FEDERAL UNIVERSITY OF TECHNOLOGY MINNA

SUSTAINABLE IRRIGATION DEVELOPMENT AND MANAGEMENT: MASTER KEY FOR NATIONAL FOOD SECURITY AND JOB CREATION

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INAUGURAL LECTURE SERIES 34

30TH APRIL, 2015

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30TH APRIL, 2015

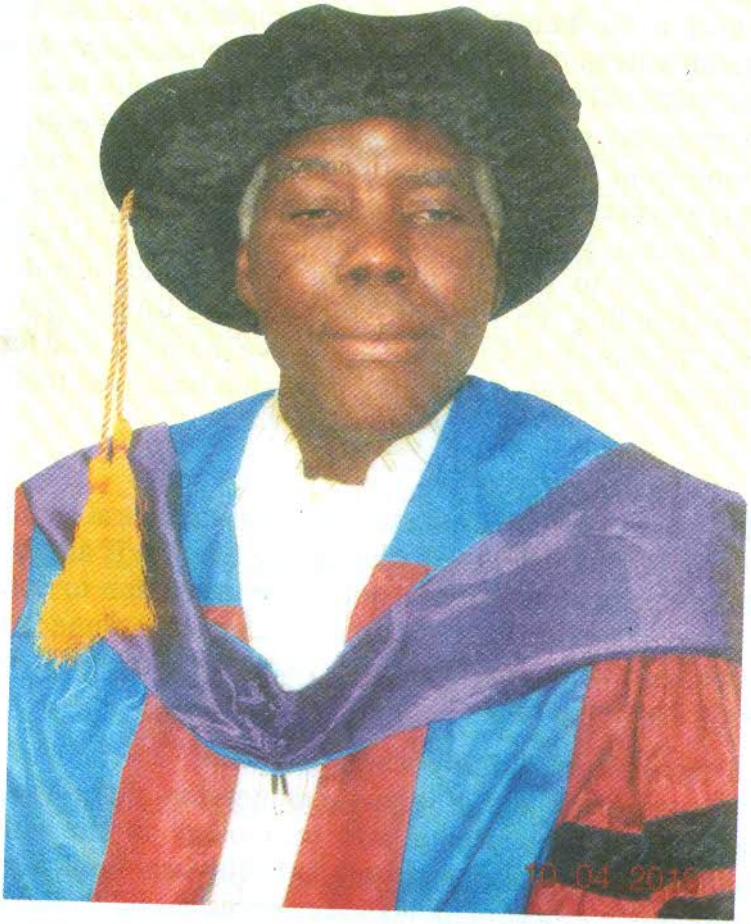
This 34th Inaugural Lecture was delivered under the Chairmanship of:

Professor M. A. Akanji, FNSMBM
Vice-Chancellor
Federal University of Technology, Minna

Published by:
University Seminar and Colloquium Committee,
Federal University of Technology, Minna.

30TH April, 2015

Design + Print:
Global Links Communications, Nigeria
✆: 08056074844, 07036446818



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PREAMBLE

I give praise and thanks to God Almighty for making it possible for me to stand before you all this very day to communicate in part my academic/research stewardship and by implication my contribution to knowledge. The inaugural lecture titled: "Sustainable Irrigation Development and Management: Master key for National Food Security and Job Creation" is a brief summary of my research work spanning about three decades beginning from Ahmadu Bello University, Zaria (as a graduate student) and perfecting itself at Federal University of Technology, Minna, Nigeria. My search for knowledge as well as research work took me to various places in Nigeria and outside the country including the state of Israel and the United States of America. To come this far, I once again give thanks to God for His faithfulness, and indeed bountiful provision bestowed freely on me.

1.0 INTRODUCTION

Mr. Vice Chancellor, sir, I wish to begin this inaugural lecture by briefly explaining what Agricultural Engineering is all about. I will then, speak on Irrigated Agriculture in relation to national food security and Job creation as well as mention some notable research contributions we have made in Soil and Water Engineering in Nigeria.

1.1 Agricultural Engineering Discipline

Agricultural Engineering is the engineering discipline that applies engineering science and technology to the efficient production and processing of food, feed, fibre and fuels. For over a decade, some aspect of biological sciences got fully married to agricultural engineering. So we now have what is called Agricultural and Biological Engineering Discipline. Others choose to call it Agricultural and Bioresources Engineering or Agricultural and Bio-systems Engineering.

According to the American Society of Agricultural & Biological

Engineering (ASABE), Agricultural and Biological Engineering is a discipline of engineering that applies engineering principles and the fundamental concepts of biology to agricultural and biological systems and tools; ranging in scale from molecular to eco-system level for the safe, efficient and environmentally sensitive production, processing and management of agricultural, biological, food and natural resources systems.

The wide range of job opportunities for Agricultural and Biological Engineers as well as the job it can generate for many others rivals many types of engineering degrees. This is because of the broad scope of problems that biological and agricultural engineers are uniquely prepared to solve. Fig 1 is a chart showing the various options under agriculture engineering and areas of interest.

