countries have tested Jatropha cultivation by “Treated wastewater with high cost irrigation systems.” Though irrigation systems cost higher investment and operation, Egyptian fruits (mangos and grapes) and olive production with irrigation system have been proven to be one of the highest quality and productivities in the world and profitable business model in Egypt.

As same as successful agribusinesses practices in Egypt, Egyptian Jatropha business model might be feasible with application of proper agribusiness business models addressing high value markets, focusing higher value and good quality products, and strictly professional and cost effective operation.

Due to the too low value of fossil fuel products, Jatropha may not be able to become profitable agribusinesses like other edible crops and fruits businesses in Egypt in the short to midterm. In this case, other higher value inedible oil crop might be alternative options to immediately solve "Increasing amount of treated wastewater management" with profitable way as same as privates activities in edible crops and fruits business models.

As no one has seriously tested the feasibility of "Elite or improved" Jatropha varieties yet, it is highly recommendable for Egyptian stakeholders, especially for privates to get involved in "effective used of treated wastewater" for new Egypt. As a part of JICA's supporting program, JICA study team has evaluated best available elite Jatropha in the world and started comparative productivity test with consensus of all stakeholders involved in this JICA study. Detail description of finally approved varieties are shown in the following section and ongoing comparison tests shore described in Appendix. 4.

15.2 Recommended Varieties and Restriction of Import Varieties

Due to the limited reliable source of improved Jatropha varieties in Egypt, JICA study team has studied the potentialities of the best available improved varieties in the world at this moment (section 6.4) and recommended three (3) improved varieties from Indonesia, Philippines, and Singapore. After the acceptance of the Egyptian stakeholders and JICA, JICA study team tried to import recommended three (3) varieties to confirm the best available productivities by imported varieties with the comparison of local varieties.

However, due to the Egyptian restriction on importation of living plants from Tropical regions, two of three varieties delivered from stem cutting were rejected to import. Followings are the summary of the recommended varieties and decisions of seed committees.

Figure 15-1 Recommended Varieties and Allowed Variety Under the Restriction of Egyptian Plant Protection Regulation

Organization	Type & Name	Claimed Yield	Price & Conditions
Agricultural Research Center/ Indonesian Univ.	P1-1 and PI-2	3.0-4.0 ton/ha in the test field	- The center agreed to provide stem cuttings and seeds with necessary administration and transportation costs. - Strict plant variety protection will be required with a formal agreement between IDN-Center & MALR/Gov.Eg.
	NOT ALLOWED due to prohibited PEST risk		
Japanese Biofuel Company, R&D Center and Plantation in Philippines	Improved Variety by selection	2.5-3.0 ton/ha in the pilot field	The company is able to provide stem cuttings and seeds with only necessary administration and transportation costs.
	NOT ALLOWED due to prohibited PEST risk		
Japanese Trading Company Having Distribution License for a Singaporean Elite Jatropha	First Generation Selection & Breeding Variety	3.5 to 4.0 ton/ha with best care in the pilot field	The company is able to provide elite seedlings with tissue culture/cloning. Their variety must be protected for the future use. - Strict plant variety protection is required with a formal agreement between JPN/SG-org & MALR/Gov.Eg.
	ONLY ALLOWED due to PEST free tissue culture seedling		

Source: JICA Study Team

Though the seeds are allowed to import from tropical regions, it is not recommendable to depend on seeds for the commercial plantation as described in section 6.4 and 15.1. However due to the requests by Egyptian stakeholders and JICA, JICA study team tried to import the seeds from the recommended suppliers in Indonesia and Philippines. By the end of the JICA study period, JICA study team could only acquire seeds from "Philippines". Comparison of seed size between local variety and Philippines variety is shown in the Appendix. 3.

The imported tissue culture seedlings will be compared with "Higher productive local stem cuttings" recommended and prepared by Luxor forests' field engineers. On the contrary, the imported seeds will be compared with "local seeds." Unfortunately, there are no selective seed collection at this moment, it is not possible to plan and compare the seeds from higher productivities. Brief description of comparison test and transplanting of the imported seedling are shown in Appendix.4.

15.3 Justification and Accountability of Treated wastewater Use for Biofuel Feed Production and/or Other Industrial Crops Production

Though Jatropha biofuel industry development could contribute to a wide varieties of new Egyptian development, it is necessary to prepare for clear accountability to justify the treated wastewater resource use and non-arable land allocation for Jatropha biofuel feed production against other productive use of treated wastewater and non-arable land. Without the proof of actual "Commercial"

Jatropha seed production, it is not possible to define the reasonable and/or applicable non-arable land and treated wastewater value.

After years of governments' short-sighted or narrow scoped expenditures or improper privileges for selected favorable private businesses, now it is strictly required for any governments' agencies to prove the advantage of any public related expenditures or activities and reasonability of privileges for privates against other "Opportunity costs." Though no one has successfully utilized treated wastewater for profitable agribusiness use in non-arable land due to the limited applicability of high value commodity production and high cost infrastructures for irrigation, it is not reasonable enough to convince policy makers and general public to provide free non-arable land and free treated wastewater supply for "Renewable energy supply", especially privates' involvement.

It has been very sensitive matters to allocate any land, especially for "large scale" land or commercial purposes. Not only just political wills but also reasonable accountability of natural resource use with long-term strategic viewpoints are necessary in new Egypt. Due to the nature of the low value commodity production with high costs, it is very clear that strong commitments by public sectors are required to realize Egyptian biofuel industry development. However, it is also true that such governments' commitments for Egyptian biofuel industry development are reasonable enough for new Egypt among other opportunities. Under present circumstances, it will take long time and tough processes to get consensus among stakeholders. Thus, policy makers should start paying attentions to realistic feasibility of biofuel industry development and consider the reasonable accountability of strategic national resource exploitation for long-term.

15.4 Clear Guidelines and Modifications of "Code 501"

15.4.1 Clear Guidelines of "Code 501"

With enforcement of the Code 501, Safe Use of Treated Sewage Water for Afforestation (SUTSWA) program was introduced to manage the tremendous amount of untreated and treated wastewater for the purpose of the Nile and ground water protection. The treated and untreated wastewater has been either discharged in the desert or exclusively used for afforestation program to grow fast growing woods, high value timber trees, and three inedible oil crops namely Jatropha, Caster and Jojoba throughout the nation.

The primary objective of the afforestation program has been sustainable safety management of treated wastewater without serious consideration of effective and profitable applications or other socioeconomic aspects such as new employment creation and public service area. One of the key suggestions from JICA Study Team is to maximize economic benefits from this unique resources with collaboration with appropriate business sectors that could effectively convert this national resource into sustainable source of energy or other competitive industrial material production.

Although the Code 501 is outcome of comprehensive studies with practical application guidelines, it is not well known among either public officers and labors or privates interested in treated

wastewater use for commercial use. It is highly recommendable for any public sectors involved in treated wastewater applications to study this practical guidelines for further safety and effective use of treated wastewater.

15.4.2 Possible Modifications of "Code 501" for more flexible application

In addition to improving awareness of Code 501 in public and private sectors, it is also recommendable to extend applicability of Code 501 for more flexible applications for effective and sustainable ways. In order to ensure the public safety and extend applicability of treated or untreated wastewater, good practices in developed countries shall be integrated in the amended Code 501, particularly European union's strategic resource management practices and cost effective treatment for "Commercial" use (cf. Directive 86/278/EEC on the protection of the environment, and in particular of the soil, when sewage sludge is used in agriculture amended in 2009).

Many developed countries consider treated wastewater and other by products, particularly dry sludge as ideal and vital resources for agriculture with appropriate treatment to ensure the human and environmental safely. Some country even allows to cultivate edible crop or fruits with higher treatment. Under the Egyptian circumstances, there are still growing needs to improve the basic infrastructures rather than high level treatment, especially in rural communities. Thus, it is recommendable to focus on inedible plant cultivation and possibly extended to industrial crop applications such as cotton.

In addition to the extension of the treated wastewater applications, it is also recommendable to utilize dry sludge as sustainable source of organic fertilizer - soil enrich agents with appropriate treatment and their strict monitoring and certification mechanism for environmental, health and safety assurance. As a part of EU's capacity development programs for neighboring countries, responsible Egyptian authorities (EEAA, MALR, HCWW) have been taking necessary technical trainings and workshops. With a set of easing Code 501, a model treatment facilities with qualified operators and reliable technologies shall be installed to improve the public awareness and create new market for the dry sludge applications.

16. Potentiality of Intergovernmental Arrangement for Egyptian Biofuel Industry Development Program (EBIDP)

16.1 Key Stakeholders of Existing Afforestation Program and Potential Stakeholders of Biofuel Industry Development in the Future

Due to the limited/restricted communication with government officials, JICA study team could not update the information after the previous JICA study in 2010 except primary stakeholders of present afforestation programs. Followings are the known facts in 2010 and updated information for accessible authorities between 2011 and 2012.

16.1.1 Ministry of State for Environmental Affairs (MSEA) / Egyptian Environmental Affairs Agency (EEAA)

Egyptian Environmental Affairs Agency (EEAA) is solely responsible agency for all environmental matters in Egypt. EEAA is also responsible for evaluating over all potentiality of unknown or new industries in Egypt covering general feasibility, economic feasibility and environmental impact assessments. As one of three key responsible stakeholders, EEAA has been monitoring nationwide Safety use of Treated Sewage Water for Afforestation Program.

16.1.2 Ministry of Housing, Utility and Urban Development

Holding Company for Water and Wastewater (HCWW) under Ministry of Housing, Utility, and Urban Development (MHUD) is the solely responsible entity to operate drinking water supply and wastewater treatment in Egypt. As one of the most important public services, HCWW and its local companies have strong ties between local governments and operate its facilities with commercial good practices in developed countries. As the key public sector development, aid agencies have supported HCWW's development and commercially oriented operations with good practices in developed contraries.

In regard to the existing afforestation program, HCWW has allocated afforestation area for the purpose of the safety wastewater management. In general, EEAA and UAE/MARL have managed the afforestation for management of treated or untreated wastewater discharge. However, recently, HCWW also operates some afforestation by itself.

16.1.3 Ministry of Agriculture and Land Reclamation

Under Secretariat for Afforestation and Environment (UAE), Ministry of Agriculture and Land Reclamation (MALR) Department is the key counterpart of the Pilot Project since (1) Import of New Jatropha Variety is responsible of MoA, (2) Testing site is located at the Luxor Plantation which is belong to MoA, Afforestation Department and operated and (3) Quarantine of New Jatropha Variety is also handled by MoA Quarantine Department.

16.1.4 Ministry of Planning and International Cooperation (MOPIC)

As MOPIC is solely responsible authority to monitor any official development assistance (ODA) by aid agencies, MOIPC is now observing this JICA study and would be responsible for any further assistance program by JICA.

In the case of national energy security matter and policy development, MOPIC would be also one of key stakeholders for policy development matter as national planting authority.

16.1.5 Ministry of Petroleum and Metallurgical Wealth (MPMW)

As a part of alternative energy resource study, Egyptian Petro Chemicals Holding Company (ECHEM) studied potentiality of the Jatropha biodiesel production from available treated wastewater in 2008. The final outcome and any specific action followed by the study is unknown. At this moment, there seemed no active communication with EEAA, MALR, and HCWW for the potential biofuel supply chain development.

