African Regional Coorperative Agreement for Research, Development and Training in Nuclear Science and Technology: A Brief, 1995– 2020

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Abstract
The African Regional Cooperative Agreement for Research, Development, and Training in Nuclear Science and Technology represents a collaborative initiative among African nations aimed at enhancing the role of nuclear science in advancing socio-economic and political development across the continent. This agreement encompasses diverse peaceful applications of nuclear technology, all directed toward supporting national, sub-regional, and continental development objectives. This paper critically examines the framework and significance of the agreement, with particular emphasis on how existing infrastructure and professional expertise in nuclear science can be effectively harnessed to benefit African societies. The study finds that the regional framework has contributed meaningfully to several key sectors, including public health, agriculture and food security, industrial processes and quality assurance, information and communication technology, as well as nuclear safety and security.
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Introduction

The African Regional Cooperative Agreement for Research, Development and Training in Nuclear Science and Technology (AFRA) constitutes a formal intergovernmental arrangement among African countries aimed at advancing the application of nuclear science and technology for sustainable development across the continent. The initiative seeks to reinforce the capacity of member states to utilize nuclear techniques in addressing developmental challenges, thereby contributing to both national and regional progress. The operational scope of AFRA extends to various peaceful uses of nuclear technology, all of which are aligned with broader development objectives within Africa.1 AFRA was originally established through an agreement signed in April 1995, and its continuity is maintained through periodic renewals by participating states at five-year intervals. This renewal process requires member countries to formally communicate their acceptance of the extension to the Director General of the International Atomic Energy Agency (IAEA), thereby reaffirming their commitment to the agreement and continued participation in its programmes.2 The most recent extension, being the fifth in the series, came into effect on April 4, 2015, and remained valid until April 3, 2020. During this period, approximately thirty African nations, including Nigeria, endorsed and participated in the extension. The implementation of AFRA's activities is supported by the IAEA, which provides essential technical expertise, scientific guidance, as well as financial and administrative assistance in accordance with its established principles and procedures governing technical cooperation initiatives.

This paper examines AFRA as a strategic regional framework designed to optimize the use of nuclear science and technology for Africa's development. For clarity and coherence, the discussion is organized into five main sections. The first section explores the mandate, vision, mission, and strategic direction of AFRA. The second section evaluates its core functions, governance structure, and cooperative framework at the regional level. The third section considers the strategies adopted to enhance regional self-reliance and long-term sustainability. The fourth section reviews key achievements and ongoing projects under AFRA. The final section presents concluding observations on the relevance and impact of the agreement.

Mandate, Vision, Mission, Strategic Goals and Strategy of AFRA (Rewritten Version)

a) Mandate

The African Regional Cooperative Agreement for Research, Development and Training in Nuclear Science and Technology (AFRA) operates with a clear mandate centered on fostering sustainable development across Africa through a coordinated regional framework. Its primary objective is to enhance the effective use of nuclear science and technology in ways that address the continent's developmental needs.

In pursuit of this objective, AFRA seeks to optimize the use of existing infrastructure and technical expertise available within member states, ensuring that these resources are efficiently deployed for maximum developmental impact. Furthermore, the agreement emphasizes the importance of advancing regional self-reliance in the peaceful application of nuclear technologies. This is achieved through the establishment and strengthening of institutional capacity, the coordination of both human and material resources, and the promotion of innovative and cost-effective practices across the region.

In addition, AFRA encourages member states to demonstrate sustained commitment to the integration of nuclear science and technology into their development agendas. This commitment is expected to be reflected not only in policy support but also in the provision of adequate and continuous funding to ensure the long-term success of its programmes and initiatives.3

b) Vision and Mission

The mission of AFRA is rooted in the foundational principles of the agreement, which recognize that national atomic energy programmes across African countries share common areas of interest. Through collaboration, these shared interests can be leveraged to enhance the efficient utilization of available resources. Consequently, member states commit to promoting and coordinating joint research, development, and training initiatives in nuclear science and technology through their respective national institutions.4

