Ghana’s Reactor Attains Criticality

Ghana’s Research Reactor at the Ghana Atomic Energy Commission (GAEC) has been declared fit and ready to undertake various research activities with respect to Nuclear Technology.

Gaece to take charge of Kwabenya SHS Science and Maths Department

The Ghana Atomic Energy Commission (GAEC) has initiated a bilateral dialogue with the leadership of Kwabenya Senior High School (SHS) to take charge of the School’s Science and Maths Department.

Director General Statement on Nuclear applications

Nuclear applications play a very important role from soil fertility to food storage in the Agriculture sector. The soil mainly supports plant growth and to the final stage of storage to solve issues of post harvest losses.
Ghana’s Research Reactor at the ‘Ghana Atomic Energy Commission (GAEC) has been declared fit and ready to undertake various research activities with respect to Nuclear Technology. Aside research, the reactor will be used for training purposes as well as product quality and standard analysis that will be beneficial to local industries.

The Director General of GAEC Prof Benjamin Nyarko brought this development to light in an interview. According to him, the Uranium enrichment level of the “Ghana Research Reactor 1 core” has been reduced from the previous 92.2 per cent, to 13 per cent. This he said will extend the fuel life span to over 25 years.

The core conversion program that lasted for a period of ten years brought together nuclear experts from the International Atomic Energy Agency with the help of Scientists from GAEC to replace the first core; ‘Highly Enriched Uranium-235 (HEU)’ with a ‘Low Enriched Uranium-235 (LEU)’.

Prof. Nyarko, explained that, the initiative forms part of the Global threat reduction programme that was initiated by the American Department of Energy to replace all highly enriched uranium fuels from nuclear research reactors in the world. “Ghana’s reactor core was installed in 1994 and had been operating for the past 20 years, although it was supposed to operate between 10 and 15 years and therefore needed to be upgraded”, he added.

He emphasized that the general functions of the research reactor have not changed with the replacement of the HEU with the LEU.

Prof. Nyarko further explained that, the conversion was in line with the country’s current Nuclear Power Programme, and also honoring its responsibility to the Non-Proliferation Treaty, of which Ghana is a signatory. “This treaty is against the production of dangerous weapons and an HEU is capable of being used for weapons production”, he said.

He disclosed that aside Ghana, other countries including Syria and Iran are also undergoing the conversion process. According to him, there was a massive media involvement worldwide to ensure transparency of the process.

The core conversion program was funded by the US Government as part of its efforts under the Global Threat Reduction Initiative to ensure the conversion of all civilian nuclear research reactors from HEU to LEU fuels for safety and security.
The Ghana Atomic Energy Commission (GAEC) has initiated a bilateral dialogue with the leadership of Kwabenya Senior High School (SHS) to take charge of the School’s Science and Maths Department.

The move is as part of efforts to raise the level of interest for Science and Mathematics among the younger generation.

The Kwabenya SHS is one of the new Community Day Senior High Schools commissioned by Ex President John Dramani Mahama.

Speaking in an interview, The Deputy Director-General of GAEC Prof. Shiloh Osae, noted that the core objective of this initiative is to eradicate the fear students have regarding the study of Science and Maths.

This development was brought into action during the 2017 Africa Scientific Renaissance Day celebration that saw various Second Cycle schools taking part in quiz competitions that was centered on Space Science and the application of Nuclear Science and Technology.

According to Prof. Osae, the involvement of students in GAEC’s activities received high commendations from the Director-General of the International Atomic Energy Agency (IAEA) during his visit to Ghana last year.

He expressed joy at GAEC’s commitment to honour IAEA’s recommendation made at its 60th General conference earlier last year, which is to make nuclear science interesting and attractive to students.

He acknowledged that the establishment of the graduate School of Nuclear and Allied Sciences (SNAS) and the GAEC Basic School are steps taken by the commission to inspire the younger generation to pursue careers in Nuclear Science and Technology.

“GAEC opens its doors to students for Educational visits and invite them to programmes. These are all initiatives taken to make science appealing and real to the younger generation” he said.

