

## **AGRICULTURAL RESIDUES AND BIOGAS PRODUCTION IN RURAL EGYPT (A CASE STUDY OF BIOGAS PROJECT IN KAFR EL- AMIR VILLAGE, EL DAKHLIA GOVERNORATE)**

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### **ABSTRACT**

Uncontrolled burning of crop residues leads to massive air pollution during the harvesting seasons, in particular during October and November. Enormous amounts of residues especially from the harvested rice crop are set alight in order to clear the lands. The result is a massive "Black cloud" that suffocates the inhabitants of nearby urban areas. (Skidmore, 2002)

The Egyptian Environmental Affairs Agency (EEAA) supported by the government of China has facilitated the construction of biogas plant in Kafr El Amir village, Tomai El Amdid district, El Dakhlia Governorate to overcome the open field burning of rice straw that causes the black cloud and to generate biogas for the village. The study objectives are: to identify the effectiveness of biogas plant in producing biogas for households in Kafr El Amir village, to identify the socio economic impact of Biogas units on the families households, and the challenges that face the sustainability of this project. (Arafa and Nelson, 1981)

The study was conducted during the period of February - April 2012. in Kafr El Amir village. To achieve the study's first objective that focuses on the Biogas plant effectiveness information were gathered through the discussions with the technical employees. While concerning the second and the third objectives respectively that focus on the socio economic impact of Biogas and the challenges facing the benefited families, a questionnaire was designed to gather data from 40% of the village citizens representing 42 chief head of benefited households.

The main findings of the study that the majority of the benefited chief households representing (90.5%) accepted the idea of the project but preferred to have the management through NGOs (55.5%) not the government due to their perception that NGOs service will be better and have more community participation than the governmental management.

The results showed that there is increase of the average degree of benefit for the chief household respondents and their families' members from the biogas project. The scale varies from (high benefit, medium benefit, low benefit) that was graded varies (3, 2, 1) respectively. The average score for the all respondents was almost close to high benefit score which is (3). The average degree of benefit for the chief of household, wife, daughter, and son was (2.7, 2.9, 2.8, 2.5) respectively. The above results are due to the advantages of the project especially from the economic perspective, as biogas support in saving money of buying butain gas cylinder in addition to the social perspective in saving effort and time exerted to buy butain gas cylinder especially in shortage of energy time. Finally from the health perspective, biogas reduces the open field burning of rice straw

Concerning the advantages of using Bio-gas energy in Kafr EL Amir village. The respondents indicated that Biogas units' advantages are as follows (safe, additional source of fuel, Save effort and time) representing (57.1%, 47.6%, 38.1% respectively). The disadvantages of using Biogas units as indicated from Kafr EL Amir of respondents indicated that the main disadvantage of using Bio-gas units is the

(Weak availability of spare parts, Weak availability of consistent maintenance staff, weak gas pressure) representing (52.4%, 50%,42.9% respectively).

**Keywords:** Biogas, Agricultural residues, rice straw.

## **INTRODUCTION**

The effectiveness of reducing the black cloud remains an unanswered question for Cairo city and other mega cities in the developing countries regardless of the actions taken by the government. This in part led to serious attention by Egypt's government, parliament and local authorities, and in the other part the media carried this issue extensively to highlight the dangers of the black cloud to the residents.

The black cloud formation over Cairo city is due to accumulation of pollution from different sources such as industries, open air solid waste burning and transportation is always in parallel to the period of rice straw burning by farmers in the delta governorates especially Dakhlia, Sharkia, and kalyobia which are the nearest governorates to Cairo. According to basic information and data adopted by the Ministry of State for Environmental Affairs using remote sensing and other methods were proven that the open field burning for agricultural residues especially rice straw during the harvesting season increase the black cloud problem.

To avoid the annual black cloud formation over Cairo and reduce pollution, the Ministry of state for Environmental Affairs and other line ministries planned to overcome the open field burning of the agricultural residues especially rice straw by encouraging economical usages of rice straw such as composting, animal feed, food production ( mushroom production , cultivation on compacted rice straw bales),and energy production (biogas).

The Ministry of State for Environmental Affairs supported many national projects in the rice production governorates in the delta area aiming to reduce the open field burning of rice straw. The current study focuses on the Biogas project which was established by a Chinese grant in Kafr El- Amir Village, Tomai El Amdid district, El Dakhlia Governorate. The main goal of the project is to produce Biogas from the agricultural wastes especially Rice straw which is used as a source of fuel, for rural households (cooking,,etc) to overcome the open field burning of rice straw that causes the clouds of smoke/black cloud. These smokes have bad impacts on the atmosphere and Egyptian citizen's health.