Vision

AFRA envisions itself as a leading regional institution in Africa, serving as a central mechanism through which member states can effectively promote and coordinate the peaceful use of nuclear science and technology. Its overarching aspiration is to contribute meaningfully to socio-economic development across the continent by facilitating cooperation and innovation in this critical field.5

Mission

Aligned with the socio-economic priorities of its member states, AFRA's mission is to build and strengthen capacity through regional collaboration. It seeks to establish and support the necessary institutional and technical frameworks that enable the safe, efficient, and cost-effective application of nuclear science and technology. Through these efforts, AFRA aims to address key developmental challenges and promote sustained socio-economic growth within African communities.6

AFRA Strategic Goals and Strategy

AFRA Strategic Goals

The African Regional Cooperative Agreement for Research, Development and Training in Nuclear Science and Technology (AFRA) is guided by a set of strategic goals designed to ensure that nuclear science contributes meaningfully to development across member states. These goals reflect both the technical and socio-political dimensions of regional cooperation.

First, AFRA seeks to strengthen the sustainable role of nuclear science and technology in addressing the developmental priorities of its member countries. This involves aligning nuclear applications with national and regional needs, particularly in sectors that directly influence economic growth and social welfare.

Second, the agreement promotes a strong culture of collaboration and mutual support among member states. Through this approach, countries are encouraged to share expertise, infrastructure, and technical knowledge, thereby enhancing the efficient use of available resources within the region. Another critical goal is the reinforcement of nuclear safety and security practices at both national and regional levels. This ensures that the application of nuclear technology is conducted in a manner that safeguards human health, the environment, and overall societal well-being. AFRA also prioritizes awareness creation and continuous engagement with key stakeholders, including policymakers, civil society organizations, end-users, and the general public. By doing so, it seeks to improve understanding and acceptance of the peaceful uses of nuclear science and technology.

Finally, the agreement emphasizes the importance of good governance and effective management in the execution of its programmes. This includes maintaining high standards of accountability, transparency, and operational excellence across all its activities.7

AFRA Strategy

To realize these strategic goals, AFRA adopts a comprehensive set of guiding principles that shape the planning, implementation, monitoring, and evaluation of its cooperative initiatives. Central to these principles is the concept of ownership, whereby member states play a leading role in directing and managing regional activities. One of the key strategic approaches involves strengthening the leadership role of member countries in the coordination of regional cooperation programmes. This ensures that initiatives are responsive to local priorities and are driven by the needs of participating states. In addition, AFRA promotes the use of thematic programme frameworks rather than isolated project-based interventions. This approach allows for more coherent planning and alignment with broader regional development objectives.

The strategy further emphasizes the utilization of existing regional expertise and infrastructure in the execution of programmes. By relying on local capacities, AFRA reduces dependency on external resources while fostering self-reliance among member states. In line with this, there is a gradual transition of managerial responsibilities from the International Atomic Energy Agency (IAEA) to AFRA's internal programme management structures, thereby strengthening institutional autonomy.

Collaboration remains a central pillar of AFRA's strategy. The agreement encourages partnerships with both regional and international development actors to enhance resource mobilization and technical support. Efforts are also directed toward building institutional capacity within member states, enabling them to sustain project outcomes independently after programme completion. To support its activities financially, AFRA develops and implements effective resource mobilization strategies, including engagement with donor organizations and advocacy for additional funding. Special consideration is given to least developed member countries, with tailored strategies designed to address their unique challenges and developmental constraints.

Furthermore, AFRA promotes inclusivity by encouraging the participation of women and youth in nuclear science and technology initiatives. This is achieved through targeted programmes, partnerships with relevant organizations, and advocacy efforts aimed at decision-makers. The strategy also underscores the importance of knowledge management, including the preservation, transfer, and continuous development of nuclear expertise within the region. Effective networking and skill retention mechanisms are prioritized to ensure long-term sustainability.