In the case of national energy security matter and policy development, MPMW would be one of key stakeholders for policy development matter.

16.1.6 Supreme Council of Energy (SCE), Prime Minister Office.

SCE is the highest energy policy advisory council for Egypt. One of the SCE members has been observing JICA's study on Jatropha biofuel industry development.

In the case of national energy security matter and policy development, SCE would be the key stakeholder for policy development matter.

16.1.7 Ministry of Investment, GAFI

General Authority for Investment (GAFI) is one stop authority for any investment projects. It promotes private investments in Egypt and is responsible for laws and regulations related to investment promotion. For the purpose of promoting investments in Egypt, GAFI also develops and operates investment zone for general industrial purposes.

In the case of commercial biofuel industry development stage, GAFI would be one of the key stakeholders of the agricultural investment promotion and its relevant policy development matter.

16.1.8 Ministry of Finance, PPP Unit

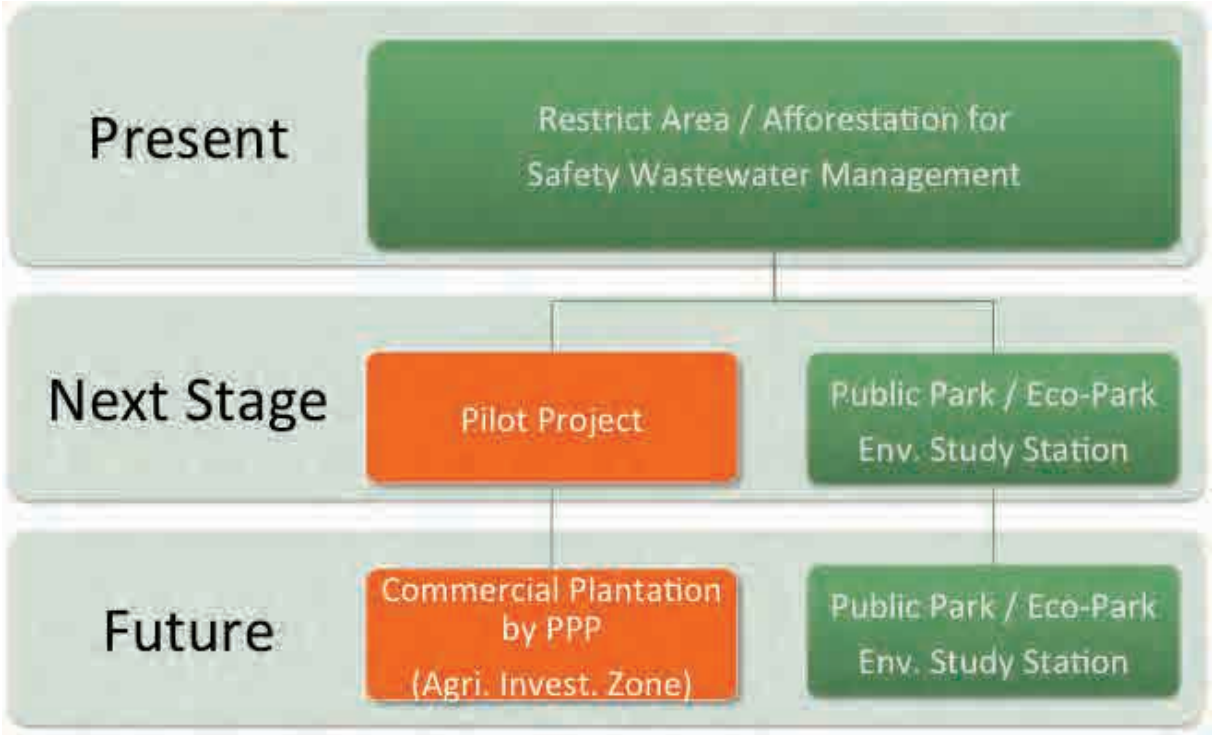
Public Private Partnership (PPP) unit under the Ministry of Finance is a specialized unit to take care of PPP scheme projects between relevant public authorities, privates, and prime minister office for special arrangement for the public interested projects with PPP.

In the case of commercial biofuel industry development stage, PPP Unit would be one of the key stakeholders to develop the national biofuel policy and implementation of such policies.

16.2 Possible Future Intergovernmental Arrangement for Afforestation/Eco-Park Program and Egyptian Biofuel Industry Development Program

Although present safety wastewater management program with afforestation successfully proved the safety management, it is not financially sustainable and hardly manage further treated wastewater in the future. Based on JICA study team's evaluation in Egypt, it is recommendable to shift to two primary usage of the treated wastewater for both scientific/social and economic purposes.

As shown below, it is recommendable to maintain existing forest as "Public park and environmental study station" and to develop new afforestation area as "commercial plantation" with collaboration with privates with PPP scheme.



16.2.1 Arrangement for Existing Afforestation

With over several decades of newly created eco system in the middle of isolated desert, it is highly recommendable to maintain the present forests as afforestation with same or similar management structure now. However, concerning the accountability of tax payers and improving public awareness of water resource management and environment, it is recommendable to open the existing afforestation to the public. Also as one of the rare artificial forests in the world, such afforestation should be also considered as environmental study stations for researchers and students in general.

Such program shall be led by present stakeholders and local government as well as additional entities to suite the local needs for such public service area development. Expected functions and objectives are as follows:

- Improve Public Awareness for Water Use and Wastewater Care
- Promote Smart Use of Treated Wastewater for Sustainable and Safety Management
- Serve the Public for Recreation Area
- Maintain and Monitor One of the Most Unique Afforestation and Manmade Eco-systems in the World

16.2.2 Evaluation of Jatropha Productivities and Preparation of Pilot Project Stage for EBIDP (2012-2013)

With the consensus of the present key stakeholders (EEAA, MALR, HCWW), observers (MOPIC, SCE) and JICA, UAE/MALR has conducted up to fifteen (15) months performance tests for both local varieties and two (2) imported varieties. During this period, there would be no further actions and discussions among stakeholders unless the monitoring results give some aspects for the further trial.

However, in the meantime, it is recommendable to share the updated information and prepare for the final decision after the evaluation tests. Monitoring program shall refer to Appendix 4.

Based on the productivity tests, there would be three scenarios followed by the evaluation period:

15 months productivity test with reference productivities	High enough:	- justification and security of funding - further steps such as pilot project
	Not enough	- sustaining monitoring - starting productivity improvement program - considering other industrial or energy crop
	Low or very low	- terminate - considering other industrial or energy crop

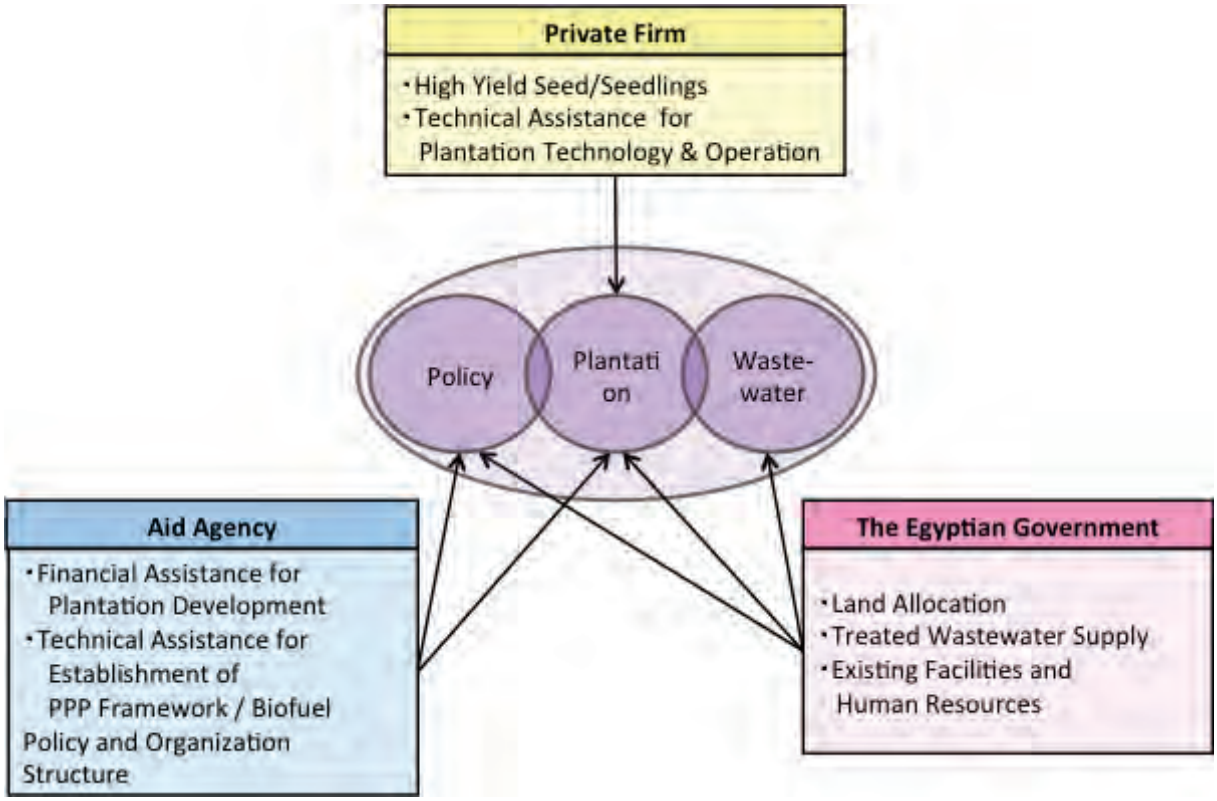
16.2.3 Implementation of Pilot Project Stage (3-4 years program)

In case of positive output from the evaluation tests (2012-13) and Government of Egypt decides to proceed with further steps such as pilot project, the structure of the stakeholders are likely to remain present afforestation program structures in technical evaluation matters. Detailed contents of the technical evaluations and commercial viability tests are shown in Chapter IV.

During the pilot project stage, it is highly recommendable to start biofuel policy development to facilitate private investors into Egyptian biofuel industry development in the following commercial plantation stage with PPP scheme. For such energy/investment/PPP policy development purposes, it is likely to require to initiate such policy development working group or bring such tasks on to the existing relevant policy makers or their working group.

The general concept of each stakeholder's role is shown below (Figure 16-1).

