Country Report

APPLICATION OF NUCEAR SCIENCE AND TECHNOLOGY FOR PROTECTION OF ENVIRONMENT IN INDONESIA

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NST for Land Remediation

- Environmental damage due to various human activities affect the decrease in land carrying capacity which generally starts from the biological degradation in the rooting areas of plants (rhizospheres). It can cause the break-down of biochemical cycles, resulting the damage to the soil aggregation and then the revegetation becomes difficult, subsequently the physical degradation occurs in the form of top-soil erosion;
- The best solution for stimulating plant growth is the inoculation of soil organic matter source and the enrichment of functional microorganisms according to the existing condition of the land.

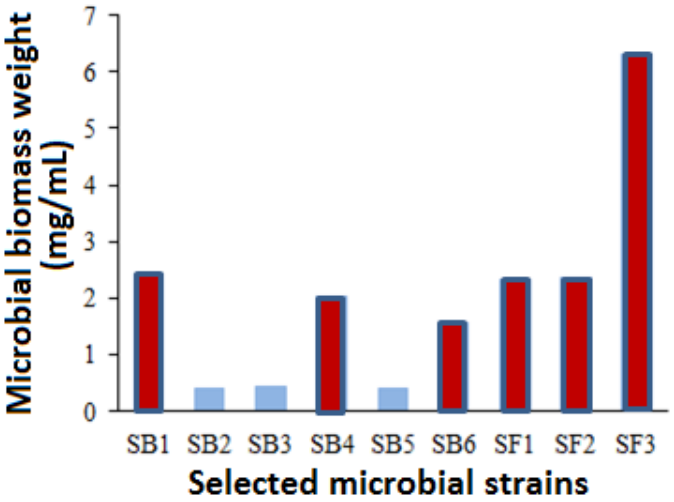
Application of Bioremediation Agents in Arid Land (Brebes, Central Java)

- **Problem**: land crusting, excess of chemical fertilizers, high pesticide residues, and low microbial rhizosphere population.
- Bioremediation agents used:
  2.5 ton/Ha of Cocopeat enriched with **rhizosphere microbes;** 10 Ha area;
  75% chemical fertilizer of recommendation.
- **Result**:
  - Improvements in some soil physical-chemical parameters (N, C organic, C/N ratio; P_2O_5);
  - Productivity of shallot tuber increased 21% (10.0 → 12.1 ton/ha).

Application of Microbial Consortium Formulation in Ex-gold Mine Land

Problem: low acidity

Application of **microbial consortium formulation** in **ex-gold mine land** (Anahoni - Buru Island - South Maluku)



Selected microbial consortium formulation and microbes origin potential for microbial enrichment which is beneficial for sites affected by **Mercury** and **acid** contaminations.

BATAN + Ministry of Envir. & Forestry

Bioremediation of Land Polluted by Oil Sludge (Cepu-Blora-Central Java)

Forest rejuvenation with problematic land of white root fungus

Initial condition: Land polluted by oil sludge which is containing HCs

Application of **Inoculant Rhizosphere Microbes (IMR) + *HCDec*** (25 kg/ha) post *in-situ* composting with sawdust (5 ton/ha)

Improvement of mango plant and elephant grass growth after application.

IMR and PBO Application for Pepper Plants in Bangka Regency

IMR = Inoculant Rhizosphere Microbes,
PBO = Bio-organic Fertilizer

- The condition of pepper plant on ex-rubber plant land with high pathogen population of *Rigidoporus microporus* (WRD = white root desease);
- Root infections cause *Nematodes* and *Fusarium spp.* to thrive.
- Using a combination of several bioremediation agents, the growth of phytopathogens such as *Fusarium spp*. can be suppressed, then the dead root tissue can be reactivated, the plant roots become healthy, soil structure can be improved, furthermore plant productivity increased.

Air Pollution Problem in Indonesia

Figure courtesy of NASA

- Increased economic development in the Indonesian region has often led to rapid and unplanned urbanization;
- Urban air pollution is a major problem in this region and growing recognition of the health effect problems resulting from airborne particles;
- Air pollution is a global phenomenon with air transport taking place across countries in a few days and around the globe in a few weeks.