Ultimately, the successful implementation of AFRA programmes depends on strong ownership by member states, supported by the integration of these programmes into national development plans and backed by consistent funding. Through these strategic approaches, AFRA aims to ensure that its initiatives remain relevant, sustainable, and impactful across the African continent.8

AFRA Members and Core Functions

As at April 2017, the African Regional Cooperative Agreement for Research, Development and Training in Nuclear Science and Technology (AFRA) comprised thirty member states drawn from different regions of the African continent. These include Algeria, Angola, Botswana, Burundi, Chad, Côte d'Ivoire, the Democratic Republic of Congo, Egypt, Ethiopia, and Ghana. Other participating countries are Kenya, Lesotho, Madagascar, Mali, Mauritania, Mauritius, Morocco, Namibia, Niger, Nigeria, Senegal, Seychelles, South Africa, Sudan, Swaziland (Eswatini), Tunisia, Uganda, Zambia, and Zimbabwe. The wide geographical representation of these states reflects a collective commitment to advancing the peaceful application of nuclear science and technology for development across Africa.

Core Functions

AFRA operates through a number of core functions designed to facilitate cooperation, capacity building, and the effective application of nuclear science and technology within the region. A central aspect of its function is the establishment of institutional linkages and coordination mechanisms that support collaboration in areas such as training, information exchange, and the integration of information and communication technologies. In this regard, particular attention is given to addressing the unique challenges faced by the least developed member states. Another important function involves the development and implementation of systems aimed at strengthening human resource capacity. This includes initiatives for training, knowledge management, and the preservation of nuclear expertise, as well as the promotion of skills acquisition and retention across member countries.

AFRA also plays a key role in harmonizing regulatory frameworks, operational practices, and procedural standards among its member states. Through this process, it facilitates the exchange of information, encourages the sharing of experiences, and promotes the dissemination of best practices in the application of nuclear technologies.

Furthermore, the agreement supports the advancement of South–South cooperation among African countries, while also fostering partnerships with regional and international organizations such as the New Partnership for Africa's Development (NEPAD). These collaborative efforts are aimed at enhancing technical capacity and expanding development opportunities within the region. In addition, AFRA coordinates and streamlines regional cooperation and assistance programmes focused on strengthening nuclear science and technology infrastructure. Special emphasis is placed on supporting countries with limited capacity, ensuring that they are not excluded from the benefits of technological advancement.9

Management

The governance structure of AFRA is anchored on a formal decision-making body known as the Meeting of AFRA Representatives. This body comprises designated government officials who are authorized to act on behalf of their respective countries in matters relating to the agreement. The meeting is held annually, usually in conjunction with the General Conference of the International Atomic Energy Agency (IAEA), providing an opportunity for member states to review progress and make key policy decisions.10 Supporting this structure is the Technical Working Group, which consists of national coordinators from member states. This group typically convenes at least once a year, often prior to the annual meeting of AFRA Representatives, to deliberate on technical matters and provide expert input into programme planning and implementation.11

Following the outcomes of the High-Level Policy Review Seminar held in November 2007, efforts were made to enhance the efficiency and effectiveness of AFRA's management processes while promoting greater ownership of its programmes by member states. As a result, a revised management framework was introduced, incorporating key committees such as the AFRA Programme Management Committee, which plays a central role in overseeing programme execution and ensuring alignment with the agreement's strategic objectives.

Within its institutional framework, AFRA is further supported by specialized committees that enhance its operational effectiveness and strategic direction. One of these is the AFRA Partnership Building and Resource Mobilization Committee, which is tasked with promoting collaboration and securing both financial and technical resources necessary for the successful implementation of AFRA programmes. Through this committee, efforts are directed towards establishing partnerships with relevant stakeholders and ensuring sustained support for regional initiatives.

In addition, the AFRA High-Level Steering Committee on Human Resource Development and Nuclear Knowledge Management plays a critical role in guiding policies related to capacity building and knowledge sustainability. This committee focuses on strengthening human capital within member states, while also ensuring the effective management, preservation, and transfer of nuclear knowledge across the region. Through its activities, it contributes to the long-term development of expertise and institutional competence in nuclear science and technology.12

AFRA Regional Strategic Cooperative Framework

The AFRA Regional Strategic Cooperative Framework (RSCF) serves as the principal planning instrument for identifying regional priorities and guiding the development of cooperative programmes under the agreement. It provides a structured approach to programme formulation and implementation, ensuring that activities are aligned with the collective development objectives of member states. The framework adopted in September 2012 outlines strategic directions for the period spanning 2014 to 2018.