### **Study objectives:**

The main objective of the study is to assess the role of the biogas project established in Kafr El Amir to reduce the pollution from open field burning of rice straw in addition to its role in energy production to rural households.

To address the above objective the following specific objectives are introduced:

- 1- To identify the effectiveness of biogas plant in producing biogas for households in Kafr El Amir village.

- 2- To identify the socio economic impacts of Biogas used by families households
- 3- To identify the challenges that face the sustainability of this project in generating Biogas energy at the community level.

**Literature review:**

**1-Black cloud formation and air pollution:**

In 1999, the residents of Cairo began to notice serious air pollution episodes, known as the "Black cloud" during the fall season every year. (Turner, D. Bruce, 1994. ) These peak levels were measured and reported by air monitoring network. The Egyptian Government requested support to this news and politically charged priority. Egyptian Environmental Affairs Agency (EEAA) responded with the following plan:

- 1- Get the facts about episodes through sound data analysis.
- 2- Help the Government anticipate episodes by developing an air quality forecasting program.
- 3- Identify short and long-term mitigation options.

Clear information is a prerequisite for sound decision-making. In the beginning there was tremendous disagreement on the causes of the episodes. The local press was filled with wild speculation about the sources of this serious health event. The EEAA source attribution study connected pollutant levels in the air with their contributing sources. For the first time, EEAA was able to show that the additional contributions from burning garbage and waste from the agricultural harvest could be drivers for these events.

In addition, the analysis showed that serious episodes can occur with the normal load of pollution in the city if poor meteorological conditions exist. With this information, the Ministry of Environment has helped raise waste management to the national agenda. Public pressure is contributing to the drive for solutions. (Springfield, Virginia, 1987) .

While episode prediction became a political imperative, solving the problem was even more important. For the immediate term, EEAA provided the Ministry of State for Environmental Affairs with an analysis of pollution reduction and exposure mitigation measures what had been applied successfully in other countries. The Government addresses the public needs for integrated strategies and long-term commitment to solve the problem.

Air pollution is a significant risk factor for multiple health conditions including respiratory infections, heart disease, and lung cancer, according to the WHO. The health effects caused by air pollution may include difficulty in breathing, wheezing, coughing and aggravation of existing respiratory and cardiac conditions. These effects can result in increased medication use, increased doctor or emergency room visits, more hospital admissions and premature death. The human health effects of poor air quality are far reaching, but principally affect the body's respiratory system and the cardiovascular system. Individual reactions to air pollutants depend on the type of pollutant a person is exposed to, the degree of exposure, the individual's health status and genetics (Collins, 2012).

The most common sources of air pollution include particulate matter, ozone, nitrogen dioxide, and sulfur dioxide. Both indoor and outdoor air

pollution have caused approximately 3.3 million deaths worldwide. Children aged less than five years that live in developing countries are the most vulnerable population in terms of total deaths attributable to indoor and outdoor air pollution. (Johnston,2002).

Air pollution is generated from a number of different sources. Table (1) indicates that burning of agricultural wastes represent 42% of the total emissions in the air pollution during the crisis, which explains the importance of establishing the Biogas project in Dakhliya governorate as the main source of air pollution (Streets, 2003)

**Table (1): Percentages of inhaled particulates sources of emissions in the air**

Sources	Percentages %
Burning of agricultural wastes	42
Vehicles exhaust	23
Industrial emissions	23
Burning of municipal wastes	12

Source: Shaban D. Abou Hussein and Omaira M. Sawan (2010) The Utilization of Agricultural Waste as One of the Environmental Issues in Egypt (A Case Study), , Journal of Applied Sciences Research, 6(8): 1116-1124, 2010 ,INSInet Publication

**2- Open field Agricultural waste burning:**

In Egypt the available crop residues after harvest are estimated at about 22.6 million tons, out of which about 13.7 million tons or 61% are used for direct burning. (Erenstein et al. ,2007).

There is limited research examining the factors that motivate farmers to burn crop residues. The practice of open field burning as a land preparation measure is present for both the rice and the wheat, crops. However, rice residues are burnt on a much larger scale than wheat residues. Only rice residues from straw varieties are used as animal feed. Coarse rice residues are not fed to livestock due to the perceived high silica content and fear of reduced milk yields.

