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Forum for Nuclear Cooperation in Asia

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Country Report

Current Situation of Nuclear Application in Indonesia

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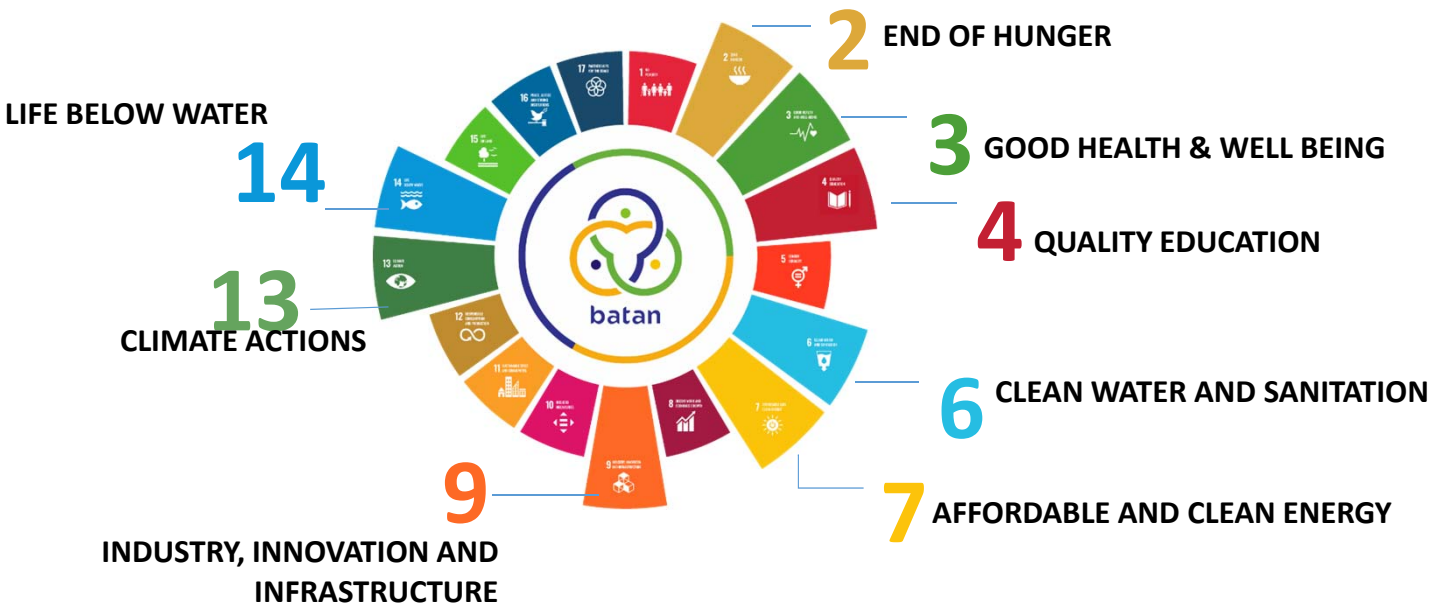
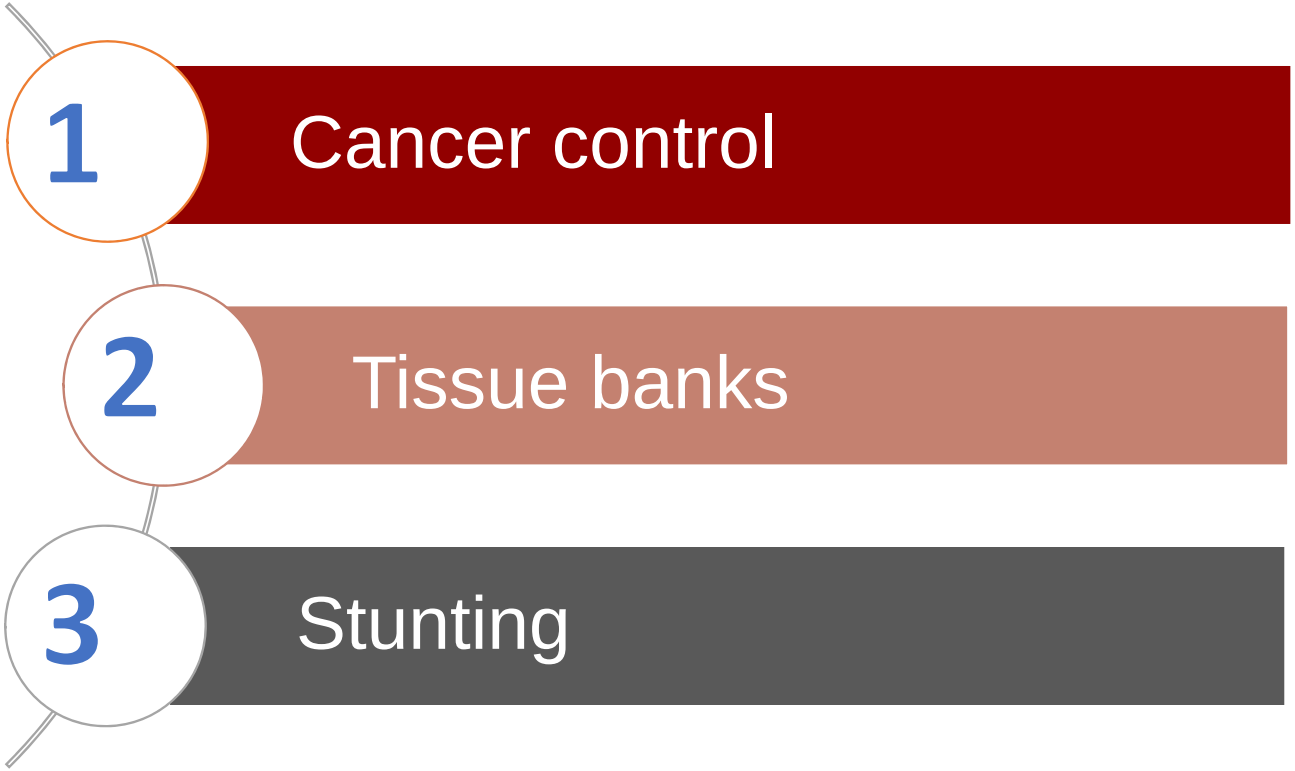
Introduction

