Alternative Concepts and Technologies for Beneficial Utilisation of Rice Straw

Report of a Seminar held in Cairo, Egypt, on June 9th, 2009

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Ministerie van Landbouw, Natuur en Voedselkwaliteit

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Colophon

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Introduction

Egypt is facing a high population growth rate, which demands for an increase in agricultural production efficiency. This is at present more urgent with high food prices and demands altogether for a lesser dependency on food imports. Consequently, agricultural waste and field residues will only increase in the future. At present, these waste streams are not economically re-used and will create even larger problems for air and surface water pollution and have therefore a negative effect on people and planet.

There is a general awareness in Egypt that field burning of agricultural residues leads to unacceptable air quality. This is partly brought about by recent reports on what is locally known as "the Black Cloud" in the media. Probably the most prominent example of this is rice straw, of which in recent years nearly 3 million tons per year is burned in the field, creating both an economic waste and an environmental problem. An integrated approach is needed in order to make optimal efficient use of agricultural produce and byproducts. In view of the actual raising of food prices, high population growth rate, and higher energy prices in Egypt, efficiency and increasing of the whole production chain process becomes more important. In this context, the beneficial re-use of agricultural waste will be economically profitable for both the farmer and the industry, environmentally sound by better using the biomass (bio-based economy), and will add to human health as large scale rice straw burning is reduced leading to less air pollution in Cairo and other areas in the Nile Delta.

In view of the above, the goal of this seminar "Alternative Concepts and Technologies for Beneficial Utilisation of Rice Straw" was to present and discuss past and current initiatives on rice straw utilisation in Egypt and elsewhere, and share results achieved so far with a wider public of stakeholders from public sector, industry and academia. The purpose of the seminar was to realise greater exchange of knowledge and ideas, and the results can be used as a basis for concrete follow-up research or implementation projects.

The workshop was funded by the Dutch government through the Ministry of Agriculture, Nature and Food Quality and organised by the Embassy of the Kingdom of the Netherlands in Cairo and Wageningen University and Research Center. The seminar was held under the auspicien of the Ministries of Environmental Affairs and of Agriculture & Land Reclamation in Egypt.

A digital copy in pdf format can be downloaded, free of charge, from http://www.biomassandbioenergy.nl/ricestraw.htm . In addition, all presentations are also available in pdf format on the same internet site.

Content

1 Opening Remarks, by H.E. Maged George, Minister of the Environment

The disposal of Rice straw and other crop residues is associated with both public health and the environment. Every year, a large volume of residues are disposed in an unsafe way. Therefore, the Egyptian government is currently concentrating on improving the situation. A national programme is headed by the Ministry of the Environment. The programme has four pilars: safe use of local residues, improving comprehensive administrative, developing full economic use of residues, and engaging in international cooperation. This is done under the guidance of the three R's: Re-use, Reduce, and Recycle.

The strategy of the Egyptian Government is to deal with the total of 13 M of agricultural residues, of which 4 M tons are comprised of rice straw. The current disposal methods leads to the well known black cloud problem, however there is also the industrial pollution, and the negative effects of municipal waste burning. With financial support of the WorldBank, the Egyptian government is now focusing on reducing pollution of the heavy industries that are most polluting, with further assistance of France, Japan, and three more parties. At the level of transportation, reducing pollution is done by replacing old cars such as taxis, and providing incentives to change to natural gas-fueled cars. Already, many cars that are run on natural taxis appear in public transportation, thanks in a large part to governmental support programmes.

For other residues, there is a need to have clear policies to clean air, and rice straw plays a major role here. A large number of alternatives are necessary to stop open field burning of straw, including producing organic fertiliser (two factories are currently operating on the basis of straw), to use straw for application in desert areas, to produce biofuels (a project supported by the Czech government), and further implementation projects in the private sector, such as collection sites for straw in the Delta, and providing further venues for treatment and recycling.

Other alternative rice straw uses that are pursued are animal feed (done in projects directed at smaller farms). Besides the technical solutions, a plan for increasing public awareness needs to be implemented. Here, other agencies should help, for instance in dealing with small farmers through education. Finally, a system for detection of air quality in major cities like Cairo will be installed. Currently, there are 4 Million cars in the streets of Cairo, with a populatioin of 17 M.

2 Overview of workshop Objectives, by Dr Hans van der Beek, Embassy of the Kingdom of the Netherlands, Cairo

The speaker welcomes all attendants on behalf of the Ambassador, H.E. Mrs Blankhart. This seminar is jointly organised by the Embassy of the Kingdom of the Netherlands in Egypt, and Wageningen University & Research Center-Institute for Food & Biobased Research, the Netherlands. In addition, technical support for the organisation was provided by EAGA.

This seminar forms part of the Policy-supporting research programme of the Dutch Ministry of Agriculture, Nature, and Food Quality. Within this programme, small grants from Dutch Ministry of Agriculture are provided for 1 – 2 year research projects. The projects are intended as seed money to initiate larger projects for collaboration between the Netherlands and other countries, including Egypt.

The objectives of this seminar are to:

1. present current initiatives in beneficial use of rice straw in Egypt
2. review other applications for rice straw and other agricultural wastes in the rest of world
3. to discuss pro's and con's of such applications, and
4. and to look into the future to other relevant developments

Egypt's agriculture can be characterised by a very high cropping intensity. In addition, agricultural exports exceeded 1700 Million $ in the year 2007-2008. While the Egyptian government is trying to reduce the acreage planted to rice, at the same the issue of sustainable rice waste management, in particular rice straw and hulls, is very relevant. There are many potential sustainable solutions for rice straw, such as converting it into building materials, biofuels, compost, feed, and mulch. On all these, and other, solutions more information will be presented at this seminar.

The Netherlands can be a reliable partner in the development and implementation of agriculture and agricultural waste management. The Netherlands goverment can provide business assistance that are geared to , for instance through programmes such as Match Making Facility and Pivate Sector Investment (PSI).

The speaker wishes all attendants a very fruitful seminar.

3 Economical Management and Use of Rice straw, by Dr Mohammed Khalil, Ministry of Environmental Affairs (EEAA)

A large number of technical programmes are now implemented that are coordinated by the Ministry for Environmental Affairs, as part of the programme to reduce environmental pollution from rice straw burning. Most of these deal with alternatives for burning. These include composting, producing organic fertilisers, gasification for heat and power, and production of animal feeds. In addition, the use of straw as substrate for production of strawberries and mushrooms has been demonstrated.

In 2008, the total cultivated area of rice in Egypt was 1,942,238 Feddan which exceeded official expected area (1.1 million Feddan) with about 72%, according to ministries of Agriculture and Water Resources. Economical management of rice straw as the most important agricultural wastes is pursued in four different strategies:
(I) implement Recycling & conversion projects:
(II) develop Cooperation Protocols:
(III) Improve Direct use for cultivation
(IV) Raise Environmental communication and awareness

(I) Implementation of Recycling projects

1-Composting plants
There are currently four composting plants: two are located in Sharqeya (Qureen & Khatara) with an annual capacity of 300,000 tons. Both were established and managed by the Arab Organization for Industrialization. In addition, there are two composting plants in Daqahleya (Qalabsho), with equally an annual capacity of 300,000 tons. Both were established by Ministry of Military Production and managed by specialized companies of the private sector. Each compost plant is amended with the proper tools and equipments

2- Recycling program for animal feeds and fertilizers heaps for small farmers
The Ministry of Environmental Affairs (MSEA), in collaboration with the Ministry of Agriculture recycles 50,000 tons of rice straw annually for small farmers into animal feeds and fertilizer heaps with financial support of MSEA. In addition, about 26,000 small farmers, extension agents and agricultural engineers attended the training programs.

3- Converting rice straw into agricultural soil alternative
A plant to convert straw in to soil additive was established on 35,000 m^2 in Menoufya (Sadat City). It consumes 20,000 tons /year in the first phase and is expected to increase its capacity to 50,000 tons in the second phase.

4- Two thermal gas production plants
Two thermal gasification plants were raised in Sharqeya & Daqahleya. Each unit serves 300-450 users (flats), has an electric power consumption of 17 kW, and gas productivity is 320 m^3/hr. Each unit consumes about 500 tons rice straw/year

5- Plant for Solid Bio-Fuel Blocks
In collaboration with the Check Republic, a pelletisation plant for rice straw was established in Sharqeya governorate , with an annual capacity of 50,000 tons. It has started October 2008

(II) Cooperation protocols with involved organizations

Three organizations are collaborating with the Ministry of Environmental affairs in recycling rice straw: the Queen Service company- National Services organization, Armed Forces, the Ministry of Agriculture and Land Reclamation (Sector of Mechanization) , and the Private Sector (Specified companies)

(a) Under the MSEA cooperation protocol with Queen Service company, National Services organization, rice straw is collected and pressed in compact bales in Sharqeya.
MSEA supported the project with 185 automatic presses and 70 tractors as well as 15 collectors and 15 small presses for narrow roads. The Armed Forces provided 95 tractors, 95 trailers and 1500 trainees as well as 10 roller presses and 10 combine for automatic harvesting. In addition, the transportation department was tasked to transfer the pressed bales of rice straw with 80 vehicles (7 tons/each). A camp was constructed in Tal-Al-Kabir on an area of 8 Feddans. The yearly capacity of this activity amounts to 70,000 tons of rice straw.

(b) Under MSEA cooperation protocol with Ministry of Agriculture and Land Reclamation (Sector of Mechanization), rice straw is collected and pressed into bales.
MSEA supported the project with 294 automatic presses and Semi automatic equipment.
The yearly capacity of this activity amounts to 50,000 tons of rice straw.

(c) Under the MSEA cooperation protocol with specialized companies (Private Sector), specific collaboration with the private sector is was implemented in Qalubeya and Daqahleya

(III) Direct use of rice straw for cultivation :

(a) Mushroom cultivation
MSEA conducted 70 training courses for different graduate youth to grow mushroom over rice straw in Qaliubeya, Daqahleya, and Gharbeya in 118 localities. This succesfull activity is expected to extend to 600 Localities

b) Cultivation on rice straw bales

Through the implementation of internal projects to facing environmental problems, MSEA attempted to apply promising previous results of research experiments in a large scale. During season 2008-2009, strawberry cultivation of exporting varieties was applied successfully on rice straw bales by major exporting companies. The strawberry cultivation resulted of in healthy plants with good quality and very good yields.