Prof. Osae reiterated that, the African scientific Renaissance Day celebration is a wakeup call to African Scientist to use Science, Technology and innovation to promote National development.

“Science is the bedrock of every country and the need to retain and develop the knowledge and capacity is essential for sustainability and future development”, he added.

He further assured African Scientist to partner with the Advanced Countries to innovate rather than being consumers of their products “The Advanced Countries need partners not consumers. Africa has always been importing everything technology, Africa can do better”, he stressed.

The DDG encouraged the new generation who have the desire to have careers in Science to be forceful.

“Science is expensive to study, you only have to push harder. Science can be equally as engaging as any subject in school”, he said.

He finally challenged Scientist not to stop at first degree, but to pursue higher degrees in Science. “We need innovative techniques to address the problems of the future. We have to ensure that the nuclear knowledge is passed on to the next generation, since they will take over from the scientist who will be retiring within the next decade and by then, the nuclear power will be in full swing”, he said.
Nuclear applications play a very important role from soil fertility issues to food storage among others in the Agriculture sector.

At the Biotechnology and Nuclear Agriculture Research Institute (BINARI), we have scientists who are into the study of the soil, where they employ nuclear techniques to conduct studies on soil characteristics.

After the study, they are able to develop seedlings; plantlets and also prepare organic fertilizers that support crop production in greater quality and quantity. I call that the ‘frontend’ which means, the beginning of getting food.

So the process starts from the seeds, the plantlet and how to nourish the soil with organic manure to yield high and thereafter, harvesting and storage comes in where there is a need to take the food through a process we call Gama irradiation in order extend the shelf life of the produce to avoid or reduce post harvest losses.

So Nuclear techniques are applicable in the field of Agriculture to supplement the conventional method of farming.

Under normal circumstances, the nuclear application seem to be more valuable than the conventional methods of farming due to the effects of the current climatic conditions we are confronted with. Also, the effect of pests and diseases that attack the plants on the field and at their various storage facilities or warehouse are reduced with the use of nuclear applications.

If we really want to move forward as a country per government’s recommendations to grow crops, we have to incorporate nuclear applications so that from start to the end of the food chain, we can use nuclear techniques to move our nation forward and produce more food and reduce poverty.
The Director of Biotechnology and Nuclear Agriculture Research Institute (BNARI) of GAEC Professor Kenneth Ellis Danso has called for stakeholder support to help boost the country's agricultural sector.

According to him, BNARI has the human resource and the capacity to be a leading Agricultural Research Institute in Africa, but this feat has remained a dream due to inadequate funds.

Pointing out some fundamental needs, he said, his outfit needs irrigated lands to carry out various research on plants. “This can be done with stakeholder intervention,” he added.

He lamented that, Government has to resort to importation of seeds to facilitate its plans to boost agriculture and job creation due the inability of Ghanaian research institutes to meet the demand.

According to Prof. Danso, Ghana’s seed sector is underdeveloped, however BNARI has proven over the years that it is capable of contributing immensely to the sector if given the needed support.

He reiterated that the agricultural wing of GAEC (BNARI) has been championing the application of Biotechnology and Nuclear techniques to improve the production of crops and livestock in Ghana and Africa.

“Over the years, the Institute has been engaged in post-harvest management of food produce through its irradiation facility. This process increases the shelf life of food produce by preventing sprouting, germination and decay after harvest”, he said.

Touching on other areas of development Prof. Danso disclosed that, scientists under his Institute have developed a new tomato variety (Cherry tomato) through mutation breeding. He hinted that, a new variety of yam, and cassava are being developed through the same technology. Farmers will cultivate this he said, after it has been released to the Ministry of Food and Agriculture (MOFA). He also revealed that the Institute is working on high bete carotene-rich cassava.

“At the moment, several facilities have been built in Ghana for compost development using the Institute's research findings”, he said. He acknowledged SAFI SANA Ltd, which is situated at Ashaiman as one of the facilities that was built using the Institute's research findings.