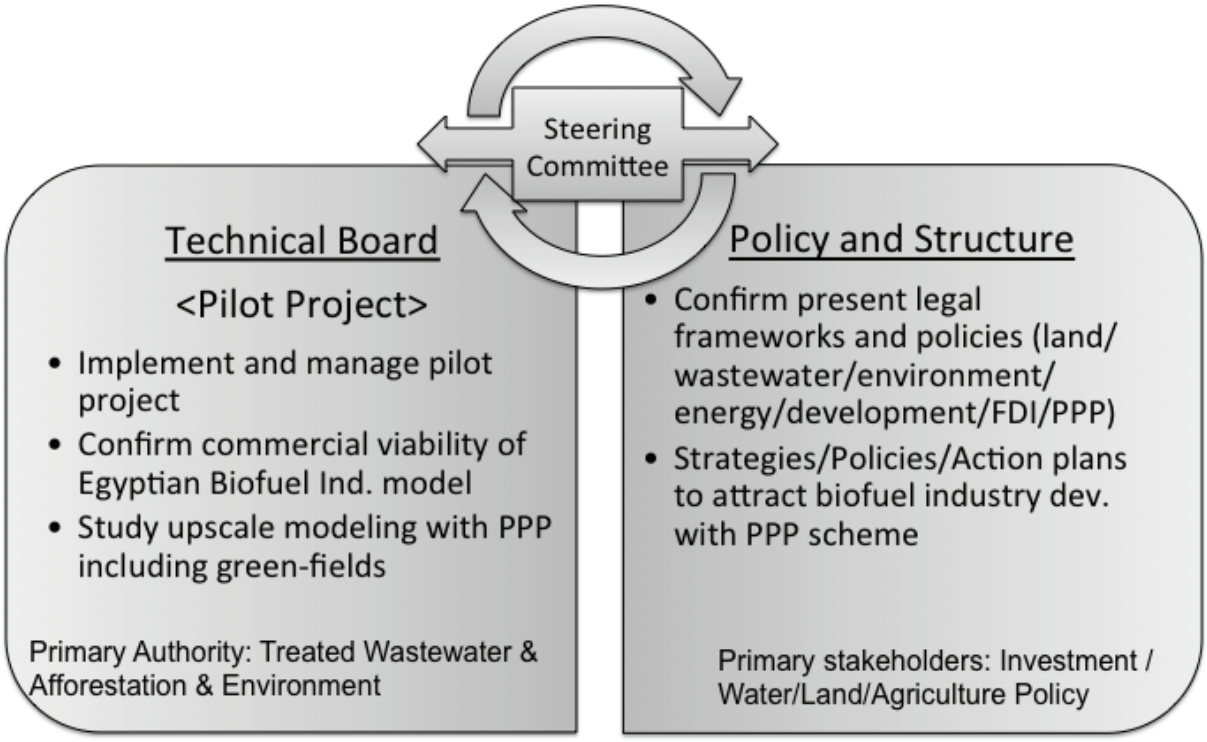
Figure 16-1 Roles and Players During the Pilot Plantation Stage



(Source: JICA Study Team)

While the mentioned commercial scale technical evaluation, policy development shall be proceeded simultaneously. The result of technical evaluation would greatly affect the PPP and biofuel policy making to attract private investments as well as justify national resources allocation for the biofuel industry development with collaboration with private investments. Thus, it is highly recommendable to prepare effective structures between technical evaluation and policy making under a steering committee. The concept of steering committee above two specialized boards (technical board and policy & implementation structure board) is shown in Figure 16-2.

Figure 16-2 Concept of a Steering Committee for Egyptian Biofuel Industry Development (BID) to Prepare for Large Scale PPP Projects



Source: JICA Study Team

16.2.4 Commercial Stage After the Pilot Project

In case of positive output from the pilot project stage (3-4 years) and successful development of policy framework for private investors into biofuel industry sectors, an entity having supreme power to coordinate all necessary business licensing and security of treated wastewater and land allocation would be required. Due to the highly dependency of public sectors' treated wastewater supply, it is not easy to facilitate and maintain competitive and attractive investment environment for the commercial scale Jatropha production. Such entity would be a curtail role for the successful start of the Jatropha biofuel industry development at the initial stages.

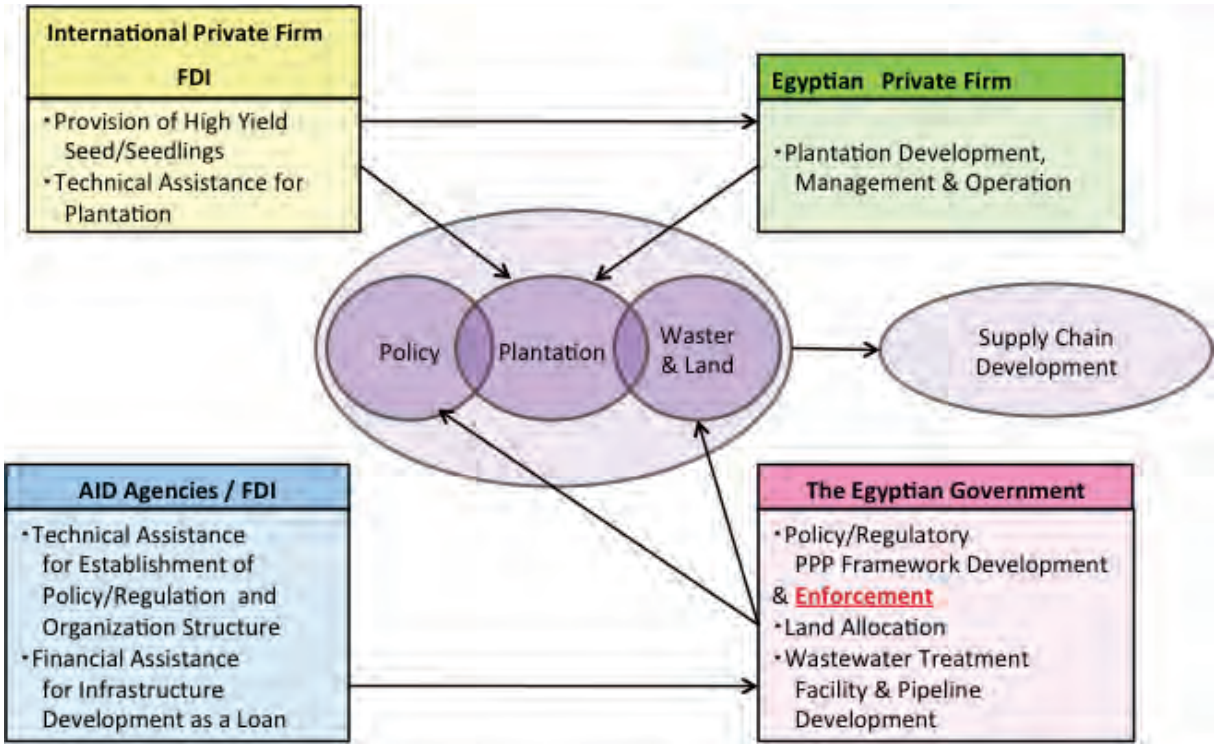
Based on successful integration of PPP schemes in Asian countries, it is highly recommendable to define clear role of public sectors and private sectors and establish a "Powerful arbitration entity" to maintain the favorable investment environment for privates. Without such trouble shooting structures, public sectors tend to abuse their powers against privates and privates quickly withdraw the investments and shift to other favorable countries for similar business opportunities.

As similar concept as industrial zone or investment zone for manufacturing, agricultural investment zone concept would be suitable for ensuring power balance between publics and privates and provide and maintain competitive investment environment for investors. The concept and general services of such agricultural investment zone is shown in figure 16-3.

Figure 16-3 Concept and Services of Agricultural Industrial Zone under an Authority Having Supreme Power Across Public Sectors

(Source: JICA Study Team)

Figure 16-4 Roles and Players During the Commercial Stage



(Source: JICA Study Team)

17. Conclusion of the Study and Recommendation

17.1 Ten Key Words for the Egyptian Biofuel Industry Development Program

Under the historical revolution period in Egypt, JICA study team has faced unreasonable difficulties to proceed with JICA study, but it has also witnessed the growing willingness to improve its society by themselves for now and next generation. If new government of Egypt can lead such strong power into its new national development, Egypt could deliver enormous performance in economic development as same as Asian economic development for last several decades. It was first time for JICA study team since its first commitment in this particular topic in 2006. We sincerely hope to assist Egypt to optimize this opportunity into its sustainable development.

With generous supports by Egyptian authorities and highly qualified and professional work by local experts, we have confirmed that Egyptian Jatropha biofuel industry could directly benefit to new Egypt in particularly:

- Smart Use of Treated Wastewater for Sustainable and Safety Management,
- Potentially Major Contributor of Egyptian GDP by Competitive Exporting Commodity Short-Mid Term,
- Renewable Energy Source for Domestic Use, and
- Rural Development and Income Generation by new Jobs.

Followings are the "**10 Key Words of Egyptian Biofuel Industry Development Program (EBIDP).**

11. One Stone Kills Four Birds	Very unique golden opportunity to address 5) High Unemployment/Income Generation in rural areas 6) Safety & effective use of treated waste water with NON-Arable land 7) Sustainable industrial crop production with privates investments 8) New industry development (Inedible Oil Crop Industry)
12. Nation Wide Inedible Oil Crop Production with Unconventional Water Sources	Production of Inedible Oil Corp (IOC: cf. Jatropha, Castor, & Jojoba) for national strategies on renewable biofuel supply or competitive new commodities for new Egypt
13. PPP Scheme	Shifting from public investments and operation to more effective and efficient privates' investments and/or operation
14. Agro-Investment Zone Scheme	Facilitation of privet developers and investors to biofuel industry development by using smart and cost effective privileges for privates
15. Profit Sharing Scheme	Encouragement for developers and investors to biofuel industry development program and reduction of INITIAL risks for investors
16. Integrated Wastewater Treatment Plant &	More efficient & effective and cost reduction: Shifting from two separate development (urban area and plantation) to integrated development for higher efficiency of investment

IOC-Plantation	
17. Leverage of EG Code 501	More flexible/wider applicability of treated wastewater and sludge with good treatment practices/technologies in EU and other reference countries
18. Leverage of Stakeholders for Commercialization	(1) Present/Public Program: EEAA, MALR, HCWW (2) Next/Pilot Project Period: Ongoing stakeholders for afforestation (3) Next/PPP Framework Development: responsible and capable authorities for biofuel policy and PPP scheme development (4) Future/Eco-Park/Public Program: Ongoing stakeholders for afforestation (4') Commercial Plantation/PPP: Facilitation of privates by public authorities and competitive operation by privates
19. Vision and Goal (0.5 million new jobs & $7 billion income)	Creation of New IOC Industry with wastewater Creation of 0.5 million new jobs and US$7.0 billion exporting commodity by 2030
20. Import & Test of High Yield Variety	(1) Confirmation of productivities to achieve the commercial viabilities (2) Confirmation of accountability for the further steps of Jatropha project

17.2 Possible Steps for overcoming the major challenges

- Step 1: Set up a Clear Vision and Bio-energy Policy and Development of Biofuel Industry using treated Waste-water
- Step2: Set up a National the Biofuel Industry Development Program
- Step3: Selection of suitable Oil Crops in each region, For example, for Upper Egypt Region, High Yield Jatropha may be selected after the testing but Lower Egypt where the weather is colder should be selecting either Castor or Jojoba based on each regional natural condition of weather, soil and water
- Step 4: Use of the Public Private Partnership (PPP) and Agro-SEZ Park system for promotion of the Biofuel Industry Development by Private sector
- Step 5: Successful Implementation and Management Structure for the Pilot Plantation Project
- Step 6: Successful Introduction and Application of High Yield Jatropha Variety and other high value Biofuel for use of wastewater
- Step 7: Development of entire Supply chain for the Biofuel Industry in Egypt by 2030.