The RSCF functions as a reference point for the design and execution of AFRA's regional initiatives. It enhances coordination and strengthens programme planning across key thematic areas, including human health, food and agriculture, water resource management, sustainable energy development, industrial applications, radiation safety, nuclear security, and human resource development. Through this framework, AFRA ensures that its projects are both coherent and responsive to regional priorities.13

a) Human Health

Within the health sector, AFRA focuses on areas where nuclear technology offers distinct advantages, particularly in addressing major public health challenges. Its interventions are directed towards cancer management, nuclear medicine, communicable disease control, and human nutrition. In the field of cancer care, AFRA prioritizes the development of human capacity in radiotherapy by promoting standardized education and training programmes across member states. It also supports the establishment of radiotherapy centres in countries where such facilities are lacking, while strengthening existing ones through improved clinical practices, enhanced safety standards, and better management systems. Specialized training is provided for professionals such as medical physicists, radiographers, and radiotherapy administrators to ensure the effective delivery of cancer treatment services.14

In the domain of nuclear medicine, AFRA works towards expanding access to diagnostic and therapeutic services, while also advocating for the recognition of medical physics as a professional discipline within member countries. The use of isotopic techniques is encouraged in monitoring nutritional interventions, particularly in programmes aimed at improving maternal and child health. These activities are supported through collaborative laboratory networks that facilitate data sharing and regional analysis.

AFRA also contributes to the control of communicable diseases such as malaria, tuberculosis, and HIV/AIDS by promoting the use of advanced nuclear-based diagnostic tools. It supports the development of innovative strategies for disease surveillance and control, including efforts to monitor drug resistance through coordinated laboratory networks across the region.15

b) Food and Agriculture

In the agricultural sector, AFRA promotes the application of nuclear techniques to improve productivity, sustainability, and food security. Its activities cover a wide range of areas, including animal production, crop improvement, soil fertility management, water resource utilization, pest and insect control, and food safety.

With regard to animal production, AFRA emphasizes capacity building in the use of nuclear technologies to support breeding programmes, particularly through artificial insemination techniques. It encourages the adoption of cost-effective methods for selecting high-quality breeding stock and developing efficient feeding systems. These approaches are intended to enhance livestock productivity while ensuring sustainability within the agricultural sector.

The conservation and sustainable use of African animal genetic resources remain a key priority, with ongoing efforts aimed at preserving biodiversity and improving livestock productivity. The AFRA programme continues to support the application of serological and molecular diagnostic methods for the detection and management of transboundary animal diseases (TADs), including Peste des Petits Ruminants (PPR), through the enhancement of laboratory infrastructure and technical capacity across member states. In addition, a strengthened collaborative framework between AFRA and the African Union (AU) is recommended to improve coordinated disease surveillance and control strategies across the continent.16

In the area of crop improvement, AFRA works to build the capacity of member states to enhance agricultural productivity through advanced breeding techniques. These include the development of drought-resistant crop varieties, the application of mutation breeding for neglected and underutilized crops, and the use of biotechnology combined with farmer-participatory approaches to ensure that crop improvement efforts align with consumer needs and local farming systems. Regarding soil fertility and water management, AFRA-supported initiatives focus on promoting sustainable land use, reducing desertification, and improving agricultural resilience. Nuclear techniques are applied to monitor plant water uptake, assess evaporation losses, evaluate drainage efficiency, and measure nitrogen use efficiency under different irrigation and cropping systems. The programme also encourages regional cooperation in adopting and scaling these technologies across member states and other regions.17

