Application of agriculture bio system engineering technologies is a must to develop Egyptian agriculture sector.

Dr Zakaria Abdelrahman Elhaddad
Professor of Agricultural Engineering, Faculty of Agriculture
Banha University Egypt

Introduction

Bio systems Engineering is the more biology-based evolution of Agricultural Engineering and applies to all living organism systems with the exception of human ones. It integrates engineering science and design with applied biological, environmental and agricultural sciences and can be defined as *"the branch of engineering that prepares students to apply engineering to solve problems in biological systems*". In the context of this evolution, Biosystems Engineering should exclude Biomedical Engineering, and Biotechnology In short, whereas Agricultural Engineering applies Engineering sciences to agricultural applications, Biosystems Engineering, extends this application of Engineering Sciences to all living organisms' applications, including agriculture and. expanding new areas of biomaterials, bio-fuels, bio-mechatronics, aquaculture engineering and precision agriculture.

Aquaculture engineering is engineering of the facilities, equipment, processes, and systems needed to grow and harvest aquatic animals and plants for commercial purposes. Aquaculture is a fast-growing industry trying to meet increasing worldwide demand for fish, shellfish, seaweeds, and other aquatic species.

This evolution process started twenty years ago in USA Universities followed by European and other developed countries..

Egyptian Universities

In Egyptian universities there are 14 agriculture engineering departments some of which started last year to develop their curriculum to bio system engineering subjects. Fortunately Banha University was exceptional as we in our agricultural engineering department started this evolution process at almost same time of European Universities. The beginning has started with postgraduate research followed by undergraduate studies .Here are the titles of some research projects:

- Study of some engineering and environmental parameters on fish production in tanks.(ph.d 1994-1999)
- Simulation model for design and management of water recirculation systems in aquaculture.(m.sc 2004,2007)
- Aquaponics: The integration of fish and vegetables culture in recirculation systems.(ph.d 2008-2012)
- Hydroponics: Studies of design and management of soilless culture systems.(ph.d 2008-now)

- Engineering and environmental parameters for biofertilizers production.(ph.d 2009 –now)
- Study of some engineering and environmental parameters for compost production.(m.sc 2004-2008)
- Effect of storage and handling techniques on the quality of some agricultural products.(ph.d 1993-1999)
- Environmental studies for broiler houses of Kaliobia Governorate (m.sc 1994-1998).
- Studies of raceway fish farming system (m.sc 2002-2007)
- The use of renewable agriculture by-products as building materials (ph.d 1999-2003)

For undergraduate our students now study courses in crop residue recycling mechanization, aqua cultural engineering, system analysis, and green house production engineering. At the moment new curriculum is almost finalized under the new name Bio system and Agriculture engineering department

2- The impact of applying some bio system engineering practices in developing Egyptian agriculture sector.

The Egyptian agriculture system now is petrochemical depends heavily on mineral fertilizer and chemical pest sides. On the other hand almost all farm operations are traditional, very poor seed bed preparation, annual planting for all crops, high volume sprayers and crop thresher. For irrigation farmers divide the field into small dikes with very poor water application efficiency beside loosing 10% of the cultivated area. As a result the potential capabilities of crop certified seeds never achieved. For example certified wheat and maize seeds can produce up to 30 and 36 ardab / feddan where the average production never exceed 18 ardab for both crops in spite of the heavy use of both chemical fertilizers and chemical pest sides Furthermore the pollution is everywhere in food, water and air. In particular our fish farming system is of the extensive type which is not suitable at all to the Egyptian environment. Most of the 350000 feddan under fish farming is an agriculture land and each feddan consumes annually 10000 cubic metre of water producing 2 ton on average Even so the produced fish is generally polluted and poisoning (table -1)

In the last 30 years numerous projects was implemented to deal with these issues. Here are results of some of these projects

Table (1) the influence of pollution on quality of fish tissue

Compound	Nr fish sampled*	MAC **	Average found	% of fish >0.5MAC	Highest found ***	Location where highest
Lead – Pb	>978	0.5	3.31	93.7	41.56	Maryut
Cadmium – Cd	>762	0.05	0.15	97.6	2.00	Nile, Banha
Arsenic – As	>164	0.06	0.23	100	1.80	Manzala
BHC	>159	0.3	4.51	95.6	12.72	Idku, comm. catch
Lindane	>148	0.5	1.83	73.0	14.50	Abou El-Gheit canal
Heptachlor	>55	0.3	0.73	50.9	3.39	Nile - Cairo
Aldrin	>42	0.3	3.53	95.2	10.30	Maryut, El-Gieria
Chlordane	>32	0.3	0.71	81.3	4.00	Rayan comm. catch
Endrin	>111	0.3	2.92	100	31.00	Abou El-Gheit canal

* Not all references show the number of fish samples: in case of doubt the lowest possible number was taken

** MAC = maximum allowable concentration in fish. Based on FAO guidelines 1989

*** Concentrations in other organs (liver, Kidney, gonads, Skin) are sometimes substantially higher

2-1 Mechanizing main agriculture operations.

