

# **African Regional Cooperative Agreement for Research, Development and Training related to Nuclear Science and Technology**

## **Profile Of The Regional Strategic Cooperative Framework (2014–2018)**



**AFRA**



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**AFRA**

**AFRICAN REGIONAL COOPERATIVE  
AGREEMENT FOR RESEARCH, DEVELOPMENT  
AND TRAINING RELATED TO NUCLEAR SCIENCE  
AND TECHNOLOGY**

**PROFILE OF THE REGIONAL STRATEGIC COOPERATIVE  
FRAMEWORK (2014–2018)**

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## A. BACKGROUND

In 1988, African Member States requested the IAEA to help establish a regional arrangement for cooperation in the field of nuclear science and technology in Africa. This initiative laid the foundations for the African Regional Cooperative Agreement for Research, Development and Training related to Nuclear Science and Technology, or AFRA. AFRA entered into force on 4 April 1990 as an intergovernmental agreement that states the responsibilities of the AFRA Member States and the cooperation modalities as well as defining the interface between the Member States and AFRA partners. Although the IAEA is not party to AFRA, it is mandated to provide technical and scientific backstopping and administrative support, in accordance with the rules and procedures that govern the provision of technical assistance to Member States.

As of December, 2012, AFRA enjoys a membership of 39 African countries: Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Central African Republic, Chad, Democratic Republic of the Congo, Côte d'Ivoire, Egypt, Eritrea, Ethiopia, Gabon, Ghana, Kenya, Lesotho, Libya, Madagascar, Malawi, Mali, Mauritania, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, Senegal, Seychelles, Sierra Leone, South Africa, Sudan, Tunisia, Uganda, United Republic of Tanzania, Zambia and Zimbabwe.

At the AFRA High Level Policy Review Seminar held in Aswan in November 2007, the AFRA Member States adopted a Regional Strategic Cooperative Framework (RCF). The present document, known as the Profile of the Regional Strategic Cooperative Framework, is a summary of the RCF.

### A.1. AFRA strategic goals

AFRA has defined five strategic goals:

Goal 1: To enhance the sustainable contribution of nuclear science and technology to meet the developmental needs and interests of Member States.

Goal 2: To entrench the culture of mutual assistance and regional cooperation in the effective utilization of available nuclear expertise and infrastructure.

Goal 3: To deepen the culture of nuclear safety and security at regional and national levels in the gainful exploitation of nuclear science and technology.

Goal 4: To interact continuously with and create awareness amongst decision-makers, civil society, users and the general public on the benefits of peaceful application of nuclear science and technology.

Goal 5: To institute good governance and excellence in the management of activities in the region.

### A.2. Purpose of the RCF

The achievement of regional strategic goals requires active cooperation among African countries based on the RCF. The purpose of the RCF is to identify and prioritise regional cooperation opportunities for the sustainable promotion of peaceful applications of nuclear science and technology, on the basis of an in-depth assessment of the most pressing regional developmental problems, needs and priorities in the African socioeconomic context. The RCF is also meant to facilitate the building of strategic partnerships with other relevant bilateral and multilateral bodies, agencies and organizations.

The RCF will serve as a basis for the formulation of AFRA regional programmes and, in turn, will be used as a frame of reference in the process of development of AFRA regional projects. In this context, it is expected that the RCF will lead to the implementation of effective and efficient regional cooperation mechanisms.

## B. THE SECOND AFRA REGIONAL STRATEGIC COOPERATIVE FRAMEWORK 2014–2018

In March 2012, a task force meeting held in Algiers developed the second AFRA RCF 2014–2018. The task force, among other responsibilities, identified high priority areas for inclusion in the AFRA Programme 2014–2018

and proposed new initiatives to improve implementation of the programme aiming to address current challenges facing the region. It is highly recognized that human resource development and partnership building of strategic partnerships with other relevant bilateral and multilateral bodies, agencies, and organizations remains the top priority of AFRA programmes.

In 2011 the task force meeting reviewed AFRA activities since 2007, analysed the implementation of the programmes under the first RCF 2008–2013 and developed a document, “*Assessment of the implementation of the AFRA Regional Cooperative Framework 2008–2013*” in April, 2011. This document was then reviewed and adopted by the 22<sup>nd</sup> Meeting of AFRA Representatives held in September 2011.

This document along with other background material was used as input by the task force meeting to develop the second AFRA RCF 2014–2018, which was endorsed by the 23<sup>rd</sup> Meeting of AFRA Representatives in September 2012.

Subsequent to the task force meeting, the AFRA Partnership Building and Resource Mobilization Committee (AFRA-PBRMC) developed a plan, included in the current document, to address the funding requirements required to implement the RCF.

## C. OPPORTUNITIES FOR FUTURE COOPERATION AND PROGRAMME FOCUS AREAS

Based on the review and analysis of the ongoing AFRA programmes, as well as the current challenges facing Africa, seven thematic areas have been identified as essential needs and priorities of the region that need to be the programme focus under the second RCF 2014–2018. These include; (i) human health, (ii) food and agriculture, (iii) water resources, (iv) sustainable energy, (v) industrial applications, (vi) radiation safety and nuclear security and, (vii) education and training. There is a wide consensus among AFRA member states that for AFRA regional priorities to be successfully advanced, there is need for capacity building in the region. Human resource development through research, education and training is of utmost importance to

enable the region to variably and independently carry out nuclear applications for development. Furthermore, cooperation and partnership between key players (Member States, international donors and the IAEA) will help in the optimization of the resources available for the implementation of AFRA activities. In addition to the identified priority areas, AFRA-PBRMC developed a framework with guided strategies to mobilize resources from potential/ development partners so as to address the funding requirements necessary for the successful implementation of the RCF.

### C.1. Human health

The three major killer diseases in Africa (HIV/AIDS, tuberculosis (TB) and Malaria) are best viewed as overlapping epidemic hindering socio-economic development efforts in region. The region has the highest HIV/AIDS infection rates worldwide and home to nearly 30 million people out of more than 40 million people living with HIV/AIDS in the world. Cancer on the other hand constitutes a major health problem in African countries compared to other regions. Cancer related deaths are expected to account for more deaths globally each year than HIV/AIDS, TB and Malaria combined. The extremely high prevalence, combined with limited health care, food insecurity and malnutrition have an impact on the workforce and human manpower, and accelerates child and maternal mortality rates. The epidemic is further exacerbated by the emergence and the spread of resistance to drugs which hinders the global efforts in the management and effectiveness of control programmes of these diseases.

The application of nuclear techniques is considered to provide unique capabilities in the control, prevention, diagnosis and treatment of the aforementioned diseases and improving nutrition status of people living with HIV/AIDS. With support from the IAEA, AFRA will promote nuclear technology in supporting human health programmes in areas of cancer therapy, nuclear medicine, communicable diseases and human nutrition.

The general AFRA human health priorities for 2014–2018:

- Building human resources in all professions related to cancer (medical physics, radiation oncology, nuclear medicine, radiation therapy technology, oncology nursing);

- Building capacities in nuclear applications related to the diagnosis of communicable diseases and malnutrition;
- Enhancing access to quality diagnosis and treatment of cancer, cardiovascular diseases and infection by establishing and expanding diagnostic and treatment centres;
- Encouraging a safe and smooth transition to new techniques in the diagnostic and treatment of cancer;
- Optimizing uptime of equipment through sustainable repair and maintenance programmes.
- Development of communities of practice utilizing information and communication technology (ICT) platforms;
- Promotion and development of research culture in human health.