They contend that the choice of the harvesting mode either manual or combine has direct implications for crop residue management. Manual harvesting of cereal crops allows for retrieval of crop by-products as crops are cut at near ground level (Gupta et al. ,2004). Attribute the open field burning of crop residues to combine harvesters that leave a large amount of loose residue on the field. The major constraint in a rice- wheat cropping system is the available short time between rice harvesting (late October and early November) and maize cob (November). Given this short time, farmers find it difficult to utilize the residues.

Table (2) shows that the main governorates in rice cultivation and produce large quantities of rice straw which is usually expose to open field burning. Dakhliya is the highest governorates in open field burning of rice straw which is 916.718 tons representing 30% of total quantity produced followed by Sharkya then Kafr el sheik which are 598.932,542.938 tons respectively representing 19%,17% respectively.

**Table (2): Quantity of rice straw produced by the main governorates of rice cultivation that affects some governorates by open field burning during the fall.**

Governorate	Quantity of straw by ton	Quantity of straws by %
Khalubya	72.000	2.43
Kafr el sheik	542.938	17
Dakhlia	916.718	30
Behira	432.356	14
Sharkya	598.932	19
Gharbeya	362.244	12
Damietta	132.276	4
Fayoum	48.978	1.57
Total	3.106.442	100

Source: Shaban D. Abou Hussein and Omaima M. Sawan (2010) The Utilization of Agricultural Waste as One of the Environmental Issues in Egypt (A Case Study), , Journal of Applied Sciences Research, 6(8): 1116-1124, 2010 ,INSInet Publication

### **3- Biogas production:**

In developing countries, biogas energy research should be planned and conducted as part of the main factors leading to its contribution to the solution of air pollution and energy problems. Keeping this in mind, the results of the research should be applicable on a nation-wide scale and constitute a part of the country's development plan. Developing alternative energy source to replace traditional fossil fuel has recently become more and more attractive due to the high energy demand, the limited resource of fossil fuel, and environmental concerns as well as a strategy to survive post-fossil fuel economy era. (Parawira et al ,2009)

Biogas technology attracted the interest of Egyptian scientists and rural developers because of the numerous benefits realized from it. Soils and Water Research Institute (SWRI) ARC started since 1980 a research and demonstration program to promote the biogas technology in rural communities and new reclaimed lands.. More than 900 biogas digesters were constructed, operating in various governorates so far, with different capacity, gas utilization, and environmental impacts.(El-Shimi, 1994)

Bio-energy has the potential to be a pivotal element in the fight against rural poverty. However, a strong policy framework at the local, national, and regional levels is required to ensure that these benefits are realized, shared equitably, and that negative impacts are minimized. (Chaggu,2007)

There is a consensus that achieving the Millennium Development Goals (MDGs) in Africa will require a significant expansion of access to modern and alternative renewable energy. Biogas is a renewable, high quality fuel, which can be utilized for various energy services such as heat, cooking, or a vehicle fuel.

Unlike other forms of energy, biogas production systems are relatively simple and can operate at small and large scales in urban and rural locations, there are no geographical limitations to the employment of this technology nor is it monopolistic. In Africa the interest in biogas technology has been further stimulated by the promotion efforts of various international

organizations and foreign aid agencies through their publications, meetings and visits. (Ubalua AO ,2008) To date, some digesters have been installed in several sub-Saharan countries, utilizing a variety of waste such as from slaughter houses, municipal wastes, industrial waste, animal dung and human excreta. Small-scale biogas plants are located all over the continent but very few of them are operational. In most African countries, for example, Burundi, Ivory Coast and Tanzania, biogas is produced through anaerobic digestion of human and animal excreta using the Chinese fixed-dome digester and the Indian floating-cover biogas digester, which are not reliable and have poor performance in most cases (Omer and Fadalla, 2003). These plants were built for schools, health clinics and mission hospitals and small scale farmers, in most cases by non-governmental organizations.

The efficiency of releasing energy from biomass by direct burning in primitive stoves is very low (5-10%) (Alaa El Din et al, 1984).The contribution of crop residues and animal dung to net energy used in rural areas represented only one-third of total energy consumption, while conventional sources met about two-thirds. The process of biogas generation from crop residues, animal droppings, municipal solid wastes and sewage sludge could positively affect the process of rural development because of the numerous benefits realized from it. (El- Shimi,.A.1994)

Biogas characteristics are as follows: (Nielsen,2008)

- 1- Biogas is renewable,It makes no net addition of carbon dioxide to the atmosphere, neither in its production nor in its use as a vehicle fuel.
- 2- Biogas provides a solution for waste and closes eco-cycles. Producing biogas from organic waste means that the waste is handled in a good way, uncontrolled emissions of methane into the atmosphere are avoided, and digestion residue can be reused as fertilizers.
- 3- Biogas is an efficient way of using biomass; the availability of biomass is and will continue to be limited. Biogas can be produced from many different flows of biomass and its energy efficiency is high.

