



# INDONESIA

UN SECURITY COUNCIL 2019-2020  
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## IMPLEMENTATION OF THE IAEA TC PROGRAMME IN INDONESIA:

### CURRENT STATUS AND ACHIEVEMENTS



## IMPLEMENTATION OF IAEA TC PROGRAMME IN INDONESIA: CURRENT STATUS AND ACHIEVEMENT

## Introduction

Indonesia believes that IAEA Technical Cooperation (TC) Programme plays indispensable role as the main vehicle for the Agency to deliver its mandate to promoting the peaceful uses of nuclear technology, especially in the developing regions of the world. In our experience, IAEA TC Programme has enabled Indonesia to develop human resource capacity and to continue research and development of nuclear science and technology for peaceful purposes which is in line with Indonesian Government national development program.

During the implementation of TC Programme since 1966 at Indonesia, some excellent achievement has been achieved by Indonesian government through sustainable support from IAEA and cooperation with other Member States, not only giving positive impact to our national development program, but also contributing at regional level and supporting global sustainable development goals. To support TC activities, Indonesia support the IAEA's Peaceful Uses Initiative (PUI). Since 2012, it has contributed to support Technical Cooperation among Developing Countries and hence is providing expertise to assist other developing countries. This initiative will continue in the future in the form of experts participation, and provide facilities for young scientists from other Member States to be trained in Indonesia, as well as contributing on the revitalization of IAEA Seibersdorf Laboratories, which has been started since 2014.

This book covers several achievements of IAEA Technical Cooperation Programme implementation at Indonesia, covering efforts at agricultural, health and medicine, energy, environmental, industrial fields and human capacity building to strengthen nuclear science & technology mastery and applications towards achieving Sustainable Development Goals.

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# Superior Seeds: Optimizing the Local Potential



## Overview

Indonesia is an agricultural country with 37 million of its citizens living in rural areas and working in the agricultural sector. Food crop productivity plays an important role in the development of these rural areas and national food security, as it will increase farmers' income and ensure the availability of food stock. With support from the IAEA through its Technical Cooperation Programme since the 1970s, the application of nuclear science and technology has helped Indonesia to strengthen food security as part of its national development program.

One major achievement of this effort is the release of more than 30 superior varieties, developed utilizing the radiation mutation breeding technique. Most are paddy and soybean varieties, which have become main staple foods for Indonesian citizen. Since 1972, BATAN researchers have been actively conducting research and development in mutation breeding for inventing new superior varieties.

The R&D has been supported by the IAEA through TC Programme TCPs (such as IAEA TC-Project INS/5/030, INS/5/038, INS/5/039, IAEA regional project RAS/5/017, RAS/5/040, RAS/5/045, RAS/5/056 and IAEA CRP Project Contract No. 16947), contributing to sustainable technology transfer to farmers and the agricultural industry.

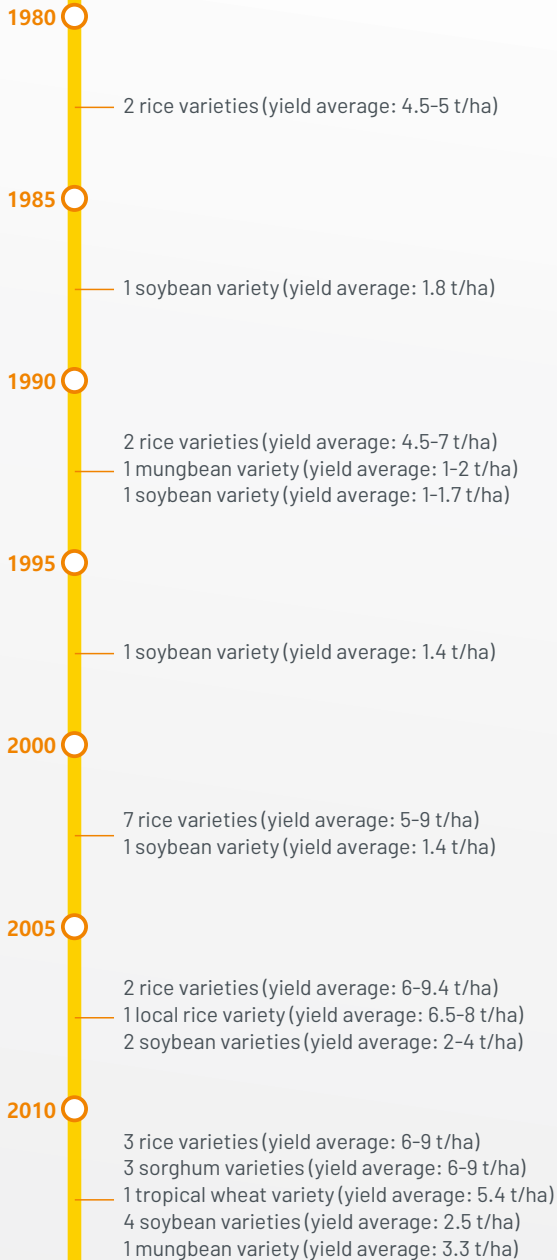
## The Goal

Food security through sustainable economically-competitive farming and industrial network.

## Objective

- Increasing farmers' access to superior seed to increase agricultural productivity.
- Empowering farmers through sustainable partnerships and industrial network.

Superior varieties developed using a combination of hybridization and radiation-induced mutation techniques



The application of mutation breeding techniques in Indonesia has contributed to the development of 20% of its national superior varieties. This remarkable achievement has been acknowledged by the Indonesian Government.