The specific AFRA programme focus is as follows:

### C.1.1. Cancer therapy

According to the World Health Organization, non-communicable diseases are considered a major health challenge of the 21st century.<sup>1</sup> Apart from the enormous limitations in addressing cancer in Africa, from the uninformed population and lack of policy and institutional capacities, it is confirmed that the greatest challenge in addressing cancer in AFRA Member States relates to human resource capacity building. There remains a critical shortage suitably qualified personnel in all professions related to the disease. The shortage of specialists exists in the field of medical physics, radiation oncology, nuclear medicine, radiation therapy technology as well as oncology nursing.

Taking this into account, AFRA's involvement in programmes on capacity building efforts will be addressed by:

- Enhancing human resource capacity in the AFRA Member States through the strategy of assisting Member States to establish their own education programmes at the tertiary education level so as to properly qualify personnel according to

internationally recognised and accredited curricula. The project will be implemented in close cooperation with the AFRA High Level Steering Committee on Human Resource Capacity Building and Nuclear Knowledge Management;

- Establishment and harmonization of education and training programmes throughout the continent.

Other high priority areas include:

- Promotion of the establishment of new radiotherapy centres in countries where there are none and consolidating the existing ones in the AFRA Member States;
- Expansion of the radiotherapy infrastructure to make the services accessible nationwide;
- Improvement in the repair and maintenance capabilities of radiotherapy equipment in the AFRA Member States;
- Implementation of sustainable and comprehensive quality assurance programmes;
- Improvement in the quality of radiotherapy in the treatment of frequently occurring cancers in the AFRA Member States;
- Encouragement of transition from 2D to 3D Conformal Radiotherapy in the AFRA Member States;
- Improvement in quality of radiotherapy for childhood cancers in the AFRA Member States;
- Development and promotion of cancer research activities in the region;
- Promotion and establishment of National Cancer Control Plan in the region;
- Recognition and regulation of medical physics as a profession in all Member States. A medical physics programme will assist participating countries to keep up to date with the latest technologies in order to ensure continuous improvement of quality control (QC) of radiotherapy practices.

Given the long term nature of the capacity building aspects of the programme, it is expected that projects after 2016 will continue to focus on the high priority aspects described here.

<sup>1</sup> World Health Statistics 2012 [http://www.who.int/gho/publications/world\\_health\\_statistics/EN\\_WHS2012\\_Full.pdf](http://www.who.int/gho/publications/world_health_statistics/EN_WHS2012_Full.pdf)



## C.1.2 Nuclear medicine

The knowledge on nuclear management and the use of nuclear medicine techniques in the region is extremely low. The situation is partly due to the shortage of human resources in professions such as medical physics and radiopharmacy; as well as the insufficient expertise to apply, develop and manage nuclear medicine facilities in many African countries with exception of a few African countries such as Algeria, Egypt, Libya, Morocco, Nigeria, South Africa, Sudan, United Republic of Tanzania, and Tunisia. The inadequacy of human resources in the field of nuclear science and technology is a direct consequence a number of factors including the absence of viable training and education in nuclear knowledge and management in the existing higher level programmes, and the lack of sufficient financial resources for the maintenance and acquisition of necessary equipment.

In addressing the acute shortage of professions in the field of nuclear medicine in the region, AFRA's priorities for 2014–2018 aim to support Member States through:

- A regional technical cooperation among developing countries (TCDC) approach;
- Education and training will be carried out in close cooperation with the High Level Steering Committee, African Energy Commission (AFREC) and a network of other cancer institutes in the region;
- The emphasis is on academic education and training in clinical nuclear medicine, related medical physics as well as radiopharmacy in Africa. This will be done through:
  1. Phased establishment of more nuclear medicine centres in individual Member States providing health care diagnostic services using radionuclides for imaging (single photon emission computed tomography (SPECT) and SPECT- computed tomography (CT)) and non-imaging procedures;
  2. Establishment of nuclear medicine centres providing health care diagnostic services and limited therapeutic services:
    - a). for benign thyroid diseases (hyperthyroidism);
    - b). for malignant thyroid diseases (thyroid cancer);
    - c). for metastatic bone pain palliation; and
    - d). radioguided surgery.

3. Establishment of consortium training programmes in advanced nuclear medicine centres in the regional designated centres (RDCs) with specialty certification:
  - a). with diploma/certificate;
  - b). with University degree.
4. Establishment of nuclear medicine centres with advanced imaging capabilities and medical cyclotron for local radiopharmacy for:
  - a). Positron emission tomography (PET);
  - b). Positron emission tomography–computed tomography (PET-CT).
5. Establishment of nuclear medicine centres with advanced imaging capabilities and medical cyclotron and centralized radiopharmacy for national / regional distribution:
  - a). PET-CT;
  - b). PET/ magnetic resonance imaging (MRI).
6. Establishment of referral nuclear medicine centres as a regional hub for advanced diagnostic and therapeutic services and health care research:
  - a). full range of radionuclide therapy;
  - b). academic nuclear medicine training and Postgraduate courses (perhaps an “African School of Nuclear Medicine”).

Moreover, the AFRA human health programme for 2014–2018 identifies medical physics profession as a high priority area that needs to be further developed and promoted in the region through:

- recognition and regulation of medical physics as a profession in all Member States;
- increase of skilled medical physicists for all specialties with medical physics involvement: radiotherapy, nuclear medicine and diagnostic radiology;
- establishment and harmonization of education and training (E&T) programmes through the continent;
- implementation of sustainable and comprehensive quality assurance (QA) programmes;
- enhance the access to diagnosis and treatment infrastructures;
- build regional capabilities in communication and cooperation among international and regional

institutions (International Organization for Medical Physics (IOMP), American Association of Physicists in Medicine (AAPM), European Society for Radiotherapy and Oncology (ESTRO), Programme of Action for Cancer Therapy (PACT),...) related to medical physics through scientific societies such as Federation of African Medical Physics Organisations (FAMPO), African Radiation Oncology Group (AFROG);

- Identification of RDCs (preferably one Anglophone and one Francophone);
- Promotion of TCDC for capacity building in the field of medical physics.

AFRA identifies potential organizations/institutions to build cooperation in education and training (E&T) in medical physics. These include:

- American Society for Therapeutic Radiology and Oncology (ASTRO) and ESTRO training programmes;
- IOMP/AAPM exchange training programmes;
- PACT/Virtual University for Cancer Control and Regional Training Network (VUCCnet) (medical physics should be included).

Further to strengthening and promoting the field of nuclear science in the region, it is important to note that AFRA regional priority programmes will continue to build on the previous and ongoing AFRA projects including:

- Expanding clinical nuclear medicine (with related medical physics) applications in high priority areas such as nuclear cardiology, nuclear oncology and childhood diseases;
- Supporting academic education and training in nuclear medicine in Africa with the introduction of e-learning in cancer and others advanced means in ICT;
- Programmes on prevention, early detection and prompt treatment of communicable and non-communicable diseases;
- Strengthening of quality control and quality assurance programmes and expanding to new modalities of producing radiopharmaceuticals. The programme will provide education of radiopharmacists to address the acute shortage of this skill/profession in the region.