Tables (1&2) show the result of (4) implemented projects; agricultural production and credit project (100 villages) ,rice mechanization project (105 villages) , wadielnile project (Benisweif) and world bank project for Monofia and Sohag (Faroonia village) Total cultivated area in the first two projects were 10603 feddan and 3584 farmer . The area of each field was in the range of .75 feddan to 3.8 feddan.

Table-2 shows that mechanizing planting increase yield by 28 -46% and revenue per feddan significantly. It also reduces seeds by more than billion Egyptian pounds annually (table 3) . It also prove that land fragmentations is not a real problem for mechanizing Egyptian agriculture.

Table-2 Influence of mechanized planting on crop yield and revenue

Crop type	Traditional planting	Mechanized planting	% of increase	Price LE/ton	Revenue increase LE/feddan
Cotton	*0.95	1.2	28	9677	2420
Wheat	1.2	2	43	2566	2050
Corn	2.4	3.5	46	1250	1375

Rice	3	4	25	2000	2000
Potatoes	9	12	30	1500	4500

Table3 Seed saving as a result of mechanized planting

Crop	Seed saving/ fed.		Cultivated area 1000 fed.	National saving	
	Mechanized planting	Traditional planting		Ton	LE Million
Wheat	60	45	3032	45480	227
Rice	60	20	1670	66800	400
Corn	15	10	1993	9965	458
Cotton	30	15	284	0.426	8.52
Total					1093

source Elhaddad Z.A.2002 ,prices adjusted to 2010 prices.

2-2 Precision farming

Precision farming is an emerging methodology designed to link management action to cite specific soil and crop conditions and place inputs of fertilizers, her besides and pest sides where they are most needed to maximize farm efficiency and minimize environmental contamination. With this understanding precision farming approach was applied in 1998 in a project titled integrated technology for wheat production. It was implemented in 43 villages involving 2838 feddan under both surface and sprinkle irrigation methods and 776 graduates . in Noubaria and Bostan areas. A team of six experts of farm mechanization, soils, plant nutrition, weed control, wheat production and extension worked together to implement this project. For each field technical assessment was carried out including soil analysis, irrigation system, and weed problems. A technical report was produced for each field including nutritional program (NPK &trace elements), weed control system, irrigation modification. The following technologies were applied: laser leveling for surface irrigation fields, seed drilling, mounted sprayers, combine harvesting and straw balling.

An evaluation team was appointed for the project. Table (3) shows part of the evaluation report which indicates the positive influence of precision agriculture on crop productivity.

Table-3 the influence of precision agriculture application on crop productivity and revenue

Some Production parameters	Mohamad Farid			Bangar Elsokar		
	Outside project	Project	% increase	Outside project	Project	% increase
No. of panicles/ m2	212	620	192	318	530	66
Production ,Ardab/fed	7.4	25	237	10.8	23	112
Heml tibn/fed	5.4	14.7	172	5.7	12.4	117
Revenue LE/fed	3638	11781	223	4989	10714	114

Now in developed nations precision farming uses more advanced technologies such as remote sensing, RE, global positioning system, GPS, geographical information system, GIS, and numerous sensors such as machinery and irrigation sensors

The picture is an application of the GIS system.The second layer is Nitrogen availability estimate from aerial photo. The fourth is for pH.

2-2 Biomaterials.

NFL manufactures and markets three types of Bio-Fertilizers, Rhizobium, Phosphate Solubilising Bacteria (PSB) and Azetobactor. Starting with a mere 23 MT production in 1995-96, the production has risen to 231 MT (Approx) in 2010-11. The Company presently markets its bio-fertilizers in Madhya Pradesh, Maharashtra, Uttar Pradesh, Uttrakhand, Chattisgarh, Bihar, Jharkhand, Himachal Pradesh, Jammu & Kashmir, Punjab, Haryana & Rajasthan.

Bio-fertilizers are used to supplement chemical fertilizers as also to maintain soil fertility; besides the following:-

1. Bio-Fertilizers are supplement to Chemical Fertilizers.
2. Bio-Fertilizers are cheap and can reduce the cost of cultivation.
3. Fix Biological Nitrogen in the soil, which is readily available to the plant.
4. Increase crop yield by 4-5% on an average.
5. Improve soil properties and sustain soil fertility.
6. Provides plant nutrient at low cost and useful for the consecutive crops.

The applicability of Bio-Fertilizers marketed by NFL of different crops is as under

2-2 Precision farming technique.

جدول 1

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2-3 Aquaculture engineering.

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DDT isomers∑	>160	0.01-0.2	3.66	100	213.00	Abou El-Gheit canal
PCB	>17	1.5	13.29	100	19.60	Maryut, El-Gieria