#### **4- Kafr El-Amir Biogas project:**

Under the supervision of the State Ministry of Environmental Affairs established the Biogas project in Kafr El Amir village, Tomay El Amdid district ,El Dkahlia governorate in 2003 using the agricultural wastes mainly Rice straw.The plant was established on 2 feddans in the village to cover and deliver biogas energy to all households in the village.(State of Ministry for Environmental Affairs,2011)

#### **The main goals of the Biogas project are:**

- a- Reducing the formation of the annual black cloud over Cairo during the period of rice straw burning by farmers in Dakhalia governorate.
- b- Creating jobs for the youth in the village by establishing maintenance companies.
- c- Decreasing the village demand on the sources of traditional energy using the butane gas cylinders for household cooking.

At the beginning of the project the plan of work include the following:

- a-The Units components were totally established in the village (e.g. the station, households' pipes, networks) to serve the village households without sharing costs from beneficiaries.

b-The project use the rice straw to produce Biogas.

The military service organization affiliated to the Ministry of Defense, who took the responsibility to collect rice straw needed for the project from the surrounding areas of the village as the first step to encourage village households and other local institutions to take the responsibility of rice collection.

c-The Ministry of state for Environmental Affairs cover all the expenses of both fixing and maintaining the plant's spare parts regularly through Chinese grant.

d-The villages families have the responsibility of maintenance for the households stoves.

e-Gas Meters without charge were placed in every household, the citizens of the village will start covering the expenses of using biogas themselves, whenever the project completes the whole village.

Until the study implementation the Biogas project succeeded to cover 42 household representing 40% of the total village households, as shown in table (3).

**Table (3): Number of households covered by Biogas plant services by the year of benefit.**

<b>Year of introducing services</b>	<b>Frequency</b>	<b>Percentage %</b>
2003	36	85.7
2004	0	0
2005	6	14.3
Total	42	100

**The Study Methodology:**

The study was conducted during the period of February - April 2012. in Kafr El Amir village , Tomai El Amdid district, El Dkahlia governorate. The Ministry of State for Environmental Affairs selected Kafr El Amir village to be the location of the Biogas project according to the following criteria:

- 1- Cultivation of large quantities of rice annually.
- 2- Availability of a large space in the village to establish a Biogas production plant owned by the government.
- 3- Community acceptance for the Biogas project implementation therefore the units of Biogas were designed to respond to the households needs.

To achieve the study's first objective that focuses on the Biogas plant effectiveness information were gathered through the discussion and observation with the technical employees. while Concerning the second and the third objectives respectively that focus on the socio economic impact of Biogas and the challenges facing the benefited families , a questionnaire was designed to gather data from 42 chief head -all chief households benefited from the project -representing 40% of the total coverage in village as total houses in the village are 105 households .

To measure the socio economic benefit of the biogas project from the point of views of all the families members (husband, wife, son, daughter) in Kafr El Amir village. A scale including 10 sentences was developed and evaluated by specialists to measure the benefit of the project, advantages, and disadvantages of biogas project which affect directly or indirectly upon the average degree of benefit from the biogas project. the scale was distributed into (high benefit -medium benefit-low benefit) , the high benefit graded by the score of (3),the medium benefit graded by( 2), and the low scale graded by (1). The scale's data were gathered from the husband, wife, a son who is engaged in transferring the Butain gas cylinder, a daughter who is engaged in domestic household, cooking,,etc

The scale included the following sentences:

- 1-Save money.
- 2-Save effort and time.
- 3-Additional source of fuel during lack of Butain gas.
- 4-Safer fuel than traditional fuel.
- 5-Easy usage.
- 6-Unstability of biogas pressure.
- 7-indoor health problems(pipe blocking, smoke,,etc)
- 8-Avoid pollution from rice straw open field burning.
- 9-weak unavailability of spare parts.
- 10-create job opportunities and can help to solve unemployment at the village.

**The study findings:**

**1-Description of the study sample :**

**1-1 Educational level:**

Table (4) The levels of education of respondents were relatively high, almost half of them and their wives in kafr El Amir village have secondary and university degrees represented by (22.6%, 21.4% respectively)

The increase in the number and percentages for both husbands and wives who have university degrees (26.1%, 16.7% respectively) indicate that high levels of education have relatively supported the community acceptance the idea of Biogas production as a new innovative model for reducing air pollution and energy production.