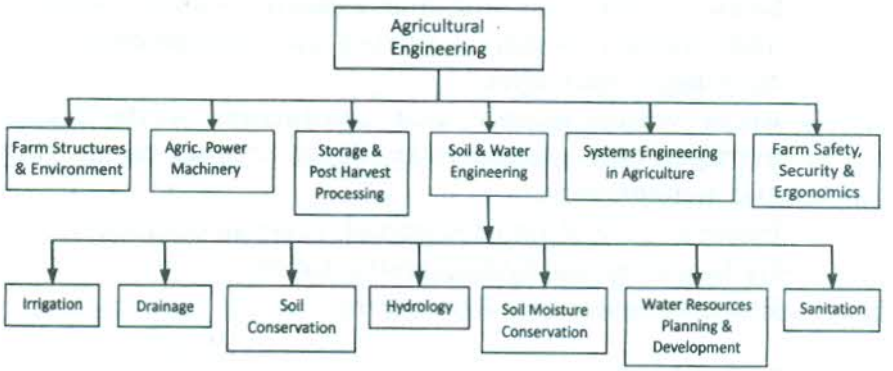

Fig. 1: Agricultural Engineering options/areas of interest

1.2 Areas of Interest to Agricultural Engineers

The various areas of interest to Agricultural Engineers are enumerated below:

- Design of agricultural machinery, equipment and farm products
- Environmental control systems, cooling and ventilation
- Energy conservation (bio fuels, bio-refineries, etc.)

- Crop production: seeding, tillage and irrigation practices
- Soil and water conservation
- Environmental controls for poultry, swine, beef, aquaculture, plants etc
- Animal production and care
- Biological production and utilization on the farm
- Post-harvest processing, handling and storage
- Precision farming technologies, machine vision GPS
- Farm operation and management
- Farm safety, security and ergonomics
- Precision agriculture, utilizing GPS, yield monitors, remote sensing and variable rate technology
- Worker safety, comfort and efficiency including the control of vibration noise, air quality, heating control etc.
- Sales, services, training management planning, market and product research related to implementing and applying technologies.
- Rural water, supply and sanitation; waste water management, groundwater development, monitoring and management
- Ponds and small dam design and reservoir operation
- Hydro power, and hydraulic structures
- Entrepreneurship in Agriculture.

1.3 Irrigation Process

Irrigation process can be explained in two ways (Levy, 1993, Egharevba, 2009)

i) Distribution of water in the fields after reserving it and transporting same from its source.

ii) Use of the input water in the most economical and efficient way in the agricultural system.

Irrigation is generally defined as the application of water to soil for the purpose of supplying the moisture essential for plant

growth. A broader and more inclusive definition is that irrigation is the application of water to the soil for any number of the following purposes (Hansen, *et al*, 1980):

a) To add water to soil to supply the moisture essential for plant growth
b) To provide crop insurance against short duration drought
c) To cool the soil and atmosphere, thereby making more favourable environment for plant growth
d) To reduce the hazard of frost
e) To wash out or dilute salts in soil
f) To soften tillage pans and clods.

The water sources needed to supply moisture for crop growth may come from precipitation (rainfall), flood water, soil moisture residue, groundwater, irrigation and drainage water. Failure to consider all these sources and the proportion of water that each supply to the total crop water need may result in faulty design of an irrigation system. Irrigation water requirement is the net depth of water that is required to be supplied to a crop to fully satisfy its specific crop water requirement (CWR). It is the fraction of CWR not satisfied by rainfall, soil water residue and groundwater contribution. The crop takes its water requirement from moisture held in the soil. Useful water for the crop varies between two levels, the permanent wilting point and field capacity (Fig. 2).