In 2009 the Government awarded the Agricultural Innovation Award to BATAN, and in 2013, Bestari, one of the most popular paddy varieties was recognized as the best variety invented by a national researcher. In 2014, Inpari Sidenuk, another paddy variety, received the same award.

At the global level, the acknowledgement of mutation breeding research was given by the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture (NAFA) in the form of the Outstanding Achievement Award in Mutation Breeding in 2014.

The first superior variety resulting from mutation breeding was released in 1982 and to date at least one variety has been released annually, contributing to the availability of superior varieties and giving options to farmers, as well as contributing to the efforts to strengthen food security at the provincial and national levels.

To date, 37 food crop varieties developed with the mutation breeding technique have been released by the Ministry of Agriculture and utilized by Indonesian farmers. These include 21 rice (*Oryza sativa* sp.) varieties, 10 soybean (*Glycine max* sp.) varieties, 3 sorghum (*Sorghum bicolor* sp.) varieties and 1 tropical wheat (*Triticum aestivum*) variety. Most of these varieties were released in the last 10 years, an excellent achievement demonstrating significant competency development among Indonesian researchers in the last decade.

These varieties have been proven to have advantages over conventional varieties, especially higher productivity, better resistance to pests and crop disease, shorter planting period, better quality and more adaptive to environmental changes, which is very much related to the global issue of climate change. To date, at least eight paddy varieties are commonly used by farmers in Indonesia, covering more than two million hectares of farm field in 22 provinces.

Five soybean varieties also have been sustainably produced by several seed producers. Based on scientific data, three of these soybean varieties have suitable characteristics for supplying the tempe, tofu and soymilk industry due to their high protein content and attractive texture, while two other varieties suit the soy sauce industry demand.



## Pathway to Prosperity

Indonesia is an agricultural country with a total population of 255 million people. Its agricultural sector plays an important role in national development and contributed 14.9% to the country's GDP from 2010 to 2013. Based on 2015 statistics, 37.75 million citizens are economically dependent on the agricultural sector and almost 30% of citizens living under the poverty level are farmers living in rural areas. These facts show developing the agricultural sector and empowering farmers are two essential factors for national development.

The current projection for 2019 is that there will be a need for 82 million tonnes of rice and 2.6 million tonnes of soybeans to meet Indonesian food demand, while to date the country is only able to produce 79.17 million tonnes of rice and 900 thousand tonnes of soybeans annually. Growth in rice and soybean demand is still projected for years to come, giving a challenge to the government to fill the supply gap.

This condition shows that supply agricultural sector development in Indonesia faces two major challenges, meeting the food demand with local production, and protecting and ensuring farmers' welfare as the main stakeholders in the food industry. Therefore, sustainable R&D, such as mutation breeding, is essential to produce and provide superior varieties with high productivity and

adaptability to local condition. This will support the availability of sustainable superior seed which will empower the farmers to increase their productivity.



To foster the utilization of mutation breeding products and help local farmers increase their productivity, the Indonesian Government has been conducting technology transfer activities involving the active participation of the Ministry of Agriculture, local governments and universities. The program, known as Promotion of Nuclear R&D Products, which also involves potential partners at the local and national levels, aims to encourage agricultural sector stakeholders to provide a sustainable supply of certified superior seed to meet market demand.

Over 18 years of application, the program has successfully encouraged new seed producers at the provincial level and enhanced the availability of superior seed stock for farmers, especially those who have difficulty accessing quality seed due to geographical barriers. This positive impact will in turn make a strong contribution to achieving food security at the national level.

By 2016, the promotion program was a successfully established partnership with more than 30 partners in more than 22 provinces in Indonesia. In addition, the utilization of the program also conducted by involving six commercial seed breeders at the national or local levels to guarantee the sustainability of the the certified seed stock. Those numbers are expected to rise in the future in harmony with the expansion of promotion areas and also the invention of new varieties of products.

Slightly differently from rice, soybean promotion mainly aims to provide foundation seed which will be further developed as extension seed. The program also targets the expansion of soybean fields into the new areas, especially outside the existing soybean producing areas.

To increase farmers interest in planting soybean, government also invested in the development of Agro Techno Parks (ATP) which are utilized as demo plant facilities and also technology incubation facilities for commercialization purposes. These ATPs are also equipped with cold storage facilities, which enables longer seed storage. This strategy will help local agricultural stakeholders and the food industry to ensure the soybean supply.

Using the mutant superior seeds not only increases productivity, but also has a direct economic impact on the farmers. The provision of excellent quality seed, as one main driving factor to increase productivity, may double farmers' income compared to conventional rice varieties. This will also make a strong contribution to efforts to alleviate poverty in farming communities.

The Inpari Sidenuk variety is a good example of positive economic impact: the variety produces 8-10 tonnes/hectare, 50% higher than national average productivity. Two tonnes margin per hectare gained by farmers combined with two weeks shorter cultivation period, will have economic benefit for Indonesian farmers.

In Gowa Regency – South Sulawesi Province, the distribution of Inpari Sidenuk seed by local producers has successfully met 3% of local seed demand. With the scheme of foundation seed production which is in turn registered as certified seed, the distribution has given new option to local farmers for rice seed with much higher productivity.

This local effort will support the provision of sustainable certified superior seed which has become a main requirement in developing farmers' welfare, especially in the eastern part of Indonesia with less access to certified seed. The use of superior seeds by farmers will have direct impact in higher yields, motivating farmers to create positive changes to their surroundings, encouraging their environment to reach autonomy and creating a sustainable effort towards food security.