### C.1.3 Communicable diseases

Drug resistance is an extremely serious problem that is by and large undermining effective healthcare for millions of people in Africa. Drug resistance dramatically increases the costs of fighting TB and malaria, and undermines the efforts to treat people living with HIV/AIDS effectively

Under the regional cooperative framework in the 2014–2018 period, it is proposed that AFRA should facilitate the network of laboratories that has collaborated in tracking drug resistance in TB and malaria. Due to the availability of new and emerging molecular tools to identify genes that confer drug resistance, AFRA should facilitate the network to exploit the use of:

1. Spoligotyping and the HAINS test/restriction fragment length polymorphism (RFLP) for TB by use of radioisotopes in the identification of extremely drug resistant TB;
2. GeneXpert comparison of Rifampicin resistance markers and use of radioisotopes in quality control by the Dot Blot technique;
3. In vitro susceptibility tests using  $^3\text{H}$ -Hypoxanthine;
4. Metabolomics and labelling using  $^{35}\text{S}$  for pathway analysis and drug inhibition studies;
5. Reverse transcriptase–polymerase chain reaction (RT-PCR) use of radionuclides in RFLP of amplified expressed genes for drug resistances in malaria parasites;
6. Loop-mediated isothermal amplification (LAMP) – Isothermal Amplification and RFLP for detection of single nucleotide polymorphisms of resistance markers.

AFRA should also;

- Ensure the effort is done in close cooperation with national control programmes to assist with monitoring the efficacy of national drug intervention programmes for TB and malaria;
- Promote capacity building in human resources for communicable diseases;
- Reinforce continued cooperation with partners in the combined efforts of development of molecular capabilities. These include national, regional and international institutions, bi/multilateral, public and private organizations and other partners which has provided potential for inter-institutional and national collaborations with good exchanges;
- Promote better use of potential funding sources from the local, regional and international institutions.

### C.1.4 Human nutrition

A network of laboratories which had previously monitored national nutrition programmes for people living with HIV and AIDS have also used isotopic techniques to monitor the efficacy of nutrition intervention schemes in support of breastfeeding mothers.

For the period of 2014–2018 and with support from the IAEA, AFRA should facilitate the continued network operations to monitor important nutrition programmes so as to gain a regional perspective on the status of these interventions. Possible areas for consideration relate to food contaminants, breastfeeding, nutrition and infection.

## C.2 Food and agriculture

The proposed AFRA programmes for 2014–2018 on food and agriculture will seek to continue exploiting the synergies from the previous projects and programmes. Equally important, AFRA has also proposed new initiatives to be considered in advancing the priorities in the food and agriculture sector, as it elaborated in each of the sub sections below.

### C.2.1 Animal health

Since the control of movement of livestock, mostly owned by small scale animal grazers is impracticable, the risk of the spread of transboundary animal diseases (TADs) is even higher with negative impacts on economies. The ongoing preventive programmes on subcontracting for vaccines and quality assurance services are expected to be completed in 2013. Therefore, for the years 2014–2018, integrated TADs control should be continued as the main intervention to be carried out under AFRA.

The AFRA programme will continue to:

- Promote the use of nuclear related techniques, develop and implement programmes and coordination mechanisms necessary to diagnose and control the transboundary livestock diseases including zoonoses. Such techniques are used for controlling diseases such as peste des petits ruminants (PPR) and serological and molecular techniques are used to diagnose and control major livestock diseases;

- Promote sub-regional cooperation through establishment and strengthening of laboratory capacity to address priority transboundary livestock diseases (for example; foot-and-mouth disease for Southern African Development Community (SADC) countries, contagious bovine pleuropneumonia for west and central Africa);
- Support some countries which have started using the skills acquired from training to carry out epidemiological studies for disease control of TADs.

Additionally, the following initiative was suggested:

- To promote an African Union (AU) (Interafrican Bureau for Animal Resources, Pan African Veterinary Vaccine Centre, Pan African Tsetse and Trypanosomosis Eradication Campaign (PATTEC))-AFRA collaborative framework towards the control of livestock diseases in Africa.

### C.2.2 Animal production

Previous programmes show that breeding systems improved as a result of the use of insemination and the management of herds improved as farmers were trained on heat detection. AFRA programmes focus for 2014–2018 shall:

- Promote further capacity building to enable its Member States to utilize nuclear techniques in programmes supporting artificial insemination (AI) programmes. The programmes will include training of human resource both professionals and extension workers and the use of software (Artificial Insemination Database Application and SPERM) for data capture to improve animal genetic resources;
- Continue to encourage its Member States to conserve and sustainably utilize the African animal genetic resources. This will include implementing cost-effective strategies and the proper selection of breeding stock and appropriate feeding strategies.

Additionally, the following initiative was suggested:

- To improve livestock productivity in Africa, components related to health, nutrition and breeding need to be integrated.

### C.2.3 Crop improvement

Food insecurity is a fundamental challenge to human welfare and economic growth in Africa. The access to sufficient food in the region is formidable particularly since the recent analyses suggest that the rate of increase in yields of crops are decreasing, severe climate changes further decreasing areas suitable for agriculture, declining length of growing seasons and potential areas for high yield in semi-arid and arid areas are also dropping. Inadequate research in agriculture improvement and the lack of knowledge of local farmers are challenges that further strengthen the poverty-hunger cycle by affecting food security and exacerbating malnutrition in the continent.

AFRA aims to meet the challenges of food security and crop improvement through the continued application of nuclear technology. The application of nuclear techniques contributes in key areas of sustainable agricultural production, high yielding resistance crops and enhancing water and nutrient use efficiency in irrigated agriculture. AFRA further aims to enhance and strengthen the contribution of Member State to increase food production and consumption, and empower farmers' technical capacity and capabilities. Such capabilities are necessary to facilitate the transformation and optimization of land crops through improved sustainable farming practices.

AFRA's main priority areas for 2014–2018 will be to assist Member States to:

- Breed drought tolerant crop varieties in view of climate change;
- Use mutation techniques to improve upon the wide array of underutilized crops available in the continent;
- Improve the performance of fresh vegetable supply chains in urban –rural interface;
- Undertake studies on consumer-focused approaches aimed at improving food production and safety as well as better utilization of land, water and capital at the peri-urban level;
- Improve crops by using mutation induction and biotechnology through farmer participatory approach. Radiation induced mutations will remain AFRA priority because it is one of the tools used for:
  - Creating variability in crop plants without changing their genetic base;

- Establishing the linkage between genes, their functions and associated agronomic characters exhibited by the plants in the field; and
- Saturating the linkage maps required for marker assisted selections.

As a new initiative, AFRA should collaborate with international organizations, such as the Africa Rice Centre, International Institute of Tropical Agriculture, International Maize and Wheat Improvement Centre, International Centre for Agricultural Research in the Dry Areas, International Crops Research Institute for the Semi-Arid Tropics, BIOVERSITY, International Water Management Institute (IWMI), Food and Agriculture Organization of the United Nations FAO to:

- improve and sustain agricultural production and productivity;
- to develop drought resistant crop varieties as a mitigation against climate change using participatory breeding approach.

### C.2.4 Soil Fertility and water management

The United Nations has highlighted soil degradation as one of the most significant environmental challenges to sustainable food production and supply of water in the 21<sup>st</sup> century. In sub-Sahara Africa, land degradation and soil fertility depletion and the increase in areas facing water stress are considered the major threats to food security and natural resource conservation. In addressing these challenges, AFRA points out that the application of nuclear techniques in assessing effectiveness of soil degradation processes and evaluating effectiveness of soil and water conservation strategies in retaining water and applied nutrients will promote sustainable food production under both rainfed and irrigated agricultural systems. Therefore, the synergies between these two areas (soil fertility and water management) should be exploited to mitigate the emerging issues related to climate change in Africa.