- Nuclear Science and Technology in Indonesia is aimed for Peace and Welfare.
- BATAN as R&D body, BAPETEN as regulatory body.
- Application of nuclear science and technology in various fields.
  - Contributing to the achievement of SDGs



Radiation Technology for Human Health



Cancer control

- Nuclear Medicine: diagnosis and therapy
- Radiation Oncology: therapy
- Radiopharmaceuticals production

Cancer in Indonesia

- New cancer case per year: 348,809
- breast cancer: 42.1 per 100,000 population with an average death rate of 17/100,000;
- cervical cancer: 23.4 per 100,000 population with an average death rate of 13.9/100,000.

2014: MoH Directive Letter

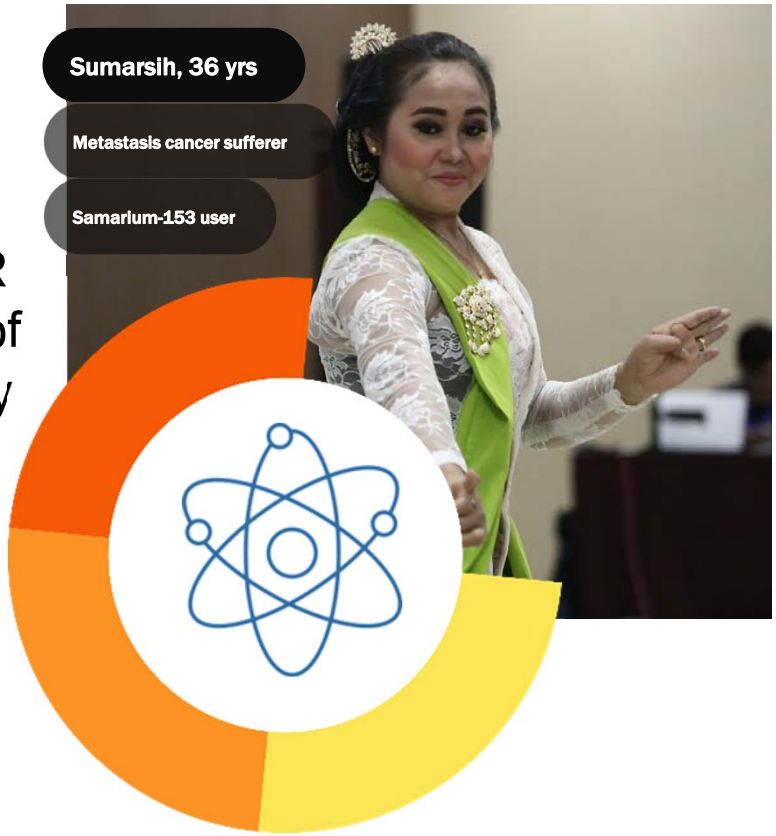
Establishment of National Cancer Control Committee (NCCC)and National Cancer Control Plan (NCCP)