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*Promoting superior varieties is focused on creating a partnership scheme to convince farmers of the benefit of certified superior seed application and to join the potential business in meeting increasing seed demand*

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# Adding Value To Indonesian Food Commodities



## Overview

Food irradiation techniques have been developed in Indonesia since 1968 in cooperation with the IAEA. Initially, food irradiation research was developed to prevent damage or loss of food commodities during storage, which caused considerable economic losses, especially applied for high economic-value commercial export products i.e. spices and dry ingredients, tuber and root crops, cereals, dried fish and frozen shrimp. The research also focused on gaining government support and to promote the utilization of the technology for food and other prospective industries.

By 1987, the issuance of Irradiated Food regulation by the Ministry of Health, No. 826/MENKES/PER/XII/1987, marked a commercialization era milestone for food irradiation in Indonesia. The regulation permitted the use of irradiation techniques for three commercial food commodities: spices, tubers and grains.

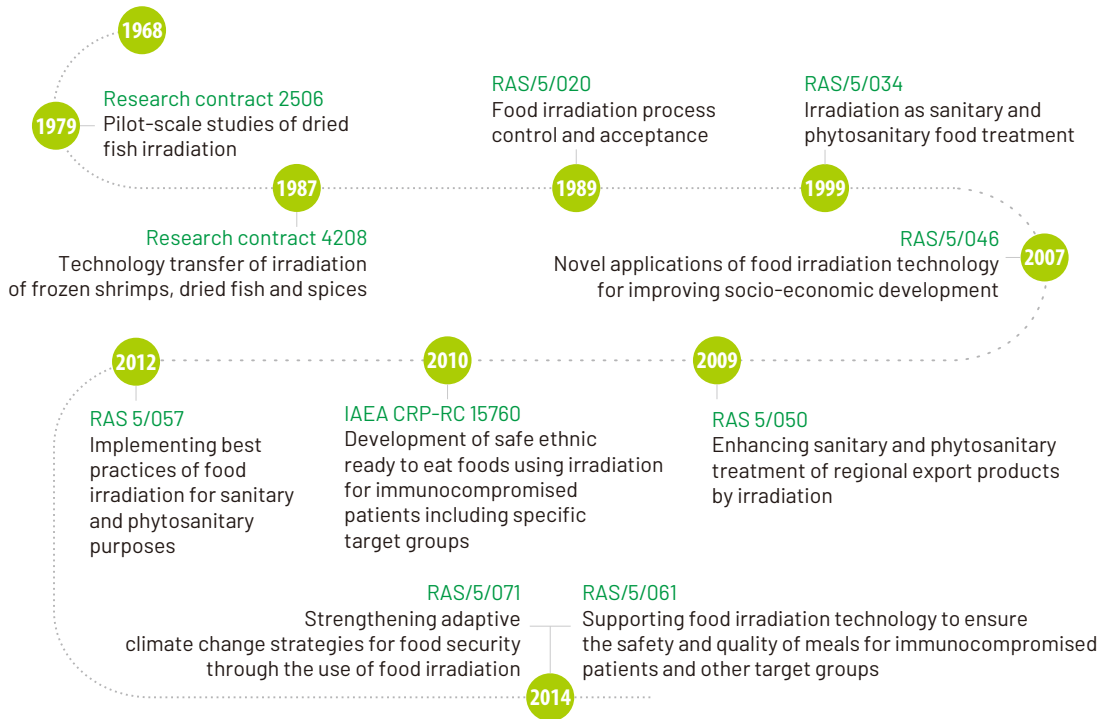
In 1995 the regulation was revised, to accommodate the addition of two commercial products, i.e frozen shrimp and frog legs as well as dried fish products. The new regulation also increased the maximum permissible dose from 1 kGy to 5 kGy, the dose level which is effective at reducing the level of pathogenic bacteria in food products. In 1996, fresh red chilli was added into the permitted list.

## The Goal

- Adding economic value and increasing safety of local food products as a nutrition commodity for applications in emergency situations, natural disasters and for patients with special dietary needs.
- Increasing Indonesian food products' competitiveness in the global market.

## Objective

Utilization of irradiation processes by the private sector and the food industry.



Today, the Ministry of Health allows the application of irradiation for 11 food commodities, including mango, mangosteen, seafood and processed products, meat and processed products, and ready-to-eat food products. The main purpose is to extend shelf-life and also sterilization. Support from the Indonesian Government is shown by the enactment of Food Act No. 18 in the year 2012; and under the supervision of the National Agency for Drug and Food Control, the use of irradiation was also expanded for sterilization of medical products and cosmetics.

This strong support had a positive impact on the development of industrial sector, as shown by the significant increase in the number of industries utilizing irradiation processes from 60 companies in 1998 to almost 200 companies in 2016. To date, Indonesia has one non-commercial irradiation facility operated by BATAN and one commercial irradiation facility operated by a private company.

The Indonesian Government aims to have the new Merah-Putih irradiation facility in operation by the end of 2017, adding a commercial irradiation facility serving industrial demand for food and medical product irradiation. The development of the Merah-Putih Irradiator with high local content levels will increase private sector interest in investing in irradiation businesses, which will further strengthen the economic value of Indonesian food products.

## Achievement

- Providing technical data on food irradiation safety for regulation drafting consideration.
- Encouraging the private sector to invest in irradiation facilities to provide irradiation services for food, cosmetics and health products.
- Increasing Indonesian products' competitiveness in regional and global markets.



## Irradiation: Making Traditional Dishes Safer and More Accessible

To foster the application of irradiation techniques in Indonesia, the research on the irradiation of ethnic ready-to-eat foods of plant and animal origins has been successfully developed. Gamma irradiation at the dose of 8-10 kGy in combination with proper packaging techniques and low temperature along the irradiation process has been implemented for most foods of plant origin, with a dose of 45 kGy for food of animal origin. This technique is aimed to prevent food poisoning, extend the shelf-life of food, and provide a safe diet for people with suppressed immune systems.