NATs in Environmental Protection

The application of nuclear analytical techniques (NATs) in environmental field has been implemented in several researches:

- It has established the national scale air quality monitoring using NATs under collaboration between BATAN with Ministry of Environment and Forestry, and several Local EPA in provinces and cities;
- BATAN made a big step in expanding sampling site locations from one sites in Bandung into 16 sites covering Java, Sumatera, Kalimantan, Sulawesi, Maluku, and Papua islands during the last 3 years;
- The results obtained from this project have supported:
  - the evaluation of effectiveness unleaded gasoline program,
  - several findings related heavy metal pollution in Tangerang and East Java province,
  - forest fires event in Sumatera and Borneo, and
  - encouraging the revision of government regulation on National Ambient Air Quality Standard and introduction of new national air quality index;

NAA for Elemental Characterization on Air Particulate Matter

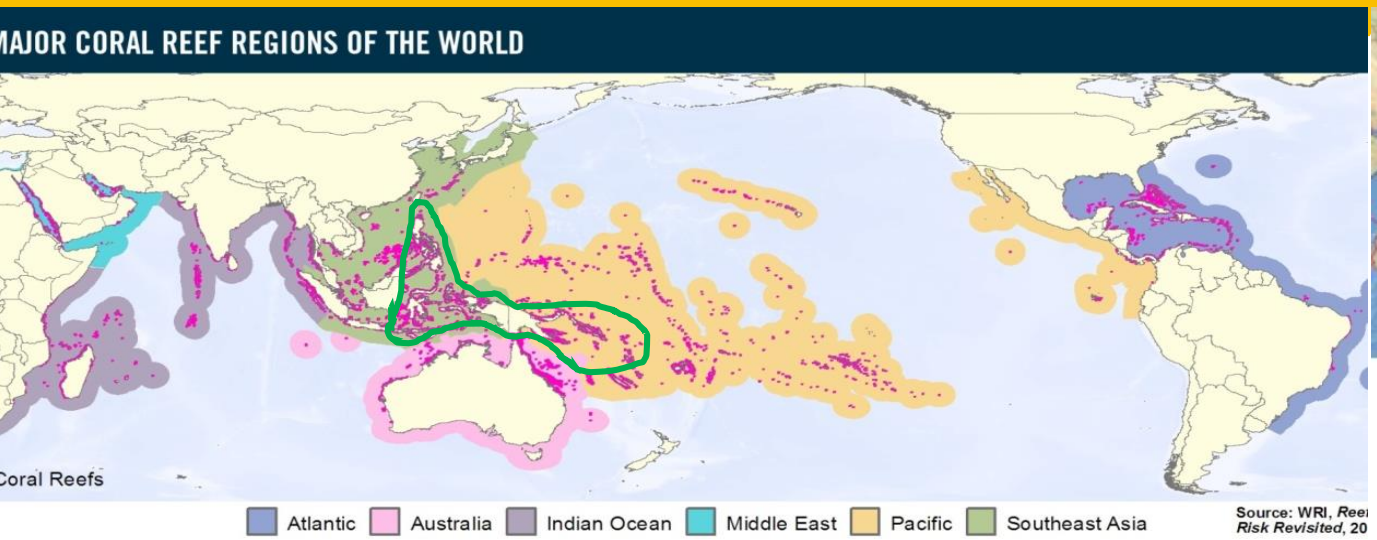
- Indonesia committed on FNCA 2016-2019 program;
- Goal: Compare the current status of air pollution to the previous result of 2002-2004 for Urban and Sub-Urban region;

Sampling of Air Particulate Matter

Site Urban: Bandung city
Sampling Periode: minimun once a month
Air Sample used: Gant stacked filter
Nuclear Analytical Techniques used: XRF, NAA

- In the near future, this project will expand to the regional scale under collaboration with several countries in Asia Pacific region, to focus on the impact of industrial activities in air quality.

NST in Climate Change



- Impacts of climate change to the marine and coastal ecosystem; increasing Sea Surface Temperature (SST) resulting of coral bleaching and El-Nino, Sea Level Rise, ocean acidification and increases in the frequency and intensity of extreme weather events (i.e., typhoons, floods, and drought);
- Indonesia holds 17% of the world's total coral reef areas;
- About 3 million hectares of mangrove forest grow along Indonesia's 95,000 km coastline. This is 23% of all mangrove ecosystems in the world;
- NST play important roles particularly in the past time climate condition (paleo-climate) which is used for model prediction so that it will be needed for adaptation and mitigation.
- BATAN + Agency for R&D of Marine and Fisheries.

