

COURSE CODE: AGE 102
COURSE TITLE: Introduction to Agricultural Engineering
CREDIT UNITS: Units
DURATION: 1 HOURS/WEEK

COURSE DETAILS:

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COURSE CONTENT:

Definition of Agricultural Engineering, various branches (options), ***contributions of Agricultural Engineering to National development**, Farm power (sources of power) – human, animal, mechanical, electrical, wind and hydro power; introduction to farm machinery – machine elements, machines for tillage, crop cultivation, seeding, weeding, plant protection, fertilization, harvesting, postharvest technology; Farm buildings such as farmstead and farm residence, animal shelters, storage structures, building materials; Post harvest technology – principles of crop drying, milling, processing, preservation, packaging; Principles of soil conservation, introduction to irrigation, drainage and farm electrification; scope of agricultural mechanization, Job prospects for agricultural engineers.

COURSE REQUIREMENT:

This is a compulsory course for all 100 level Agricultural Engineering Students. Students are required to participate in all class activities and have a minimum of 75 % attendance to qualify for final examination.

READING LIST:

LECTURE NOTES:

1.0 Introduction

Agricultural Engineering is a specialized branch of engineering which deals with the application of engineering science and technology to agricultural production with the aim of reducing complexity and increasing productivity. Agricultural production is faced with a number of challenges and problems such as production of crops and animals; storage; processing; management of resources required for production such as land, water, energy, waste disposal and utilization etc. Agricultural engineering evolved out of the three founding branches of engineering namely: Civil, Mechanical and Electrical Engineering.

Agricultural engineering combines the basic engineering knowledge from three major disciplines and applies it to agriculture; this is what makes agricultural engineering the most versatile branch in engineering. It is concerned with the utilization of all branches of engineering science and technology in the art, science and business of crop production, animal husbandry, as well as handling, processing and preservation, storage, manufacture and distribution of products that feed, shelter and cloth mankind.

Agricultural engineering has been applying scientific principles for the optimal conversion of natural resources into agricultural land, machinery, structure, processes, and systems for the benefit of man. Machinery, for example, multiplies the tiny power (about 0.07 kW) of a farmer into the 70 kW power of a tractor which makes possible the production of food several hundred times more than what a farmer can produce manually.

Processing technology reduces food loss and adds much more nutritional values to agricultural products than they originally had. The role of agricultural engineering is increasing with the dawning of a new century. Agriculture will have to supply not only food, but also other materials such as bio-fuels, organic feed stocks for secondary industries of destruction, and even medical ingredients.

Furthermore, new agricultural technology is also expected to help *reduce* environmental destruction.

1.1 Areas of specialization in Agricultural Engineering

Agricultural Engineering can be divided into six major areas of specializations, namely: Farm Power and Machinery Engineering, Soil and Water Engineering, Processing or Post Harvest Systems Engineering, Farm Structures and Environmental Control Engineering, Forestry and Wood Product Engineering and Food Engineering. Other areas that are emerging from the specializations are Amenity (Ecological) Engineering, Mechatronics and Robotics, Information and Communication Technology, Renewable Energy and Environmental Engineering.

1.1.1 Farm Power and Machinery Engineering

This area deals with the design, construction, operation and maintenance of power and machinery systems needed for all aspects of Agricultural Mechanization. The power aspect refers to the development of all prime movers and power sources for all phases of agricultural production, processing and distribution. These include tractors, electric motors, stationary engines, generators, pumps, truck engines, solar energy, wind mills and hydro power systems. The machinery aspect handles the machines used for production, which may or may not be powered by the power units mentioned above i.e. machines/machineries for land clearing, tillage, planting, tending (weeding and spraying), harvesting and transportation.

1.1.2 Soil and Water Engineering

Soil and water are the basic natural resources for agricultural production. The development and management of these resources must be done scientifically in order to achieve long term sustainability. This aspect of Agricultural Engineering deals with the harnessing and management of the soil and water resources of the ecosystem. The area covers land degradation, soil and water conservation, land reclamation, irrigation technology, land drainage systems, water supply, catchment modeling, hydrology and hydraulics, agricultural waste management and environment. Agricultural Engineers who specialize in this area are involved in the design, construction, installation, operation and management of engineering structures and machines required in the areas listed above. Some of the structures include: dams, canals, erosion control structures, reservoirs, boreholes, irrigation pumps etc.

1.1.3 Post Harvest Systems Engineering

This aspect of Agricultural Engineering deals with all the activities, processes, structures and machines which convert agricultural raw materials (harvested crops) into finished consumer goods. It covers the area of value addition to crops with the aim of converting the crops to more usable form or extends the storage life of the crops. Specialist in this aspect handle the design, construction, operation and management of machines and structures which carry out the following operations: cleaning, sorting, separation, cooling and drying, size reduction, pelleting, extruding, expelling, refining, extraction etc.

In carrying out all these processes, the material has to be conveyed from one point to the other especially in crop/food processing factories. In this case, machines for conveyance, discharging and packaging are very essential.