The ready-to-eat food irradiation which was initially developed for space mission personnel, is now being adopted in Indonesia not only to provide a safe diet for patients with special dietary needs, but also to provide nutritious food for personnel assigned to remote areas or for people in emergency situations and in the case of natural disasters.

The irradiated ready-to-eat food not only ensures the availability of quality food for long periods, but also gives new opportunities for people to consume "home-made food" even in the case of emergency and other difficult situations. This technique also provides opportunities to provide nutritious food even when there is no cold storage, due to its ability to extend shelf life at room temperature storage.

Active participation in the Joint FAO/IAEA Division project for food preservation has enabled Indonesian researchers to provide nutritious and safe food with familiar taste for Indonesian people. The application of irradiation techniques has made available a variety of ready-to-eat meals based on traditional Indonesian dishes which are directly consumable or cooked and have a long shelf-life. These food products also enable for patients with special dietary needs to consume a large variety of food during their medical treatment, enhancing their nutrition and increasing their physical immunity, contributing to faster recovery.



In applications for natural disasters, Indonesia has experience in supplying irradiated ready-to-eat foods for disaster victims. In 2014, during the evacuation and recovery period for the landslide in Cikadu regency, West Java, BATAN in cooperation with ACT NGO provided food for 200 refugee who were living in temporary evacuation facilities. Special traditional food such as meat rendang and tofu-based food which were familiar for them, was provided to their facilities.

The irradiation process eliminated any micro-organisms that could spoil the food, enabling it to be transported to the distant emergency centres and stored at room temperature for a long time. Similar experience was also gained after the earthquake in Nepal in April 2015. This technique enabled the Indonesian Government and ACT promptly supply humanitarian assistance to the victims in Nepal.

This non-commercial application of irradiation techniques is strong evidence that this excellent technique is not only useful for increasing food quality for commercial purposes, but also gives opportunities to contribute to a peaceful world. As shown in the case of Indonesian experiences during emergencies and natural disasters, with irradiated food packages filled with home-cooked foods, there was immediate positive feedback, patients and evacuees can taste their connection to something familiar: **home**.

*"Varieties of traditional ready-to-eat dishes which have been sterilized using irradiation technique provide dietary alternatives for patients, with home-made flavour, while also maintaining an adequate nutritional level"*

Researcher opinion on irradiation application for patients with special dietary needs



## New Facilities Development: Building Capacity and Industrial Network



To foster the application of irradiation techniques in Indonesia, the Indonesian Government in cooperation with the Hungarian Government, is building a new irradiation facility at Serpong Nuclear Complex in Banten Province. The facility is being built with a technology transfer cooperation scheme between researchers and engineers of the two countries, enabling the Indonesian Government to build the facility with high local content, while mastering the facility development technology. The new facility is named "Merah-Putih Irradiator" referring to the high local content which symbolizes the empowerment of national industry in developing new technology.

The aim of this project, which is projected to be in operation by August 2017, is to provide the Indonesian food industry with a reliable facility for food and health product irradiation at the commercial level. This project also gives Indonesian industry the opportunity to develop and build its own irradiation facilities in the future with high local content, not only empowering the local food industry with modern technology but also strengthening national industry competitiveness in regional and global market.

*The new Merah-Putih irradiation facility will enable national industry to develop and build similar facilities in the future, to meet food industry and market demand for food irradiation services*





# IAEA Collaborating Centre For R&D and Nuclear Capacity Building in NonDestructive Diagnostics, Testing and Inspection Technologies



## Overview

Non Destructive Testing (NDT) has been known for decades as the best solution for many investigation applications at industrial, environmental and health sectors due to its special ability in providing fast investigation results without giving any physical impact to the investigation objects with excellent quality.

NDT development in Indonesia has been conducted for decades, combining conventional NDT techniques such as X-Ray film investigation or Gamma Ray investigation with new and modern technology such as Computed Tomography (CT) technique, Betatron instrument, Neutron Analytical Technique (NAT) and Neutron Radiography. Through its continuous research and development, accompanied with sustainable workforce development, Indonesia has reached the level of advance mastery of non-destructive technologies.

Since 2014, Indonesia has been appointed by IAEA as Collaborating Centre for Research and Development and Capacity Building in Nondestructive Diagnostics, Testing and Inspection Technologies (NDE), an acknowledgement for Indonesia as focal point for the development of Advanced NDE methods and also engineering development of Advanced NDE Instruments at Asia-Pacific Region.

## The Goal

Establishment of NDE Collaborating Centre which meet national and international standards for NDE research, development and applications.

## Objective

- Providing reliable standards and services for material testing, inspection and facilities maintenance.
- Development of advanced NDE instruments and softwares.
- Providing certified training facilities for NDE professionals.
- Providing standard & certified facilities for NDE technologies development.



During the appointment as NDE Collaborating Centre, which is hosted by CIRA-BATAN, Indonesia has hosted several regional workshop and training as part of Indonesia commitment in supporting IAEA goal in developing human resources in NDE field. During the period as well, Indonesia has reached several important milestones towards building national capacity in application of non-destructive methods to increase quality and reliability of national industrial products, and also increase industrial safety standards, to support national program in increasing national industrial sector competitiveness.

IAEA Collaborating Centre of NDE at Indonesia involves several R&D Centres covering broad spectrum of non-destructive methods, industrial sector as user, universities, regulators and professional associations. Excellent synergy of these important stakeholders has managed to empower NDE Collaborating Centre to become focal point of research, development and application of non destructive methods at national and regional level.



