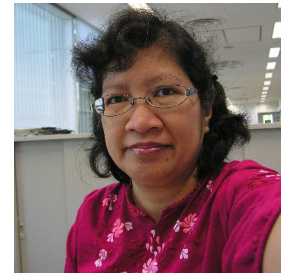


Before and After the International Collaboration on Inventory and Sustainable Use of Microbes in Indonesia

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The inventory and sustainable use of microbes in Indonesia especially in Indonesian Institute of Sciences (LIPI) was started in Treub Laboratory of Buitenzorg (Bogor) Botanical Garden. Bogor Botanical Garden itself had been established in 1817, and Dr. M. Treub was the botanist and director the Garden for nearly 30 years (1880-1909). Many microorganisms such as mychorizal fungi, fresh water microalgae, plant disease bacteria such as *Bacillus saccharis*, *Aspergillus* sp., and *Penicillium* sp., had been studied and collected by Dr. M. Treub itself or scientific visitors from all over the world in the Laboratory. All the microorganisms were related to tropical plants such as orchids, sugar cane, plant disease microbes, microalgae, etc.

In 1934, the researches in Treub Laboratory of Bogor Botanical Garden were stops and the collection of microbes was not continued. The research in the Laboratory was starting again in 1959 by Indonesian Government and Indonesian researchers, but the microbiological work has just begun in 1960s. The research topics were tailored to or incline to support government programs mainly on the application of science to improve human welfare. Inventory of microbes should be related of the uses of microbes. In 1970s, microbiologist community in Indonesia had succeeded in establishing the Indonesian Society of Microbiology in September 1973 to maintain the required contact and communication microbiologist society in Indonesia. The number of members has flourished from around 100 to almost 1,000 at present and this society is very active society in Indonesia in organizing international seminar every year and publishing an international journal. In LIPI, the microbiologist have been developed and increased also in this time.

The collection of fungi, *Rhizobium*, and yeast in LIPI was increased since 1977. Focus has been attention to microbes in agriculture and fermented foods. Although for centuries microbes have been used in Indonesia to prepare traditional fermented foods and beverages such as tempe (fermented soybean by *Rhizopus*), oncom (fermented tofu waste by red mold), tapai (fermented glutinous rice), terasi (fermented fish paste), kecap (sweet soy sauce), brem (fermented rice), and tuak (fermented beverage from rice), there are no large scale industries in these microbial processes. Until now, these foods have been produced through home-based operations, the techniques and equipment recycled from generation to generation. Understandably, production processes have scarcely changed, much less improved. Modern science has not entered into these traditional food production methods, although they could become important industrial resources. Currently, only the inoculums of tempe is producing by LIPI.

The international collaboration on the uses of microbes between LIPI and overseas partners under a variety of cooperative schemes such as between LIPI-EU (European Union), LIPI and Australia-ASEAN member countries, and LIPI-JSPS, therefore, have been developed in 1980s-1990s. The results of collaboration were not only in increasing the number of holdings cultures focus on agriculture and fermentation technology, but also the number of publications in internationally scientific journals as well as the number of qualified researchers.

After the declaration of Convention of Biological Diversity (CBD) in 1992, the consideration of the richness of Indonesia as mega biodiversity country has been increased. The attempt for inventory the microbial cultures as well as flora and fauna Indonesia have been increased. Indonesia does not yet have the capacity to explore, inventory, and study of its microbial resources, an international collaboration, therefore, would be needed for that purpose. In this context, collaboration research activities with other countries had been developed on the scheme of CBD to conserve and preserve microbes.

In collaboration with IMI (International Mycology Institute) from April 1994 to March 1996, 6 fungal taxonomist and 22 staffs have been train to isolate, identify, and preserve microorganisms. The aim of this collaboration is to enhance the LIPI Microbial Collection (LIPIMC) to help put in a position to support the *ex situ* conservation and maintenance of representative

Indonesian Microbial Diversity. This collaboration awarded the Darwin Initiative funding to facilitate collection, identification and exploitation of local microbial diversity. The activities were focused on the collection of fermented foods and 400 freshly isolated fungi have been added to the collection.

In collaboration with LIPI, BPPT, and NEDO/JBA from April 1997-March 2000, the diversity of economic important bacteria, acetic acid bacteria and lactic acid bacteria, in natural resources have been studied and preserved in culture collection in LIPI. Results of a number of studies revealed the high diversity of these two groups as evidence by the identification of two new genera in acetic acid bacteria, *Asaia* gen. nov and *Kozakia* gen. nov., as well as 7 new species of acetic acid bacteria. Regarding the lactic acid bacteria, a number of species had been identified and these species are of important in traditional fermentation as well as in silage making. Around 100 isolates of acetic acid bacteria and 200 isolates of lactic acid bacteria have been collected, well identified, and well preserved.

Through 9 intensive meetings (about 2½ years) collaboration with LIPI-NITE on the taxonomical and ecological study of fungi and actinomycetes in Indonesia (April 2003-March 2009) and characterization of oil degrading microbes isolated from Indonesian environments (April 2006-March 2009) have been conducted. During 6 years activities, significantly achievement in term of the number of economic important collection, man power development, number of international publications had revealed. From this collaboration more than 7,500 of fungi, actinomycetes, and oil degrading microbes have been collected, well identified, and well preserved. In the next 5 years (FY2011-FY2016), again, LIPI with NBRC-NITE is continuing the collaboration for the Development of International Standardized of Microbial Resources Center in Indonesia. This collaboration is very important and the collaboration should success as before.

During and after the collaboration between LIPI and NITE, many Indonesian researchers from government institutions or universities would like to access the microbes collected from the results of collaboration research. Several research activities in LIPI with collaboration with university in Japan or not have been conducted on screening and discovery of new or known enzymes from the isolates. As the results of screening of 100 actinomycetes from the LIPI-NITE collaboration, an actinomycete that excretes inulin fructotransferase to the culture supernatant was able to produce di-D-fructofuranose 1,2':2,3' dianhydride (DFA III) from inulin, with the greatest rate of enzyme activity at 65°C and at a pH of 5.5. Screening of manannase, cellulose, xylanase also have been conducted by LIPI researchers. Some isolates also were tested for inhibition of ATPase activity of RNA helicase from Japanese encephalitis virus (JEV) or hepatitis virus, in order to identify a drug candidate.

Unfortunately, the Indonesian private sectors has not undertaken microbial or biotechnological work such as screening of active compounds or discovery of new active compounds from microbial collection, but Indonesian researchers at many universities and governmental research institutions have approached it. Attempts to improve the microbial strains used in agriculture, food, health, and energy industries have had some success, but still no impact on industries. In Indonesia, almost fundamental research activities are conducted by and taking place in government of government sponsored research institutions and university via the provision of facilities, funding, and the man power that sometimes still lack. The private sectors, in general, due to their lack of entrepreneurship and limited research budget allocation do not have any role or interest in doing any long-term or fundamental research.

LIPI, as a scientific authority in Indonesia, had commitment to continue the inventory of microbial genetic resources in Indonesia which is important to human welfare. Attempt should be made to collaborate with private sectors in Indonesia to conduct fundamental researches until the microbial product have impact to industry. In the near future, it is believed that with collaboration with research institutions, universities, private companies, *etc*, the sustainable use of the microbial collection will give the great impact to human welfare.