Towards this end, AFRA programme focus and projects for 2014–2018 should gear towards protecting the sustainability of soil and combating desertification, and should make concerted efforts in formulating strategies for i) changing agricultural patterns, ii) the use of nuclear techniques for monitoring water uptake by plants and losses through evaporation and/or drainage and iii) for

quantifying efficiency of nitrogen applied under different irrigated cropping systems through the use of labelled fertilizers.

Therefore, AFRA's main priority areas will be to assist Member States to:

- Develop efficient soil fertility and water management systems using isotopic-nuclear techniques and disseminate via extension services to farmers. Nuclear techniques such as radio/stable isotope techniques can be used in the following areas:
  - Conservation agriculture to ensure natural enrichment of the soil;
  - Proper land use management to avoid the use of arable land for other infrastructure development;
  - Assist member states to adopt small scale irrigation systems for crop production.
- Strengthen Member State scientists working in water management, the use of isotopic and conventional techniques and modern irrigation technology;
- Enhance the knowledge base of extension services in water management and communication technology and its transfer to the farmers;
- Assist farmers in peri-urban fresh vegetable production and supply chain system through the study of the farming systems, quality of water use for vegetable production and the quality of the product;
- Up-scaling the technology to other regions.

The following initiatives are suggested for the successful implementation of the programme on soil fertility and water management:

- Collaborate with international organizations such as IWMI to manage water and nutrients in the rural-urban interface, a key for climate change resilience using isotopic techniques;
- AFRA should encourage Member States to initiate programmes on conservation agriculture and build small units for small scale irrigation to support subsistence farming.

## C.2.5 Food safety

Recent trends in global food production processing, distribution and preparation have made it necessary to address food safety issues along the entire food chain processes from production to consumption. AFRA's main priority in the region shall focus on assisting Member states on the development of food safety programmes and facilitate local, regional, interregional and international trade. With the support of IAEA and collaboration with development partners, AFRA programme focus (through the ongoing project) seeks to ensure that Member states have access to sufficient, safe and nutritious food in the region. AFRA seeks to make a breakthrough to causes of food insecurity such as the inadequate production of staple foods and lack of trained manpower by further promoting the importance of crops sustainability, food production and processing and enhancing knowledge on skills in this field.

In assisting Member States to improve the levels of food safety, AFRA is expected to:

- Strengthen the establishment of analytical laboratories for applying relevant standard procedures and application of production practices in member states;
- Assist in the implementation of analytical methods and procedures that can enable Member States to evaluate the impact of their production practices as well as control food quality parameters;
- Strengthen food safety production systems by the identification and reduction of sources of hazards arising from chemical and microbiological contamination;
- Employ already developed protocols to provide assistance. The use of nuclear techniques, such as radio-labelled compounds and stable isotope techniques, optimize different steps such as validation of methods, estimation and control of measurement uncertainty arising during the development of analytical techniques, and for traceability of food stuffs. These techniques can be applied in the following areas:
  - Monitoring pesticide residues and other contaminants in food and environmental samples;
  - Veterinary drug analyses;
  - Quality assurance and quality management in the laboratory (accreditation) and certification of products;
  - Establishment of regional designated centres for food safety surveillance.

## C.2.6 Insect and pest control

FAO estimates that Africa loses US\$ 4.5 billion annually due to diseases transmitted by pesticides and insecticides such as tsetse fly. Notwithstanding, analysis of the application of sterile insect technique (SIT) with the combination of other techniques in the Africa confirms that the technology has been able to successfully manage and control some pests and insects in the region. The SIT yields economic importance by reducing the impact of pests and increased food production and processing. However, in most cases, Member States in Africa wishing to utilize SIT are in a phase of developing infrastructure and human resources.

AFRA's role will therefore be to facilitate the establishment of regional programmes on education and training so as to ensure the successful use of IAEA's technology for control of insects and pests. The programme will focus on:

- The recognition of AFRA RDCs to promote TCDC will be pursued;
- Building capacity and developing skills by identifying;
  - **The availability of knowledge/expertise** (research institutions, established international organizations, private companies, consultants and experts);
  - **The needs of Member States;** PATTEC, regional Mediterranean fruit fly and false codling moth programmes and country programmes;
  - **Type of assistance offered/required:**
    - Training/capacity building – all disciplines;
    - Standard operating procedures;
    - Quality management systems;
    - Improvement in quality control;
    - Assistance with business plans;
    - Improvement in rearing techniques/facilities - (research and development, methodology);
    - Identification of research projects;
    - Establishment and strengthening of regional/ sub-regional centres and programme
    - Radiation dosimetry;
    - Shipping, test release techniques and sites;
    - Pooling of resources;
    - Knowledge sharing – expert visits (in), scientific visits (out).

Moreover, the *priority pests and insects to be controlled* include:

- False codling moth, Mediterranean fruit fly, mosquitoes and tsetse fly. There are national, regional and international facilities (AU, Burkina Faso, Ethiopia, IAEA, International Centre of Insect Physiology and Ecology, South Africa).

The following initiatives are suggested to improve the control of pests and insects in the region:

- To reinforce the capacity of the tsetse rearing facilities in Kaliti, Ethiopia, and Bobo Dioulasso, Burkina Faso and to use them for rearing flies from other countries;
- To expand all area-wide fruit fly activities involving SIT taking place in South Africa to other countries in the Southern African Development Community (SADC) region;
- Offering training opportunities in existing insect rearing and SIT facilities.

## C.3 Water resources

According to the United Nations Millennium Development Goals (MDGs) Report 2012, over 40% of all people without improved drinking water live in sub-Saharan Africa and the region is not on track to meet the MDG drinking water target by 2015.<sup>2</sup> The lack of access to clean water supply and sanitation affects all aspects of development including health, agricultural productivity, education and opportunities of women and children, stability and peace, the environment as well as economic productivity. The sustainability of Africa's water resources and the inadequate access to basic supply and sanitation services is increasingly threatened by both natural and human factors including rapid population growth, mismanagement of water basins; pollution, environmental degradation, and deforestation; failure to invest in resource assessment, protection and development and unsustainable financing and technological investments in water supply and sanitation. The natural threats to water resources include the multiplicity of transboundary water basins; spatial and temporal variability of climate and rainfall, climate change; and growing water scarcity, shrinking of water

<sup>2</sup> Millennium Development Goals Report 2012 in <http://www.un.org/en/globalissues/water/>

bodies, and desertification. However, the overarching challenge to inadequate access to basic water supply and sanitation services in Africa (despite having huge water bodies) is rooted in the shortage of expertise, and financial and technological constraints. Addressing these threats calls for the adoption of innovative technologies and developing frameworks for cooperative action guided by a shared vision.

Based on the review and analysis of the ongoing AFRA programmes as well as the current water resources challenges facing the region, the following are AFRA regional priorities proposed for the RCF 2014–2018 so as to address the water resource management. Capacity building tops the agenda and will remain the main priority for AFRA and the member states. The priorities are:

### C.3.1 Building capacity for the use of isotope hydrology in water resources management in Africa

- Strengthen regional designated centres (RDCs) in the isotope hydrology application. Three RDCs have been created to support regional efforts to integrate isotope methodologies and to ensure that there are operational sub-regional analytical laboratory facilities;
- Promote the training of isotope hydrology methods and technology through the inclusion of isotope hydrology in curriculum of training institutes/universities;
- Raise awareness and upscale use of isotope hydrology in water resources leading to increased integration of isotope hydrology in water resources management programmes;
- Application of ICT and space technology in water resources development and management using tools such as geospatial information system (GIS), remote sensing and radar, and integrating them with isotope hydrology techniques will be promoted.