(IV) Environmental communication and awareness

The programme to raise environmental communication and awareness includes the preparation and distribution of brochures and handouts as well asl Mobile Environmental awareness unit, and the organisation of meetings and workshops for farmers

4 Recycling of rice straw by degradation in the field, by Prof. Moustafa Abo-Habaga, Mansoura University

One of the main problems of re-using rice straw are the collection and the transportation costs. The rice straw collection depends on the mostly on grain harvesting technique. Currently, manual harvesting is done on 10-15% of the rice cultivated area, whereas automated harvesting by using combines is done on 85-90% of the cultivated area.

Automated harvesting leads to straw distributed throughout the field, as compared to manual harvesting which leaves straw in piles. After automated harvesting by combine, much more efforts is required to collect straw for alternative uses. The three main desposal techniques: burning (the most popular method by farmers), collecting and pressing the straw in bales to be stored in open places for later use, and baling the straw and transport it to store in covered places.

At Mansoura University, the goal of the research activities is to develop new techniques for direct straw recycling, i.e. without removing the straw from the field. Two machines have been developed: (1) a straw cutting machine that can be adapted to existing grain combines, and (2) a mixing-cutting machine, which mixes straw with microorganisms and/or enzymes, and also can plant the next crop.

In the research programme, the following studying parameters are assessed:
1- The straw distribution after harvesting: the distribution of straw extends over the full width (130cm) of the machinery;
2- Length of the straw after cutting: Most straw particles are approx. 5 cm in length after cutting thereby increasing speed of degradation;
3- Distribution of cut straw in tillage section: the majority of straw can be found in the surface layer (0-5cm) of the soil, while the remainder is located in the 5 – 10 cm layer
4- Rice straw hydrolysis: the application of new microorganisms appears to accelerate the degradation of straw, especially after 1 month after the tillage (80% degraded versus 50 -60% for treatment without enzymes)
5- Effect of rice straw on the soil anions and cations: there seems to be no negative effect on soil anions and cations (mainly carbonate and calcium)
6- Effect of addition on the productivity: after two seasons there is a 20% increase in yield for fields where straw was added, compared to control treatment where straw was removed.

In summary, these results lead to the conclusion that cutting/treatment and incorporation can be appliced as cost-effective fertilizer. Farmers who have participated in the trials are enthousiastic about this new technique, as it can be carried out by available agricultural machinery.

5 Rice Industrial City: Rice Residue Management for Rice Bran, Straw & Husk, by Dr Amr Mohamed Helal, IT&M/KEAP

Egyptian Rice Residues could be the diamonds of the future, if they are used for new valuable applications. Currently, three projects are implemented by our company: (1) Rice Bran , (2) Rice Straw, and (3) Rice Husk,

1. Rice bran

Given the yearly rice production in Egypt of about 8 million ton, approximately 300,000 metric tons of rice bran are produced each year. Due to the instability of Rice Bran, it is still discarded or used as animal feed despite its high content of bioactive substances. Rice bran can provide a wealth of vitamins, minerals and cures for newly discovered disease fighting. Antioxidants are found as well as Nutraceuticals for alleviation of major illness symptoms (CVD, DM type II, elevated Cholesterol levels, Anti inflammatory & Hypertension).

A current R&D project, in collaboration with IMC, is being implemented with rice bran stabilization as major goal, and a study of phytochemical and nutritional aspects of the stabilized Rice bran. In addition, implementations of the different rice bran products in food , pharmaceutical and cosmetic industries is being evaluated. The total project cost exceeds one million Egyptian Pounds.

2. Rice straw and 3. Rice husk

Under a grant contract entitled " Innovative, Environmental and Economic Rice Waste Management (Composite material and active carbon made from rice straw and husk)", a collaboration with various partners is focusing on new application for straw and husk. Main activities are:

- to develop innovative recipes and manufacturing processes for NFPC (Natural Fibre Plastic Composites) derived from Rice Straw and Rice Hulls
- to convert Rice Hulls into Active Carbon with good adsorption performances
- to enhancing the environmentally utilization of undesirable lignocellulosic wastes, by conversion to Active Carbon; Natural Fibre Plastic Composites

6 Lignocellulosic Biomass Conversion Technologies for Biofuels: Barries and Opportunities, by Dr Eid M.A. Mageed, ARC

Why biofuels?
On of the primary reasons for introducing biofuels is the reduction of CO2 emissions, and to decrease vehicle contribution to local air pollution, as most biofuels have a cleaner burning than common fossil fuels. In addition, using biofuels can diversify fuel sources, stabilize fuel prices, and lead to development of new industry with associated economic impact, and biofuels point out different solution to the way out of fossil oil dependence.
The transportation fuels represents about 27% of the world primary consumption, and this share continuous to grow and today it is mainly dependant on fossil oil. In Egypt, the transportation fuels represent around 30% of total fuel consumption

Biomass resources in Egypt
Egypt is endowed with a very high intensity of direct solar radiation ranging: between 2000-3200 kwh/m2 /year from North to South. The sunshine duration ranges from 9-11 hours per day accordin to a study by Energy Research Center, 2006. Crop residues in the Egyptioan Agriculture sector were estimated to be 27.3 million metric tons/year. There are additional crop-related residues from post harvest processing, e.g. rice husk 1.6 million tons per year and bagasse 4.7 million tons Solid Municipal Waste. The estimated quantities of municipal solid wastes generated in urban areas are around 25 million tons/year. According to the conclusion of the above mentioned study, it appears that there is a good potential for the utilization of biomass resources in Egypt for bio-refinery. Out of the estimated amount of 60 million tons per year a conservative estimate of 20% of that biomass resources can be easily collected and used for bio-refinery production in the short term. However, current cropping systems generally are designed to optimize grain production and are not designed to harvest all the above ground portion of the plants

Biomass resource assessment per governorate included 8.2 million tons of wheat straw, 4.9 million tons rice straw, 6.7 million tons of maize stalks, 11.9 million tons of cotton stalks, and 4.8 million tons of sugar cane residues.

Lignocellulosic Biomass Distribution in Egypt
Due to the general small scale of agribusiness the distribution pattern of the different crops residues (mostly lignocellulosic materials) is very critica. Rice straw is mostly dominating in the North and East of Delta areas (Kafr El-Shiekh, Sharkia, Dakahlia, and Gharbia), corn stover is dominating Middle of Delta (Monofyia) and South of the Nile valley (Menia). Sorghum stalks are dominating far south of Nile valley (Assuit and Sohag) and Sugar cane residues in Qena and Aswan. There are costs associated to harvest, collection, handling and transport of the biomass, and deliver to bio-ethanol refineries located within a reasonable distance (60-70 km).

Barriers and Opportunities

Technologies to convert lignocellulosic materials to biofuels are in the phase of R&D in particular for biochemical hydrolysis. Thermochemical conversion experiences are not feasible in Egypt. Other barriers include: there are no enzymes production facilities available in the region, there is a lack of Government promotion programmes, there is no Tax exemption plan for biofuels, and associated Legislation.

7 Sustainable building materials from Rice Straw, by Edwin R.P. Keijsers, Wageningen UR-Food & Biobased Research

In the transition to a bio-based economy, biomass resources abundantly available at competing cost for sustainable development. Options for sustainable building are:

- to reuse and recycling of building materials
- to save energy by insulation
- to produce during production of building materials
- to use alternative energy sources (photovoltaic cells, heat pumps)

There are various applications of renewable resources in building, e.g. Ecological building, Sustainable buildling (Adobe), Building material selection: Agrodome

Building materials from rice straw include Particle board, Medium density fibre board Straw Board, Straw Bales, Thatched roofs, Cement bonded boards, and Composites. Buildling materials from rice husk include cement and Gypsum Board

Rice straw particle board can be used for Inner walls and are Sound absorbing. There are various Production Process, for instance with the use of UF (urea formaldehyde) resin. Improvements are required in regard to mechanical strength of the board, and Water Absorption.

Rice straw medium dense fibreboard can be used for walls, ceilings, furniture. The resin used in the production process includes UF (Urea Formaldehyde), MUF (Melamine urea Formaldehyde), and pMDI (polymeric methylene diphenyl diisocyanate). Improvements are required in terms of silica content (which leads to higher wear on the cutting tools), increasing Mechanical strength, and improving Water resistance.

Rice straw boards can be used for Walls and Roofing. There are production processes that include the use of a binder, and there are binderless boards. Generally, rice straw boards a covered with outside layers. Improvements are required in regards to Mechanical properties, in particular.

Rice straw cement bonded boards can be used as building blocks, ceiling panels. Straw-fibre cement building blocks can be very cheap recyclable building materials, but generally have low strength. However, their thermal insulation is generally good. Improvements are needed in regard to the bonding of of straw and cement, and the acidity of the straw.