1.1.4 Farm Structures and Environment Control Engineering

This option in Agricultural engineering deals with the design and construction of all structures that are used in agricultural production. The structures include farm roads, residential buildings, livestock pens, warehouses for storage and food processing, implement sheds and farm shops, storage structures, holding bays for produce. The other aspect of the option deals with the control of environmental factors in farm buildings such as temperature, humidity, light and air. Agricultural waste management is also an important part of the option and it includes waste treatment and recycling, bio gas production, waste conversion etc.

1.1.4 Food Engineering

This is a specialized area of Agricultural Engineering which deal with the processes and machinery that are required for processing agricultural products into consumable foods. Areas covered by this option include operation of feed mills, rice mills, flour mills, vegetable oil processing, beverage manufacturing, and confectionaries machines for baking, sweet. In general, it involves the operation and management of food processing industries.

1.1.5 Wood Products Engineering

This field of specialization deals with the machines required for exploiting forest products such as timber and non-timber forest products. It also handles machinery for afforestation such as loggers, tree fellers/pushers etc.

1.1.6 Emerging Areas in Agricultural Engineering

The discipline of Agricultural Engineering is currently undergoing major and important changes as it responds to new developments and challenges These Emerging areas include: Information and communication Technology (ICT); Biotechnology; Environmental Engineering, Renewable Energy, Ecological Engineering.

ICT involves the use of computer and communications equipment for data acquisition, machines control, information management and simulation of agricultural systems. ICT enables information on genes, data bank on crops and similar data to be compiled uploaded on the internet. This information can be accessed or downloaded by farmers or researchers from any part of the world. Other applications of ICT in agriculture include weather monitoring and forecasting and tracking of soil nutrients using remote control systems, Hydrological monitoring network and precision farming.

Biotechnology involves the engineering of biological material. Applications include gene manipulation, waste recycling, fermentation, vegetable-based fuels etc. These require specialized equipment such as reactors and sensors.

Environmental Engineering involves all activities concerned with the conservation of the environment. Most agricultural processes impact negatively on the environment (soil, water air). Thus, Agricultural Engineering is becoming more important with the current world wide concern for soil and water degradation and pollution, as well as contamination of air as a result of increased application of technology for exploitation of natural resources. Problems of pollution of farm lands by crude oil production, urbanization and its encroachment agricultural land, conversion of urban waste into manure, etc are some of the issues that are addressed in this area.

Another area, which is not really new but which is currently engaging the nation of Agricultural Engineers is Renewable Energy Systems. These include the processing and utilization of Solar,

Water and Wind Energy for agricultural production, processing and handling. New projects in this area have addressed control of animal and of environment using solar energy, generating electricity using solar energy and wind is for power generating. Others include alternative bio-fuels for internal combustion engines and optimization of energy systems.

2.0 Contributions of Agricultural Engineering in National Development

Agricultural Engineering plays a pivotal role in the development of Nigeria. These are in the area of food security, reduction of drudgery in agricultural work, rural infrastructural development, soil and water resources management, environmental management, improvement in the quality of life of farmers, sustainable agriculture and industrial development.

2.1 Food Security

Food security has recently become an important concept in sub-Saharan Africa. In Nigeria, the idea of food security revolves around ensuring that there is readily available food in the right quantity and quality and at an affordable price. Food security can only be achieved if food is produced in abundant quantity and at commercial scale. Even when food is abundantly produced, if it is not properly processed, most of it will be lost to deterioration agents. Thus part of food security is to ensure that what is produced is preserved appropriately.

The Federal Government and some states in Nigeria have recognized the need for food security and so they established a number of institutions to ensure food security. These include the Federal Food Reserve Agency. In all these areas, Agricultural Engineering principles are practiced to ensure that there is adequate supply of food all year round.

2.2 Reduction of Drudgery in Agricultural Work

The traditional farming method and system in Nigeria is characterized by the use of primitive tools and technology. These include the hoe, machete, and axe. A visit to any rural farming community will reveal how tedious it is to work with hand tools. For toiling under the sun for hours, most farmers can only cover a few fractions of a hectare. The drudgery involved in Nigerian traditional agricultural system can be seen on the faces and body of farmers.

With the introduction of machines, tedious operations hitherto handled by man are mechanized. Operating machines is less tedious than manual operations. The reduction in drudgery that comes with the introduction of machine makes agricultural work to be more attractive to the younger generation. This has a number of implications including a reduction in rural – urban migration, and improved dignity of the agricultural worker.

2.3 Rural Infrastructural Development

Most large-scale agriculture development programmes involve the development of basic rural infrastructure. These infrastructures include water, roads, electricity, schools, markets, energy supply system, maintenance systems, processing systems and waste management systems. Thus Agricultural Engineering has been referred to as a catalyst for rural infrastructural development because the standard of living of rural dwellers is improved significantly as they have access to basic necessities of life

2.4 Natural Resources Conservation

The natural resources on which the practice of agriculture is based are soil, water and air. One of the important roles of Agricultural Engineering is to ensure an optimum management of these resources. This will ensure that these resources are conserved. If soil and water resources are used without conservation. Then one day, the resources will deplete to a point where they can no longer support plant and animal life.