17.3 Recommendations

1) Successful implementation of inedible oil crop development program (IOCDP) and biofuel industry development (BID) require the following new policy & strategy

(1) Apply the PPP scheme for plantation portion of IOCDP/BID attracting Private investors and reducing public spending.

(2) Introduce a new Agricultural Investment Zone concept for IOCDP/BID and other Agricultural large scale developments

(3) Review of "Code 501" for more flexible and clear guidelines for use of treated wastewater and sludge

(4) Systematic arbitration mechanism (Trouble Solving Supreme Entity) for resolving problems arising from the IOCDP is also recommended.

(5) Role of PPP Unit, MOF and GAFI for the IOCDP/BID will be important to facilitate and ease privates hustle works.

(6) Role of Aid Agencies will be the Key for the successful implementation of IOCDP/BID especially in the Pilot Project stage:

- SHORT TERM ASISSTANCE

(iv) Supporting the Pilot Project for Egyptian IOCDP/BID as a first step since the program is unique and may have a big impact on Egyptian Economy in terms of income generation and job creation.

(v) Possible technical support for the Formulation of Agricultural Investment Zone Program may be needed, which is likely to increase private investment in OCIDP/BID and Agriculture sector in general.

(vi) Possible Technical support for Innovative Integrated Wastewater Treatment & Plantation PPP Scheme to HCWW, which is likely to allow more the PPP scheme and increase chance for JICA to participate in new green field integrated wastewater treatment plant and plantation combined project.

- MID-LONG TERM ASISSTANCE

(iv) Financial and Technical Assistance for the Greenfield Integrated Wastewater Plant Development in Egypt by Yen loan will be ready for financing for the newly proposed integrated wastewater treatment plant & Agricultural Investment Zone together.

(v) Financial and Technical Assistance for an Agricultural Investment Zone program for Agriculture sector and Inedible Oil crop Development Program if the Agricultural Investment Zone program will be read for financing mainly key infrastructure such as electric power, irrigation, roads and ports. If the projects are public, JICA use direct Yen loan and if projects are by private sector, the 2-step loan can be considered.

(vi) Financial and Technical Assistance for the Inedible Oil crop industry supply chain development and BID such as oil extraction factory and exporting facilities. If the projects are public, JICA use direct Yen loan and if projects are by private sector, the 2-step loan can be considered.

APPENDIX

Appendix 1. Law 82 for 2002

LAW ON THE PROTECTION OF INTELLECTUAL PROPERTY RIGHTS

BOOK FOUR PLANT VARIETIES

Article 189

Under the provisions of this Law, protection is granted to plant varieties, derived inside or outside Egypt, whether developed through biological or non-biological means, when registered in the special register of protected plant varieties.

Article 190

The Prime Minister shall establish an office to be known as the Office of Plant Variety Protection. The Office shall be competent to receive, examine and decide on applications submitted for the protection of plant varieties, in accordance with the rules and procedures stipulated in the establishment decision.

Article 191

Without prejudice to international conventions in force in Egypt, any natural person or legal entity, Egyptian or foreign, belonging to, domiciled or active in a country or an entity that is a member of the World Trade Organization or that applies reciprocity to Egypt, shall have the right to protection of plant varieties as prescribed in this Book.

Article 192

To be eligible for protection a variety shall be new, distinct, uniform, stable and shall be subject of a denomination.

A variety shall be considered new if, at the filing date of the application, the vegetation propagation of the variety was not sold or otherwise transmitted to third parties by the breeder or with his consent for the exploitation of the variety. A variety shall not lose its novelty if it was exposed or circulated in Egypt for more than one year prior to the effective filing date of the application. Where a variety has been exposed or circulated outside Egypt, such period shall not exceed six years in case of trees and vines or four years for other crops. The variety shall also satisfy the condition of novelty where the sale or disposal to others, with the consent of the breeder, has taken place prior to the granting of protection to such variety.

A variety shall be considered distinct if it is distinguishable from other known plant varieties, by one or more obvious characteristics, provided that the variety maintains this characteristic after propagation.

A variety shall be considered uniform when the variations among its class remain within permissible limits.

A variety shall be considered stable, when replanted, if its essential characteristics do not change after repeated propagation for a period prescribed in the Regulations.

A breeder’s right certificate shall be granted to the person, whether a natural person or a legal entity, who discovers the plant variety that fulfills the protection conditions.

Article 193

The term of protection for plant varieties shall be 25 years for trees and vines and 20 years for other crops.

The term of protection shall run from the date of the grant.

Nevertheless, a variety, for which a breeder's right is requested, shall be granted a temporary protection starting from the date of the filing of the application and expires on the date of the publication of the grant of the title. During this period, the breeder's right as stipulated in Article 194, shall be limited to a fair compensation as soon as such protection is granted, provided that the breeder has notified his application to the party that has been exploiting the plant variety prior to granting the protection.

Article 194

The holder of a breeder's right certificate shall have an exclusive right to the commercial exploitation of the protected variety in any form whatsoever. The production, propagation, circulation, sale, marketing, importing, exporting of propagation material shall not be allowed without the written consent of the variety breeder..

Article 195

The protection shall not prevent third parties from the following acts:
(i) Non-commercial activities and use of the result of propagation material, by farmers on their own holdings for private propagating purposes;
(ii) Activities related to experiments and scientific research purposes;
(iii) Activities of breeding, cross-breeding and selection for the purpose of breeding new varieties;
(d) Activities related to teaching and training purposes;
(e) Activities of use, commercial exploitation and consumption of the crop material, prime and intermediate material and finished products, which are made or derived directly or indirectly from the crop material, whether the crop material is an entire plant or part thereof.

Article 196

The Office of Plant Variety Protection, on submission by the Minister of Agriculture and after the approval of a ministerial committee established by a decision of the Prime

Minister, may grant non-voluntary licenses to use and exploit the protected variety without the consent of the breeder, when necessary to safeguard the public interest and where the breeder fails to produce the variety on his own or to provide the propagation material of the protected variety, and where he refuses to grant third parties license for the exploitation of the variety, despite the appropriate conditions offered, or where he practices unfair competition.

The breeder is entitled to fair compensation for the use and exploitation, by third parties, during the non-voluntary license period. The assessment of such compensation shall take into consideration the economic value of the variety.

Article 197

In accordance with the provisions of Article 196, the licensee shall, during the period of the license, abide by the conditions of the license and shall not assign the license to a third party or prejudice other rights of the breeder.

The license shall lapse at the end of its duration or where the licensee does not comply with any of the terms of the license.

Article 198

The breeder's rights on the material of the protected variety shall lapse if offered by him or by his consent for circulation outside Egypt. In this case, third parties are entitled to circulate, sell, commercialize, distribute or import the protected variety whether in the form of propagation material or crop material from an entire plant or part thereof or products derived or manufactured from the crop or other plant components.

The breeder has the right to prevent others from exporting the protected variety if such exportation would lead to the propagation of the variety in a country where the variety does not enjoy protection.

Article 199

The Minister of Agriculture may, on the recommendation of the ministerial committee referred to in Article 196, limit the exercise of the breeder of all or some of his rights provided for in this Law in any manner with the aim of safeguarding the public interest, and in particular if it appears that the protected plant variety:

(a) has harmful effects on the natural environment, the safety of biological diversity, the agricultural sector, the life or health of humans, animals or plants, in Egypt;

(b) has harmful economic or social effects, hampers local agricultural activities, or it appears that its use is incompatible with the values and beliefs of the community.

Article 200

The breeder shall disclose the genetic source relied on to develop the new plant variety. The protection of the new plant variety requires that the breeder has acquired that source by legitimate means under the Egyptian law.

Such a requirement extends to traditional knowledge and experience accumulated among local communities the breeder could have relied on in his efforts to develop the new plant variety.

Likewise, the breeder who deals with Egyptian genetic sources, with a view to develop new varieties derived therefrom, shall undertake to obtain the approval of the relevant competent administrative authorities. He shall also undertake to acknowledge the Egyptian traditional knowledge as sources to what he could have achieved using such knowledge and experience, through the disclosure of the Egyptian source the breeder benefited from, and by sharing the profits gained with the interested party, as prescribed in the Regulations of this Law.

A register shall be established in the Ministry of Agriculture to include the genetic Egyptian plants, both wild and domesticated.

Article 201

The Office of Plant Variety Protection shall issue breeder's right certificates in accordance with the procedures prescribed in the Regulations, against a fee prescribed therein, not exceeding 5,000 pounds.

The grant of such a certificate shall be published, at the expense of the title holder, in a monthly gazette issued by the Office. Where an application is rejected, the applicant shall be informed of the rejection decision and the reasons thereof. Any interested party may, within 15 days from the publication date or the date of notification, oppose the decision to grant a breeder's right certificate or to reject an application for the protection of a plant variety, as may be the case.
The Regulations shall prescribe the rules and procedures for the notification, examination of the appeal and the decision thereon.

Article 202

Where a variety loses one of the conditions required for granting a breeder's right, or when granted in violation of the provisions of this Law, the certificate of the breeder's right shall be cancelled in accordance with the rules and procedures as decided by the Minister of Agriculture.

Notification of this decision to the concerned parties shall be in a registered letter with acknowledgement of receipt, and may be appealed within 15 days from the date of notification.

The Minister of Agriculture shall issue a decision establishing the rules and procedures for examination and settlement of the appeal.

Article 203

Without prejudice to any more severe punishment under any other law, deliberate violation of the provisions contained in this Book shall be punishable by a fine of not less than 10,000 pounds and not more than 50,000 pounds.

In case of repetition, the punishment shall be an imprisonment for a period of not less than three months and not more than one year and a fine of not less than 20,000 pounds and not more than 100,000 pounds.

In all cases, the incriminated seeds and the propagating materials shall be confiscated.

Article 204

Upon the request of any concerned party, the president of the competent court considering the merits of the case, may issue a decision, by petition, to order one or more of the appropriate conservatory measures, and in particular:
(1) Establishing infringement of a protected right.
(2) Drawing a detailed inventory and detailed description of the infringing products and the implements used or may be used in the infringement.
(3) Seizure of all articles stated in item 2.

In all cases, the president may designate one or more experts to assist the bailiff in charge of the execution of such measures. He may require the applicant to deposit an appropriate financial security.

Where the applicant fails to submit the merits of the case to the competent court, within 15 days following the date of the order, such order shall cease to have effect.