## Achievement

- **Development of Advanced NDT Service.** IAEA NDE Collaborating Centre has helped Indonesian engineers mastering materials investigation utilizing Digital Radiography, Computed Tomography X-Ray, Gamma and Neutron Beam, Gamma Tomography, Neutron Radiography, Neutron Activation Analysis and Neutron Analytical Technique.
- **Advanced NDT Instruments Engineering.** Development of Advanced NDT Instruments such as Gamma Ray Digital Radiography and Computed Tomography was achieved under coordination of IAEA NDE Collaborating Centre. The development of new methods for nuclear industry facilities maintenance was also achieved utilizing non-radioactive NDT techniques such as Ultrasonic Testing, Acoustic Emission and Infrared Testing. Automatic Gamma Scanning for industrial applications was also developed.
- **Human Resources Development.** Regular trainings and education for NDT professionals are also conducted under IAEA NDE Collaboration Centre coordination. Trainings in digital radiography, computed tomography, ultrasonic, thermography, acoustic emission and Eddy current regularly held for national and regional professionals.
- **Accreditation of NDE Facilities.** The development of NDE facilities management and its supporting aspects has enabled these facilities becoming national & international Competency Test Facilities for NDT professionals.





# Nuclear Technique For Air Pollution Control: Improving Air Quality in Asia-Pacific Region

## Overview

Air pollution caused by airborne particulate matters (APM) is recognized as a problem not only for individual countries but also contributing to problems within regions and globally. Air pollution has a serious impact on human health, visibility and climate change. Global efforts to study pollution trends, its pathways and evaluating measures are needed to decrease pollution and essential to provide cleaner air for us and future generations.

As part of this global effort, the IAEA has been continuously supporting and encouraging Member States to participate in its program to utilize advanced nuclear analytical techniques (NAT) to characterize the APM, creating a database for pollution trends, identify the sources of particulate pollution and reaching its ultimate objective of contributing to the improvement of air quality in the Asia and Pacific region.

The IAEA through its Regional Cooperation Agreement with states in the Asian and Pacific regions initiated an air pollution project to assist member states in applying advanced NATs to the assessment of APM pollution.

The fifteen participating countries have developed the capability to collect and analyze the samples, and utilize the resulting data to identify the anthropogenic and natural pollution sources and to assess the extent of their impact.

As part of the Asia-Pacific community, Indonesia is also actively participating in the project. During the project, Indonesian researchers gained several skills, knowledge and experiences related air pollution research. This improved capability has enabled Indonesian researchers to conduct air quality monitoring and obtained large datasets contain detailed information on mass and chemical compositions which are essential to reveal the type and sources of pollution.

The project also benefits Indonesian environmental agency, as the data obtained will be used as scientific based reference to the introduction of re-evaluate and re-new the regulation. A long involvement in this project enable the researchers to contribute in solving air pollution problem related heavy metal pollution in spesific area in Indonesia.

By cooperation with the Ministry of Environment, several efforts i.e. sampling, sample analysis and data interpretation using receptor model have been conducted and the main source of pollution was found. This success bring to enhance the collaboration between BATAN and Ministry of Environment (MoE) by signing the MoU by minister of MoE and Head of BATAN on August 4, 2011.

## Achievement

During the implementation of the project, Indonesia with other Member States has been contributing to a regional database, the Asia-Pacific Aerosol Database (A-PAD) for fine and coarse particulate matter. The database provides useful information and is very essential for all Member States in creating decisions on pollution mitigation and control strategies.

Indonesia has been success in expanding this project in national scale through sampling in 16 big cities in Indonesia covering Sumatra, Java, Borneo, Sulawesi, Maluku, Bali, West Nusa Tenggara and Papua Islands. The NAT capabilities has also supported the national programs of air quality improvement through several findings such as heavy metal pollution in Banten and East Java provinces, forest fires event in Borneo and Sumatera, and the evaluation of effectiveness national program on unleaded gasoline through long term monitoring data of Pb concentration in APM.

This nasional project facilitates human capability improvement through workshops, trainings and meetings for local EPAs in several cities/provinces under collaboration with Ministry of Environment and Forestry. The project will make a strong contribution in updating Air Quality Index, the Environmental Quality Index or other air pollution management programs. This project also strengthens the environmental quality monitoring system in Indonesia.

## The Goal

- Improving air quality in the Asia-Pacific Region through application of nuclear analytical techniques (NAT) for air pollution control.
- Providing baseline data as scientific reference to formulate national regulations and corrective actions to address the air pollution problem.

## Objective

- Develop NAT infrastructure for air pollution monitoring.
- Assess and identify particulate pollution and its sources.
- Create a reliable high-quality region wide data base that will enable government air-quality managers to make informed decisions on pollution abatement and control strategies.



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# Coral Reef Research: Contributing to National and Global Efforts in Ocean Preservation and Climate Change Mitigation

## Overview

The Indonesian archipelago is situated between the Indian Ocean and the Pacific Ocean, making it a perfect location to study coral ecosystems and observe ocean changes caused by climate change. The study and observation utilizing nuclear technology is not only beneficial for the local community through preserving coral ecosystems and their products, which are essential for the marine food and tourism industries, but also making excellent contributions to global efforts in climate change mitigation.

In Indonesia, coral reefs are valuable resources for the food and tourism industries. The commercialization of molluscs, seaweed and coral reef fish are essential for the marine food industry in Indonesia. The beauty of Indonesian coral reefs also attracts tourist, which benefits the tourism industry. Unfortunately, natural disturbances, such as volcanic activity, earthquakes and cyclones, combined with human-induced disturbances like pollutants have threatened the preservation of these beautiful and productive coral reefs. The disturbances to sea temperature and ocean currents also caused by global climate change, have further threateaned the existence of this natural gift.