At the same time ,almost the other half of the sample are Illiterate which is a common characteristic of rural areas which explains the reasons which led to the weak assistance for the project management in collecting rice straw and sustaining the project .



**Table (4): Educational status of respondents' (chief of the households) beneficiaries and their wives from Biogas projects in kafr El Amir village.**

Level of Education	Beneficiaries					
	Wives		Husbands		Total	
	No.	%	No.	%	No.	%
Illiterate	9	21.4	8	16.7	16	19
Read and write	5	11.9	4	9.5	9	10.7
Primary	4	9.5	3	7.2	7	8.3
Preparatory	9	21.4	6	14.3	15	17.9
Secondary	8	19	11	26.2	19	22.6
University	7	16.7	11	26.1	18	21.4
Total	42	100	42	100	100	100

**1-2 Occupational status:**

Table (5) shows the different occupations for the respondents' families in Kafr El Amir Village. The results revealed that the most common occupations in Kafr El Amir village were agricultural laborer/farm holder represents (28.6%) of total respondents, followed by admin employee represents (26.2%)The variation in occupations is due to the variation in levels of education.

**Table (5): Occupational status of the respondents' (chief of the households) beneficiaries from Biogas project in kafr El Amir village.**

Occupation of chief of the households	Beneficiaries	
	No.	%
Retired employee	3	7.1
Merchant	3	7.1
Admin employee	11	26.2
Agricultural laborer/farm holder	12	28.6
Employee in police	2	4.8
Teacher	2	4.8
Physician	2	4.8
Driver	5	11.9
Technician	2	4.8
Total	42	100

**1-3 Household ownership:**

Table (6) indicated that (90.5%) of the projects' beneficiaries owned their houses in Kafr El Amir village which show relatively good economic level of respondents, due to the relatively high level of education and level of income.

**Table (6): Status of household ownership for the respondents' (chief of the households) beneficiaries from Biogas projects in kafr El Amir village.**

Households ownership	Beneficiaries	
	No.	%
Owned	38	90.5
Rented	4	9.5
Total	42	100

**1-4 Average income:**

Table (7) shows that half of the respondents (50 %) of respondents in Kafr El Amir village receive an approximate monthly income 500LE and over. These results indicate good economic status of respondents due to the high levels of education and occupations in the village.

**Table (7): Average monthly income received by respondents' (chief of the households) beneficiaries from Biogas projects in kafr El Amir village.**

Monthly income (L.E.)	respondents	
	No.	%
300-400	10	23.8
400 -500	11	26.2
500 and over	21	50
Total	42	100

**2- Effectiveness of Biogas plant in Kafr El Amir village.**

Through the discussions with the responsible technical employees, they confirmed that the main reasons behind the poor production of the Biogas Plant was due to the following factors:

**2-1 Lack of a clear mechanism for rice straw collection:**

The process of rice straw collection started by a strong political will in 2003 to reduce the black cloud over Cairo so the military service organization affiliated to the Ministry of Defense, who took the responsibility to collect rice straw needed for the project from the surrounding areas of the village as the first step to encourage villagers to put a clear mechanism for rice straw collection through local NGOs or any other way. Accordingly the military support decreased gradually after this without having a clear plan of rice straw collection sustainability and creating citizens' ownership towards the project.

In order to operate the biogas plant for extended periods of time, there should be sufficient rice straw resources available nearby along the year. There will be need for a considerable logistical system and large scale storage. When crop residues are produced during one particular season, each kilotonne of (baled) agro residue will require 3-4,000m<sup>3</sup>. storage needs for a 500KWe gasifier will then require storage in the order of 10,000m<sup>3</sup>.

Densification is a physical process whereby materials such as rice straw are compacted under high pressure into a uniform shape (e.g. briquettes). The density of the material increases enormously, from bulk densities of around 1.2 kg/1. (UNDP, 2010).

Densification introduces large benefits for logistics (transport and storage) use of the biomass (e.g.in the hearths or fixed led gasifiers), and hygienisation (seeds and insects are killed in the process). Due to the somewhat lower moisture content in comparison to the raw material, the calorific value may be somewhat higher (16-17MJ/Kg) The main drawback is the energy use of the process around 100 KW he/tonne.( UNDP ,2010).

When fuel is produced during a short period of time (e.g during harvest time), large amounts of biomass will need to be stored for year – round plant operations. This could be minimized by implementing an installation with a high level of fuel flexibility. If such a system can utilize different seasons, the required storage of each residue can be limited. In addition, in periods of low fuel availability a fossil fuel could be (co-) combusted.