MoH Regulation No. 34 year 2015 on Prevention of Breast Cancer and Cervical Cancer:

a sustainable public health service program prioritizes promotive and preventive aspects that are carried out comprehensively, effectively, and efficiently.

Nuclear Medicine (NM)

- In 1965: The TRIGA Mark II in Bandung operated. The R&D for radioisotopes and radiopharmaceutical started.
- In 1971: The first Nuclear Medicine (NM) Department in DR Hasan Sadikin Hospital /School of Medicine - Padjadjaran University established.
- In 1995: the first SPECT-CT was installed.
- In 2010: the first PET-CT was in operation.
- In 2019:
  - 22 NM centers
  - 51 nuclear medicine specialist



Radiotherapy (RT) Center

2019

- No of RT machine: 94
- Total machine needed: 343
  - 19/34 provinces with RT
    - 58 Centers.

2020

- No of RT machine: 103
- 22/34 provinces with RT
- 67 centers.

- Target: **Fulfillment and distribution of <u>Facility</u> according to standard**
- Program:
  - Setting up system for regional cancer center
  - Increasing number of services in screening and early detection in hospital

Radiopharmaceutical Production

BONE SCAN KaeF (KIT MDP) 1
diagnosis of myocardial perfusion (cardiac muscle) and the diagnosis of cardiac function

CARDIOSCAN KaeF (KIT MIBI) 2
diagnosis of bone cancer

RENALSCAN KaeF (KIT DTPA) 3
renal imaging

ENDONEUROSCAN KaeF (I-131 MIBG) 4
palliative treatment of bone metastases

T-BONE KaeF (Samarium-153 EDTMP) 5
diagnosis of neuroblastoma cancer

Ethambutol-Iodine-131 capsul*, ^{131}I-MIBG for therapy 6

*in the process of getting production permit

Tissue Bank

- BATAN, Dr. Sutomo Hospital (Surabaya) and Dr. Djamil Hospital (Padang) have produced some biological tissues, such as allograft, xenograft, and amniotic membrane, which are sterilized using gamma radiation
- Those products are used for surgery, wound dressing etc.

Combating Stunting

- Since 2016, nuclear techniques are used to support combating stunting:

- Stable isotopes technique to measure energy expenditure and body composition data of normal and stunting children.

- Nuclear Analytical technique to analyze the micro nutrient content in food in malnutrition detected region

Nuclear's HRD in Indonesia

- BATAN and BAPETEN have own Center for Education and Training for nuclear capacity building of their employees or public in various field of nuclear science and technology.
- BATAN has "Polytechnic Institute of Nuclear Technology" (STTN Yogyakarta), a vocational college.
- University of Gadjah Mada (UGM), Bandung Institute of Technology (ITB) and Universitas Indonesia have a program study in the field of nuclear science and technology for bachelor, Master and Doctorate degree.
- As the employees are ageing, in order to preserve the knowledge, BATAN has a Nuclear Knowledge Management programme.