Other uses of straw in building materials includes thatched roofs, composite boards, composites, and Biocomposites

Common building materials from Rice Husk include use in Gypsum boards, and the use of Rice husk in cement (together with lime; see also presentation Mr Helmi)

High-end applications for Rice byproducts include options whereby the hierarchical porous carbon structure from rice straw is used, and include production of Lithium ion batteries. In addition, use of natural Textile fibres is a growing area, whereby high-end cellulose is extracted through chemical and enzymatic extraction processes. These natural cellulose fibres are reported to have properties that are comparable to linnen

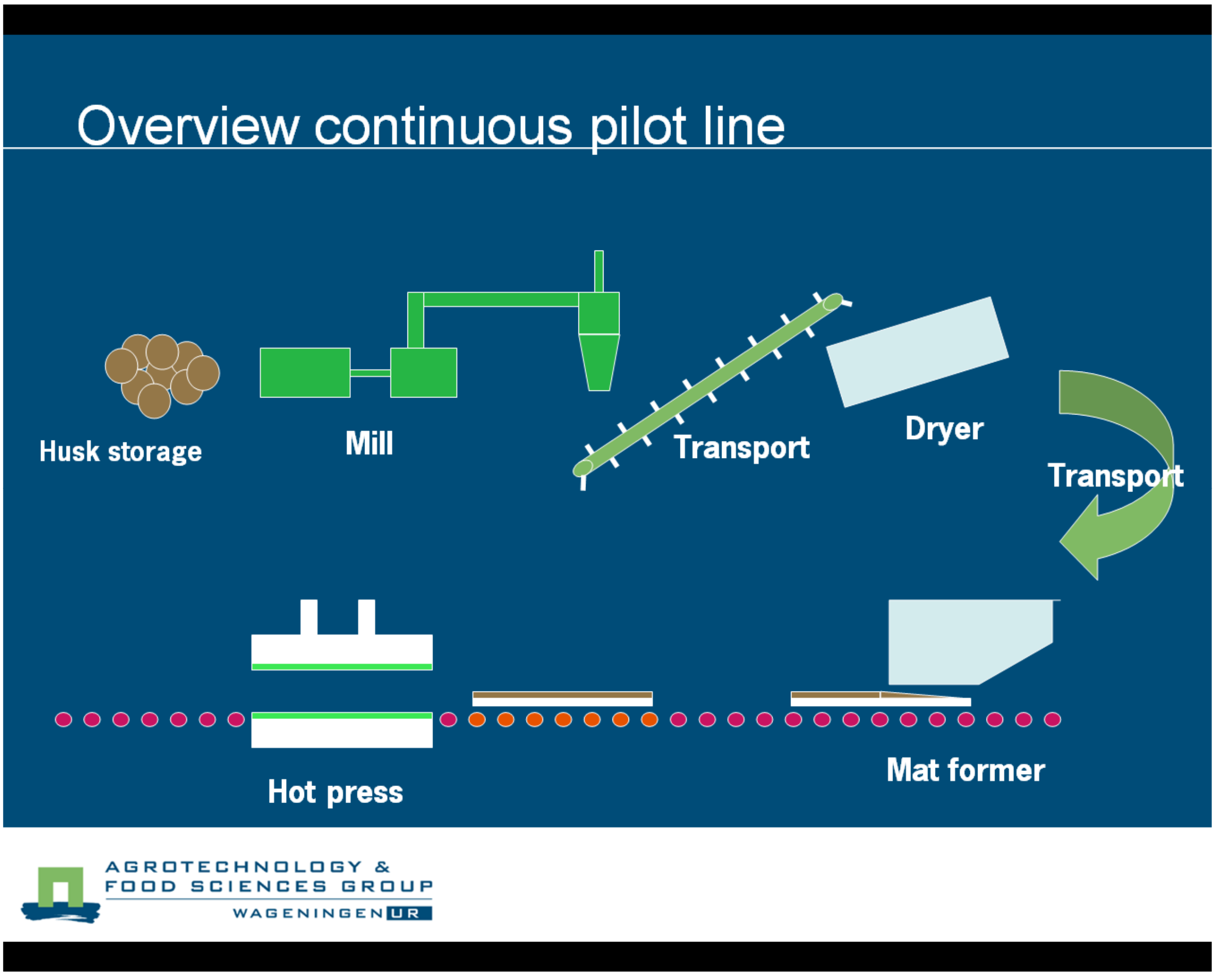
Given these options for sustainable, beneficial use of straw and husk, there are various strategies for new product development. The development could be focused on

- Existing Products that can be produced at a competing price
- Products that have with new properties
- New technologies, and
- New products

In other words, there are different ways to develop products from rice straw. I will show two examples of product development

Examples of project for development of new products or processes:

In a CFC/FAO funded project, we developed a binderless board from the waste coconut husk, to be applied in the Philippines or other countries. This figure shows an outline of the pilot production unit realised in the Philippines. The final product is a binderless, three dimensional product, fully based on coconut husk.



Composites could be made from a plastic matrix and fibres such as rice straw. A two stage process was developed in the Netherlands, producing pellets by extrusion, followed by injection moulding. As shown, the product can be used in the production of car parts (e.g. door panels, dashboards). We are the first to produce pellets by way of a continuos process direct from extruder from natural fibres.

In conclusions, there multiple opportunities for Rice Byproducts in sustainable building materials. They can provide an important alternative for existing wood products, but can also provide new products. In order to realise this, Product development is necessary, both to improve the productsm but also the economy processes, in order to make them more economically attractive. In summary, rice straw and rice husk can be an integral part of the new Biobased Economy

8 Building materials from rice straw and rice husk, by Dr Maher Helmi Wahba, Alexandria

This presentation will highlight the rice husk potential utilization as a major raw material in the building & construction Industry.

Since rice is grown on every continent except Antarctica, since it ranks second only to wheat in terms of worldwide area & production, and since the hull represents on average 20% of the harvested weight of rice, our planet ends up with an abundance of this scaly residue. More than 100,000,000 Metric Tons of rice hulls are generated each year throughout the world. These abundant agriculture wastes are available Free-of-Charge. This abundant agriculture waste has all properties one could ever expect: in their raw unprocessed state rice hulls constitute class A insulation material & can be very economically used to insulate wall, floor, roof cavities, its R value(thermal resistance) is greater than 3/inch. Since most mills store rough rice & process it only on daily basis, fresh, dry hulls are available throughout the year. Since hulls do not biodegrade or burn easily, this obsolete by-product is also resistant to the best efforts of man to dispose of it; they are available Free-of-Charge.

1950 Helmi's Brick Project
Back to 1950's was the starting date for innovation in building systems; generalizing new walling material, to encourage and develop new walling material to substitute solid clay brick(made mainly from fertile earth natural resources-mud/Clay-burned to cure) and support the utilization of waste resources, lighthearted Civil Engineer Helmi Wahba; pioneer with a vision and, yet inventor, of an exclusive brick; made of burned rice husk found in abundance as reject waste, free of charge; from rice mills previously operated by steam energy .(Rice husk was used as fuel to fire-up rice mill boilers, and to a steam turbine to run the mill).

The Inventor Helmi Wahba successful application producing, the new brick at his factory considered an industrial revolution in the building material industry; and yet he was unaware that he had achieved and to date 2009; what leading experts had declared could not be done. Helmi's brick is a patented lightweight solid concrete brick approved by the "Egyptian Ministry of Commerce and Industry", Invention No.120/1951 code 10.
Helmi's brick is also a registered and approved product by the "Egyptian General Authority for Governmental Building" code 49/31/5 class 3 – 1957/1958

An innovative Brick made from carbon, is a simple logical solution for sustainable building systems, in particular when the carbon is derived from waste organic matter.

In the brick fabrication, Carbonised Rice Husk (CRH) is used, in stead of fly ash, or rice husk ash. In Helmy's brick, up to 80% of CRH can be used, while all others and to-date 2009 used fly ash to a maximum of 30%.

Major advantages of this brick are:

- Lighter Weight (– 50% less than clay brick), thereby decreasing the total load transfer capacity overall building, foundation by almost 15%.
- Moreover & due to its minimal surface area/brick will save on the building mortar by almost 35% for each 1 square meter built.
- It will save approximately 20 - 25 % on steel reinforced concrete.
- Savings in energy, as no thermal heat is necessary for drying the bricks

Does brick size matter?
When it comes to the cost of construction, and masonry costs; these costs are not determined just by number of bricks, but by the size, shape and style of the brick that is chosen for your building or renovation and the labor involved in laying brick.

Mason cost/one square meter built: In case using the new brick size 23x11x11 cm. only 39 Brick are laid per square meter. In case of other standard bricks size 25x9x6 cm, the mason lays more than 85 brick per square meter. The Mason can use one hand in laying the brick more faster by almost 40% much less, physical efforts by 40-50% lifting weight
of 79 kg/square meter, instead of 150 kg when compared to most of other types of bricks.

Heat Insulation,
Owing to the brick formulae composition, which it is mainly fully carbonized inorganic raw material (char) and small amounts of cement, lime, sand, + minor patented material are mix together in a Cold Process used mixing operation. The brick is cured when left to dry in open-air storage area. Thus, there is no need for brick kilns, or furnaces that operates by fossil fuels all

year round to cure as with the baked clay bricks, thus saving energy & no pollutant gases generated. A compression process, in which all brick material is compressed by a hydraulic press inside steel molds, thus no air cavities exists or used as insulation criteria like other competitor brands such as the Autoclaved Aerated Concrete Bricks.

Compressive strength

The compressive Strength of the bricks makes it ideal for; both Load bearing & Non-Load bearing Buildings Engineering concepts, also classified as bulletproof. For the above reasons, makes Helmi's/carbon brick is most competent to realise sustainable future buildings; for its outstanding insulation properties and makes the inside of the building more resistant to loose or gain outside ambient temperature, which of course could save up to 25% & up to 50% on total electrical consumption in air conditioning & any other additional insulation cost. A feasibility study (dated 2009) has shown that the bricks are cheaper than all other, existing bricks. The bricks are also sound proof, making the brick compatible for Cinemas, Theaters, Hospitals, Hotels & Apartment building. Owing to its dry density 800-850, Kg/M3, its high compressive strength, will minimize the Loads & Seismic Stresses even at 7.2 degree on Richter scale. The bricks can be classified as fireproof & could resist fire up to 4 Hrs. without distortion up till 860 deg. centigrade. The workability is good as well, due to its precise molding dimensions is easily laid, cut it, saw it, punctured, using ordinary carpentry tools, facilitating the make of electrical & sanitary conduits. The brick can be classified as environmentally friendly, since no pollutant gas emission or hazardous chemicals effluents & no waste materials are emitted in the production.

Clay to Carbon Bricks - Conversion process (from clay brick to Carbon Brick).

Factory owners will need technical and financial assistance to make the switch, and properly funded program aimed at reducing greenhouse-gas emissions in Egypt. As a pilot program, one clay brick factory, which uses coal or other fossil fuel to cure; and producing 1-Million Brick/Months. When converted to self- cure Carbon Brick and running on bio-gas; it is expected to reduce greenhouse-gas emissions by 800 Ton CO_2 per month, or 10,000.00 Ton per year one for one converted factory. Once the brick factory license is granted & approved, it is expected that the Government will subsidize cements cost by average 15-20% less, Government tax exemption for the first five years is always the case, and up to ten years in case of environmentally friendly projects. This would pay for the Green products on their effective quality delivery.