### **2-2 Lack of project local management**

The project lacks to the community participation in which the local community members didn't contribute financially or technically to the project in order to create their ownership and community loyalty

The EEAA is a governmental organization that didn't have a sustainability action plan drawn with the local authorities in Kafr El Amir village.

After the implementation of the project some technical problems rose, such as instability of gas pressure distributed from the Biogas plant to the households which require some type of a distribution grid and a minimum gas pressure.

### **3- Socio economic impact of Biogas units on the families' households:**

#### **3-1 Community members' acceptance to the Biogas project.**

Table (8) shows that In the beginning of the project only 4 chief of households who benefited now from the project didn't accept the idea of Biogas model due to their perceptions of negative impact of Biogas. Although the majority of the benefited chief households representing (90.5%) accepted the idea of the project but preferred to have the management through NGOs not the government due to their perception that NGOs service will be better and have more community participation than the governmental management .

**Table (8): Acceptance of community members to the Biogas project.**

Accepted				Total		Unaccepted		Total	
Under governmental management		Under NGOs management				No.	%	No.	%
No.	%	No.	%	No.	%	4	9.5	42	100
17	44.7	21	55.3	38	90.5				

### 3-2 Degree of socio economic benefits from the biogas projects at both the household and community levels.

Table (9) shows the increase of the average degree of benefit for the chief household respondents and their families' members from the biogas project. The scale varies from (high benefit, medium benefit, low benefit) that was graded varies (3,2,1) respectively.

The average score for the all respondents was almost close to high benefit score which is (3).The average degree of benefit for the chief of household, wife, daughter, and son was (2.7, 2.9, 2.8, 2.5) respectively.

The above results are due to the be advantages of the project especially from the economic perspective, as biogas support in saving money of buying butain gas cylinder in addition to the social perspective in saving effort and time exerted to buy butain gas cylinder especially in shortage of energy time.finally from the health perspective, biogas reduces the open field burning of rice straw.

**Table (9:): The degree of socio economic benefit from the biogas project at both the household and community levels from the family members point of view.**

Household members	Degree of benefit						Average degree of benefit
	High Benefit		Meduim Benefit		Low benefit		
	No.	%	No.	%	No.	%	
Chief of household/ respondent	31	73.8	11	26.2	0	0	2.7
Wife	39	92.9	5	11.9	0	0	2.9
Daughter	37	88.1	3	7.1	2	4.8	2.8
Son	28	66.7	9	21.4	5	11.9	2.5

### 3-3 Advantages and disadvantages faced the benefited families from their point of views in Kafr El Amir village

The respondents' feedback was positive when asked about the advantages and disadvantages of using Biogas energy in their daily life activities. Most of the respondents indicated that they benefit from the biogas project although they experienced few problems concerning maintenance.

Table (10) shows the advantages of using Bio-gas energy in Kafr EL Amir village. The respondents indicated that Biogas units' advantages are as follows (safe, additional source of fuel, Save effort and time) representing (57.1%,47.6%, 38.1% respectively) .

The disadvantages of using Biogas units as indicated from Kafr EL Amir of respondents indicated that the main disadvantage of using Bio-gas units is the (Weak availability of spare parts, Weak availability of consistent maintenance staff, weak gas pressure) representing (52.4%, 50%,42.9% respectively). For the the weak availability of spare parts is as the closest spare parts center is in Tanta city, for the weak availability of maintenance staff is due to the necessity of establishment of maintenance system, and for the weak gas pressure is due to the instability of rice straw quantities that

reach biogas units due to the lack of systematic mechanism of transferring the straw which leads to weak quantity of fuel generated.

**Table (10): The advantages and disadvantages of using Biogas energy according to the respondents' point of views.**

<b>Advantages</b>	<b>Frequency</b>	<b>Percentage%</b>
Preserve the environment	15	35.7
Create job opportunities	8	19.0
Easy usage	13	31
Safe	24	57.1
Additional source of fuel	20	47.6
Save effort and time	16	38.1
Save money	12	28.6
Total number of respondents	42	
<b>Disadvantages</b>		
Smell of smoke	7	16.7
Weak gas pressure	18	42.9
Weak availability of consistent maintenance staff	21	50.0
Weak availability of spare parts	22	52.4
Pipes blockage	10	23.8
Health problems	3	7.1
Total number of respondents	42	

**3-4 Operations of biogas for the benefited respondents of households:**

The project's management conducted awareness sessions and trainings for the beneficiaries on the ways to handle biogas stoves, gas pipes, and maintenance and energy production. The trainings were attended by 38 respondents while 4 respondents did not attend who had negative feedback towards biogas project as shown in table (11).