In the area of insect and pest management, AFRA promotes regional training and educational programmes designed to support the effective application of nuclear-based pest control methods. These efforts target major agricultural pests such as the false codling moth, Mediterranean fruit fly, mosquitoes, and tsetse fly, with the aim of improving food security and reducing crop losses. In relation to food safety, AFRA initiatives contribute to strengthening food quality standards by supporting sustainable agricultural production, improved processing practices, and capacity building in food safety management. These interventions enhance knowledge transfer and technical skills among stakeholders in the sector.18

Furthermore, AFRA places strong emphasis on water resource management by enhancing regional technical capacities, particularly through the strengthening of Regional Designated Centres (RDCs) specializing in isotope hydrology. These efforts support integrated water resources management, with a focus on transboundary surface and groundwater systems as well as dam safety. The programme fosters cross-sector collaboration and partnerships with relevant institutions and development agencies to ensure sustainable water resource governance.19

c) Sustainable Energy Development

AFRA also promotes the wider adoption of the International Atomic Energy Agency's (IAEA) analytical tools for energy planning and policy development. Regional cooperation is strengthened through the establishment of additional Regional Designated Centres (RDCs) dedicated to energy planning, alongside partnerships with organizations involved in energy development. These collaborative efforts support regional coordination in energy strategy formulation, including preparation for countries exploring nuclear power generation. In addition, AFRA activities support the advancement of non-destructive testing techniques for industrial quality assurance, promote the use of radiation processing technologies, and optimize the application of radioisotopes for industrial diagnostics. The programme further encourages the effective utilization of research reactors and particle accelerators to enhance scientific and technological development across the region.20

d) Radiation Safety and Nuclear Security

The AFRA framework on radiation safety encourages the adoption of self-assessment tools to support the development and continuous improvement of radiation protection systems across member states. In the area of nuclear security, AFRA initiatives focus on enhancing human capacity through innovative approaches such as triangular cooperation models, practical, hands-on training programmes, Regional Designated Centres (RDCs), and the active participation of regional experts alongside Project Scientific Consultants (PSCs). Furthermore, AFRA plays a significant role in strengthening regional capacities for radioactive waste management by utilizing RDCs for the retrieval, conditioning, and safe handling of radioactive sources.21

e) Human Resource Development

AFRA's human resource development strategy emphasizes education and specialized training across diverse fields of nuclear science and technology, with the aim of addressing skill gaps and meeting regional needs in Africa. These efforts are supported through the recognition and expansion of RDCs into new thematic areas, as well as the integration of information and communication technologies into training and research activities. In addition, the programme promotes research and development within the regional framework and strengthens cooperation through Technical Cooperation among Developing Countries (TCDC), often formalized through bilateral agreements or memoranda of understanding.22

AFRA and the Promotion of Regional Self-Reliance and Sustainability

Member states under AFRA are committed to achieving sustainable and self-reliant development in the peaceful, safe, and secure use of nuclear technology, guided by the principles of Technical Cooperation among Developing Countries. 23.To support these objectives, AFRA has introduced several operational mechanisms, including strategies for human resource development and nuclear knowledge management, the establishment of Regional Designated Centres, deployment of specialized teams, engagement of Project Scientific Consultants, and efforts to strengthen national nuclear institutions and related infrastructure.

a) Strategy on Human Resource Development and Nuclear Knowledge Management

AFRA member states implement a coordinated regional approach to Human Resource Development (HRD) and Nuclear Knowledge Management (NKM) through the AFRA Network for Education in Nuclear Science and Technology (AFRA-NEST). A High-Level Steering Committee has been established to guide and monitor these initiatives across the region. Additionally, a standardized curriculum for the AFRA Master's programme in Nuclear Science and Technology has been adopted as a benchmark for regional academic training. Efforts have also been made to designate Regional Designated Centres (RDCs) for advanced education and professional training, particularly to support member states lacking the institutional

capacity to deliver the standardized curriculum. A high-priority follow-up project was approved for the 2014–2016 period, enabling students from participating countries to access RDCs through structured fellowship programmes.24