### C.3.2 Enhancing the adoption of isotope hydrology techniques in integrated water resources management

- Support specially focused on transboundary surface water and groundwater resources. The core of the activities will be monitoring, collection and

evaluation of isotope data for purposes of integrated groundwater and surface water resources management;

- Focus is on dam safety;
- Improve the understanding of groundwater resources and climate change in respect to how groundwater can be utilized in response to human and climatic impacts and how its potential can be improved, for example through artificial recharge, sea water intrusion, reuse of treated waste water, rainwater harvesting and assessing feasibility of groundwater as an option for climate change adaptation.

### C.3.3 Building linkages with other sectors to maximize benefits.

- Establish cross-sectoral linkages such as agriculture, health and energy etc. in order to maximize benefits by employing a nexus approach to address interconnected issues (for example, the issues of soil and water management will be handled in collaboration with the agricultural thematic area. Similarly water pollution issues will establish collaboration with the health theme and on water resources availability, dam leakage, erosion and sedimentation of reservoirs issues could be handled collaboratively with the energy theme);
- The possible areas of collaboration between and among the various themes of AFRA will be identified through a specially organized forum or meeting.

AFRA identified existing opportunities for creating partnership in the application of nuclear technology in addressing key issue in region:

- **Regional integration nexus**  
AFRA to closely cooperate with the Regional Economic Commissions in the application isotope technology in water resources management;
- **Forging partnership**  
AFRA will have to explore the possibility of creating strong innovative partnerships with regional and sub-regional institutions, development partners, and international organizations with shared objectives in order to commonly address the challenges facing

the region. Identified partners include RECs, World Bank, African Development Bank (ADB), Global Environment Facility/ United Nations Environment Programme (GEF/UNEP), United Nations Educational, Scientific and Cultural Organization (UNESCO), United Nations Development Programme (UNDP) and FAO.

AFRA could consider some new initiatives to improve the delivery and impact of the programme as follows:

- a). Collaborate more with regional economic communities and relevant intergovernmental bodies. AFRA could enter into special agreements or memorandums of understanding with the RECs in areas of cooperation. This will be very useful for future regularization of the AFRA relationship with the AU;
- b). Cooperate more with transboundary rivers and groundwater basins and other regional and international agencies dealing with water related issues for purposes of integrating isotope hydrology techniques in their activities;
- c). Promote research in isotope hydrology through coordinated research projects and participation in conferences by key representatives of Member States;
- d). Support fellowship training in isotope hydrology especially for the implementation of isotope hydrology curriculum in universities and institutes. This may involve training of lecturers to take on isotope hydrology courses;
- e). Assess potential of the triangular arrangement for training in isotope hydrology, where theoretical training in isotope hydrology could take place in one country without an isotope laboratory, while practical laboratory training could take place in another country with laboratory facilities. This could promote capacity building, collaboration and involvement of as many Member States as possible.

## C.4 Sustainable energy development

The challenges facing the energy sector are comparable in most of the African countries and have a great impact on human progress and economic development. These

key challenges include extremely low generation, transformation and transportation capacities despite huge water bodies; low access to and supply of modern energy, particularly in rural areas; weak human and institutional capacities especially related to governance in the energy sector; lack of adequate tools for effective energy planning and policy formulation; and a weak energy demand base. Overcoming these challenges will require intensive regional cooperative efforts to enhance capacity building in energy analysis and planning and to improve energy stability, reliability and efficiency.

In supporting this endeavour, AFRA programmes have developed appropriate mechanisms and frameworks to foster regional collaboration and networking in the field of energy planning, analysis and capacity building to benefit AFRA Member States. This is made possible from the access to energy planning tools developed by the IAEA. Consequently, AFRA programme 2014–2018 will build on the achievements made under previous projects on strengthening regional planning capabilities for sustainable energy development, where Member States were assisted to use several software programmes for energy planning and benefited from the capacity building efforts.

Five regional priorities which will be addressed and promote include:

### C.4.1 Human resource development;

Human resources development is the foundation upon which the other activities depend and is a prerequisite for meaningful energy planning. In maintaining the advantages and success of the already initiated programme on energy modelling and increase the energy planning skills in the relevant African energy institutions, AFRA has reviewed the existing courses and introduced the following programmes:

- Postgraduate qualifications in energy modelling;
- Train the trainers;
  - A distance learning (e-learning approach).
- Development of indigenous models.
  - Priority research output is the development of indigenous energy models.



## C.4.2 Energy planning

Facilitate the expansion from national energy planning capabilities to establishing regional energy planning. AFRA previous programme promoted Economic Community of West African States (ECOWAS) countries as a model for sub-regional approach. The 2014–2018 programme aims to use this approach to further promote strong linkages across the regions

## C.4.3 Partnership building

AFRA aims to build partnership and networks in the field of energy planning with potential partners at the national, regional, sub-regional and international levels through:

- Establishing and consolidating a web of networks which will provide an opportunity to share and exchange experiences, knowledge and information on the energy sector;
- Make use of the networks and combined partnership activities such as trainings which will optimize resources and increase effectiveness. Partners include United Nations Industrial Development Organization (UNIDO), United Nations Department of Economic and Social Affairs (UNDESA), United Nations Economic Commission for Africa (UNECA), New Partnership for Africa's Development (NEPAD) and AFREC. On the regional level, pooling together power tools from ECOWAS, east, west, central and south Africa, cooperation with Southern African Development Community (SADC) and Comité Maghrébin de l'Energie Electrique;
- Facilitate collaboration on energy matters with AFREC by utilizing the database/statistics provided by AFREC.

## C.4.4 Regional designated centres (RDCs)

RDCs are seen as a mechanism towards achieving AFRA priority programme areas in human resource development, energy planning and partnership building programme areas. For effective operations, AFRA should ensure the establishment of at least one other RDC for energy planning possibly in the Francophone countries, other than the RDC established at the University of Cape Town in South Africa.

## C.4.5 Nuclear power programmes

A number of African governments have expressed political commitment to embark on nuclear electricity generation programmes. However, in most of these countries the expertise and competence in core nuclear technologies and infrastructure are lacking. To overcome these challenges, AFRA Member States wishing to embark on nuclear electricity generation programmes should:

- Establish a working group to identify areas in which the IAEA's assistance will be needed in the preparatory work for their nuclear power programmes, and to promote the regional partnership in these areas;
- Activities to support the assessment of the readiness of a country to embark on a nuclear power programme are being undertaken by the IAEA Nuclear Energy Department (where appropriate in conjunction with the Department of Technical Cooperation);
- AFRA Member States should take advantage of the existing opportunities to implement triangular partnerships with South African entities who are preparing for the expansion of the nuclear power programme. South Africa, being the only African country operating nuclear power reactors, offers opportunities that could be beneficial to other member states;
- AFRA project concepts on nuclear power to be submitted to the IAEA for 2014–2015 technical cooperation programme should include the following complements:
  - Quality management system for energy planning data;
  - Develop competencies/strengthen the capacity to undertake power siting studies/characterization;
  - Develop competencies / strengthen the capacity to undertake off-site transmission grid reliability studies.