But the project management didn't succeed in providing spare parts. Also due to lack of respondents' participation and responsibility, therefore none of the village respondents opened a maintenance workshop

As indicated in table (11) that only seven respondents could maintain self repairing the biogas units although the rest of the rest of the respondents depend on other laborer to fix any technical problem.

**Table (11): Operations of Biogas units distributed by responsibility of maintenance, spare parts availability, self repair in Kafr El Amir village**

Operations	frequency N=42	Percentage %
Operating Biogas stove		
Simple	42	100
Difficult	0	0
Responsible person for maintenance		
Beneficiaries	21	50
laborers	21	50
Spare parts availability		
Available	7	16.6
Not available	35	83.3
Self repair Biogas units		
Yes	7	16.6
No	35	83.3
Respondents trained on operating Biogas units		
Trained	38	90.4
Not trained	4	9.5

#### **4- Challenges that face the sustainability of the project in producing biogas energy.**

According to the discussions with the project management and local residents, We can summarize the challenges that face the sustainability of the project as follows:

a- The importance of building the capacity of a local commercial or semi commercial entity which after the end of the project can continue to market and offer its services for professional construction and operation of biomass energy technology (BET) plants on a self sustaining cost-recovery basis. A biomass energy commercial association or another entity should be established to serve as a focal point for further promotion activities of bioenergy technologies on a self sustaining basis.

b- A plan of community raising awareness strategy is needed which include activities that demonstrate socio economic benefits of BET systems particularly for sustaining rural development in the village especially after coverage of all the village houses by biogas energy.

c- the importance of having a clear plan for rice straw collection in order to store and have enough stock to operate the biogas plant.

Table (12) indicated that most of chief households' beneficiaries are willing to encourage others to benefit from the Biogas project representing 80.9% which indicates that most of the respondents had the desire to encourage others to benefit from the project

**Table (12): Willingness of chief of the households' beneficiaries to encourage others to use Biogas.**

<b>Response</b>	<b>Frequency</b>	<b>%percentage</b>
Yes	34	80.9
No	8	19.1
Total	42	100

Generally speaking, at the national level promoting biomass energy technologies doesn't develop at the desired speed and especially that subsidized fossil fuel and electricity prices continue to be the major barriers to enhanced utilization of biomass energy. while the current subsidizes can obviously not be removed overnight, the biogas projects seeks to facilitate that at least for transition period adequate financial and fiscal incentives and other public support can be made available to create a level for bioenergy completion.

**Summary and Conclusions:**

The community acceptance for the biogas projects is generally high this is due to high levels of education of respondents, almost half of the respondents have secondary and university degrees represented by (22.6%, 21.4% respectively). The results revealed that the most common occupations in Kafr El Amir village were agricultural laborer/farm holder represents (28.6%) of total respondents, followed by admin employee represents (26.2%)The variation in occupations is due to the variation in levels of education.

The process of rice straw collection started by a strong political will in 2003 to reduce the black cloud over Cairo so the military service organization affiliated to the Ministry of Defense, who took the responsibility to collect rice straw needed for the project from the surrounding areas of the village as the first step to encourage village households. Accordingly the military support decreased gradually after this without having a clear plan of rice straw collection sustainability and creating citizens' ownership towards the project.

In the beginning of the project only 4 chief of households who benefited from the project didn't accept the idea of Biogas model due to their perceptions of negative impact of Biogas. Although the majority (38 respondents) of the benefited chief households representing (90.5%) accepted generally the idea of the project. But ( 55.5%) preferred to have the management through NGOs not the government due to their perception that NGOs service will be better and have more community participation than the governmental management .

The results showed that there is increase of the average degree of benefit for the chief household respondents and their families' members from the biogas project. The scale varies from (high benefit, medium benefit, low benefit) that was graded varies (3, 2, 1) respectively. The average score for the all respondents was almost close to high benefit score which is (3).The average degree of benefit for the chief of household, wife, daughter, and son was (2.7, 2.9, 2.8, 2.5) respectively. The above results are due to the be advantages of the project especially from the economic perspective, as

biogas support in saving money of buying butain gas cylinder in addition to the social perspective in saving effort and time exerted to buy butain gas cylinder especially in shortage of energy time. Finally from the health perspective, biogas reduces the open field burning of rice straw.

Concerning the advantages of using Bio-gas energy in Kafr EL Amir village. The respondents indicated that Biogas units' advantages are as follows (safe, additional source of fuel, Save effort and time) representing (57.1%,47.6%, 38.1% respectively) .