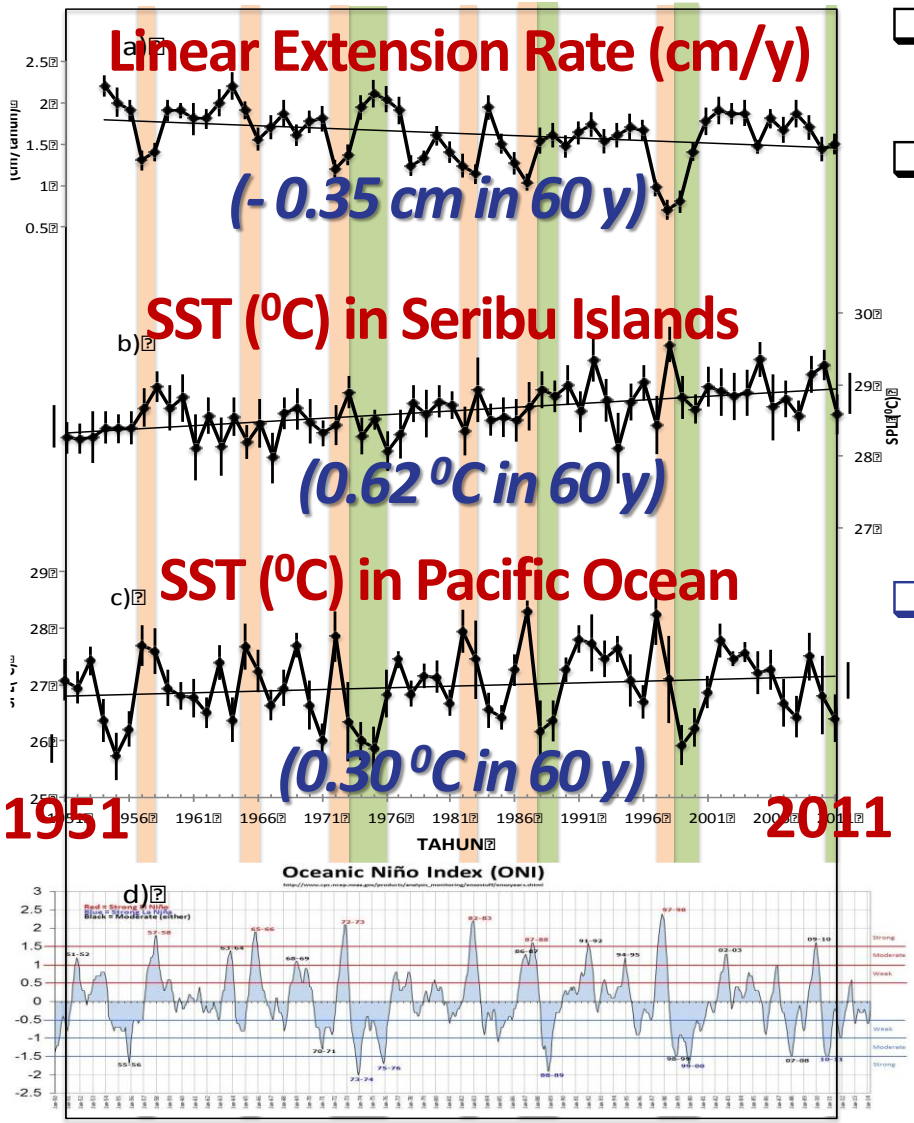
Implementations:
Coral → Reconstruct SST and Salinity

Coral sampling sites: Lampung and Banten bay in the western part, Bali and Lombok in the central, and Wakatobi (Southeast Sulawesi) and Bunaken (North Sulawesi) in the eastern part of Indonesia.

- Nuclear Technologies:
  - X-ray radiography for annual banding (extension rate);
  - Stable isotopes O-18 and Sr/Ca for SST and Salinity.

- Based on the annual banding and linear extension rates of corals, mostly show that they decreased from about 100 years ago up to now which is related to the increase of temperature.

El-Nino Events Related to Linear Extension Rates of Coral and SST in Seribu Islands



Implementation on Mangrove → "Blue Carbon" on The Carbon Stock

- 80% of carbon in mangrove systems in Indonesia is stored in the soil.
- By using dating method of C-14 and Pb-210, it can be estimated the flux and rate of it deposition (accumulation) in the sediment. Meanwhile, C-13 and N-15 can be used for identification of carbon sources in the sediment mangrove.
- Future plan, Indonesia will focus to the blue carbon research on mangrove forest in order to contribute to the regional Asia Pacific database in term of climate change.

Sediment coring

Indonesia Experimental Power Reactor (I-EPR) and Irradiator Facility Establishment

- I-EPR → entry points for NPP;
- → strategic effort for mastering NPP project management, engineering capacity building and HRD to strengthen the role of TSO;
- I-EPR will be a master of Indonesia Commercial NPP in the future to support fulfilling energy demand;
- roject Status : Pre-project has been completed, **Site Permit has been issued on 23 Jan 2017.**

- Gamma Irradiator for **health**, **industry**, and **food processing** has been established;
- This facility is intended to be functioned as a pilot project for the establishment of other similar irradiators by local governments and private institutions.

Thank You