Soil and Water Engineering option in Agricultural Engineering ensures that soil and water are conserved and reclaimed where necessary. Agricultural Engineering practices such as conservation tillage, terracing, erosion control, etc are used for soil and water conservation.

2.5 Industrial Development

Agricultural Engineering has contributed immensely to industrial development through the improvement of agricultural production leading to increased raw material production for agro allied industries

2.6 Employment Generation

Agricultural Engineering has contributed to creation of employment opportunities in the country. Apart from providing training in equipment production, the mechanization of agricultural operations has led to massive expansion leading to employment of personnel to boost production. Diversification has been created as many livestock farms now have capacity to produce their own feed

2.7 Others

Other contributions of Agricultural Engineering include: improved quality of life of farmers, Sustainable agricultural production and Environmental Management.

3.0 Career Opportunities in Agricultural Engineering

The numerous roles that Agricultural Engineers has to play in National Development brings to the for employment opportunities. Jobs are available for graduates of the profession in the following areas.

3.1 Government Ministries

Nigeria operate three tiers of government, namely federal, State, and local government. Each of these tiers of government operates ministries where agricultural engineers are employed. At the federal level, these include ministries of Agricultural, water Resource, Environment, Science and Technology. Each of the ministries has department under which many agricultural engineers are contributing their quota towards nation development. For example, the ministries of water Resources has department of irrigation and Drainage, Flood and Erosion Control etc. under this ministry also there are 11 River Basin Development Authorities where Agricultural Engineer work. At the State and local government level, similar ministries exist and each of them has an engineering division where and tractor hiring company agricultural engineers work.

3.2 Government Parastatal

There are many government agencies, which are either supervised by some ministries or are directly supervised by the Chief Executives of the State or at the federal level by the presidency. Some of these have been phased out but many of them are still operational and since their services are agricultural based, they employ agricultural engineers. These include Tractor and Equipment Hiring companies, Environmental Protection Agencies in the State and at the federal level, Nation Centre for Agricultural Mechanization; Agricultural Mechanics and Operators Training Centre, Rural Agro-Industrial Development Scheme, Poverty Alleviation Programmes, Agricultural Mechanization Authority, River Basin Development Authority, Erosion and Flood Control Programmes etc.

3.3 Private Companies and Industries

In the private sector, there are many opportunities for Agricultural Engineers in the service and production industry. In this sector, there are companies who provide agricultural service with engineering content. There include companies involved in marketing and maintenance of agricultural machinery, agrochemicals and provision of agricultural service of different forms. Companies in this category include Tractor and Equipment (Division of UAC); SCOATRAC (Division of SCOA), Diezengof, Levantis Technical, Addis Engineering, Protect Nig Ltd and a host of other smaller indigenous companies. In the production sector, there are food processing

companies and equipment manufacturing companies, flourmills, rice mills. Starch mills, tractor assembly plant milk processing companies, beverage manufacturers confectioneries manufacturers (eg. Steyr, west African milk company (WAMCO), Nigeria flour mill plc; pokobros Ltd; Life vegetable oils, Anambra vegetable oil Manufacturing company (AVOP); Olympic Maize milling industry; Bacita Sugar company Ltd; National fertilizer company (NAFCON); Ad palm Ltd, Rison palm Nucleus Estate, etc).

3.4 Educational Institutions

Educational institutions in Nigeria include colleges of Agricultural, Education, and Technology. There are also polytechnics and University. Some of the institutions are listed in section 5.3 of this book. Each of the institution has a department of Agricultural Engineering as well as a farm operations Centre where Agricultural Engineers are employed. In some of the institutions, some Agricultural Engineers work in the faculty of Agricultural either in crop science, Agronomy or soil science.

3.5 Research and Development Institutions

There are many research and development (R&D) institutions in Nigeria. Under the federal ministry of Agriculture, there are over 18 Agricultural Research institutes. Each of the institutes has an Agricultural Engineering Department as well as field Demonstration farm and industrial Development units where Agricultural Engineers work. There are some research institutes under the federal ministry of science and Technology where Agricultural Engineers work

3.6 International Organizations

There are a number of international organizations resident in Nigeria who are involved in agricultural and rural development and so employ Agricultural Engineers. These include the United Nations Development Programmer (UNDP). Food and Agricultural Organization (FAO), World Bank, international labour organization (ILO), United Nations Educational and Scientific organization (UNESCO) America Agency for international Development (USAID). In addition to these, there are some Non-Government Organizations (NGOs) who are involved in Agricultural and rural Development. These include Ford Foundation, Warnock International, United National Fund for Women (UNIFEM), international Fund for Agricultural and Development (IFAD)etc

3.7 Self Employment

Self employment is an area that has not been fully explored or exploited by Agricultural Engineers. Opportunities exist in consultancy field in almost all government parastatals and the

NGOs as well as companies in the private sector. These include all areas of project feasibility, implementation, monitoring and evaluation. Many food processing industries need agricultural raw materials, which can be supplied by Agricultural Engineers, especially those interested in post harvest systems. There are also wide- ranges of opportunities in storage. Young Agricultural Engineers can also get into operation and maintenance of equipment and logistics business (Haulages)