The AFRA initiative further supports the establishment of International Nuclear Information System (INIS) centres in new member states and the strengthening of existing national institutions. These efforts aim to improve access to reliable and authoritative nuclear information resources, thereby enhancing national and regional capacity to implement effective nuclear science and technology programmes.25

Nuclear Literature and Information Exchange

This initiative focuses on strengthening access to nuclear literature and promoting the exchange of technical expertise among member states. It also encourages the sharing of resources and best practices in nuclear information management and processing, thereby improving regional collaboration and knowledge dissemination.

b) Regional Designated Centres (RDCs)

Within the AFRA framework, Regional Designated Centres (RDCs) are recognized African institutions mandated to provide multinational services in line with the AFRA Agreement. Member states apply a strict evaluation process to identify and approve institutions as RDCs. As of March 2017, several institutions had been designated across Africa based on their areas of specialization. These include:

- South African Nuclear Energy Corporation, Pretoria, South Africa – specializing in radioactive waste management
- Tygerberg Hospital, Cape Town, South Africa – specializing in clinical radiotherapy and medical physics
- National Cancer Institute, Cairo University, Egypt – specializing in radiotherapy and medical physics
- Southern Africa Institute of Welding – specializing in non-destructive testing techniques
- Agricultural Research Council, Pretoria, South Africa – specializing in mutation breeding and biotechnology applications
- Nuclear Research Centre under the Egyptian Atomic Energy Authority, Cairo, Egypt – specializing in radiation technologies
- Graduate School of Nuclear and Allied Sciences, University of Ghana, Accra, Ghana – specializing in nuclear education and professional training
- General Directorate for Policies and Energy Planning, Ministry of Petroleum / Sudanese Petroleum Corporation, Khartoum, Sudan
- Laboratory of Radio-Analyses and Environment, National School of Engineers of Sfax, University of Sfax, Tunisia – specializing in environmental hydrology
- Central Veterinary Laboratory, Algiers, Algeria – specializing in food safety and quality assurance
- National Food Technology Research Centre, Kanye, Botswana – specializing in stable isotope applications in human nutrition
- National Veterinary School, Sidi Thabet, Tunisia – specializing in animal health and reproductive sciences, among others 26

c) Specialized Teams

AFRA makes use of specialized teams composed of regional experts who provide technical services in various nuclear-related areas. Their responsibilities include the conditioning and secure storage of sealed radioactive sources, assessment and auditing of radiotherapy and nuclear medicine facilities, and advisory support aimed at strengthening national nuclear institutions and promoting long-term sustainability and self-reliance.27

d) Project Scientific Consultants

When necessary, AFRA member states appoint Project Scientific Consultants to provide technical support and advisory services to participating countries and project committees. These consultants are highly qualified African experts recognized for their leadership and technical competence in specific nuclear fields. They contribute to AFRA programmes in their personal professional capacity and offer guidance to enhance project implementation and effectiveness across the region.28

Promoting the Sustainability of National Nuclear Institutions and Other Facilities

AFRA supports member states by providing guidance on the development and implementation of strategic action plans aimed at strengthening national nuclear institutions. These plans are designed to enhance institutional sustainability, ensuring that such organizations remain relevant and capable of adapting effectively to changes in their external operating environments. Through this approach, AFRA helps member states build resilient nuclear infrastructures that can continuously evolve in response to emerging scientific, technological, and policy demands.29

f) Regional Conferences

AFRA functions as an important platform for the exchange of information and the promotion of professional networking across Africa. This is achieved through periodic project coordination meetings, which are often organized alongside regional conferences. One notable example is the conference held in Kenya in April 2015, titled the "3rd African Nuclear Power and Energy Conference and Coordination Meeting," which brought together experts and stakeholders to discuss regional priorities and collaborative strategies in the nuclear energy sector.30

Achievements of AFRA

Since its establishment in 1995, the African Regional Cooperative Agreement (AFRA) on research, development, and training in nuclear science and technology has recorded significant progress across multiple thematic areas over the past twenty-five years. These achievements span human health, agriculture and food security, industrial applications and quality assurance, information and communication technologies, and nuclear security.