Furthermore, venture might be approved as a Clean Development Mechanism (CDM) initiative. The CDM is one of various processes established under the 1997 Kyoto Protocol to the United Nations Framework Convention on Climate Change to help cut down on greenhouse-gas emissions. The mechanism permits industrialized nations to meet agreed targets for greenhouse-gas reductions by investing in projects that cut emissions in developing countries. CDM approval could provide this green project with certified emission reductions, which can be traded internationally as carbon credits. To date, only four projects in the North African country have managed to start selling carbon credits.

Acknowledgement
This Project Presentation is especially dedicated to my to Engineer Helmi Wahba (late father of the presentor) the sole inventor of this exclusive innovative invention.

9 Rice Straw for Electricity and Heat Production, by Dr Robert Bakker, Wageningen UR-Food & Biobased Research

There are three main reasons for producing energy and heat: (1) there is always a market for electricity, and often for heat, (2) we can produce substantial energy production from agricultural waste if we convert them to energy, and (3) we can provide substantial environmental savings by avoiding landfilling or open field burning.

When we look at the energy demand increase in the world of the past one and half century, there is clearly shown the tremendous increase in energy during the past 50 years. This increase is largely filled by fossil, non-renewable, energy sources: coal, natural gas, and oil. In other words, 80% ore more of our energy demands today comes from non-renewable resources, which clearly indicates the issue of sustainability of our energy supply.

When we look at one of the main energy sources, oil, we can see the tremendous increase in the past 10 years. Also many developing countries have, within a short amount of time, transfered from being a net oil exporteur to a oil importeur

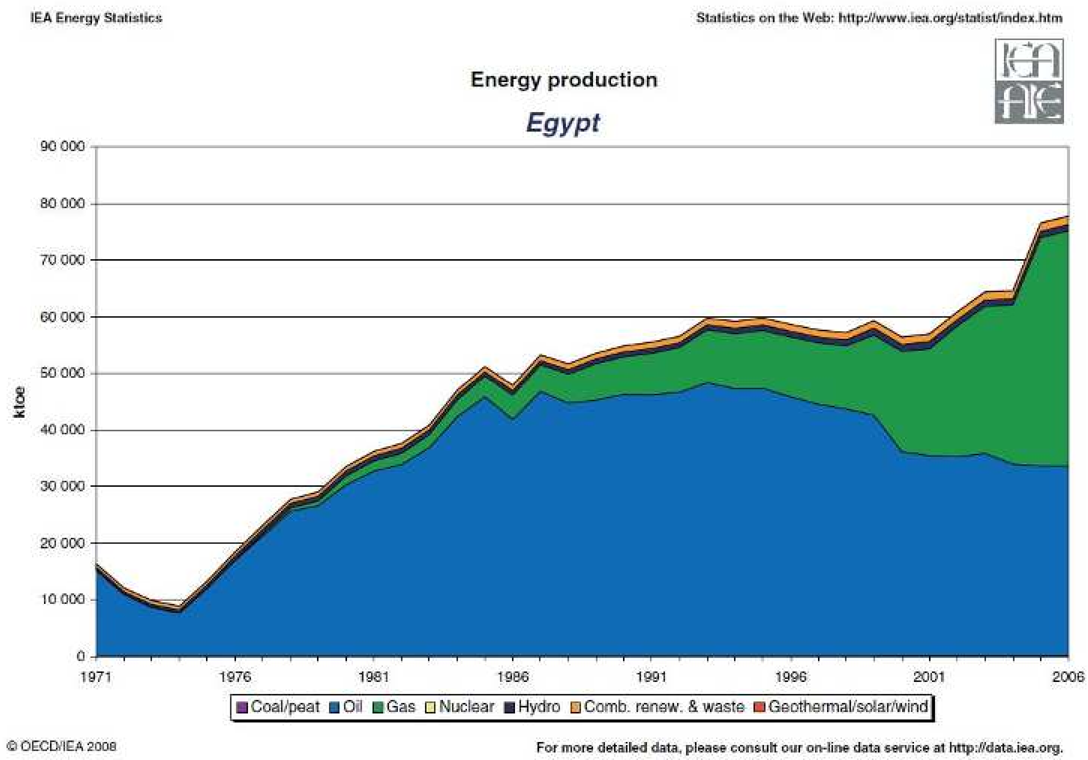


Figure : Energy Production in Egypt (source: IEA)

According to statistics provided by the International Energy Agency, developments in Egypt are not that different from those elsewhere in the world. In particular, the increasing use of natural gas of the last 20 years (shown by the green) is remarkable. An even more remarkable development is shown by the electricity production in Egypt, which is, again, largely provided by fossil fuels.

Besides increases in energy production, the production of food crops has also increase over the past decaeds, As this picture from the International Rice Research Institute (IRRI) shows, the yearly increase in rice production amounts to 1.5% increase per year, on average. More rice grain production, also means more rice waste production or by-products, such as rice straw. This provides a real opportunity for using the waste for beneficial purposes.

Can straw become a new income source for farmers? Currently, only a fraction is used by farmers. However, the potential energy contained in rice straw is tremendous. If burning of straw in the field, a current practice in many rice-growing countries, can be avoided by using rice straw for beneficial purposes, we can also achieve tremendous environmental benefits.

Based on the 3.5 million tons of rice straw that is produced every year in Egypt, we estimated air pollutants emissions from rice straw burning. The top four represent the main greenhouse gases, which lead to a total of 5.5 millon metric tons of CO_2, and about 25% of this emission could be avoided by generating energy from rice straw. More importantly, other polluting gases could be avoided as well. For instance, as shown at the bottom of the table, other pollutant emissions are shown, including oxides of nitrogen and sulfur, and fine particulate matter (PM 10; particles smaller then 10 micron, and PM25-particle smaller than 25 micros) which are the main causes of respiratory diseases in human beings.

There are four main technologies available to produce electricity and heat from rice straw. Energy can be producerd either directly, by combustion, or indirectly, by producing an intermediate form such biogas, which later can be converted to electricity or heat. In addition, two important technologies : gasification and pyrolysis, are in development for biomass; therefore emphasis is on combustion and anaerobic digestion
Not included in this overview are biofuels used for transportation: these will be dealt with in separate presentation

1.Combustion
Combustion is the most well-known conversion method, and the technology generally consists of a boiler coupled to heat exchanger, and a steam turbine with electricity generator. Options for rice straw combustion:are "Stand-alone" systems, normallly relatively small-scale for electricity and heat, and co-combustion, where the straw is combustion together with coal or other fuels (co-firing).

There are specific and important challenges related to rice straw combustion, these are mainly related to the high ash content (up to 20%), and the ash composition. Due to is chemical composition, at higher temperatures inorganic components in rice straw react with each other, leading to problems in boiler systems. Quality of rice straw is therefore a major issue! Many boiler operators have found that they could not accept rice straw as fuel, whereas they are successfully use other biomass fuels, such as woods. Finally, a separate bottleneck is the need to densify or compress the straw prior to combustion, for both economic (logistics) and technical reasons.

Biomass-fueled power plants at smaller scale (5 – 15MW_e) are well established, while for larger systems the transportation distances to bring the straw to one combustion facility may become a problem! In addition, an outlet for straw ash needs to be identified

This picture of a boiler tube that was removed from a biomass boiler, shows what troublesome inorganic elements can do. At the ends of the tube, you see a hard deposit that is produced by molten ashes. Secondly, in the middle, where the deposits were removed, you see tremendous steel corrosion brought about by the chlorine present in the fuel.

Ash agglomeration

The figure shows a ash deposit taken from a fluidised bed reactor after 3.5 hours of operation on just 10% rice straw, mixed in wood.

Figure: Bed agglomerate removed from a fluidized bed combustor burning a blend of 10% rice straw in wood fuel after 3.5 h of operation (courtesy Prof Bryan Jenkins, University of California)

There a number of solutions for ash-related problems of rice straw combustion:

- rice straw can be combined with other fuels that are lower in ash, alkali and chlorine
- boiler systems can be designed with lower operating temperatures, thereby reducing ash agglomeration problems
- troublesome components, such as K and Cl, can be removed prior to combustion in a process known as leaching, which can be accomplished either by naturall means (rainfall) or by washing the straw prior to combustion

Some of these solution have been successfully tried with rice straw. In general, these solutions also lead to higher costs for straw utilisation, which often makes the use incompetitive.

2. Anaerobic Digestion

Anaerobic digestion is a well-proven technology for various agricultural wastes, including straw. The technology can be characterised by low maintenance costs, and the technology is not complicated. Also, it can be implemented at relatively small scale, which translates in short transportion distance from the field to the facility.

There are two main applications for the end-product: Biogas. Direct use of biogas can be done when gas is used for cooking and heating. Indirect use of Biogas involves feeding the gas into an engine that is equippeed with electricity generator.

Often, rice straw is digested together with other biomass types, including Animal manure, or other organic wastes. Biogas technologies that only use rice straw, are still in development. In conclusions, the major drawback of this technology that besides straw, you need to have other raw materials available to effectively turn rice straw into biogas.

3. Pyrolysis, and 4. Gasification

Pyrolysis is done at lower temperatures and yields two fractions: bio-oil and bio-char

Gasification yields only a gas, but the composition is quite different compared to biogas. The produced gas can be used, however it needs cleaning of impurities.

These technologies have shown great promise, and have a potentially higher energy conversion efficiency, but they have so far not been implemented at large scale. Main developments in the technology to date are:

In Denmark, a system was developed whereby straw is first gasified, an the gas is then converted to electricity in a different boiler.

Related to rice straw is the combustion of rice husk or rice hulls, which is often more succesful compare to combustion of rice straw. There are three reasons for this: (1) rice husk is already collected in one site (at the rice mill); (2) its composition is somewhat more benign than rice straw, especially in regard to alkali and chlorine, and (3) rice husk ash is often marketable product, depending on operating conditions. There are many commercially operated, small scale rice husk furnaces, gasifiers, and pyrolysis units. In addition, industrial scale rice husk utilisation can be found throughout the rice growing areas of the world, including the USA, Thailand, China, etc.