## The Goal

- Gathering information and analyzing ongoing changes in coral ecosystems caused by natural disturbances and human activities.
- Observing historical climate change data.

## Objective

Providing scientific information on historical data of ocean temperatures, forecasting future changes in coral environments in order to improve the national ability to mitigate and adapt in response to climate change.

## Contribution

Providing an isotopic record of ocean temperatures going back centuries and forecasting future changes to the coral environment, providing an opportunity for local stakeholders to adapt in response of climate change.

Giving contribution to local and global effort in coral reef and sea environment preservation.

Indonesia, along with the global community, needs information and data on these ocean changes, to understand the risks and threats posed by natural and human-induced disturbances, for future planning of coral reef preservation and to adapt to potential future changes in the sea environment. As a response to this challenge, Indonesian researchers, with support from IAEA Technical Cooperation (TC) project INS/7/006, launched a research project to gather information and analyze ongoing changes in coral ecosystems in Indonesia.

In line with the National Climate Change Adaptation Action Plan and global efforts to combat climate change, this project also provide historical climate change data, which is 'recorded' by coral reefs.

## Sampling Sites

A total of 17 cores have been collected with lengths from 0.5 to 2 m



The application of nuclear techniques, covering x-ray imaging, neutron activation analysis, isotope tracers and gamma spectroscopy, enables Indonesian researchers to understand local coral reefs history, present and future environment.

Today, Indonesia has successfully contributed to the global community in providing an isotopic record of historical ocean temperature data benefiting global researchers studying climate change in the past and also enabling forecasts of future changes in coral reefs and the sea environment.

The project also enabled Indonesia to analyze the human-induced pollution that occurred in the past and its effects on coral reef development, providing valuable data to environmentalists to create a response in preserve coral reefs and the sea environment.

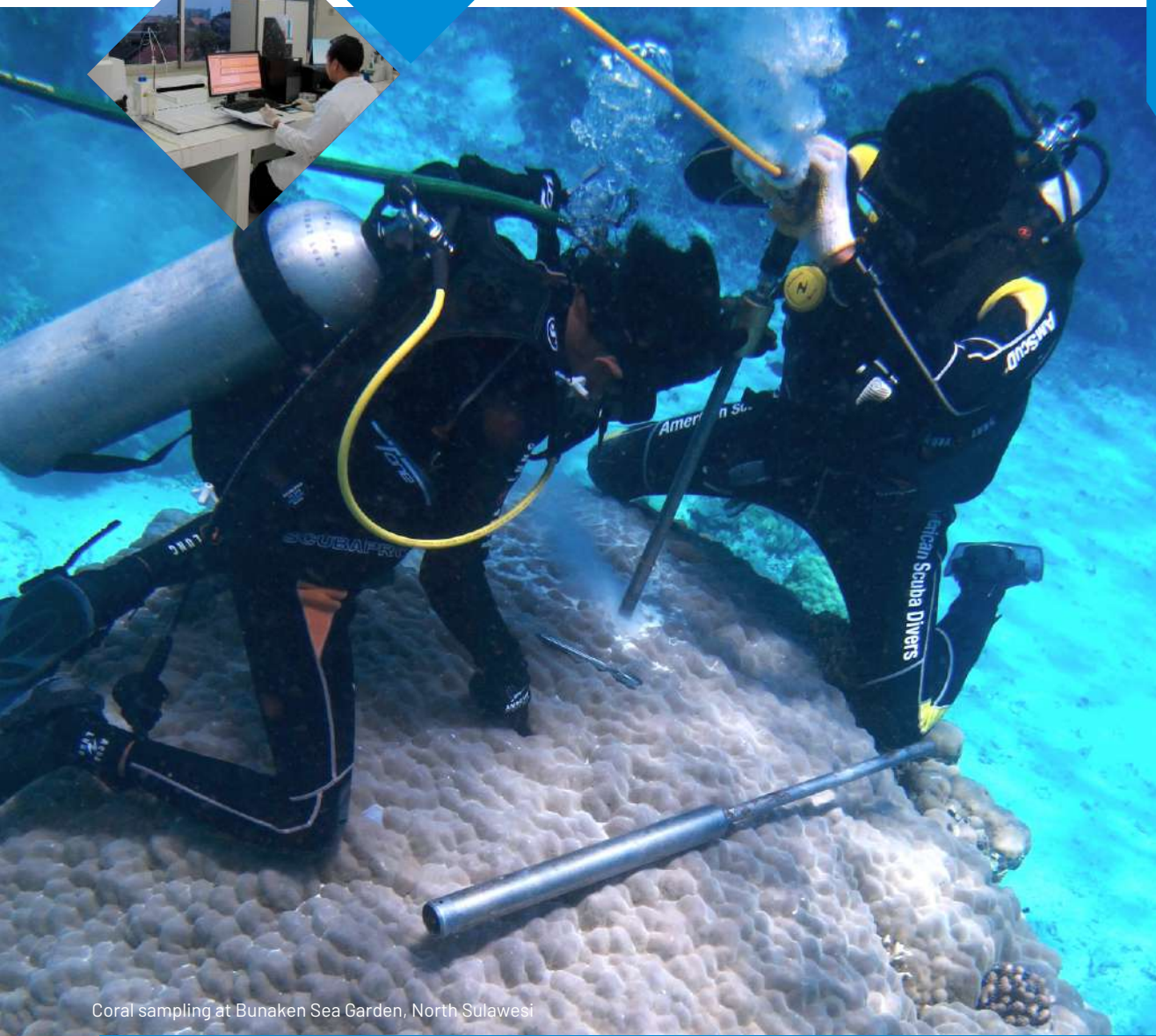
These data sets are essential to efforts by Indonesia and the global community to develop a climate change adaptation response plan, to ensure the preservation of coral reefs and the sea environment. They directly benefit the food and tourism industries, and preserve the beauty of the ocean environment.