a) Human Health

Under the AFRA programme, substantial improvements have been made in the field of radiotherapy across the continent. Approximately forty radiotherapy centers in eighteen African countries have been either established or upgraded, while over 250 professionals—including radiotherapists, medical physicists, nurses, and radiographers—have received specialized training in advanced radiotherapy techniques, medical physics, and the management of radiotherapy services.31

AFRA initiatives in radiotherapy and medical physics have been strategically developed to address both national and regional training gaps. This has been achieved through the creation of harmonized curricula that facilitate standardized training across African institutions and support the recognition of medical physics as a professional discipline. Regional Designated Centres (RDCs) have played a critical role in implementing these training programmes. The curricula developed under AFRA have been adopted by several African countries with established academic programmes in the field.

A key focus of the programme has been strengthening member states' capacity to respond to the growing burden of cancer. Efforts have also been directed toward improving the management of prevalent cancer types across the region. In addition, AFRA has supported the organization of biennial meetings of the African Radiation Oncology Group (AFROG), which provide a platform for radiation oncologists and medical physicists to share knowledge, address professional challenges, and develop coordinated strategies for cancer control in Africa.32

AFRA further contributes to strengthening regional expertise in clinical nuclear medicine. The programme has enhanced diagnostic and treatment capacities for conditions such as coronary artery disease, rheumatoid arthritis, thyroid disorders, liver cancer, bone metastases, and lymphoma. It has also promoted best practices in medical physics within nuclear medicine applications. Specialized AFRA expert teams have conducted audits of nuclear medicine facilities in several member states, identifying key operational and infrastructural challenges. The recommendations from these assessments have proven valuable in integrating nuclear medicine services into national healthcare systems, thereby improving overall service delivery and strengthening health sector performance across participating countries.33

b) Food and Agriculture

Within the livestock production sector, the AFRA programme provides substantial support to member states in developing and applying appropriate selection methods for genetically improved livestock breeds. A key focus of this intervention has been the examination of the relationship between animal nutrition and reproductive performance, with the aim of enhancing overall productivity. In addition, modern reproductive biotechnologies have been introduced and promoted to improve both the reproductive efficiency and output of livestock systems across the continent.34

Crop improvement also represents a major area of achievement under AFRA initiatives. Approximately seventeen member states are actively engaged in the enhancement of underutilized or neglected crops that have not traditionally benefited from conventional breeding approaches. Significant attention has been directed toward the development of drought-resistant crop varieties, which is particularly important given the increasing impact of climate variability on African agriculture.

As a result of these efforts, five new crop varieties have been successfully released in several countries, including sesame in Egypt, cassava in Ghana, wheat in Kenya, banana in Sudan, and finger millet and cotton in Zambia. Furthermore, additional member states are currently advancing the development of mutant crop materials, with several projects now at advanced stages of experimentation and field evaluation.

Other notable achievements include the establishment of fully functional plant tissue culture laboratories in nearly all participating countries, as well as the development of molecular biology laboratories in at least three member states. Emerging initiatives are also being implemented in countries such as Tanzania, where research institutions are collaborating closely with agricultural and food industry stakeholders to develop improved barley varieties. These developments have encouraged other member states to adopt similar approaches, promoting the dissemination of staple and commercial crops through mutation breeding techniques and biotechnology, supported by participatory involvement of farmers.35

c) Industrial Applications and Quality Management

AFRA has recorded significant progress in the application of non-destructive testing (NDT) techniques for industrial quality assurance. To optimize limited resources, African member states have adopted a regional collaborative approach for training and certification in this field. Currently, many countries rely on Regional Designated Centres (RDCs), particularly the Southern African Institute of Welding and the Centres Techniques des Industries Mécaniques et Électriques in Tunisia, for the training and certification of NDT personnel.