In order to further promoting the support of the energy sector in the region, the following recommendations are proposed:

- Establishment of RDCs related to education and training specifically for nuclear power programmes;
- Foster research in the development of indigenous energy planning models through publishing of

research in journals, visiting scholars in research activities and symposia;

- Promote cooperation with/between AFRA, AFREC, International Energy Agency (IEA) and the IAEA for appropriate data collection for energy planning purposes;
- Promote TCDC for energy planning cooperation, Integrated Nuclear Infrastructure Reviews in preparing for nuclear power programmes;
- Promote Multi-angulation between more than 2 countries – individuals or teams to visit each other to discuss common issues and share knowledge and successes as part of ongoing regional projects.

## C.5 Industrial applications

It is recognised that over the last twenty years AFRA has supported the establishment and utilization of nuclear technologies in several industrial areas.

### C.5.1 Non-destructive testing (NDT)

AFRA and IAEA have proven to be excellent vehicles for coordinating, facilitating and encouraging regional cooperation and harmonization of NDT activities in Africa. A large degree of regional self-reliance and sustainability has been attained in the areas of NDT which has been made possible with IAEA technical support.

Within the context of the existing NDT projects and to ensure that the increased capabilities are sustainable, the following modalities are used for cooperation and **need to continue:**

1. The establishment of the African Federation of NDT has provided a forum for exchange of technology through regular conferences;
2. Expand common interests through establishing cooperation among AFRA Member States (e.g. Ethiopia and South Africa) or form alliances between RDC and training institutions in Member States;
3. Highly recommended to increase the number of RDCs to meet the needs of the continent, since RDCs are recognized to play a leading

role in training, certification and harmonization of standards.

It is further proposed that AFRA should:

- Use the new modality of triangular partnerships to promote technical cooperation among developing countries (TCDC) in the area of NDT;
- AFRA should promote project partnership and cooperation with the AU and UN organizations such as UNIDO so as to seek support of AFRA technical projects, improve self-reliance and ensure sustainability among Member States. The cooperation should be established through the IAEA and AFRA developed model employed for NDT and a mirror image approach used for welding and pressure vessel inspections;
- AFRA should introduce additional training over and above the current programmes such specialist training programmes for trained inspection personnel, for example, the American Society Mechanical Engineers Standards<sup>†</sup> (ASME) so as to meet the specific NDT requirements of nuclear power generation plants.

### C.5.2 Radiation processing

Similar to NDT, an enormous/satisfactory degree of regional self-reliance and sustainability has been attained for radiation processing. Several advanced radiation processing facilities established in some African Member States now operate according to business plans and are generating income. For instance, the facility in Egypt has led to the development of highly qualified manpower, facilitating the implementation of the technology in other countries through TCDC activities.

It is also proposed that AFRA should:

- Use the new modality of triangular partnerships to promote TCDC in radiation processing;
- Promote the cooperation between the private sector in radiation processing in materials and environmental applications as positive progress has been confirmed in few countries. Cooperation with the private-industrial sector in some African countries has proven feasible for better utilization of radiation processing technology in some specific applications;

- Explore the existing opportunity emanating from the availability of a wide range of unexplored indigenous materials that could increase in value when exposed to ionizing radiation;
- Enhance the application of radiation processing technology in addressing agricultural, health and industrial aspects, and especially those related to direct human demand, such as food supply and health care, as well as the contribution to the protection of the environment (eg; sterilization of single use medical products; pharmaceutical, tissues and decontamination of spices, foods and medical herbs; purification of waste water and contaminated water). This technology has proven to be promising to the health and welfare of human mankind.

### C.5.3 Radioisotopes for trouble shooting

There is an increasingly high demand for the use of radioisotope technology in industries since the technology is necessary for enhancing quality, productivity, reliability and process safety; improve production efficiency and reducing production downtime; utilizing manpower; saving money and other resources; and is used to make engineering decisions- whether to stop production or to continue. radioisotope applications are applicable across broad industrial spectrum such as in petrochemical and chemical industries, mining and mineral ore processing, cement and material construction industries, gas and oil fields and wastewater treatment plants. In some African countries radioisotope technology continue to play an important role to fulfil the needs of industrial sector. Algeria, Ghana, Nigeria, Morocco, Sudan and Tunisia extensively use radioisotope density and level in industries while some countries use the technology in petrochemical industries and mineral ore processing plants.

However, at present the use of radioisotope technology is still underutilized and therefore strong incentives are needed to improve the situation. Taking this into consideration, AFRA project focus scheduled for 2012-2016 will assist Member States on:

- Promotion of self-reliance and sustainability through development of facility business plans and income generation;
- Promotion of radioisotope technology services at national and regional levels, through sensitization, partnership building and networking;

- Upgrading national infrastructure for industrial radioisotope technologies;
- Optimization of technical processes in petrochemical industries, mineral ore processing and chemical industries; such as cement, paper, sugar and the like;
- Maximizing the utilization of radioisotope technologies to monitor and improve the efficiency of waste water treatment plants, oil recovery mechanisms in oil fields;
- Developing national capability on nucleonic control systems (NCSs) applications;
- Facilitation and promotion of regional and TCDC activities in the field of radioisotope technologies based on the identified objectives, taking into consideration the varying levels of development of the participating countries.

Consequently, in order to optimize the usage of the technology the following aspects need attention:

- Identification of regional designated centres (RDCs) in the field of radioisotope applications;
- Industrial partnership and networking communication;
- Effective communication with stakeholders and end-users;
- Participation of African Conferences on Industrial Isotope Technology;
- Sustainability of national nuclear institutions.

Furthermore, AFRA projects should consider launching the following aspects on promoting the application of radioisotope technology in industries:

- Develop ICT based training material especially in the field of radiotracer applications, column scanning and neutron backscatter technology;
- Improving quality and quality control of mineral product in the AFRA region's metalliferous mining industries through the application of off-belt and on-belt neutron-gamma Nucleonic Analysis Systems is an important aspect of the new development in this field;
- Development and validation of new soft wares for radiotracers applications;
- Validation and utilization of suitable radionuclide generators for industrial radiotracer technology;

- Establishment of the quality control and accreditation systems in radioisotope application in industry according to ISO standards, 9001-2000, and ISO 17025;
- Appoint/create a small team of trained personnel to help to maintain consulting capability among Member States by monitoring the nucleonic gauges used in used in Member State industries, to calibrate, to repair if possible, to train the operators and to check their safety.

On the other hand **Member States** will need to address the utilization of the technology through:

- Establish an infrastructure to build strong ongoing linkages across a broad range of industries using radioisotope-based technology to verify and detect process problems and process control (NCS);
- Publicize and promote in the region the potential advantage of radioisotope technology in troubleshooting and optimizing industrial processes (i.e. advertisements, seminars, exhibitions, practitioners trained on marketing skills to promote the technology etc.).