*"Indonesia has potential role in global community efforts in conducting climate change mitigation"*

Researcher opinion on coral reef research



Coral sampling at Bunaken Sea Garden, North Sulawesi



# Renograph Instrument

## Improving Access to Healthcare Solution for the Underprivileged and Hospital in Remote Areas

### Overview

During the last two decades, the number of patients with kidney problems reached 20,000 number with increasing trend tends to occur in the future. Conventionally, renal problems can be examined using radiology techniques (CT Scan) combined with other techniques such as ultrasound. However these techniques have limitation only able to assess the anatomy or morphology of renal organ and the results needs longer time to be delivered to the doctors.

Other common technique is the use of gamma camera with specific radioisotope injected to the patient, which offers not only imaging of the organ but also the function of the organs in much more accurate meaning. However the expensive price of this instrument, makes grade B and C hospitals difficult in purchasing the instrument.

Renograph, a renal function detection instrument offers its advantages to answer these medical challenges. Providing a much faster analysis results with more detailed accuracy, renograph shows its superiority compared with other instruments and method.

Economically competitive, high mobility and the use of short half-life radioisotopes in low dose becomes its superior characteristics, overcoming its limitation in providing renogram only as analysis results. These characteristics give solution for hospitals, especially for those located at sub-urban dan rural areas.

Renograph development in Indonesia has been done since 1985. The development is aimed to optimize the local content in its components to reduce dependency to imported component products, and also to address local operator and examination room needed during the instrument operation.

Basic principal of renograph electronic system and software has been presented during IAEA Workshop at Yangoon under RAS/4/017 Project. Based on the validation conducted during the workshop, the electronic module and software developed by Indonesian engineers was adopted to upgrade the renograph owned by Yangoon General Hospital.

## The Goal

- Providing medical instrument with low cost investment and maintenance.
- Increasing engineers competency in ICT-based nuclear engineering to develop national capacity in medical instrument industry.

## Objective

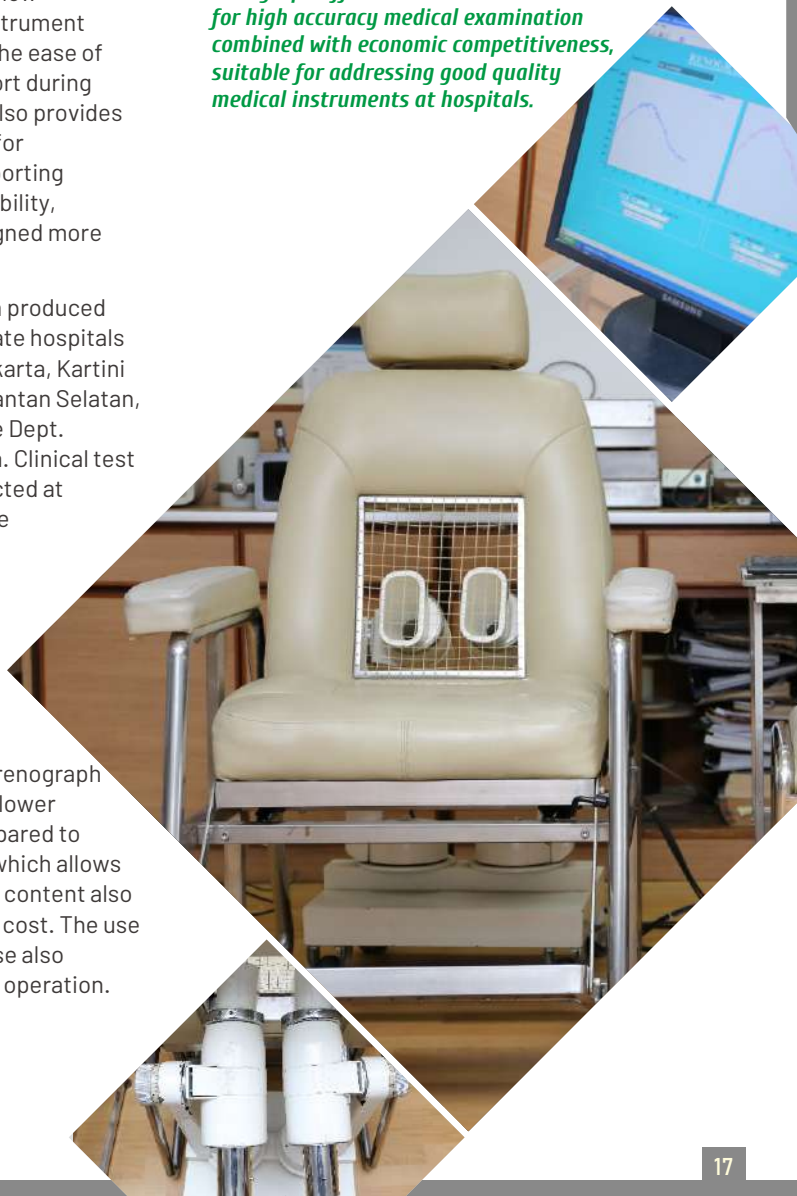
Increasing public medical service quality through provision of economically competitive medical instrument and can be developed commercially

To date, Indonesian engineers at BATAN has succeed producing 6 generation of renograph prototypes. The development carried out adopting ICT development for data acquisition and processing. Technology innovation as part of state of the art of new technology is developed to increase instrument realibility and data processing quality, the ease of mobility and to increase patients comfort during health examination. The latest design also provides dose calibration estimation, a solution for procurement of dose calibrator as supporting instrument. To increase instrument mobility, electronic system and module are designed more compact.


