Effective Microorganisms (EM) Technology towards Sustainable Agriculture and Environmental Management in Bali Island

By

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Bali island is one of the famous tourist destination area in Indonesia, because of it's amazing of natural beauty and traditional culture. The development of tourist activities in Bali island is supported by the high development of accommodation, transportation and communication services and readiness of the Balinese societies to conserve the natural beauty of rural, sea and urban areas. More than one million of international visitors and three million of domestic visitor visit Bali each year.

The development of agriculture and animal husbandry in Bali is directed to fulfil the food demand of the population and visitors. On other hand, the development of conventional agriculture that using chemical fertilizers and pesticides is worried to destruct the environment, polluting soil, river, ground water and sea. Finally, it can destruct the natural beauty of Bali. Also the development of animal husbandry, especially for the poultry, cattle livestock and pig raising can emerge some pollutions of malodorous that is very sensitive for the visitors. Conservation of natural resources and proper management of waste water of hotel, city garbage and waste of animal husbandry are the most suitable method to maintain the natural beauty of Bali island.

The application of EM Technology in Bali island is being conducted in Agriculture, animal husbandry and waste water management since 1993. In agricultural field, the EM Technology is applied to the grape, citrus, vegetables, rice, vanilla and coffee plantation. In animal husbandry field, the EM Technology is applied to the poultry, cattle livestock, and pig raising. In the waste water management, EM Technology is applied to the waste water management of hotel.

The application of EM Technology give some encouraging possibilities to maintain the natural beauty of Bali through nature farming and recycling of urban waste. The idea to develop Agro-Tourism activities that can introduce the concept of nature farming and EM Technology to the international and domestic visitors is very interesting to show the possibilities of using **EM Technology towards sustainable agriculture and environment**. It is also have some possibilities to establish the Bali island as model island of EM Technology application in the worlds.

Bioremediation

Bioremediation is a new treatment technology to clean up contaminated environments through the use of microorganisms. The natural predatory characteristics of the organisms are utilized to either destroy or change hazardous contaminants to a less harmful form. This technology has proven to recover contaminated sites in a more cost effective manner with less risks to humans than conventional methods.

Two cleaning methods have been used--**in situ** treatment methods degrade or change contaminants in place while **ex situ** clean-up methods require the contaminants to be removed from the site to be clean-up somewhere else.

Examples of toxic wastes that have been cleaned-up through bioremediation are oil, sewage, pesticides, and agricultural chemicals.

One laboratory which researches bioremediation is the Lawrence Berkeley National Laboratory at the Center for Environmental

Biotechnology. This laboratory is relatively new and participates in two different areas.

One area is to facilitate and coordinate interdisciplinary projects for six divisions and 70 scientists at LBNL. These interdisciplinary teams share their expertise to further the success of the projects. Imagine dealing with all the different problems associated with environmental pollution. Developing clean-up methods requires the attention and expertise of a variety of different scientists. For example in a toxic waste spill, a geologist would know the effects of pollution on the soil whereas a biologist would be able to assess the human risks associated with a particular pollutant.

The second area is to research microorganisms and bioremediation. Researchers are interested in the behavior of microorganisms in various polluted environments. They are researching how a microorganism has the capability of surviving in a polluted environment as well as how it uses the pollutant as a nutrient.

Bioremediation

Microbes play an important role in every ecosystem. Without their constant work, an ecosystem would cease to function and die. Besides

keeping it healthy, microbes can also repair a damaged ecosystem, consuming foreign and harmful substances and replacing them with beneficial byproducts.

Terry Hazen is a scientist using nature to cure itself. He is an expert in bioremediation -- the use of microbes to clean up contamination.

One of his projects was the federal government's 310-square-mile Savannah River Site (SRS) in South Carolina. SRS is one of the most polluted tracts of land in the United States. At the site, radioactive materials for America's nuclear weapons were made for over four decades. Solvents used in the process and stored in tanks were routinely transported through pipes buried underground. The pipes developed leaks, and the solvents seeped underground.

Usually, chlorinated solvents are very difficult to clean-up, but Hazen tried a new tactic. He enlisted the help of microbe that is already available in the soil. Methanotrophs, microbes which thrive in methane gas, naturally consume contaminants, but they usually exist in small numbers. Hazen increased the population of methanotrophs in the soil of SRS by pumping methane gas through pipes leading to the contaminated soil. The microbe population began to grow and biodegrade the contaminants in the soil.

When the soil is no longer contaminated, all Hazen has to do is stop pumping the methane. The microbes die back to natural levels. It's an effective but low tech solution.

methane pipes