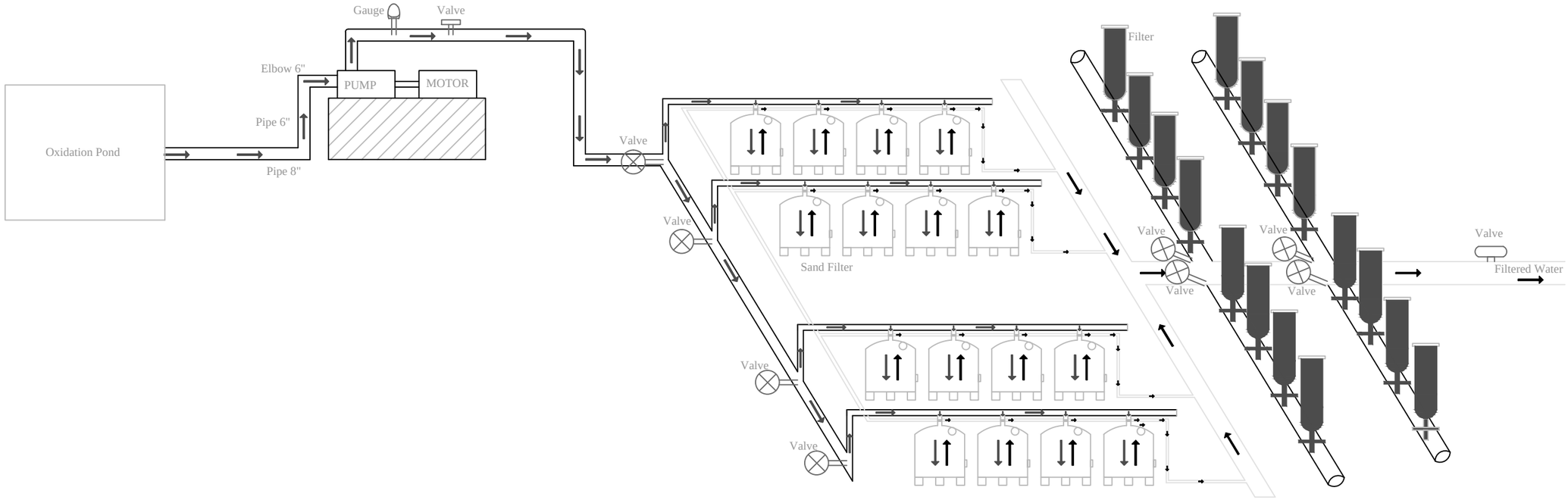
Article 205

The concerned parties may, within 30 days from the date of issue or publication of the order, as may be the case, appeal to the president of the court who issued that order. The president may confirm or revoke the order totally or partly, in accordance with the rules and procedures provided for under the law of civil and commercial proceedings.

Article 206

The Minister of Justice, in agreement with the Minister of Agriculture, shall issue a decision designating law enforcement officers for the purpose of implementing the provisions contained in this Book.

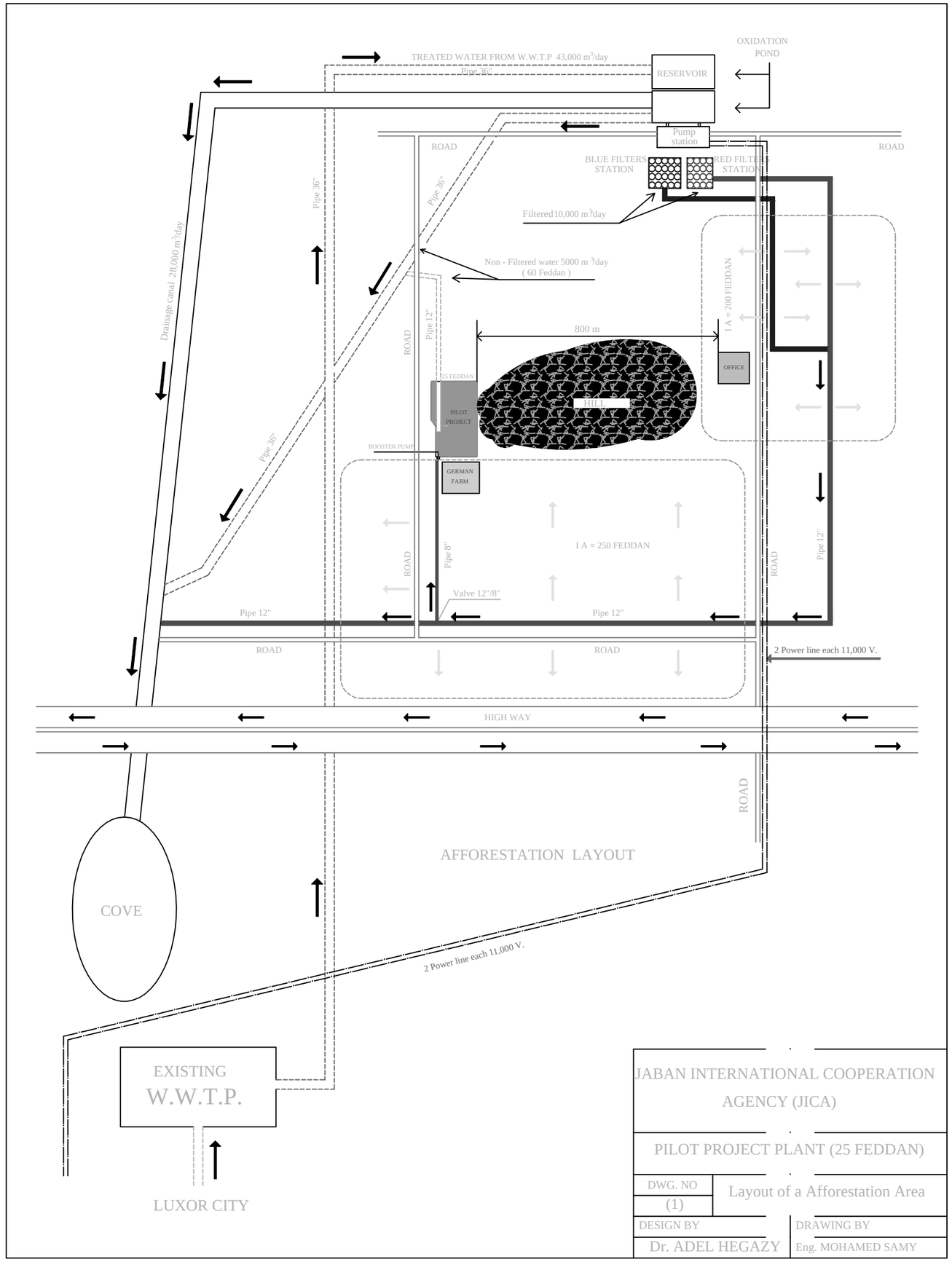
Appendix 2. Drawings of Proposed Pilot Plantation Design

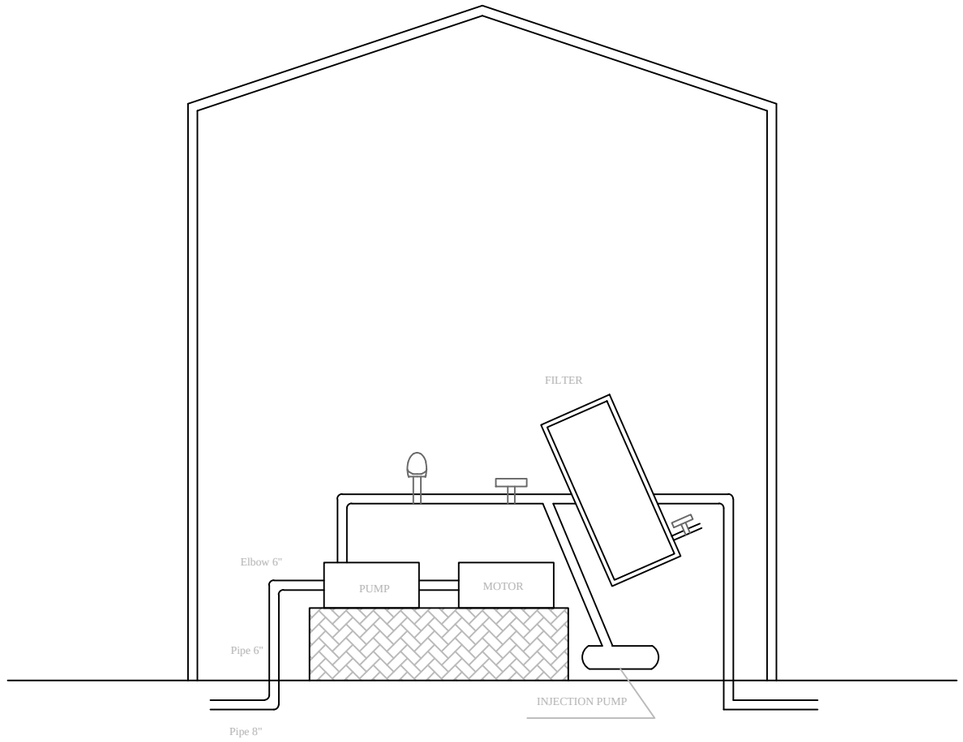


JABAN INTERNATIONAL COOPERATION AGENCY (JICA)

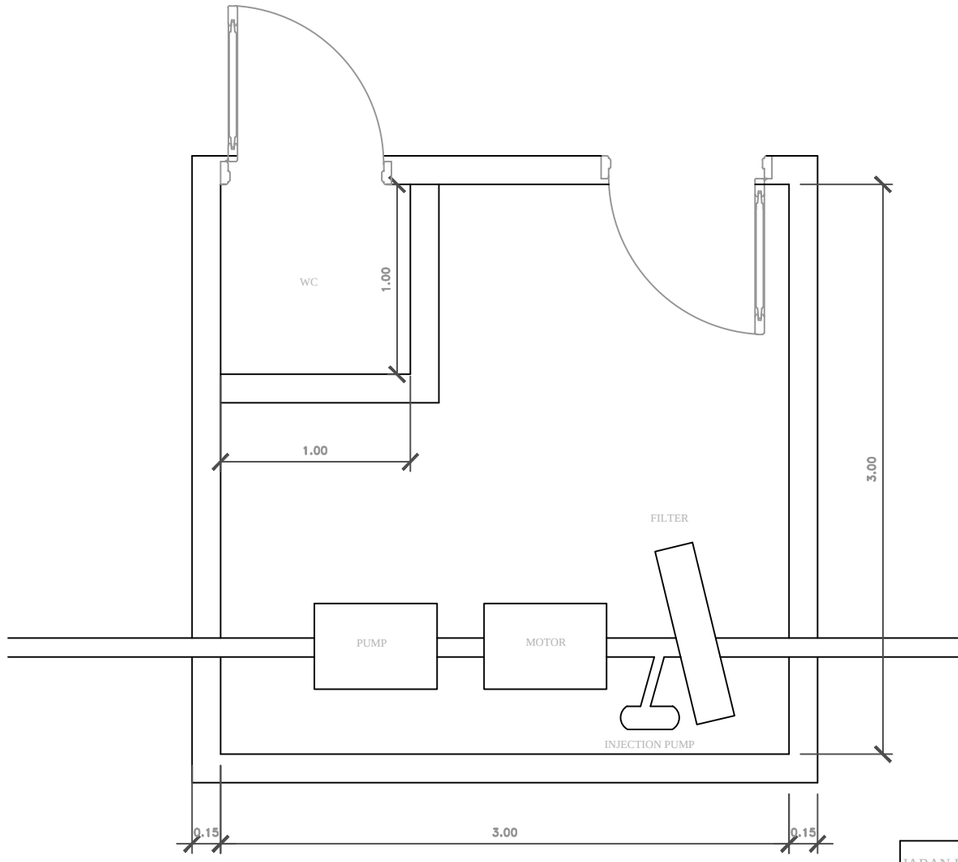
PILOT PROJECT PLANT (25 FEDDAN)