NuCaB

Contribution to Regional and International

2 IAEA COLLABORATING CENTRES

- IAEA Collaborating Centre for Non Destructive Investigation
- IAEA Collaborating Centre for Mutation Breeding

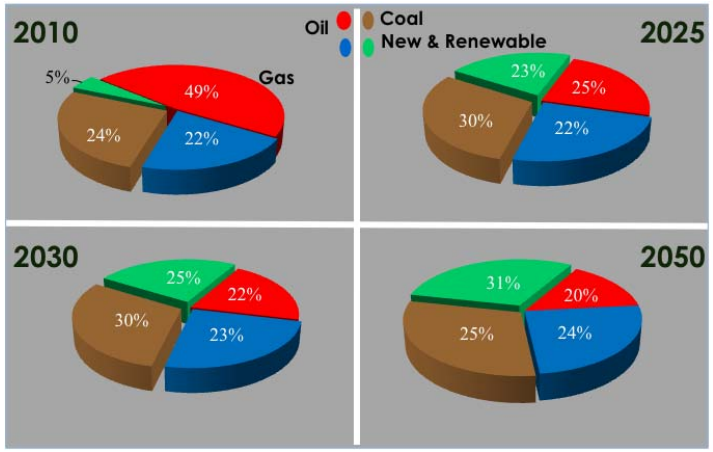
KARTINI INTERNET REACTOR LABORATORY (IRL)

Reactor operation practices through an internet

Ministry of Research & Technology/National Innovation Research Agency of Indonesia

Nuclear Energy Policy and Activities

- Energy Mixed policy (President Regulation No. 79 year 2014 on National Energy Policy): promotes the use of new and renewable energy (NRE) sources.
- Nuclear energy is part of new energy
- Targets NRE: at least 23% of total energy sources in the year 2025, and 31% in the year 2050.



- Site study for introduction of NPP in South and West Bangka (2011-2013) has been conducted by BATAN and PT. PLN: two sites fulfill all criteria and could host 4 and 6 units of 1000 MWe NPP, respectively. However, no decision and continuation of the construction plan up to now.
- Several local governments expressed their interest to build NPP for fulfilling their electricity need.
- Based on the request from the local government, BATAN conducted initial site survey in several regions, such as West Nusa Tenggara, West Kalimantan and East Kalimantan.
- BATAN continues to conduct R&D on technology and safety of NPP, especially from Gen III/III+, SMR and GEN IV types.

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FNCA Projects in Indonesia

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Radiation Oncology

- Four protocols developed in FNCA have been introduced in several radiotherapy centers in Indonesia:
  - Cervix-V protocol
  - Cervix-IV protocol
  - Breast-I protocol
  - NPC-III protocol
- The impact of FNCA protocol not only in radiotherapy practice but also in scientific publication as well as collaboration among RT centers .

Mutation Breeding

Soybean Planting

- Indonesia has released some superior varieties: 25 rices, 12 soybeans, 3 sorghums, 1 tropical wheat, 3 mung beans, 2 peanuts, 1 banana, 1 cotton.
- In the FNCA project, Indonesia focus on mutation breeding on rice and soybean.
- In 2019, Indonesia released
  - 2 soybean varieties: **Kemuning-1** and **Kemuning-2,** which are drought resistant, potential yield is 3.7 tons/Ha, and early-age harvest.

Lampai Sirandah

  - 3 new rice varieties **("Rojolele Srinuk"** and **"Rojolele Srinar"**), a famous local rice from Central Java, and **Limpai Sirandah** from West Sumatra.