Case 1: Rice straw power production in China (source: Gadde et al, 2008)
There are various biomass power projects in Jiangsu Province. The typical size of the straw-fired powerplants is 12 – 25 MW electricity, per powerplant. In all cases, the fuel consists of 50 – 60% of rice straw, and the remainder is made up of other types of agricultural waste. Most facilities source their raw material from an area with a radius of 25 to 50 km radius around the powerplants. The main concern of the powerplant operators is the cost of the raw material, as was this quote suggeste *"It is assumed that collection and transportation charges will increase every year because of increasing labor and transport costs." (Gadde, 2008)*

Case 2: Biomass power production in California
In California, rice is produced in mono-crop, and straw becomes available after the grain harvest in August-September. Since the 1990's, legislation passed by the State of California has led to a mandatory phase-out of field burning of rice straw. Currently, the primary disposal method is in-field recycling by farmers. In California, there are at least 15 medium-sized facility to produce electricity from biomass. However up to know, these facilities have largely used other types of agricultural waste, and not rice straw, due to the ash-related problems with rice straw. There are however some other uses of rice straw in California, including the use of rice straw for erosion control. For instance, the State of California uses rice straw to avoid erosion of embankments of public roads. Another examples is the production of so-called "wattles" which are also used on steep slopes. These wattles are largely made out of rice straw.

Case 3: India (Punjab)
In the Punjab, in Northern India, rice is grown followed by wheat. Increasingly, rice is harvested mechanically by combines. Thereby, the agricultural production systems bears a lot of similarities with those in Egypt. There are two major initiatives for electric power production from rice straw, both small 10 MWe-sized powerplants and community biogas plants. There is limited success in their implementation, as over time the number of biogas plants have reduced, due to increase in cost of raw material, and cheaper & abundantly available cooking gas from other (e.g. fossil) sources.

Conclusions

Many technologies are available for producing electricity and heat from rice straw. However, up to now the potential of rice straw has not been realised. This is in contrast with energy production from rice husk, which in general is quite successful. Major challenges that are encountered with straw include

- Technological challenges, mainly related to the chemical compositions of rice straw,
- Organisational challenges: mainly related to the logistics of straw collection
- Economic challenges: mainly related to the cost of straw conversion, versus revenues.

Even with these important challenges, substantial environmental savings can be achieved, if rice straw conversion to energy leads to avoidance of field burning.

Recommendations

Given the logistical bottlenecks of collection of rice straw for large scale application, opportunities for decentralised energy production from straw should be assessed. Besides using straw near its source, possible rice straw could be used as source of energy for other agriculture-related operations, such as operation of cooling or freezing houses. In all cases, the energy production should be coupled with local industry needs for energy. Furthermore, opportunities for CDM-type projects should be evaluated as well, as a large amount of emission savings can be accomplished, not only by producing CO_2-neutral energy, but also by avoiding greenhousegas emission (mainly CH_4 and N_2O) from field burning. Finally, markets for biomass energy feedstocks outside Egypt should be studied as well. There is a growing international market for biomass fuels. In this case, the technical challenges of energy production from straw, in particular due to its ash composition, should not be overlooked.

10 Using Rice Straw in Compost Production, by Dr Nader Al Sayed, El Saleh for Integrated Investment/NCSE

The current presentation is representing the activities of the Al Saleh Company's experience in the field of compost and waste recycling. This company is working on new ideas for using plant waste in compost. The Alsaleh Co. for waste management was established in 2004, with a paid capita of: 5,000,000 L.E. The main factory of AlSaleh Co. located in Minoufyia Governorate, is serving Delta region and Canal Zone. Approximately 25,000t. of waste are processed at this site. In addition, the company is planning to open a new factory in Fayoum.

Compost is the end result of controlled aerobic decomposition of organic matter, which is also known as composting. It is used in landscaping, horticulture and agriculture as soil conditioner and fertilizer to add vital humus or humic-acids. It is also useful for erosion control, land and stream reclamation, wetland construction, and as landfill cover .

Products from the AlSaleh Co include:

- Pure Solid waste Compost with no additives from a 10 years old municipal land fill
- Solid waste Compost mixed with Green waste.
- Municipal sludge mixed with green waste.

Various techniques are applied for the processing of waste, including Screening solid waste, Composting with additives, Solarization, and Composting with green waste. For rice straw, the Al Saleh company uses rice straw in compost in heaps of 5.5m length, 3 m width and 1.3m high. After each layer, mineralized water is added and the process is repeated. The heaps are mixed after 2 months and watered every 15 days. Optionally, sludge and/or other solid wastes are optionally used with rice straw.

The potential production in Fayoum governorate in 2006 96,000 tons, based on the availability of straw. Advantages of the technique are:

- Large scale production can be accomplished
- Environmental benefits including reduction of carbon emission.
- Economical benefits due to straw utilisation
- Soil improvement, especially in new land
- Social learning and awareness.

Recognised challenges are the access to regular supply of rice straw and green waste through long term agreement with farmers, and the cost associated to transportation and potential risk of price increase as value of rice straw recognized.

11 Industrial Development: Biofuels for Transportation, by Dr Robert Bakker, Wageningen UR-Food & Biobased Research

Biofuels are commonly defined as transportation fuels that are derived from biomass. The most prominent examples are bioethanol, which is used as replacement for gasoline (petrol), and biodiesel, which can replace diesel. In many countries throughout the world, legislation has been implemented that leads to higher demand for biofuels. Currently, there is large scale production of biofuel in Brazil, the U.S.A., China, and a number of European countries. Current raw materials used for biofuels include: Sugarcane, Maize, Wheat, Barley, Sugarbeets for bioethanol production, and Rapeseed, Sunflower, and Palm oil for biodiesel production. The use of these raw materials also leads to discussion on whether it is wise to use agricultural feedstocks that are also used for food production, into fuel. Furthermore, questions are raised in regard to the environmental sustainability of biofuel production.

Currently, the transportation sector in many countries is for more than 80% dependent on oil imports. One of the main drivers for biofuels therefore is to reduce the dependency on imported oil. Another very important driver for biofuels, is the reduction of greenhouse gas emissions in the transportation sector. Also, biofuel production may lead to new economic impulses for agriculture and agri-industry, and it may add value to by-products, in case byproducts or wastes are used to produce biofuels.

Current biofuel Production in the World

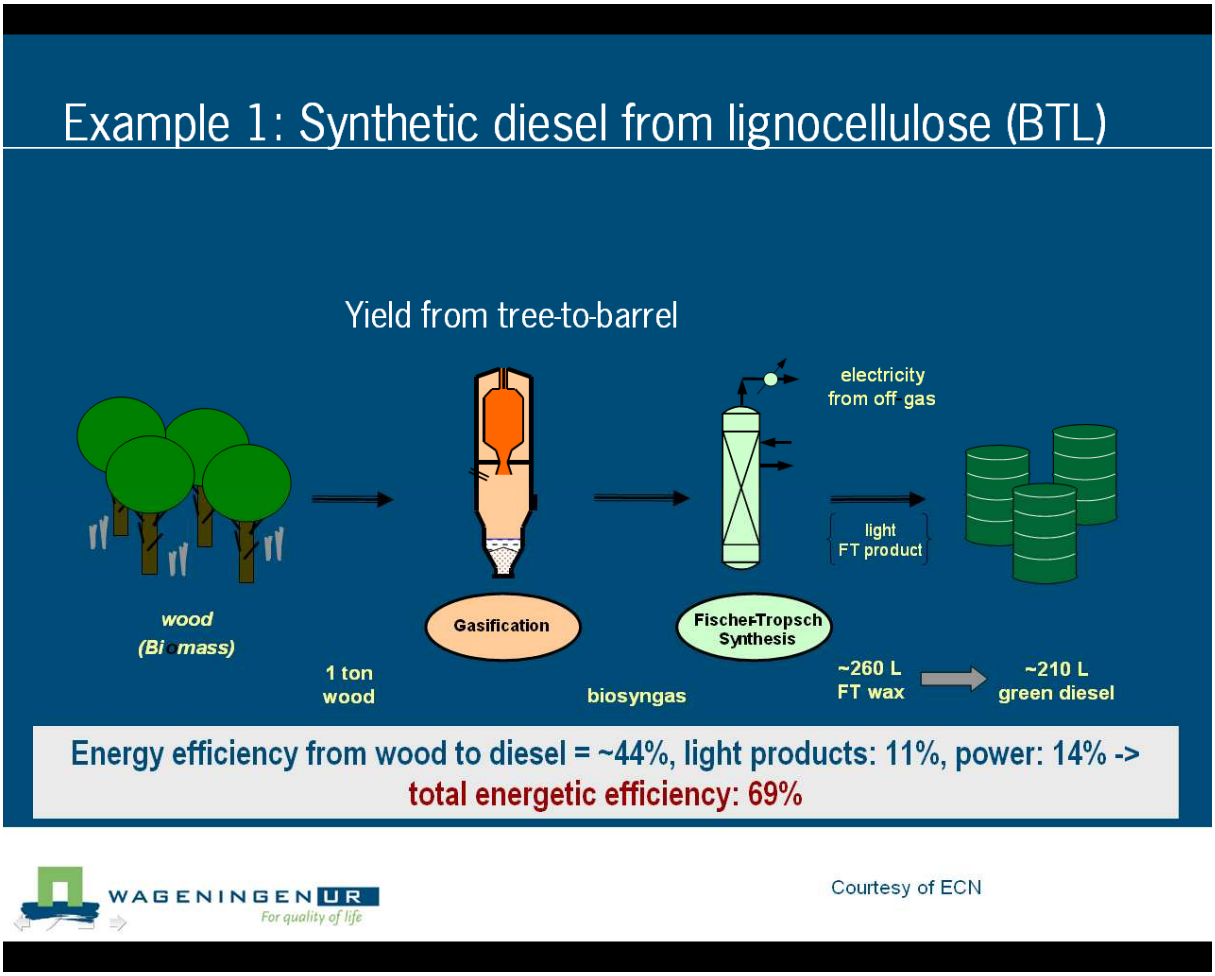
The main biofuels currently used in the world are bioethanol (or alcohol), and biodiesel. In the world, bioethanol production far exceeds the biodiesel production. The main producers are Brazil, and the United States.