DWG. NO	Design of 1,000 feddan Pump - Motor and Filter Station booster pump
(12)	
DESIGN BY	DRAWING BY
Dr. ADEL HEGAZY	Eng. MOHAMED SAMY


TREATED WATER FROM W.W.T.P 43,000 m3/day
Pipe 36"
RESERVOIR
OXIDATION POND
Pump station
ROAD
ROAD
BLUE FILTERS STATION
RED FILTERS STATION
Filtered 10,000 m3/day
Non - Filtered water 5000 m 3/day
(60 Feddan)
Drainage canal 28,000 m3/day
Pipe 36"
Pipe 36"
Pipe 12"
ROAD
800 m
I A = 200 FEDDAN
OFFICE
25 FEDDAN
PILOT PROJECT
POND
BOOSTER PUMP
GERMAN FARM
Pipe 36"
I A = 250 FEDDAN
Pipe 8"
ROAD
ROAD
Pipe 12"
Valve 12"/8"
Pipe 12"
Pipe 12"
ROAD
ROAD
2 Power line each 11,000 V.
HIGH WAY
ROAD
AFFORESTATION LAYOUT
COVE
2 Power line each 11,000 V.
EXISTING
W.W.T.P.
LUXOR CITY
JABAN INTERNATIONAL COOPERATION AGENCY (JICA)
PILOT PROJECT PLANT (25 FEDDAN)
DWG. NO
(1)
Layout of a Afforestation Area
DESIGN BY
Dr. ADEL HEGAZY
DRAWING BY
Eng. MOHAMED SAMY

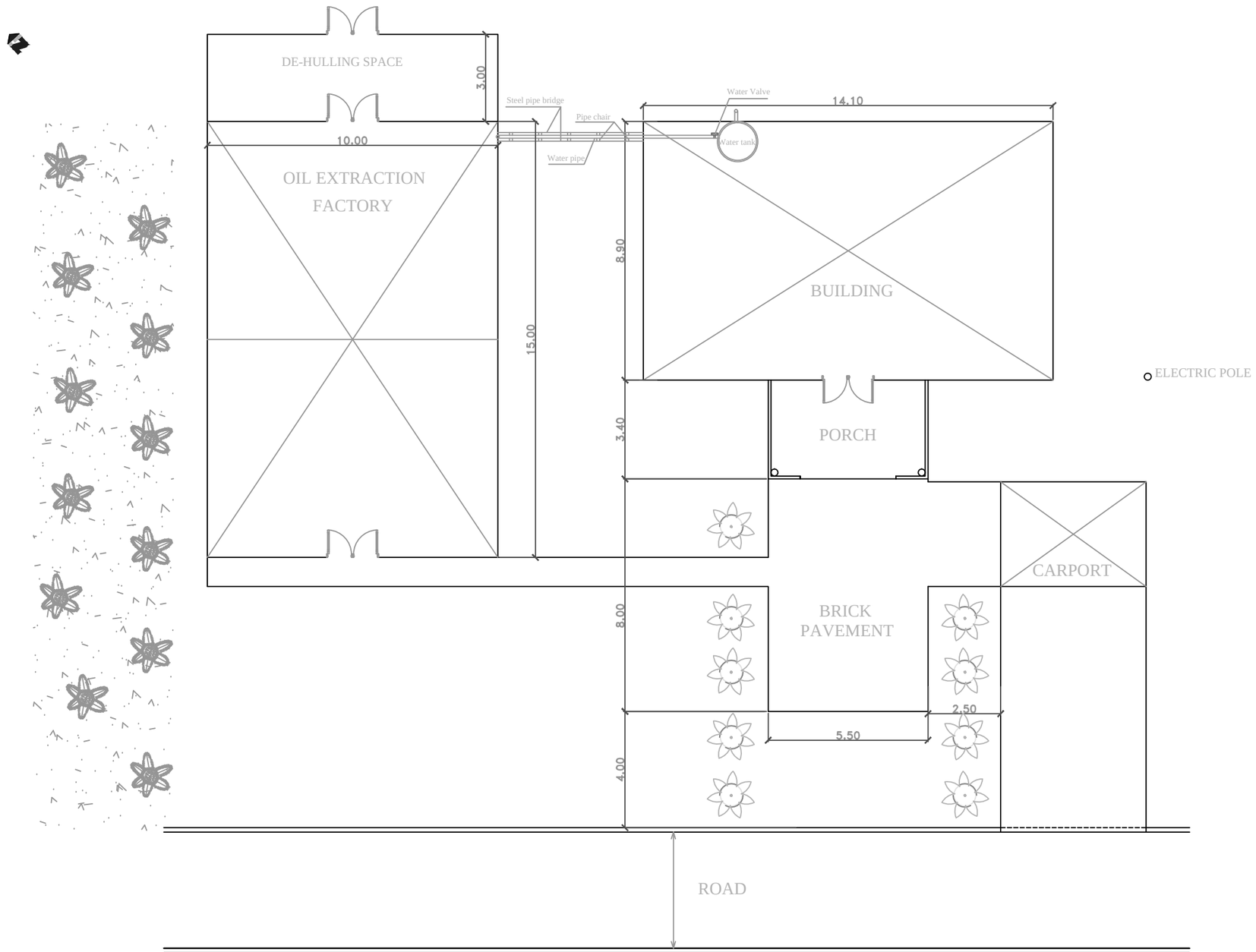


BOOSTER PUMP SECTION

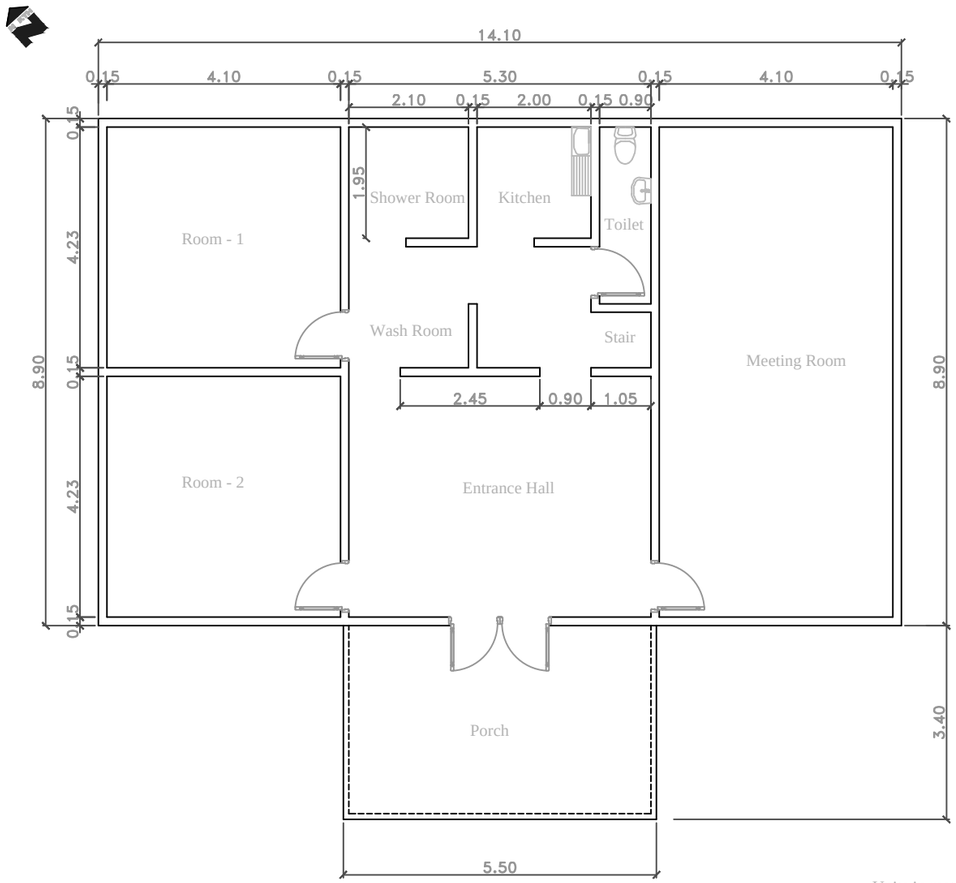


BOOSTER PUMP PLAN

JABAN INTERNATIONAL COOPERATION AGENCY (JICA)	
PILOT PROJECT PLANT (25 FEDDAN)	
DWG. NO (3)	Design of Booster pump
DESIGN BY	DRAWING BY
Dr. ADEL HEGAZY	Eng. MOHAMED SAMY



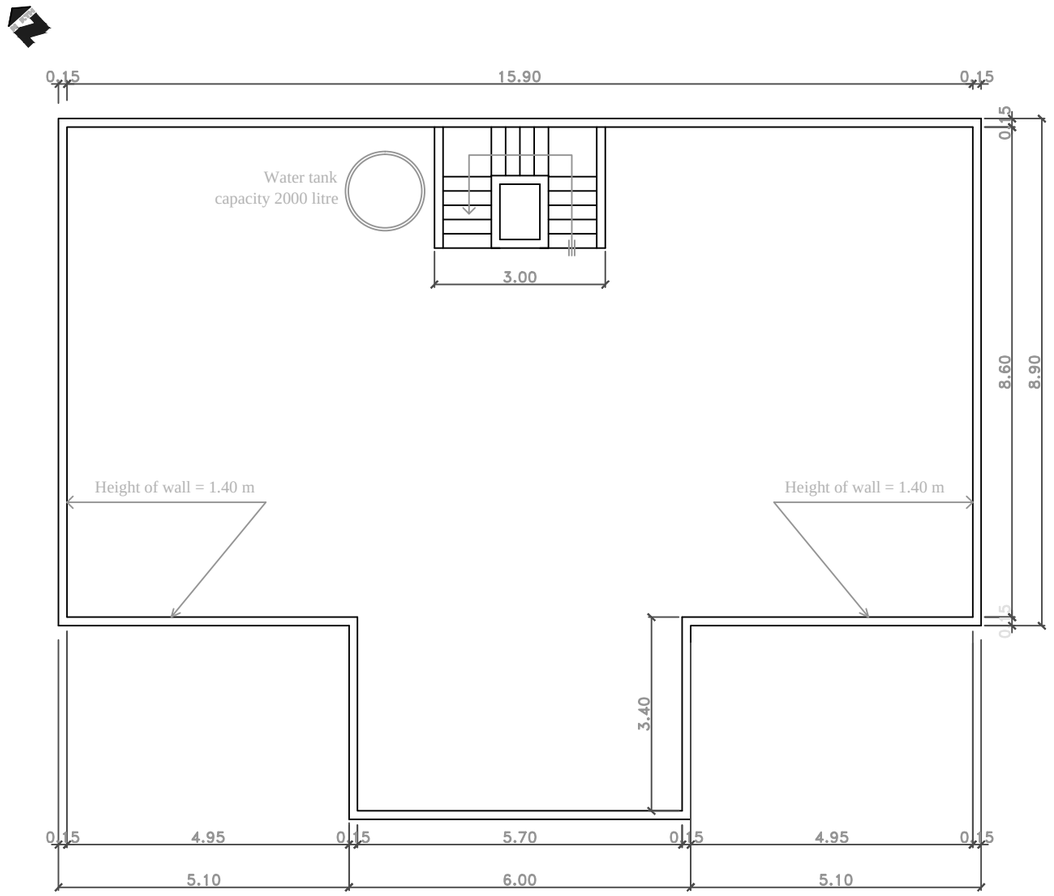
JABAN INTERNATIONAL COOPERATION AGENCY (JICA)	
PILOT PROJECT PLANT (25 FEDDAN)	
DWG. NO (4)	Layout of Office Building Camps
DESIGN BY Dr. ADEL HEGAZY	DRAWING BY Eng. MOHAMED SAMY