The disadvantages of using Biogas units as indicated from Kafr EL Amir of respondents indicated that the main disadvantage of using Bio-gas units is the (Weak availability of spare parts, Weak availability of consistent maintenance staff, weak gas pressure) representing (52.4%, 50%,42.9% respectively). For the weak availability of spare parts is as the closest spare parts center is in Tanta city, for the weak availability of maintenance staff is due to the necessity of establishment of maintenance system, and for the weak gas pressure is due to the instability of rice straw quantities that reach biogas units due to the lack of systematic mechanism of transferring the straw which leads to weak quantity of fuel generated.

The project's management conducted awareness sessions and trainings for the beneficiaries. Finally, most of chief households' beneficiaries are willing to encourage others to benefit from the Biogas project representing 80.9% which indicates that most of the respondents had the desire to encourage others to benefit from the project.

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**المخلفات الزراعية و إنتاج الوقود الحيوى فى الريف المصرى (دراسة حالة لمشروع إنتاج البيوجاز بقرية كفر الأمير – محافظة الدقهلية) جاسنت إبراهيم ريحان قسم المجتمع الريفي و الإرشاد الزراعي, كلية الزراعة, جامعة عين شمس**

يؤدى الحرق المكشوف للمخلفات الزراعية إلى تلوث الهواء و تكوين السحابة السوداء التى يمتد تأثيرها لمدينة القاهرة و ذلك أثناء مواسم الحصاد، و بصفة خاصة حيث موسم حصاد الأرز خلال فصل الخريف (أكتوبر- نوفمبر).

و للتغلب على تلك المشكلة قام جهاز شئون البيئة بالتعاون مع الجانب الصينى و من خلال منحة صينية بإنشاء مصنع لإنتاج الوقود الحيوى(البيوجاز) باستخدام قش الأرز بقرية كفر الأمير، مركز تمي الأمديد، محافظة الدقهلية، على إعتبار أن محافظة الدقهلية تعد من أكبر المحافظات زراعة للأرز، و ذلك بغرض التغلب على مشكلة الحرق المكشوف لقش الأرز و إمداد مساكن القرية بالغاز الحيوى لإستخدامه فى الأغراض المنزلية.

و تهدف الدراسة الحالية: التعرف على فعالية المصنع فى إنتاج البيوجاز، وكذلك الأثار الأقتصادية و الأجتماعية للمشروع على المستفيدين من إستخدام البيوجاز و أخيرا التحديات التى تواجه إستمرارية العمل بالمشروع.

و لتحقيق أهداف الدراسة تم الإعتماد على إسلوبين فى تجميع البيانات و المعلومات ، الأول من خلال المناقشة مع الفنيين العاملين بالمصنع للوقوف على فاعلية التشغيل و الثانى من خلال إستمارة إستبيان تم تصميمها لهذا الغرض و جمعها من أرباب الأسر المستفيدة من المشروع و عددهم ٤٢ رب أسرة.

ولقد أسفرت الدراسة عن مجموعة من النتائج أبرزها ضعف التشغيل بالمصنع لنقص الإمدادات بقش الأرز حيث لا توجد خطة واضحة لتجميع قش الأرز و كبسه و نقله من الحقول إلى المصنع، حيث قام جهاز الخدمة الوطنية بالقوات المسلحة بتلك المهمة فى بداية التشغيل، ثم تناقص دوره تدريجيا مع عدم وجود بديل لذلك. و على مستوى المبحوثين كانت درجة الإستفادة مرتفعة حيث أنه بلغ متوسط الدرجات التى حصل عليها المبحوثين و التى اقتربت من الثلاث درجات حيث ان متوسط الإستفادة طبقا لإجابات على الترتيب (2.7, 2.9, 2, 8, 2.5) لكل من الزوج، الزوجة، الإبن، الإبنة

الا انهم يعانون من مشكلة الصيانة المنزلية و نقص قطع الغيار اللازمة للمواقد المستخدمة فى الإستعمالات المنزلية. و بالنسبة للتحديات التى تواجه إستمرارية المشلروع تظل مشكلة نقص الإمدادات بقش الأرز المشكلة الرئيسية حيث تؤثر على إمدادات المنازل بالوقود الحيوى و يفضل المبحوثين أن تنتقل إدارة المشروع إلى منظمة أهلية تعمل بنظام إقتصادي.

**الكلمات المفتاحية:** بيوجاز ، المخلفات الزراعية ، قش الأرز.

**بتحكيم البحث**

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