Using rice straw to produce Biofuels

If we are to use Rice Straw as raw material for biofuels, we should think of what is commonly known as “second generation” biofuels. As mentioned above, almost all current biofuels produced are made out of food crops, therefore they are often referred to as first generation biofuels. Second generation indicates the use of lignocellulosic biomass, as raw material. There are important advantages associated to 2nd generation biofuels, including lower competition with food production, higher greenhouse gas emission reduction benefits, and a further increase in the diversity of biofuels as well as biobased products. However, the technologies for producing biofuels from raw materials such as rice straw are still in development, as current production costs are not yet competitive with current biofuel production.

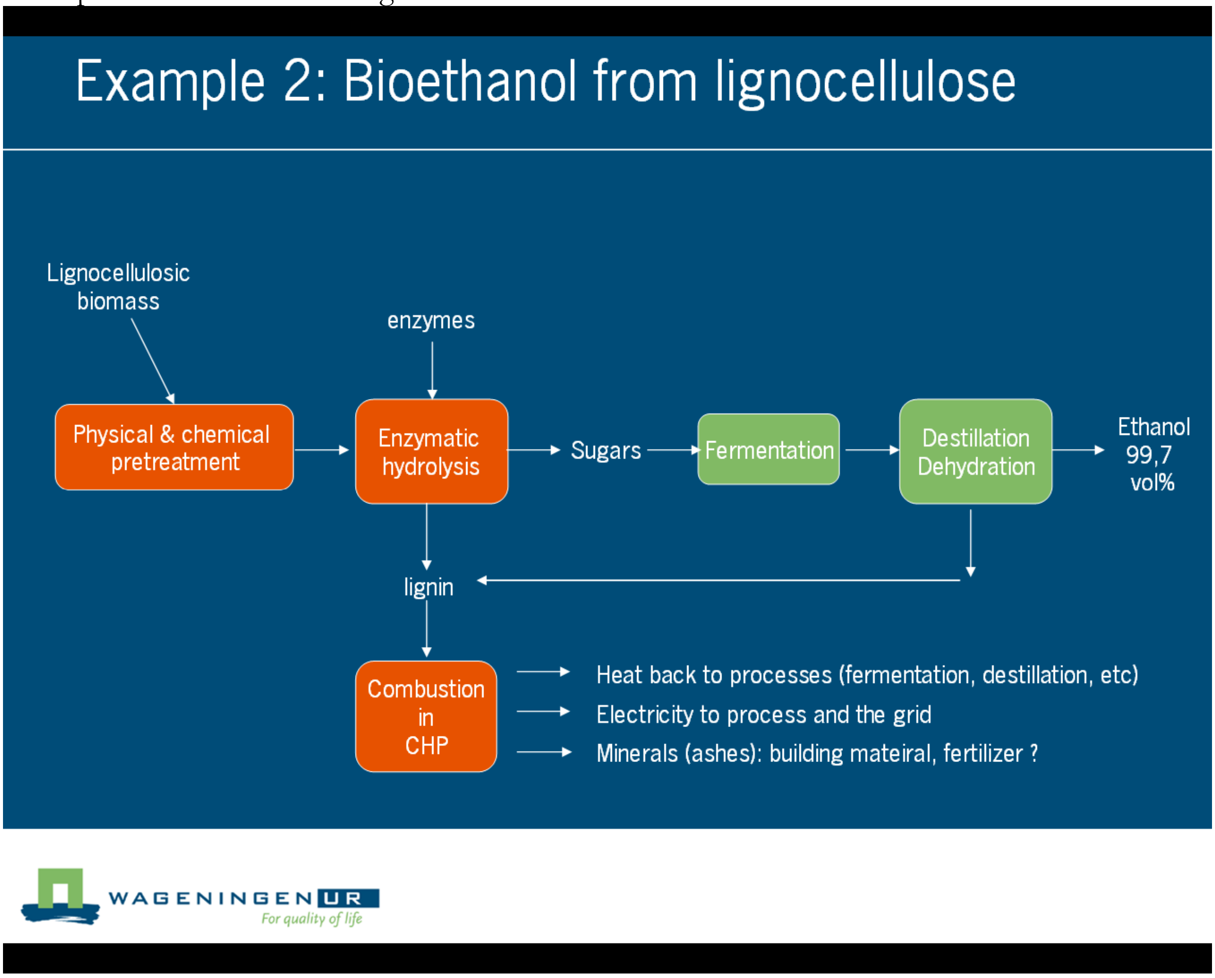
Lignocellulose is a common term used for all organic matter that contains plant fibres. So, all woods, straw, grasses, pulp, are forms of lignocellulose. There are two main methods of producing biofuel from lignocellulose: the thermochemical method, and the biochemical method. For both these pathways, technologies are in various stages of development.

Example 1: Synthetic diesel from lignocellulose (BTL)



A simple schematic of the thermochemical pathway, often referred to as Biomass to Liquids or BTL is shown above. Essentially, from the raw material a synthetic gas is produced, which is further processed into a synthetic liquid, Fischer Tropsch liquid, that can be used in petrol or diesel engines.

Example 2: Bioethanol from lignocellulose



A simple schematic of the biochemical pathway: after pretreatment, the raw material is degraded by enzymes, which produce sugars for fermentation to alcpohol. In addition, a byproduct, lignin is produced that used for electricity and heat

Biomass to Liquids: developments

The german company Choren is quite far in development of BTL or synthetic fuel from woody biomass. Although this is a important development, it will take still at least 3 to 5 years before we can expect full industrial-scale production.

Ethanol from lignocellulose: developments

There are several companies around the world that are developing biofuel production technologies based on lignocellulosic feedstocks. There are two companies, Abengoa in Spain, and Iogen in Canada, that are developing bioethanol production methods based on straw. In addition, there is a Danish consortium developing new technologies based on using straw. As with the other technologies, we are still at least 4 to 5 years away from full industrial scale production. There are large capital investments associated with these types of industrial developments.

Public-private partnerships: Bioethanol from lignocellulose

In the Netherlands, several parties are involved in Research and Development related to biofuel production. Most of the research is done in public-private partnerships, a from of collaboration actively supported by the Dutch and European government. An example of such a project, where our institute was involved as partner, was the bioethanol/lactic acid research programme which was funded by the Dutch Ministery of Economic affairs through the EET (economy, ecology, Technology) grant programme. Unfortunately, there is not sufficient time today to present all the results of the technical research, therefore, only main results of the economic evaluation are reviewed. Production costs of bioethanol produced from straw were estimated at around half a euro per litre (our about 4 Egyptian Pounds per liter), although in a business concept (wich includes a commercial rate of return) that price would increase to about 0.75 Euro (6 Egyptian pounds).

The future: Biorefinery

Finally, one cannot talk about biofuels without mentioning biorefineries. Biorefinery is the processing of organic material into marketable products, not just energy and biofuels. The Netherlands is leading in a number of biorefinery-related initiatives. More information can be seen at the following websites: www.biorefinery.nl

As yet another example of a public-private partnership, the Dutch Prograss Consortium has provided the proof of concept by this pilot-scale biorefinery facility, where harvested grass is fraction. Definitely, biofuels will be an integral part of biorefineries in the future

In conclusions regarding advanced biofuel production, important improvements have been realised in recent years in particular by innovations in Industrial Biotechnology, Process technology. The outlook for coming years is that further transfer of technology to the industry will be accomplished. In this, there is an important role for public-private partnerships. Active support for Research and Development by governments remains crucial.

In summary, the technology for conversion of lignocellulose, including rice straw, is applicable to a broad range of raw materials, and a broad range of fuels and products. In our view, the role for Egypt will be to join international consortia for further development of 2nd generation biofuels, including straw.

12 Report on the plenary Discussion

Helwan University: If rice straw is mixed with sludge for compost production, Heavy metals contained in compost can be transferred to crops when the compost is applied to, for instance, fruits and vegetables. We should warn the users not to use these types of fertilizers.

A.: This is an importation question. Using this compost in food production is prohibited by law. Wageningen UR can ask this to expert in the field. In any case, awareness of this among producers and consumers is an important question.

IT&M: what would be a better investment: putting money into biofuels such as ethanol, or putting money into algae, that can produce oil and from which biodiesel can be produced?

A.: Ethanol from lignocellulose is developed by a number of large companies, here the questions if a small company has a competitive advantage in investing in this technology. Algae production, at least in the EU, is pursued by groups of smaller companies-hence this may provide better opportunities to enter into the market.

However, both are technologies that are in development, and it is not sure when they become commercially available. A economic feasibility of algae production conducted by Wageningen UR concluded that producing algae only for biofuel, is not likely to be economically competitive-it should be combined with producing other materials, chemicals, or animal feed.

Al Hissewy: based on experiences obtained during a study done for FAO, our view is to start solutions with the small farmers. In Egypt, straw is a fragmented resource, how to organize collection to a main factory is a major problem. Also, social inclusion of technologies should be viewed upon. The Chinese gasifiers that were installed by the Ministry of the Environment are a good example of a solution that can be implemented at the small scale, and. As a result of the gasifier, none of the residents of the village have to purchase butane. Therefore, it is a simple and cheap solution that is integrated in the villages.

Moustafa: thank you for organizing the seminar, it was beyond my expectation. My question relates to the presentation by Mansoura University; what is the expected return on investment to farmers on this new technique for in-field recycling of rice straw? Is it not too expensive?.

A: From our studies we conclude that it is economically feasible. The normal cost for mechanical harvesting is 170 LE/feddan, the rice straw chopping and incorporation will only add 10 to 20 LE/feddan. The farmer is willing to add this cost, and he will not get any fine from not burning. The cost for land preparation for the next crop is not different than in case of field burning.

Tarek Morad (chair): I have a question: is the Department of Agriculture going to recommend this technique (in-field recycling directly after rice harvest) to farmers?

ARC: I am truly amazed by all the technological and industrial developments that were presented during the seminar. However, usually with industrial development there usually also comes a period that society becomes critical of industrial development and starts fighting it, an example is the development of organic farming. Now, my question: is how much energy is used in the presented technologies, and are these new processes really sustainable?

A.: Life cycle analysis is now a standard analysis technique in all biofuel development projects. In this, the use of energy in the conversion process is critically analysed, and improvements in the process are made when necessary. In most new cases for producing biofuels with the second generation technology , there is by far a positive energy balance: much more energy is produced, then is used during the process. This is ofcourse not true for all first generation biofuel processes, so your comment is well taken.