#### C.5.4 Research reactors

AFRA has through the previous programmes addressed the two key aspects of reactor safety and utilization of research reactors (RRs) in Member States. Given the importance and complexities associated with these facilities, the focus areas are **unlikely to change in the 2014–2018 period**. The programme will encourage Member States with research reactors to:

- Follow the AFRA guidelines and indicators for the achievement of sustainable and self-reliance in research reactor operation;
- Perform proficiency tests by following QA/QC procedures and eventually obtain certification and accreditation for laboratories;
- Continue to develop strategic/business plans with marketing strategies to address the socioeconomic problems related to utilizing RRs in order to solve problems of health, nutrition, industry, agriculture and environment. The programme for the utilization should focus on income generation;

- Establish nuclear regulatory infrastructure and adhere to basic safety and security requirements. The AFRA Member States should sign and ratify international conventions of safety and security; and
- Develop appropriate manpower for design, operation and utilization of research reactor and associated facilities, through education and training.

Resource sharing and networking in research reactor utilization and safety will make optimum use of available facilities in the region. Therefore, various aspects of regional collaboration among participating AFRA countries have been proposed for 2014–2018 to enhance utilization of research reactors and address the following areas:

- Opening up of facilities for users from AFRA countries in the region to undertake research activities involving the use of nuclear techniques and computational methods to enhance utilization;
- Strong links should be established with the universities and other research institutions in the region;
- A forum of interested parties, users and organizations for the utilization and safety of the RRs in the region should be established. The forum should be open to all countries with or without research reactors and with relevant regional and international organizations and potential partners. Formal and extensive collaboration should be established through bilateral and/or multilateral agreements and memorandum of understanding (MoU);
- African research reactors could be used for isotopes production for industrial applications of NDT, radiation processing, oil exploration and medical applications;
- Utilizing RRs for geochemical mapping of the region for elements of economic importance and exploration of uranium deposits within the African region to support future nuclear programmes of African Member States;
- Integrate the AFRA project on utilization of research reactors into AU programmes to support industrialization and trade in Africa; and
- Use research reactors for training of nuclear engineers and related fields required for the safe operation of future nuclear power plants in Africa.

Additionally, to enhance the utilization of RR for commercialization, there is the urgent need for AFRA to:

- Develop an awareness programme and publicity to attract stakeholders to utilize the facility for addressing the many socioeconomic problems facing Africa;
- Further explore the opportunities for collaboration and partnership with government institutions, universities, industries and regional organizations so as to promote the utilization of RR;
- Promote utilization of the TCDC modality for the exchange of scientists and students to undertake research and development (R&D) and educational activities at the centres.

### C.5.5 Accelerators

During the past two decades the IAEA has assisted many national laboratories in its Member States in various fields of accelerator applications. The IAEA has provided several laboratories in developing countries with low energy accelerator systems, fellowships and expert visits. This assistance has been realized through both regional and national technical cooperation projects, coordinated research projects and other IAEA activities. The IAEA sub-programmes and/or projects related to accelerator utilization are supporting the use of electron and ion accelerators for electron and ion beam processing, material analysis, radioisotope production and other medical applications.

A number of African countries now have accelerator facilities and AFRA should begin to play a role in promoting their maximum utilization through a regional approach.

The following areas of applications should be developed to address socioeconomic issues facing the region:

- Atmospheric aerosols and environmental investigations;
- Thin layer analysis;
- Geological investigation;
- Archaeology;
- Production of radioisotopes and medical application;
- Medicinal herb analysis;

Accelerators have played and will continue to play important role in the processing of materials. In this context, they have had a significant impact on the economy of developed countries and have contributed in a major way to the development of high technology products.

### C.6 Radiation safety and nuclear security

The radiation safety and nuclear security sector continues to be a very important area for all of the AFRA Member States. The programme focus for 2014–2018 will cover three main thematic areas: a) radioactive waste management; b) radiation protection; and c) nuclear security.

In order to strengthen the capacities and capabilities of Member States in the area of radiation safety and nuclear security, it is proposed that potential regional projects on radiation safety and nuclear security sector should include the following components:

1. Improving national regulatory infrastructures for the control of radiation sources;
2. Strengthening nuclear security capabilities in Africa;
3. Strengthening the radioactive waste management infrastructure in Africa;
4. Sustainability of regional radiation protection infrastructure;
5. Strengthening effective safe transport of radioactive materials;
6. Strengthening technical capacities for occupational exposure control;
7. Strengthening legislative and safety infrastructures;
8. Strengthening occupational radiation protection;
9. Strengthening national regulatory infrastructures;
10. Strengthening capabilities for the protection of the public and the environment from radiation practices;
11. Strengthening national and regional Capabilities for transboundary detection of radiation sources;
12. Developing safe naturally occurring radioactive material (NORM) and technologically enhanced

naturally occurring radioactive materials (TENORM) waste disposal technology and long term repository designs;

### 13. Development of technical support capabilities for regulatory authorities in Africa.

More specifically, AFRA regional priorities for 2014–2018 are elaborated as follows:

#### C.6.1 Radioactive waste management

AFRA will continue to play a key role in improving the regional capability to deal with radioactive waste. Using TCDC modalities (primarily through RDCs) the programme will continue to assist AFRA Member States to:

- Establish national policies and strategies and to develop a quality assurance management system for radioactive waste;
- Develop and implement waste repository options;
- Develop safe NORM and TENORM waste disposal technology.

AFRA points out that efforts to retrieve, condition and safely store orphan sources will continue as a priority using specialized teams drawn from the RDCs.

#### C.6.2 Radiation protection

For 2014–2018, AFRA will continue to reinforce the approach on promoting the use of self-assessment methodologies to promote the establishment and improvement of radiation protection infrastructure amongst its Member States. This approach has proved to be beneficial to many of the participating countries through the previous programmes. AFRA projects in radiation protection should be seen to supplement other regional projects implemented by the IAEA.

Important aspects related to the five thematic areas as contained in the International Basic Safety Standards will continue to receive attention to enable Member States to:

- Adopt legislations and regulations in line with international recommendations and guidance;
- Provide regulatory bodies with sufficient numbers of

competent staff and financial resources;

- Improve national regulatory infrastructures for the control of radiation sources;
- Provide radiation protection services;
- Strengthen effective safe transport of radioactive materials;
- Strengthen occupational exposure control;
- Develop capabilities to respond to emergencies;
- Strengthening capabilities for protection of the public and the environment from radiation practices;
- Establish environmental monitoring systems where needed.

Equally important, an introduction of Postgraduate course in radiation protection has become part of the AFRA programme from 2012. Personnel will undergo training leading to a Postgraduate diploma at the RDCs from 2012-2015.

#### C.6.3 Nuclear security

AFRA has worked in close collaboration with the IAEA, supported by the Nuclear Security Fund, in building capacity of Member States to respond to the threats posed to/or by nuclear security. During 2014–2018, this approach should be sustainably reinforced particularly on:

- Strengthening of human resource capacity building;
- Strengthening national and regional capabilities for transboundary detection of radiation sources;
- Promoting awareness among the front line nuclear security responders.

Additionally, AFRA has further recommended the following models to be applied in the promotion of R&D and TCDC in Africa:

#### Triangular model initiative:

An initiative between Member States, international funding institutions and IAEA/AFRA to encourage donors to provide technical and financial support to Member States through bilateral agreements. This approach will help in the optimization of the resources available for the implementation

of AFRA activities including Research and Development.

### Switch from “classical” training to “hands on” training:

This approach will help in maximizing the applied technical capabilities of trainees and researchers in Member States and encourage train the trainers approach for project sustainability.

### RDCs :

Establishing more RDCs and supporting the existing centres in order to sustain the TCDC approach.

### Involvement of regional experts:

Encouraging the use of regional experts along with international experts in all missions and training courses so as to enhance transfer of know-how and expertise to the region.