Prior to 2003, no AFRA member state had developed the capacity to certify NDT professionals at Level III, which represents the highest level of competence required for establishing sustainable national training systems and promoting advanced NDT practices. Since then, several regional training programmes have been implemented, enabling practitioners from fourteen African countries to attain Level III certification. In total, more than one hundred certifications aligned with ISO 9712 standards have been awarded. The success rates recorded are comparable with international benchmarks, demonstrating that Africa has developed a strong and sustainable capacity for training and certifying advanced NDT professionals.36

In addition, AFRA's quality management programme has strengthened the institutional capacity of nuclear and related organizations across member states. This has been achieved through targeted training for managers and decision-makers, the promotion of best practices in quality assurance systems, and the facilitation of regional professional networks. The programme has also supported the certification and accreditation of nuclear laboratories, contributing to improved governance, reliability, and standardization across the nuclear sector in Africa.37

Information and Communication Technology (ICT)

AFRA member states have developed both national and regional capacities for the application of Information and Communication Technology (ICT) in training and education across various nuclear science and technology domains. These include agriculture, human health, environmental monitoring, water resources management, nuclear instrumentation, and other related nuclear fields. A key focus has been placed on building the capacity of nuclear engineers, computer scientists, and

technical personnel, with the objective of strengthening regional ability to deliver training through ICT-based learning materials. This approach has also enhanced the integration of digital tools into national training systems to meet local development needs. In several African countries, ICT telecentres have been established to support these initiatives and expand access to nuclear education and training resources.38

e) Radioactive Waste Safety

Sealed radioactive sources provide significant benefits across multiple socio-economic sectors; however, when these sources reach the end of their operational life, they remain highly radioactive and pose potential risks to human health and the environment if not properly managed. In response to this challenge, AFRA, in collaboration with the South African Atomic Energy Corporation, developed the Borehole Disposal System (BOSS), which is designed to ensure the safe and secure disposal of disused sealed radioactive sources.

In addition, AFRA member states have introduced mobile hot cell facilities to support the safe management of Spent High Activity Radioactive Sources (SHARS), thereby improving handling, conditioning, and storage processes for high-risk radioactive materials.

f) Nuclear Security

AFRA member states recognize nuclear security as a critical issue of global importance and a key area for regional cooperation. Since 2002, the International Atomic Energy Agency (IAEA) Nuclear Security Programme has supported African countries in strengthening systems for the protection of nuclear and other radioactive materials during use, storage, and transportation. It has also assisted in efforts to prevent and combat illicit trafficking of such materials. Since the inception of the programme, collaboration between AFRA member states and the IAEA has steadily expanded. Based on comprehensive needs assessments conducted jointly with member states, several regional nuclear security initiatives have been implemented successfully to enhance national security frameworks. AFRA also provides extensive support in human capacity development, including assistance in the establishment of Nuclear Security Support Centres. By 2020, more than 850 professionals—including law enforcement officers, customs officials, civil defence personnel, and regulatory authorities—had received specialized nuclear security training under AFRA programmes.

Furthermore, regional workshops on illicit trafficking information management have strengthened communication channels, improved operational coordination, and promoted best practices among stakeholders across member states. The commitment of AFRA countries to strengthening nuclear security is further demonstrated by their increasing participation in and support for relevant international conventions and agreements.

Conclusion

The African Regional Cooperative Agreement (AFRA) for Research, Development, and Training in Nuclear Science and Technology represents a regional legal and institutional framework established by African states to enhance and expand the application of nuclear science and technology for socio-economic development across the continent. The Agreement encompasses a broad spectrum of peaceful nuclear applications that contribute directly to the attainment of both national and regional development objectives. Since its establishment in 1995, AFRA has implemented a series of operational programmes and projects spanning key sectors such as food and agriculture, human health, sustainable energy development, water resource management, radiation protection, nuclear security, and industrial applications. These initiatives have significantly contributed to capacity building and technological advancement within member states. In general terms, AFRA can be regarded as a highly valuable regional initiative that African countries should actively participate in, given its potential to advance scientific innovation and development. It provides a strategic platform through which member states can accelerate progress in science and technology for development purposes. However, the realization of its full potential depends largely on strong political commitment, as well as the effective mobilization and utilization of both human and material resources in pursuit of its vision and objectives.

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