He concluded by calling for stakeholder support to aid the Institute carry out activities that can sustain and improve agriculture in the country.
The Biotechnology and Nuclear Agriculture Research Institute (BNARI) was established in 1993 as one of the research, development and technology transfer Institutes of GAEC, which was established in 1963 by an Act of Parliament, Act 204 of 1963. The founding Act, Act 204 of 1963 was amended by PNDC Law 308 of 1993 to enable GAEC create new Institutes, and was superseded by Act 588 of 2000 which enabled the Commission to commercialize its research findings.

These amendments resulted in the creation of the Institute by upgrading the Department of Biology, Food and Agriculture, which was under the National Nuclear Research Institute (NNRI), to BNARI. The main objective of the Institute is to apply Nuclear and Biotechnologies for increased agricultural and economic development of Ghana.

The Institute has five Centres namely;

- The Biotechnology Centre (BTC)
- Nuclear Agriculture Research Centre (NARC)
- Radiation Technology Centre (RTC)
- Radiation Entomology & Pest Management Centre (REPMC)
- Soil Environmental & Science Research Centre (SESRC)

THE BIOTECHNOLOGY CENTRE (BTC)

Summary of BTC’s Activities
1. Supply of large quantities of disease free planting materials to farmers using Tissue Culture
2. The production of plants from seeds that otherwise have very low chances of germinating and growing
3. Conservation/preservation of plants for future use
4. Germ plasma exchange between countries.
5. Plant genetic engineering which is the creation of a plant containing a fragment of foreign DNA stably inserted into its nuclear genome. It simply means making changes to the genes of plant to produce a desired trait or characteristic
6. Consultancy services

RADIATION TECHNOLOGY CENTRE (RTC)

Summary of RTC’s Activities
- Extension of shelf-life of agricultural produce
- Post-harvest management of food and prevention of insect infestation
- Sterilization of grains and pulses to decontaminate them
- Sterilization of medical equipment and pharmaceutical products
- Proximate analysis
- Provide consultancy services

THE NUCLEAR AGRICULTURE RESEARCH CENTRE (NARC)

Summary of NARC’s Activities
1. Crop improvement through immitation breeding and hybridization.
2. Development of seedlings for horticultural losses
3. Supply farmers with improved crop varieties
4. Consultancy services

RADIATION ENTOMOLOGY AND PEST MANAGEMENT CENTRE (REPMC)

Summary of Activities of REPMC
- Research and development of pest control solutions using nuclear, biotechnology and related techniques.
- Testing of insecticides (Newly produced) to give technical advice on dosage
- Mushroom production (Natural and Fresh)
Livestock Farming: Poultry and Piggery

The chickens that are raised at BNARI are known as broilers, thus they are produced for their meat. One would not be far from wrong by referring to the animal farming at the Institute as scientific livestock farming. BNARI chickens and pigs are known for their low fat content and this is attributable to the feeding regime that is being employed.

Feed preparation is scientifically and carefully done with the right amounts of nutrients to give BNARI chicken and pigs a taste with a difference. Similarly, managers of the piggery use scientific management practices to produce quality and healthy animals and low fat meat.

Summary of SESRC Activities

- Organic composting for enhanced crop production
- Organic Vegetable farming
- Biological nitrogen fixation
- Consultancy and Extension Service

SOIL ENVIRONMENTAL AND SCIENCE RESEARCH CENTRE (SESRC)

TECHNOLOGY TRANSFER UNIT (TTU) OF BNARI

Livestock Farming: Poultry and Piggery

- Visitation of farms and offering training workshop to farmers
- Techniques to reduce the population of tsetse flies, mosquitoes, and fruit flies with the objective of reducing their population.
- A Veterinary clinic that provides primary care to animals

Ghana Atomic Energy Commission
“Work is progressing steadily on the construction of the factory for the project” he revealed.

Dr. Osae further disclosed that, the centre has over the past years worked with farmers in dealing with insects and pests of economic importance. He said, REPMC pioneered the use of ‘Sterile Insect Technique’ that was used to suppress tsetsefly population in the Northern region by over 80%.