Q.: I have a company that deals with residues from the production of maize. What type of biofuel technology would be appropriate for this type of residu?

A.: The residue you are referring to is also often referred to as corn stover. In essence, this type of material is also lignocellulose, so it is comparable to rice straw. So, the development of 2nd generation biofuel technology will also be relevant for maize residues. However, as we mentioned it will take a few years before this technology will become available. For the time being, it would seem that biogas production would be an appropriate energy technology for maize residues. Utilisation of maize residues for biogas production is widely practiced in the EU.

ARC: We have at least 2 million tons of rice straw, 1 million ton of rice husk and 200,000 tons of rice bran. In order to utilize this effectively, we need effective integration of solutions. We need extension of ideas, and privatization.

The problem is that in order to effectively implement new projects, we need an integration mechanism. *"We are all working in isolated islands"* This is not only the case for rice straw but also other materials, such as sugar cane bagasse.

Comment: the decision whether to invest in algae, bioethanol or other fuels also depends on the market: what does the market require?

Comment: The problem of why new ideas do not get realized, is extension. Why not take the recycling process developed by Mansoura University to the agricultural extension, demonstrate is on a larger scale, and communicate results widely?

Director Field crops research/ARC: Straw is produced by many small farmers, in fragmented areas. I believe that we should seek solutions for straw that can be applied on or near the farms, and solutions should be practical. One current problem is the high cost of feed for animals. My proposal is that straw is mixed with the first cut of Bersim (clover), which has a very high water content. So, a new type of animal feed could be produced by a mixture of straw, bersim, and additives that improve the feed quality.

Comment: we have not talked about the role of women. We should provide small machines for converting straw into marketable products. More attention should be given to the women, they are very influential.

Helwan University: paper production from straw suffers from production of a byproduct, black liquor, that has a high silica content. Since there is no use for it, its disposal leads to environmental pollution. We can separate black liquor and provide new uses for it, making paper production form rice straw economically feasible. Another idea is to make refractory bricks which contain 10% cement and 90% rice straw, for producing toilets. I went to the Ministry of Environment 5 years ago with this idea, but was not successful in implementing it.

Agricultural Engineering Institute: We have developed an idea to cut rice straw very finely right after harvest, in this way a larger volume of straw can be recycled. We tested the degradation of straw in the soil 1 day and 20 days after cultivation for the second crop, and found that this technique was very efficient in recycling straw back to the field.

The chairperson, Dr Morad thanked all people in attendance for their useful questions and comments.

References

Further background information

Summary

There is a general awareness in Egypt that field burning of straw, in particular rice straw, leads to unacceptable air quality. This is partly brought about by recent reports on what is locally known as "the Black Cloud" in the media, newspapers, etc. In view of this, the Egyptian government, industry, institutes, and farmers are actively engaged in finding new ways of utilising straw in a beneficial and environmental sustainable way. In fact, there are many organisations in Egypt involved in rice straw pollution abatement and alternative utilisation. Hence, there was great interest in participating in the rice straw seminar, and the seminar brought various actors from different sectors together. It is also notable that various donors, such as the EU and other Embassies, were represented in the audience.

There are multiple opportunities for Rice Straw utilisation in different sectors of the economy. These include applications near the source, such as in-field recycling and composting, applications within the region, such as decentral energy production, and applications at the national level. A number of very promising developments and new concepts were presented at this seminar, including composting, energy applications, and sustainable building materials. They can provide an important alternative for existing wood products, renewable energy, and reducing the cost of agricultural production, such as fertilizer use. However, in many case further product development is necessary, both to improve the products but also the economy of the process, in order to make them more economically attractive. For those technologies that have reached maturity, further demonstration and extension is needed. In addition, while there are many initiatives such as pilot and demonstration projects on alternative rice straw utilisation, these initiatives are generally fragmentised, and projects seem not linked. A more integrated approach is therefore required. Other recognised challenges of beneficial rice straw utilisation are the access to regular supply of rice straw and other wastes through long term agreement with farmers, and the cost associated to transportation and potential risk of price increase as value of rice straw is recognized. Finally, attempts to increase recycling and utilisation or rice straw can serve as example of using other crop wastes.

In summary, rice straw and other agricultural byproducts can be an integral part of the new Biobased Economy in which fossil sources of energy and materials are gradually replaced by renewable sources.

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- Dr Hamdy Saad, of chair group VPPC, Wageningen UR
- EAGA, Cairo, for logistical and organisational support

Appendix I: List of attendants

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1	أحمد عبد القادر	ahmed abd elkader	مركز البحوث الزراعية	Agricultural Research Center
2	صلاح محمود عبد السلام	slah Mahmod abd elslam	مركز البحوث الزراعية	Agricultural Research Center
3	عادل أحمد بكر يونس	Adel Ahmed Bakr Yones	مركز البحوث الزراعية	Agricultural Research Center
4	وائل السيد جبر إبراهيم	Wael Elseed gabr	مركز البحوث والتدريب في الأرز	Rice Research center and training
5	ياسر زين الرفاعي	yaser zen elrfaeey	مركز البحوث الزراعية	Agricultural Research Center
6	عبد السلام عبيد	abd elslam ebaid	المركز الإقليمي للبحوث	Regional Reserch center
7	وليد خالد	walid khalid	المركز القومي للبحوث	Agricultural Research Center
8	تامر جلال عبد العظيم	tamer glal	قعة أوتيس الزراعة	Otis Agriculture training
9	أحمد بهاء دياب	ahmed bhae dyab	شركة الواحة مصر لتصنيع الحاصلات الزراعية	Private sector
10	ناجي ميخائيل	nagy mekhaeil	أسنان الجراحة طباع خاص	Private sector
11	سعيد محمد شبيل	saeid mohamed Shobil	مركز بحوث الأرز بسخا	rice Research center and training at Sakha
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13	عيسى		كلية العلوم جامعة حلوان	Faculty of Science Helwan University
14	محمد المنشاوي عيسى شلبي	Mohamed elmenshawy said	مركز بحوث وتطوير الفلاتر	Research center anf filter developement
15	حنان عبد العزيز	hanan abd elazez	المركز القومي لبحوث الإسكان	National Center for housing research & construction
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20	أمنية عباس	omnia abas	UNIDO	unido
21	دسوقي عبد الحكيم	desoky abd elhakem	مدينة مبارك للتعليم بالإسكندرية	Mubarak City for education at alexandria
22	خانو أرمان خايف	khano arman khaef	شركة رامسكو	Ramsco Co.
23	مها محمد إبراهيم	maha mohamed ebrahem	المركز القومي للبحوث	national Center for research

(continued on next page)

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26	تامر سامح	tamer sameh	شركة التجار المصريين	The egytian traderds Co.
27	مجدي هلال	magdy hlal	مركز بحوث الإسكان والبناء	National Center for housing research & construction
28		Zomaa Merabet	NSCE	
29		Sabri Merabet	NSCE	
30		Damiens Florence	EC Delegahion To Egypt	
31	هيثم محمد الشرقاوي	haytham mohamed elshrkawy	مركز بحوث الأرز	Rice Research center
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34	محمود محمد الحبشي	mahmod mohamed elhabashy	بحث معهد البساتين الحقلية	Horticulture Research Institute of Field
35	السيد سعيد نعيم	elsayid saeid naeim	بحث معهد البساتين الحقلية	Horticulture Research Institute of Field
36	شهرت عارف	shohrat Aref	الشرق الأوسط- محررة	shark EL Awsat Journalist
37		josh goldey	Us Embassy	Us Embassy
38	عادل القاضي	adel el Kady	رئيس مركز بحوث الأرز	Rice Reserch Center
39	شريف أحمد يسري	Sherif Ahmad Yosry	مسئول برامج أول	مسئول برامج أول
40	راوية إبراهيم غازي	Rawya Ebrahim Ghazy	رئيس مجلس إدارة شركة رامبكو	Rambco Co.
41	محمد إبراهيم غازي	Mohamed Ebrahim Ghazy	مدرس زراعة المنصورة	مدرس زراعة المنصورة
42	حسام الدين حسن سليم	Hussam Eldin Hassan Slim	مركز بحوث البناء	National Center for housing research & construction
43	أحمد سمير هنداوي	Ahmad Samir Hendawy	مركز بحوث الأرز بسخا	Rice Reasearch center at Sakha
44	تامر فاروق متولي	Tamer Farok	مركز بحوث الأرز	Rice Reasearch center at Sakha
45	فتحي عبد العزيز سلامة	Fathy Abd Elazez Slama	شركة مضارب كفر الشيخ	Rice Mills Co. at Kafr El Sheikh
46	السيد صادق	Elsayed Sadek	شركة مضارب الشرقية	Rice Mills Co. at Sharqeya

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No		Name	Company Ar	Company En
47	السيد أحمد الشربيني	Elsayed Ahmad Elsherbiny	شركة مضارب دمياط و بلقاس	Rice Mills Co. at Danietta & Belquass
48	رؤوف كمال	Rouf Kmal	جمعية خبراء العلم والتكنولوجي	Science and technology experts association
49	محمد عبد المنعم	Mohamed Abd Elmenam	شركة النور للتنمية الزراعية والغذائية	AL Nour co.
50	محمد محمد المدني	Mohamed Mohamed Medny	شركة مستشار للتبادل بين الشمال والجنوب	North & South Exchange Consultation Co.
51	زهير لاشين	Zohir Lashin	زراعة عين شمس	Faculty of Agriculture , ein Shams university
52	محمد النحراوي	Mohamed Elnahrawy	مركز البحوث الزراعية	Agricultural Research Center
53	رباب ممدوح	Rabab Mamdoh	مركز البحوث الزراعية	Agricultural Research Center
54	عمرو فاروق	Amr Farok	وزارة البحث العلمي	Ministry of Research
55	مصطفى محمد	Mostafa Mohamed	كلية الزراعة جامعة المنصورة	Faculty of agriculture , Mansoura university
56	إيهاب مصطفى	Ehab Mostafa	شركة السنبلة	Sonbola Co.
57	كمال أمير قشوط	Kmal Amir Kshot	مضارب رشيد	Rashid Rice Mills
58	عمرو محمد هلال	Amr Mohamed Helal	الدولية للتسويق	EL Dawlia marketing co.
59	شيماء توفيق محمد	Shymae Twfek Mohamed	مجموعة النظافة البيئية	مجموعة النظافة البيئية
60	نظمي حافظ	Nazmy Hafez	شركة مضارب الإسكندرية	Rice Mills at Alexandria
61	هبة جودة	Heba Goda	قناة النيل للأخبار	Nile News Channel
62	حسن البنا عثمان	Hassan Elbana Osman	معهد بحوث الهندسة الوراثية	Genetic Engineering Research institute
63	مجدي أحمد بيومي	Magdy Ahmed Bayomy	معهد بحوث الهندسة الزراعية	agricultural engineering research institute
64	علياء إبراهيم	Alia Ebrahim	NSCE	NSCE
65	محمود عبد السلام	Mahmoud Abd Elslam	NSCE	NSCE
66	حسن عامر	Hassan Amer	البشاير	EL Bashayer Co.
67	طارق يحيى قابيل	Tarek Yehya Kabil	ASPT & CU	ASPT & CU
68	ماهر وهبة	Maher Wehba	الإسكندرية	Alexandria
69	خالد عمرو	Khalid Amro	شركة النصر	EL Nasr Co.