Units in meters

Scale 1:100

GROUND FLOOR PLAN

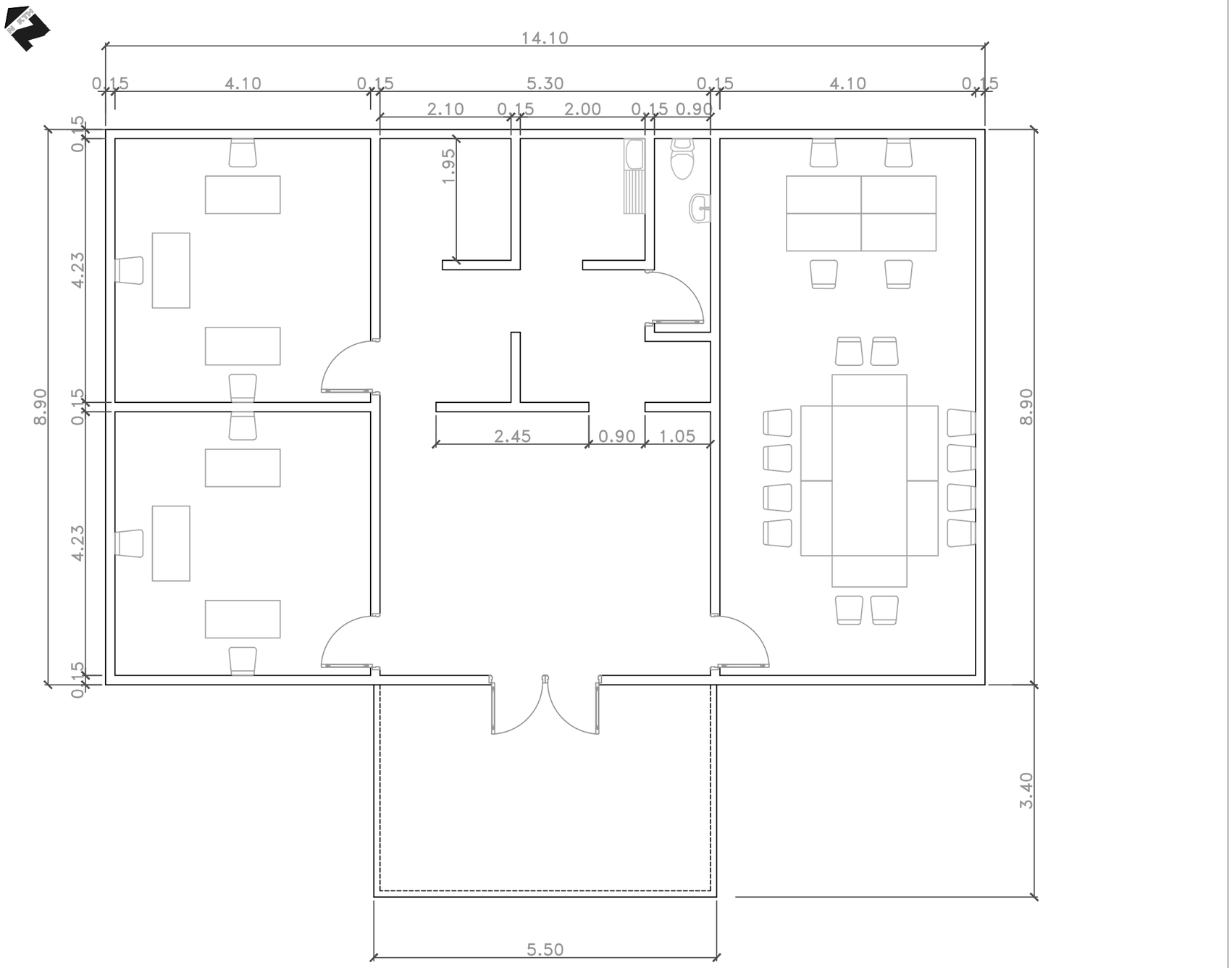


Units in meters

Scale 1:100

ROOF FLOOR PLAN

JABAN INTERNATIONAL COOPERATION AGENCY (JICA)	
PILOT PROJECT PLANT (25 FEDDAN)	
DWG. NO (5)	Plan of Ground Floor - Roof
DESIGN BY Dr. ADEL HEGAZY	DRAWING BY Eng. MOHAMED SAMY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0.15
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8.90
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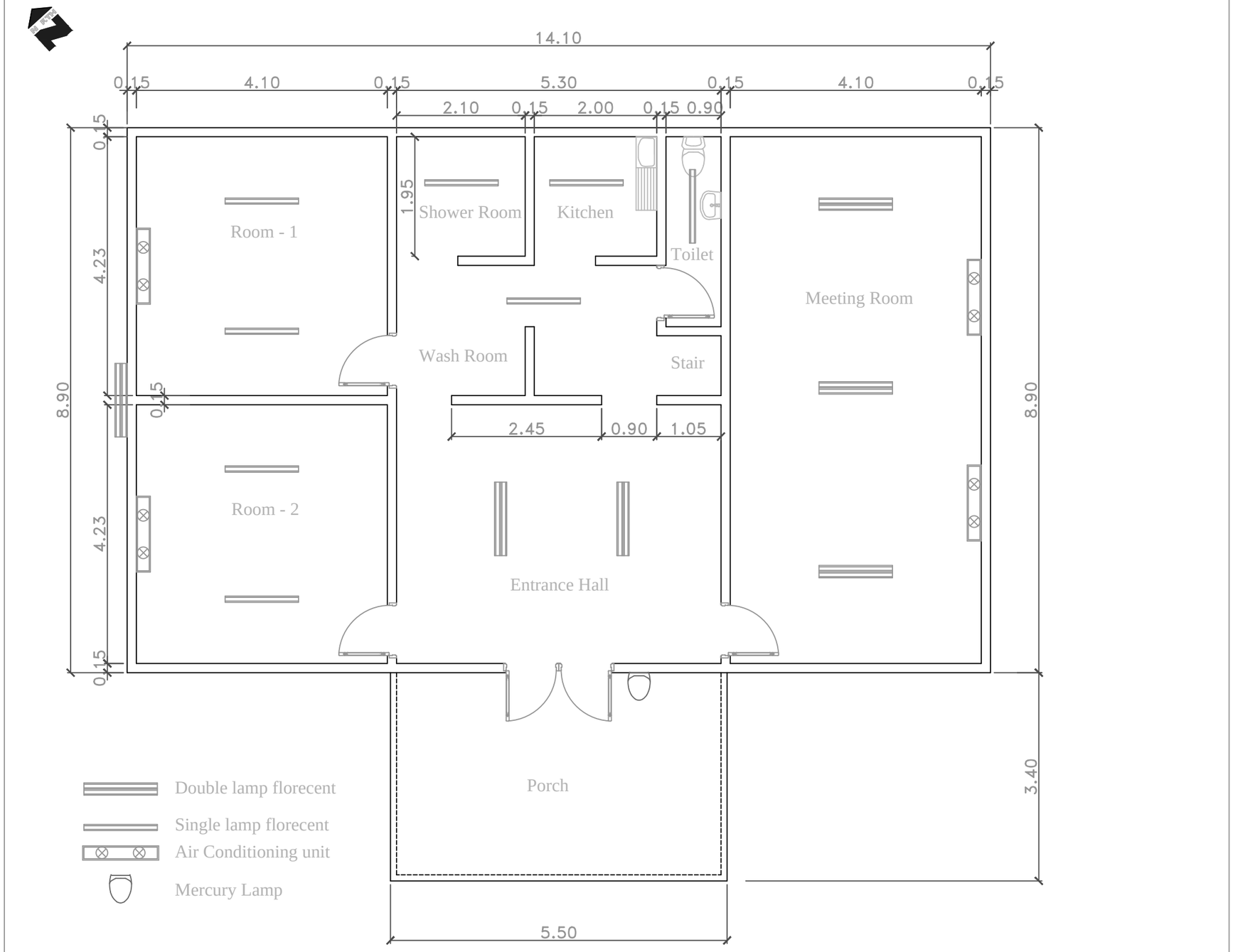
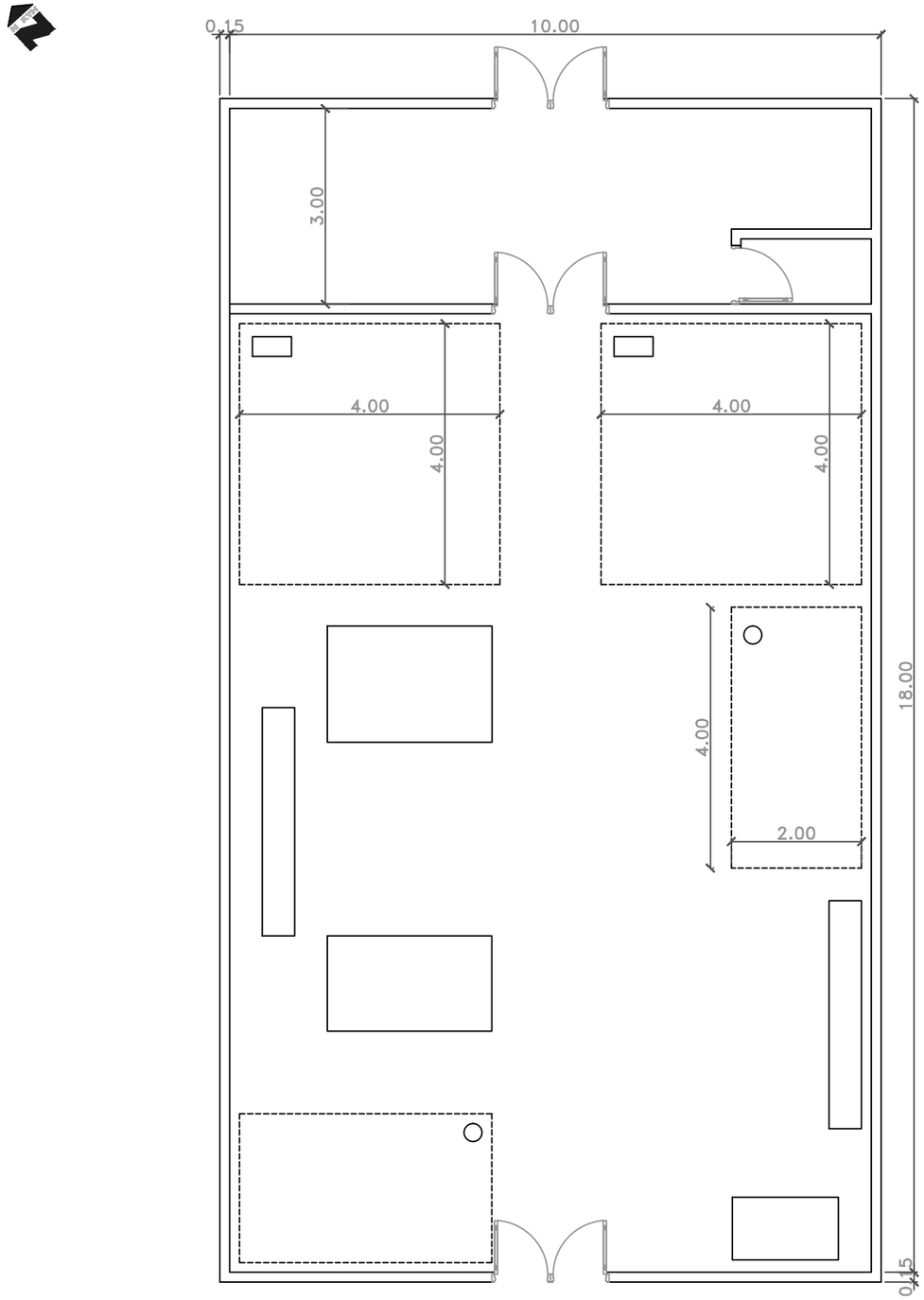
5.50