“Through that project, many people were trained. Also, over the years, REPMC has developed a technology to control cereal stem borers. These stem borers bore into the stem of cereals, such as maize and sugar cane and as a result, cause devastating losses. The centre has played a key role in controlling them in Ghana” he disclosed.

The center he said has collaborated with University of Cape Coast on best practices to conserve pollinators. The move according to him is targeted at Mangoes in the Greater Accra and Eastern regions to find out the decline in plant pollinators.

Throwing light on prospects of REPMC, Dr. Osae said he Centre will device means to deal with the Fall armyworm and other emerging pests. He hinted that, plans are underway to introduce programs through the graduate School of Nuclear and Allied Sciences (SNAS) to train more young people in Integrated Pest Management. The move is to ensure that the use of insecticides is reduced to its barest minimum as well as make agriculture enticing to the youth.

He pointed inadequate human resource and lack of funding as threats to the centre’s projects. He lamented that, the centre has no funds to employ fresh nuclear engineers that graduates from SNAS every year.

The Manager of the Radiation, Entomology and Pest Management Centre (REPMC), BNARI, Dr. Michael Osae, has cautioned against the continuous use of insecticides saying it may have multiple adverse effects on human health.

He disclosed that, most of the insecticides contain chemicals that pollute the environment and leave residue in the soil, water, as well as produce that ends up on the market. He expressed worry that the situation poses severe threat to the lives of unsuspecting farmers, consumers and a subsequently polluting the environment.

Proposing a solution to the challenge Dr. Osae recommended that farmers adopt the Integrated Pest Management (IPM) System, which involves the integration of several technologies to fight insects, pests and diseases.

“Basically, what we do is a combination of several techniques to achieve the same results that insecticides would achieve without polluting the environment”, he said.

He cited the Protein Bait Development project that employs the use of natural techniques to control the influx of fruit flies as one of the technologies adopted by his Centre. He expressed delight at a successful piloting of the technology in both laboratory and field.

Dr. Osae explained that a number of tools are being used for this fruit-fly control, which requires the use of protein with an insecticide. He said protein bait is infused with the insecticide and dropped under the plants to attract the flies rather than blanket spraying. “They eat the protein and thereafter, die. Farmers have already been trained on how to use some of these techniques on the field” he said.

“The Centre has subsequently received funds from the Skill Development Fund of the Council for Technical and Vocational Education and Training (COTVET) to build the Protein Bait Factory in
Operations at the Biotechnology Center of the Ghana Atomic Energy Commission (GAEC) has been brought to a halt due to severe power challenges.

The centre which falls under the Biotechnology and Nuclear Agriculture Research Institute (BNARI), adopts the use of Tissue Culture and Molecular Biology for crop improvement. However, due to the installation of pre-paid meters activities at the Tissue Culture Laboratory has been negatively affected.

The Centre Manager, Dr. Amiteye, who disclosed the development in an interview said the situation was reached due to their inability to pay electricity bills that has accumulated over a period of time.

According to him, the only sustainable measure was to move the centers Molecular Research laboratory to the Insect Science building. He lamented that the Tissue Culture laboratory cannot be moved, hence stalling research activities for three years.

“Initially, the centre resorted to solar panels to supply electricity to the laboratories with funding from the International Atomic Energy (IAEA), however, we were unable to raise the money required for the counter funding”, he revealed.

He further revealed that the Centre deals with the in-vivo and in-vitro propagation of plant to produce planting materials examples, yam, cassava for farmers. He added that his Centre through the application of various technologies has made a variety of planting materials available for the public since such crops do not produce seeds.

Dr. Amiteye indicated that the Centre over the years has done the mass production of MD-2 pineapples from Brazil for distribution in Ghana. He said, this came at a time when the European market expressed interest in MD-2 variety. “It presented an opportunity for Ghanaian farmers business”, he Added.

Touching on other achievements Dr. Amiteye noted that, the center was able to provide sweet potatoes for Vegetable Producers and Exporters Association of Ghana (VEPEAG) through micro propagation.