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No		Name	Company Ar	Company En
70	هدبع حامس	Samah Abdo	ةئيبلا ريزول يملعلا بتكملا	Ministry of Enviroment
71	يماس ماشه	Hesham Samy	زرلا برضم ةيه	Rice Mills
72	دشار فيرش	Sherif Rashed	يعلسلا سلجملا	Comodoty Council
73	دوعسلا وبأ دمحم	Mohamed Abo Elsoid	ةيعارزلا ثوحبلا زكرم	Agricultural Research Center
74	نيدلا دعس حودمم	Mamdoh Saad Eldin	نوركيم ةكرش	Micron Co.
75	يراجنلا ىفطصم ريمس	Samir Mostafa Elnaggary	ةجزاطلا ةهكافلا ةكرش /رصم	Fresh Fruit Co
76	ليعامص نيفين	Nefen Somael	ةيكيلوثاكلا تاثاغلا ةئيه	Catholic relief commission
77	ينغلا دبع ةلاه	Hala Abd Elghany	ةيئاذغلا تاعانصلل ايلاطيا رصم	Misr Italis for agriproducts
78	حوتف يدمح	Hamdy Ftoh	يموقلا زرلا جمانرب	Natinal Rice Program
79	لداع ةماسا	Osama Adel	ايجولونكتلاو مولعلا ءاربخ ةيعمج	Science and technology experts association
80	يجيلملا تحدم	Medhat Elmligy	ةيلتسبلا تلاصاحلا يردصمو يجتنم داحتا ريدم	Union of Producers and Exporters of Horticultu
81	لامك مثيه	Haytham Kmal	EEAA	EEAA
82	فسوي دومحم	Mamoud Yosef		
83		KOJT KITAMMRA	JICA	JICA
84	ورمع دمحم ورمع	Amro Mohamed Amro		

Appendix II: Photos

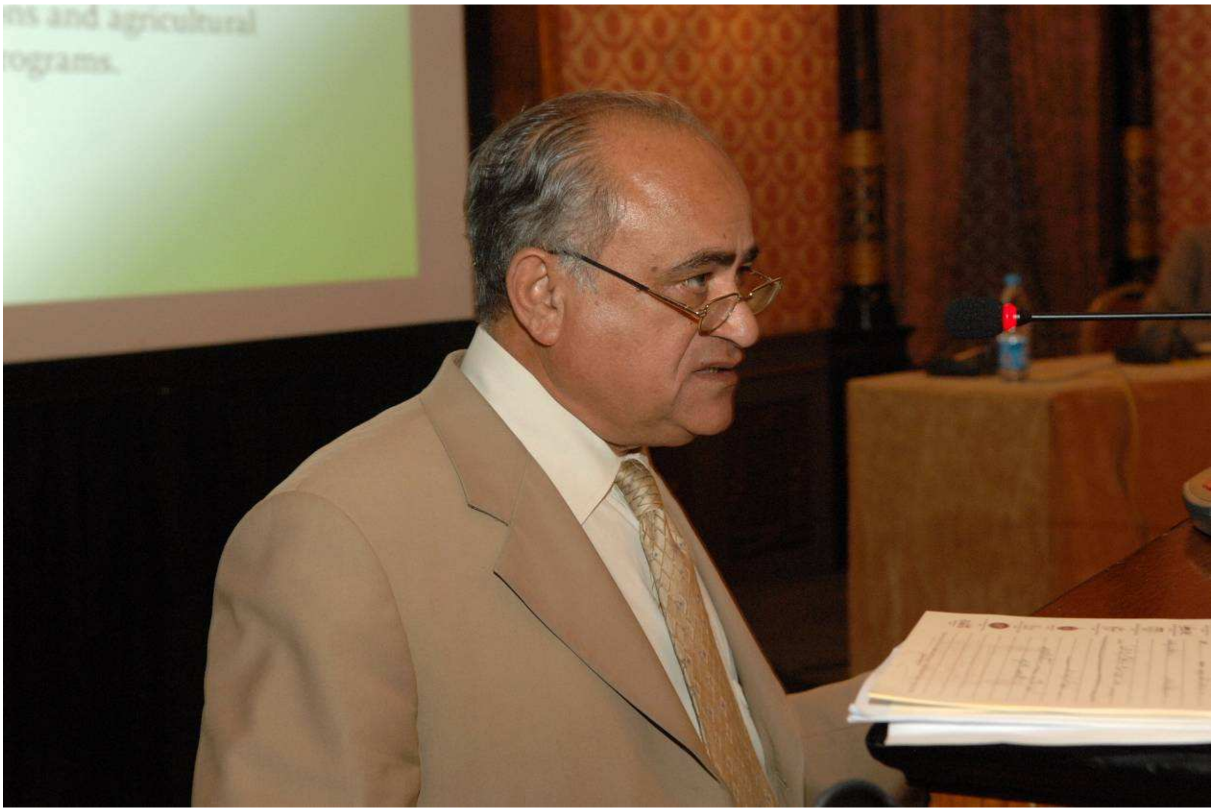
Photo 1. Opening by H.E. Maged George

Photo 2. Welcome remarks by Dr Hans vd Beek

Photo 3. Presenting of token of appreciation to H.E. Maged George

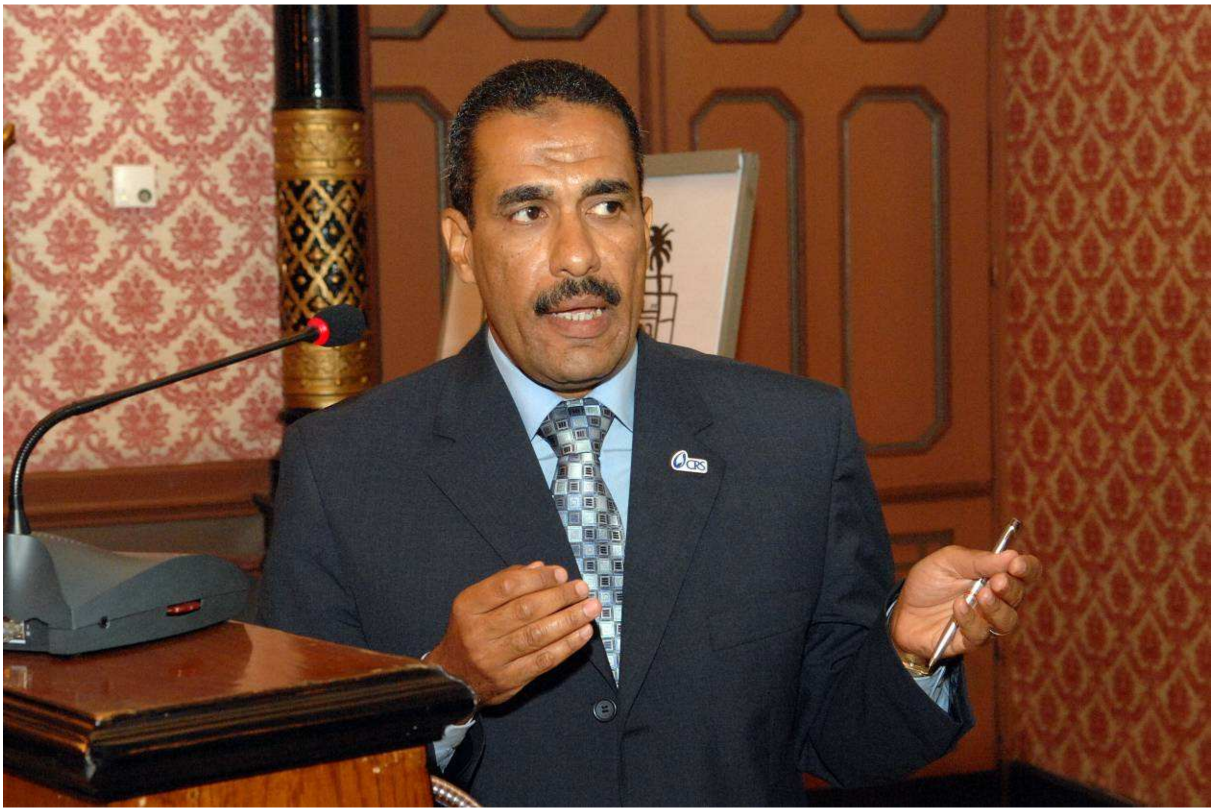
Photo 4. Impression of Seminar Audience

Photo 5: Seminar Chairperson Dr Tarak Morad, H.E. Maged George, and Dr Hans vd Beek



Dr Mohammed Khalil, Ministry of Environmental Quality (EEAA)

Prof. Moustafa Abo-Habaga, Mansoura University



Mr. Mohamed Sabry, Catholic Relief Services, Fayoum

Dr. Nader Al Sayed, NSCE

Dr Eid M.A. Mageed, ARC

Mr Edwin Keijsers, Wageningen UR


Dr Maher Helmi Wahba, Alexandria


Dr Amr Mohamed Helal, IT&M/KEAP

Dr Robert Bakker, Wageningen UR