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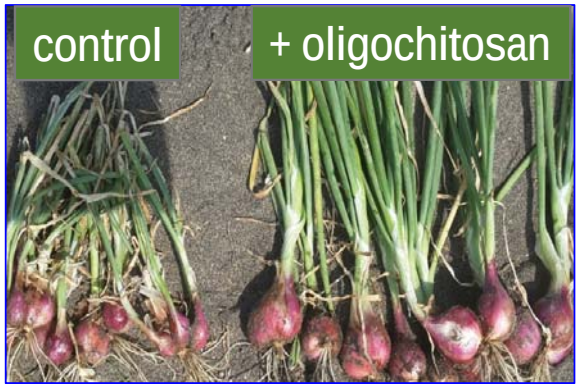
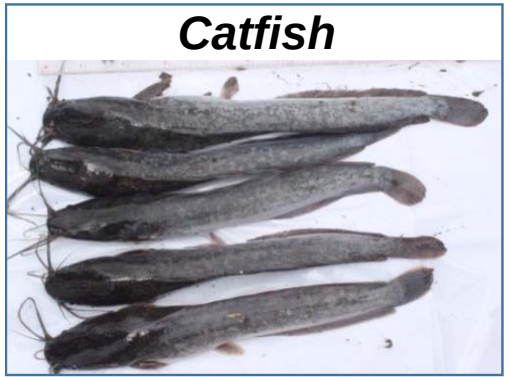
Radiation Processing and Polymer Modification

Research on radiation processing and polymer modification by gamma radiation produces **oligochitosan** (from Crustaceaous sp. waste), which has been applied as supplement for crops (chrysanthemum, corn, onion, pepper, coffee), animal husbandry (laying hens), and fisheries (catfish).





Results: increase in crop productivity, improve the growth of livestock and fish, and increase plant resistance to disease.

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Climate Change

In collaboration with University of Diponegoro – Semarang, BATAN conducts a study to analyze the phenomenon of carbon sequestration by mangrove plants along the coast of Semarang, Bali, and Lombok using stable isotopes of C-13 and N-15, as well as carbon content studies in cells diatom microalgae in Rawa Pening Lake in Semarang, Telaga Warna and Pengilon Lakes in Dieng, Central Java.

Collecting the supporting data; rainfall, satellite image of mangrove, sea level rise

Climate Archive sediment lake project; by combining the application of environmental isotopes ^{210}Pb to determine sediment accumulation rate as well as the age of sediment (up to 150 years) and diatoms in Telaga Warna revealed clear correlation with human activities in the catchment area over the past 124 years.

Blue Carbon project (Mangrove area); by using environmental isotopes ^{210}Pb together with analysis of Carbon in above and below ground (sediment), as well as isotopes C-13 and N-15, we found

- about 85% of carbon stored in sediment and varied depend on the accumulation rates of sediment layers (in the restoration area of Lombok)
- the importance of restoring the mangrove (coastal ecosystems) to storing carbon.

Utilizations of Research Reactor -1

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Gem Stone Coloration


Radioisotopes Production


Neutron Radiography


Power Ramp Test for nuclear fuel test


Neutron Spectrometer & Diffractometer


Neutron Activation Analysis


Education and Training


54 years

Reactor Triga Mark II


40 years

Reactor Kartini


32 years

MPR G.A Siwabessy

Utilizations of Research Reactor 2

- **Laboratory Inter-comparison**
  - The goal of this activity is improvement of NAA laboratory capability on Rare Earth Elements (REE) analysis.
  - Three mineral samples have been obtained from ANSTO-Australia to be analyzed. Those samples contains a low, medium and high Uranium concentration.

- **Neutron Activation Analysis (NAA) for measuring air pollutant**
  - This activity has contributed as input in determining environmental quality standard policies at the Ministry of Environment and Forestry
  - Sampling site: Bandung City - West Java in an urban area;
  - Sampling time: 24 hours, once a week;
  - GANT Stacked Air Sampler placed on the roof to collect a fine ($PM_{2.5}$) and coarce (PM_{10}) particles by using Nuclefore filter.

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Safeguards and Security Implementation

- Indonesia has periodically carried out physical protection training in collaboration with law enforcement agencies.
- Indonesia was the first country to organize an internalization of security culture and to implement a self-assessment of security culture for nuclear facility. Based on that experience, BATAN established Center for Security Culture and Assessment (CSCA).
- Indonesia also committed to build capacity on nuclear security through establishing a laboratory for training on physical protection.

Response Force

Security Check at Main Gate

Classroom is under construction since

Nuclear for welfare, nuclear for better life !!!
Safety and security are our priorities !!!