### High involvement of Project Scientific Consultants (PSCs):

The PSCs should be more involved in the planning and implementation of the respective projects and in particular in technical meetings, workshops, conferences etc... related to the project so as to provide consultancy and assistance to project coordinators.

## C.7 Education and training

The AFRA programme on promoting human resource development aims to assist Member States to acquire knowledge and management in the field of nuclear science and technology. Through the establishment of the High Level Steering Committee which oversees the implementation of education and training programmes, AFRA has made significant progress in addressing the long term capacity building needs in the region. As can be seen from the six thematic areas described above, human resource development (HRD) is an overarching need for the region. AFRA envisions that, by the end

of 2018, every AFRA Member States will have the possibility to educate and train its citizens in various fields of nuclear science and technology, within Africa, to meet its needs and bridge the gap in human resources for the required field.

### C.7.1 Education

The following areas are high priority in need of HRD Postgraduate programmes:

- Human health;
  - Radiation therapy;
  - Nuclear medicine;
  - Medical physics;
  - Radiopharmacy.
- Sustainable energy development;
  - Nuclear engineering.
- Radiation and waste safety;
  - Radiation protection and health physics;
  - Nuclear safety and security.
- Isotope hydrology;
- Nuclear analytical techniques involving neutron activation analysis, X-ray fluorescence, ion beam analysis, using accelerators;
- Radiation entomology for SIT technique;
- Communicable diseases for isotopic and molecular techniques;
- Isotope and molecular techniques in nutrition.

### C.7.2 Training

The following areas were identified as training priorities (less or equal to 6 months):

- Water resources;
  - Stable isotope techniques;
  - Radioactive dating.
- Food and agriculture;
  - Sterile insect technique;
  - Radiation processing;

- Mutation breeding and biotechnology.
- Industrial applications.
  - Radioactive tracer techniques;
  - NDT;
  - Radiation processing;
  - Nuclear analytical techniques.

In addition to programmes on education and training, AFRA will;

- Recognise regional designated centres, where not yet available, to provide the above regional education and training programmes;
- Integrate ICT, into AFRA education and training programmes as a supporting tool;
- Promote research and development in various fields which will be accommodated within the framework of the regional programme in education and training;
- TCDC mechanism should be established through bilateral agreements and/or through Memorandum of Understandings so as to exchange and share expertise and knowledge, and the pooling of resources;
- AFRA should explore the existing opportunities to optimize cooperation with strategic partners in the area of education and training, in the field of nuclear science and technology. Potential partners include; African Virtual University (AVU) and establishment of VUCCnet to support regional cancer training and mentorship network, African Ministerial Council on Science and Technology (AMCOST) and the African Science and Technology Consolidated Plan of Action (CPA); AFREC; UNESCO and AU's Department of Human Resources in Science and Technology.

## D. Partnership building and resource mobilization strategy in support of AFRA RCF 2014–2018

The successful implementation of AFRA programmes and projects depends by and large on the will and responsibilities of Member States to implement stated objectives, and equally important, requires

the mobilization of resources (material, technical and financial) so as to attain the set objectives and address the challenges facing the region. Taking this into account, the AFRA-PBRMC developed a framework (including basic principles and strategy) to be used for partnership building and resource mobilization.

The four basic **principles will** guide resource mobilization from potential partners:

- **“Self-help” principle:** AFRA countries should contribute first funds for the implementation of AFRA activities;
- **Sound and well-documented projects:** All AFRA projects have to be well designed and formulated, need-driven and solutions-oriented; clear objectives, inputs, expected outputs and success criteria;
- **Sponsorship:** AFRA has solicited support from the AU as well as the Vienna-based African Group to use their political influence to help AFRA mobilize the required funding;
- **Use of TCDC modality:** This modality proved to be instrumental for optimizing/reducing regional projects costs. Hence AFRA makes use of this modality in all its cooperative projects with particular emphasis on the principle of *“fewer but better”*.

In order to address the funding requirements required to implement the RCF. The following **strategies** need to be taking into consideration:

- **Analysis of the current AFRA situation including the available resources;**
  - Developing a comprehensive strategic framework is necessary to guide priority areas which require resources for implementation;
  - A thorough and concrete analysis of AFRA programmes and projects is necessary so as to identify areas which require further intervention and helps to identify new priority areas to be addressed, and thus help to identify and establish development partners and mobilize resources to fulfil the objectives of AFRA. Thus a comprehensive strategic framework is necessary to guide priority areas which require resources for implementation.
- **Analysis of the development assistance environment include;**
  - Innovative development internationally and nationally;



- Economic growth and competitiveness; (globalization, 'Nuclear Renaissance', NEPAD);
  - Political factors (improved political acceptance, Atomic Energy Commissions/National Nuclear Institutions restructuring and legislative changes);
  - Re-regulation of the energy sector as well as heightened security imperatives;
  - Cooperative agreements;
  - Regulations on safety standards and regulatory practices;
  - Limited resource base vs. high expectations;
  - New reactor technology (such as pebble bed modular reactors and the International Project on Innovative Nuclear Reactors and Fuel Cycles);
  - Prospects and challenges of implementation of the Pelindaba Treaty.
- **Identification of the potential partners and donors;**
    - **Donor countries:** China, France, Japan, Russia, Spain and USA;
    - **Partner organization** FAO, Japan International Cooperation Agency, GEF, UNESCO, UNEP, UNICEF, UNDP, UNEP, GEF (Global Environmental Facility) EU Commission (Brussels), Cooperation on Science and Technology, International Development Research, National Institution of Health and the AU Commission as well as NEPAD;
    - **Financial Institutions** especially regional: African Development Bank, Organization of the Petroleum Exporting Countries Fund and the Islamic Development Bank;
    - **The Vienna-based African Group (V-BAG)** was identified as gateway to many of the potential donors like China and Japan for partnership building; **Tokyo-Based African Group (T-BAG)** would be very instrumental in facilitating contacts with Japan;
    - **The TCDC** activities could be strengthened with a new approach by interacting with some regional agreements to learn about their practices and experiences in cooperation matters: RCA, ARCAL, ARASIA and the Mediterranean Agreement.
- **Development of effective communication strategy;**
    - AFRA should promote AFRA programmes and projects and create public awareness on the benefits of peaceful application of nuclear technology in attaining socioeconomic development in Africa;
    - This will be done by a Public Relations Officer through the development of promotional tools such as exhibition material, a web page, e-mail information network, presentation material, social networks (Twitter, Facebook), and public relations projects in order to promote AFRA and its activities at large.
- **Developing and nurturing of relevant partnerships;**
    - The systematic processes of identifying potential partners with common interests and the final establishment of cooperation with potential partners initially will involve AFRA-PBRMC; followed by the AFRA Chair and the support of the IAEA Secretariat;
    - Identified areas of cooperation will require negotiations and laying out modalities of implementation before reaching agreements through signing of MoU.
- **Mobilization of the required resources.**
    - AFRA-PBRMC working together with the AFRA-Programme Management Committee shall determine the AFRA programme resources requirements and initiate necessary actions for the mobilization of resources for the full implementation of the programmes;
    - The AFRA Fund which shall be administered by the IAEA will be used for the purpose of raising and collecting the voluntary contributions of donors and AFRA Member States.



**AFRA**

African Regional Cooperative Agreement for Research, Development  
and Training related to Nuclear Science and Technology  
<http://www.afra-iaea.org/>