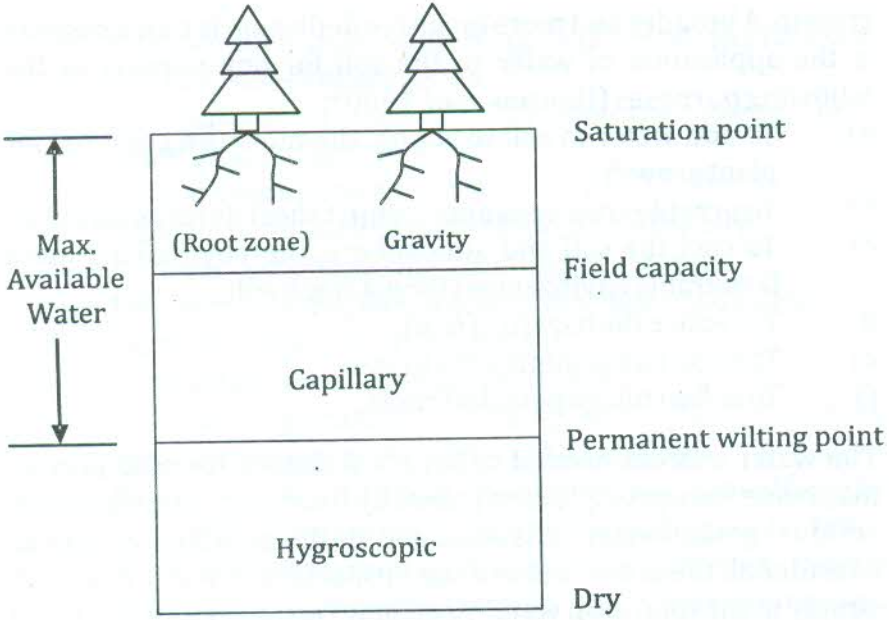

Fig. 2: Soil moisture quantities

Source: Adapted from Egharevba (2009)

1.4 Crop Growth as a Function of Soil Moisture

The rate of crop growth depends on the moisture content of the soil. There is an optimum growth rate condition in which the soil water content lies at a point between the field capacity and the permanent wilting point (Fig. 3). However, this point varies for different crops and for different stages of growth. The main practical aspects of irrigation are the determination of how much water to apply to a given crop and when to apply the water.

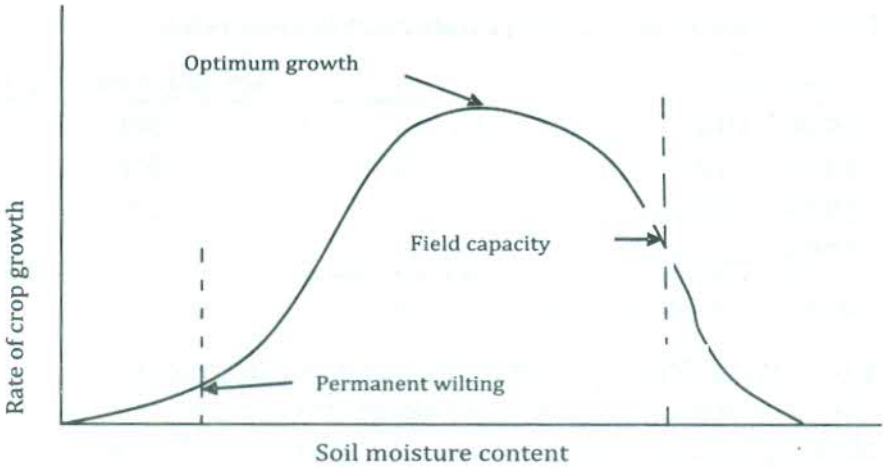

Fig. 3: Rate of crop growth as a function of soil moisture
Source: Egharevba (2009)

1.5 Trends in Global Agriculture

The world population is on the increase even with a declining growth rate. Population growth means a growing demand for food and fibre. However, the rate of agriculture is declining and so evidently noticeable in developing countries (Tables 1 and 2).

In Nigeria, the population growth rate remains at about 3% per annum, which indeed is far below food and agricultural rate o 6% per annum, Ingawa *et al,* (2009). It has been reported by Central Bank of Nigeria that food demand is higher than supply (CBN, 2001).

Table 1: Population growth trends (%)

	1980 - 1990	1990 - 2000	2000 - 2010	2010-2015
World	1.8	1.7	1.4	
Developed Countries	2.1	2.0	1.7	
Nigeria	2.1	2.5	2.7	2.8

Sources: Adapted from Alexandratos (1995); Worldometers (www.Worldometers.info)

Table 2: Global Agricultural Production growth rates

Period	Growth rate (%)
1960 – 1969	3.0
1970 – 1979	2.3
1980 – 1992	2.0
1993 – 2010	1.8

Sources: Alexandratos (1995); Egharevba (2009)

1.6 Water Resources Potential and Development

The development of water resources involves the conception, planning, design, construction, and operation of facilities to control and utilize water. Water resources development projects are planned to serve the following purposes (Modi, 1995); hydro-electric power, irrigation, employment, domestic and industrial water supply, drainage and so on.

An assessment by the National Water Resources Master Plan, NWRMP (1995) showed that the water consumption and demand in Nigeria would increase from 2,750 Mm^3 in 1995 to approximately nine fold increase (24, 140 Mm^3) by 2020. It was projected that only an average of about 8% of both the potential surface water resources will be consumed by 2020, with the notable exception of lake Chad Basin where 35.6% of the surface water and 11% of the groundwater shall be consumed. Therefore, it is significant to stress the need for greater attention to water resources monitoring, and more innovative water operations of projects (Jimoh, 2010). Multiple uses of proper facilities may increase benefits without a proportional increase in costs and thus enhance the economic justification for the project. In Nigeria the water allocation from reservoirs falls into three main uses: irrigation, domestic water supply and hydro power. Irrigation activity alone accounts for 36%, which is the highest proportion consumptive use of water (FAO, 1993).