To date, 20 units of renograph has been produced and operated at several public and private hospitals at Indonesia: Bethesda Hospital Yogyakarta, Kartini Hospital - Jepara, Ulin Hospital - Kalimantan Selatan, Gatot Subroto Hospital, Sukamto Police Dept. Hospital and Annur Hospital Yogyakarta. Clinical test involving patients also has been conducted at Sardjito Hospital Yogyakarta to analyze engineering design feasibility covering measuring indication of operational success-failure rate and stakeholders satisfaction. Based on the test results, renograph was granted marketing certification by the Ministry of Health in 2015 and ready to be commercialized.

Based on economical feasibility study, renograph offers lower investation and also much lower operational cost for single patient compared to Gamma Camera. Recent development which allows production of renograph with high local content also offers low maintainance and spare part cost. The use of short half-life radioisotope in low dose also support the safety aspect of renograph operation.

*Renograph offers alternative for high accuracy medical examination combined with economic competitiveness, suitable for addressing good quality medical instruments at hospitals.*







# Compendium on Nuclear Science and Technology for Secondary School

## Empowering Teachers and Encouraging young generation

### Overview

Giving opportunities to the young generation to learn nuclear science and technology in a fun and popular way is essential to encourage their interest in pursuing a career path in STEM (science, technology, engineering and mathematics), as they are an important asset to ensure the availability of a future workforce in the nuclear industry. As an effort to create opportunities for the young generation to be exposed to fun learning, it is also important to empower the education community (schools, teachers and practitioners) with new methods of learning about nuclear science and technology.

Since 2014, Indonesia, with other three pilot countries has been actively involved in the IAEA TC Project for Introducing Nuclear Sciences and Technology to Secondary Schools as part of the Asia Pacific Region Project RAS/0/065 "Supporting Sustainability and Networking of National Nuclear Institutions in Asia and the Pacific Region".

The project mainly focuses on implementing the pilot project on introduction of a Compendium of Nuclear Sciences and Technology for Secondary Schools at several high schools in Indonesia, evaluating its effectiveness and integration with the existing curriculum and also developing the competency of teachers and education practitioners.

### The Goal

- Implementing new teaching methods for nuclear science and technology at the secondary level.
- Enriching the implementation of the existing national education curriculum.

### Objective

Expose the young generation to nuclear science and technology education, to encourage them to pursue a career path in STEM.



## Achievement

The project is implemented under the coordination of the Ministry of Education and Cultural Affairs and BATAN, involving four pilot schools at South Tangerang City and Surabaya City. During the pilot project implementation, the IAEA through TC Programme has been continuously giving support to the Indonesian education community. Missions of experts from experienced Member States (Japan, Australia, United States of America and United Kingdom) were launched in the initial period of the project. The experts shared their experiences and knowledge with Indonesian teachers, giving new ideas on implementing a fun popular way of teaching nuclear science and technology to students.

The project also supported the sending of several Indonesian teachers and practitioners on a Scientific Visit and Fellowship in the United States of America, to develop their science teaching competency and to gain experience in implementing compendium in schools. To strengthen regional cooperation, the project also supported teacher exchanges between pilot countries, allowing them to share knowledge and experiences in curriculum and teaching methods.

The implementation and impact of the pilot project in adapting Compendium of Nuclear Science and Technology for Secondary Schools has shown successful milestones in terms of empowering teachers, enriching education curriculum and also the resulting large number of beneficiaries in Indonesia and other pilot countries.

- The pilot project implementation at South Tangerang City has encouraged schools (SMAN 1 and 2 South Tangerang) to establish a special science class with enriched curriculum focusing on nuclear science and technology applications. These special classes have been successfully allowing students to get exposed to new information on nuclear applications for human welfare as well as interactive learning in nuclear science and technology.
- The pilot project implementation at Surabaya City has encouraged teachers to establish new teaching materials (books and lessons plan) which are enriched with new learning methods as introduced by the compendium.
- The experiment instruments procurement by IAEA and Japan Government at Indonesian schools has inspired schools to develop specific nuclear science laboratories, giving students new opportunities to learn nuclear science in a much more interactive and interesting way.

Achievements and milestones reached during the implementation of pilot projects since 2014 have inspired the Indonesian education community to continue cooperation in the implementation of the compendium for the next cycle of TC programme. Expansion of the program implementation is targeted to reach at least 10 new cities until 2019, as part of the effort to contribute to implementation of the national education curriculum effectively.





## Impact

- Facilitating teachers in accessing nuclear science textbooks, lesson plans and other teaching resources.
- Development of teachers and education practitioners in nuclear science and technology.
- Thousands of students as beneficiaries, with proper knowledge of nuclear science and technology.

*"The Compendium project has inspired me in creating new teaching resources for nuclear science topics, which will be useful for all science teacher in Indonesia"*



Yani - SMAN 11 Surabaya  
Chemistry Science Teacher's  
opinion on Compendium Project



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Layout Designer: Theresia E. Wijayanti  
Photo on title 1&2: Raymond Sormin

Published by:  
Centre for Dissemination and Partnership  
National Nuclear Energy Agency (BATAN)  
Republic of Indonesia  
[www.batan.go.id](http://www.batan.go.id) | email: [pdk@batan.go.id](mailto:pdk@batan.go.id)



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