“Again, the Centre, backed by government, rejuvenated the production of yam in the Northern region. This was after a shortage of yam erupted due to an acute tribal conflict. The centre propagated various variety of yams for farmers to plant again”, he disclosed.

Throwing light on other areas of achievements, he noted that the Centre has also been offering consultancy and extension service to farmers in areas of biotechnology, biosafety and mutation breeding. “However, these activities have been greatly stalled by the power crisis”, he lamented.

Dr. Amiteye is hopeful that BNARI as an Institute will device sustainable means to confront the power situation in order to re-ignite the Tissue Culture laboratory.

Tissue Culture Laboratory
IRRADIATED FOODS ARE NOT POISONOUS, MR. ADU GYAMFI DECLARES

The Manager of the Radiation Technology Centre (RTC) at the Ghana Atomic Energy Commission (GAEC), Mr. Adu Gyamfi, has called on the general public to patronize irradiated foods saying; they are not poisonous.

The RTC, which falls directly under the Biotechnology and Nuclear Agriculture Research Institute (BNARI) irradiates cereals and tuber crops among others in order to prolong their shelf life. The RTC also sterilizes health equipment using irradiation.

Mr. Gyamfi expressed worry at the high rate of food decay in most warehouses due to farmers’ reluctance to irradiate their food crops. According to him, most farmers fail to resort to the use of the available nuclear technology due to a perception that irradiated foods are not safe for consumption or the process is expensive.

“We just put the food in the field for irradiation, just like how you put an object in the way of a torch light to see it well, the radiation does not affect food at all, so even the temperature of the food does not change, neither does it leave residue in the food”, he explained.

He warned that foods stored with chemicals stand a high risk of leaving residue and other unwanted materials which may be poisonous when consumed. According to him, the facility’s main aim is to increase the shelf life of foods and sterilize medical equipment.

“Currently, there are various research works being done in the facility to increase the quality of Bissap leaves. Sobolo is a drink that is locally prepared with the local bissap leaves. Students at the centre are currently researching into ways of treating the leaves to make them last longer and retain the quality of the nutrients. This research hopes to use nuclear techniques to improve the quality of the leaves”, he disclosed.

“There is also research in the area of poultry. Considering the high rate of consumption of poultry products, researchers at the centre are looking at better ways of improving poultry food through irradiation. Making of chicken powder is a new area the centre intends to explore also through irradiation. Basically, researchers at the centre hope to make flakes from the chicken”, he said.

He disclosed that despite the immense potential of the facility, the source of strength of the Cobalt-60 source, has gone down by more than half of its initial strength. Although this does not affect the quality of products irradiated at the facility, the processing takes quiet a longer time. The Centre is therefore calling on stakeholders to help upgrade or replace the Cobalt-60 source

ORGANIC WASTE RECYCLING; A FERTILE JOB CREATION AVENUE FOR YOUTH – DR. SAMUEL NII AKAI NETTEY

A research scientist at the Soil and Environmental Sciences Research Center (SESRC) of the Ghana Atomic Energy Commission (GAEC) has identified Organic Waste recycling as an avenue to breach the high unemployment gab in the country.

Dr. Samuel Nii Akai Nettey whose centre falls directly under the Biotechnology and Nuclear Agricultural Research Institute (BNARI) disclosed in an interview that, the municipal waste management systems put in place by the city authorities able to collect just about 67 percent of waste in Accra.

According to Dr. Nettey, the situation is not different from the other major cities in Ghana. He stressed that the challenge poses significant threat to public health, especially in underserved low-income areas.

He said, the rapid population growth in the country’s urban areas is a wakeup call to city authorities to employ effective means to manage waste related problems. "The quest to feed the urban population is demanding more from urban and pre-urban agricultural industry – one that is already aggravated by poor soil fertility", he added.

Dr. Nettey is of the view that, adding value to the various components of separated waste presents an
opportunity for job creation, which will eventually reduce the amount of waste dumped at landfill sites.

If SESRC together with other stakeholders can be resourced to transfer knowledge gained from research activities to youth groups, waste collection firms and farmers, sanitation will improve in our cities. This initiative according to him will syphon waste from our environmental for compost production to improve soil fertility.