JABAN INTERNATIONAL COOPERATION AGENCY (JICA)	
PILOT PROJECT PLANT (25 FEDDAN)	
DWG. NO (7)	Plan of Ground Floor Lighting
DESIGN BY Dr. ADEL HEGAZY	DRAWING BY Eng. MOHAMED SAMY


0.15
10.00
3.00
4.00
4.00
4.00
4.00
4.00
2.00
18.00
0.15

Appendix 3. Transplant of Jatropha Vitrolants Under Plant Quarantine Greenhouse Conditions in Luxor

Transplant of *Jatropha* Vitrolants Under Plant Quarantine Greenhouse Conditions in Luxor.

Prof., Dr. Adel Hegazy
Associate Professor
Genetic Engineering & Biotechnology Research Institute, Minufiya University
Agricultural Advisor to JICA Study Team.

INTRODUCTION

Based on the consensus among stakeholders of JICA Jatropha Biofuel Industry Development Study (2011-2012), Under secretariat for Afforestation and Environment, Ministry of Agriculture and Land Reclamation (UAE/MALR) agreed to proceed a comparison test of Imported Jatropha varieties with Local control varieties supported by JICA.

The major objectives of this study is

1) To monitor the growth of the imported varieties (tissue culture seedlings and seeds) with reference overseas monitoring results,
2) To measure the seed productivities of each tree under Egyptian environment with treated wastewater,
3) To assume the expected productivities at the matured stage,
4) To evaluate the feasibility of the Jatropha production based on the monitored and assumed productivities,
5) To give recommendation to Egyptian authorities and JICA for the further needs of actions.

MATERIALS AND METHODS

This work was carried out under plant quarantine greenhouse conditions at Luxor afforestation started from 30/5/2012. Jatropha saplings 270 healthy and uniform plants were imported from JOil Singapore laboratory and implemented in this study.

Plants preparation in nursery:

Saplings were removed from the box and immersed in tap water for 15 min., followed by soaking in Bioseat (0.2 %, w/v) as a fungicide for 20 min. Saplings were individually transplanted into black polyethylene plastic leaky bags of 25 cm width and 25 cm length and filled with one of 8 different soil mixture of; pure peat moss, peat moss + sand (1:1, v/v), peat moss + foam (1:1, v/v), peat moss + clay (1:1, v/v), peat moss + wood (1:1, v/v), peat moss + clay + foam (1:1:1, v/v), peat moss + clay + wood (1:1:1, v/v) and clay + wood + sand (1:1:1, v/v). Then, they were transferred to greenhouse covered with black seran sheets (63 % shade), 30 ºC and 70-80 % relative humidity under tunnels covered with transparent agril sheets to maintain relative humidity. Which gradually will removed within 4 weeks. Starting from the second week of culture, plants were fertigated weekly with nutrient solution of NPK (Nitrolev 1.0 g/l) at the ratio of 20: 20: 20. Sprinkler mist system was applied to compensate the reduction in relative humidity. After 2 weeks plants became ready for the morphological comparison and after 4 weeks saplings will ready for open field transfer.

Identification of plant comparison:

Morphological comparison of all plantlets (270) was classified and counted. All replicates were used and data were recorded every 4 weeks intervals:

- Plant survival percentage.
- Plant height (cm) measured from the soil surface up to the last emerged leaf edge.
- Plant area width (cm^2) was measured distance between the right and left branches ends
- Weight of 100 seeds (g).
- Weight of total plant seeds (g).

Monitoring forms are attached at the end of Appendix. 4.

RESULTS AND DISCUSSION

Nursery: Data presented in Table [(1, 2 and Fig. (a)] showed that good results were almost recorded with the soil mixture contained peat moss alone or in a combination with clay, foam and wood. However, absence of peat moss affect saplings vegetative growth
as indicated in Table (1) treatment number (8). On the other hand, soil mixture contained peat moss and sand recorded the lowest survival percentage as compared with the other studied treatments. In general, data in Table(2) and fig. (b) indicated that fast response in vegetative growth were obtained with the saplings as compeered with the local cuttings.
Local cuttings needs some more time for further comparison.

Table (1): Effect of soil mixture types on survival percentage of *Jatropha* vitoplantlets after 2 weeks from transplantation in greenhouse.

Rank	Soil mixture types			Growth characters			Plants Growth Evaluation
				No. of Plants		Survival %	
				Survive	Dead		
1	Peat moss	----		33	2	94.3	A
2		+ Sand	(1:1, v/v)	20	5	80	F
3		+ Foam	(1:1, v/v)	24	1	96	D
4		+ Clay	(1:1, v/v)	23	2	92	C
5		+ Sawdust	(1:1, v/v)	21	4	84	E
6		+ Clay + Foam	(1:1:1, v/v)	27	---	100	B
7		+ Clay + Sawdust	(1:1:1, v/v)	29	2	93.5	G
8	Clay + Sawdust + Sand		(1:1:1, v/v)	36	2	94.7	H

Table (2): Effect of soil mixture types on survival percentage of local *Jatropha* Stem cuttings after 2 weeks from plantation in greenhouse.

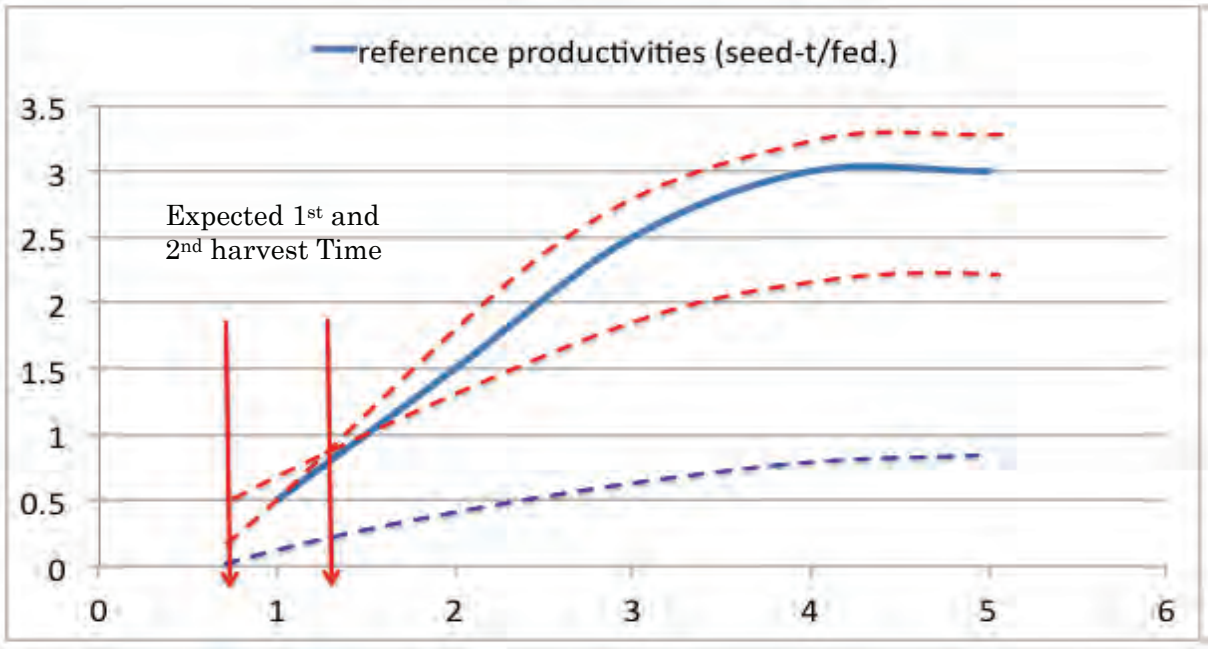
Rank	Soil mixture types			Growth characters			Plants Growth Evaluation
				No. of cuttings emerge new leaves		Survival %	
				+	-		
1	Peat moss	----		12	3	100	
2		+ Sand	(1:1, v/v)	---	---	----	
3		+ Foam	(1:1, v/v)	5	---	100	
4		+ Clay	(1:1, v/v)	5	1	100	
5		+ Sawdust	(1:1, v/v)	5	1	100	
6		+ Clay + Foam	(1:1:1, v/v)	5	1	100	
7		+ Clay + Sawdust	(1:1:1, v/v)	7	5	100	
8	Clay + Sawdust + Sand		(1:1:1, v/v)	9	1	100	

MONITORING

UAE/MALR is going to monitor the imported varieties (one tissue culture seedlings and one seeds) with “Good” local varieties (stem cutting and seeds). Due to the short monitoring time, reference productivities of tissue culture seedling in similar environment shall be used for both

imported and local varieties to shorten the evaluation time.. Concept of the 15 months productivity test is shown below (Figure A4-1)

Figure A4-1 Concept of Performance Evaluation



Source: JICA Study Team and Seedling Supplier(s)

Table (3): Reference Indexes for the Imported Tissue Culture Varieties

Months After Planting	Data Range			
	Plant Height (cm)	Canopy Width (cm)	Seed Yield (g/plant)	100 Seeds Weight (g)
3 Months After Planting	50 to 75	25 to 35	0	0
6 Months After Planting	75 to 100	50 to 75	125 to 160	58 to 60
9 Months After Planting	100 to 120	100 to 120	525 to 625	58 to 61
12 Months After Planting	120 to 145	130 to 140	675 to 800	60 to 62

Seed Committee Members' Investigation

Site Authorization

Tissue Culture Seedlings

Preparation of Local Stem Cutting

Preparation of Soil Mix # 3

Maintenance of High Air Humidity

<TS/Seedling> Transplanting

<StemCutting> Transplanting

<TS/Seedling>Two Weeks After Transplanting

<StemCutting> Two Weeks after Transplanting

Comparison of Local (left/smaller/different size)
and Philipines (right/silghtly larger/same size) Seeds

Hard pruning test