The objective of the SESRC center is to make meaningful contribution towards the creation of a sustainable environment for sustainable agriculture in Ghana. Its activities include; Climate change adaptation and Mitigation Study, Improving Biodiversity and Landscape Preservation, Solid and Liquid waste Management Techniques, Organic Agriculture among others.

According to Dr. Nettey, SESRC researched for Safi Sana Ghana Ltd to establish a waste recycling firm at Ashiaman. The firm he said uses biogas plants to process raw waste into composting.

"Their plant also has the capacity to convert the gas generated into electricity, which they use to run their daily operation and feed the rest into the national grid", he disclosed.

Touching on other areas of achievement, Dr. Nettey acknowledged that his centre collaborated with 'Global Communities' to train and equip youth groups across Greater Accra who uses tri-cycles to collect organic waste for composting, a move to enhance their livelihoods.

He mentioned International Water Management Institute (IWMI), Agro Eco Louis Bulk Institute, Biofil and Composters Limited (BIOFILCOM) and other sister institutions as partners.

According to Dr. Nettey, GAEC is ready to offer support with respect to governments quest of job creation. He said SESCR is ready to transfer every available technology to any interested district assembly to construct 10 -15 tones capacity compost plants, educating the populace on the need for waste separation, train the youths to sort the waste and produce compost for vegetable production.

He revealed that, the centre's compost plant is about 60 % completed. "This was meant to scale-up research work done into a semi commercial activity to serve the growing needs of farmers and the general public" he said.

**Narc Records Highest Cassava Beta-Carotenoid in Africa**

The Nuclear Agriculture Research Centre (NARC), at the Ghana Atomic Energy Commission (GAEC) has recorded a value of 17.85 µg/g (ppm) Carotenoids level in yellow flesh cassava.

The record is said to be the highest beta-caroten level ever recorded in Africa.

The Manager of NARC, Dr Godwin Amenorpe said in an interview that the centre achieved this by using mutation breeding.

Carotenoids, also called the pro-vitamin A, are organic pigments produced by plants, which protects the retina of the human eye when consumed. The centre that falls directly under the Biotechnology and Nuclear Agriculture Research Institute (BNARI), according to Dr. Amenorpe, is leading in the use of nuclear and other techniques like molecular biology to find solutions to agricultural related problems.

He revealed that the centre has several cassava genotypes to be released as varieties ranging from disease to drought resistant, higher beta-carotenoids to produce pro-vitamin 'A' which helps in clearer vision and other varieties for higher yields.

He commended the effort of the hard working and highly trained human resource that have constantly researched to produce different kinds of cassava seeds for the research. "Other genotypes varieties are at different stages of research”, he said.

"We irradiate cassava seeds under different situations for various reasons. The farmers give us feedback on how the genotypes perform on the field. Also, four of the yellow flesh genotypes, for example, are at the last stage for release. We achieve this in collaboration
with the University of Cape Coast and International Institute of Tropical Culture (IITA), Ibadan-Nigeria. Dr. Amenorpe elaborated.

He said that the Centre has successfully developed a fat-free poultry formulation for BNARI’s poultry house, which led to an increase in the Internally Generated Funds of the Institute. It also handled the planting of mangoes at the mango fields at BNARI by training farmers in the area of grafting.

At the moment, the Centre is faced with power outages in our laboratories. As a result, researchers have to use laboratories at the University of Ghana for bio-chemical analysis. The Centre is confident that given the needed support, these challenges can be overcome to ensure sustainable Research & Development in GAEC.
The third edition of the GAEC newsletter covers mainly the activities of the Biotechnology and Nuclear Agricultural Research Institute of GAEC. It also touches on the just ended Ghana Research Reactor 1 Nuclear Reactor Core Conversion programme and the 2017 Africa Scientific Renaissance Day celebration.

We hope that BNARI’s activities will be well understood through this publication. On behalf of the production team, we present to you, the third issue of the GAEC Newsletter. Thank you.

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