

# **Program for the Integrated Management of Solid Wastes at EARTH University: A Small Community's Self-management Experience in the Humid Tropical Region**

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***Abstract :** The traditional models of rural development and growth have created serious problems of soil, air, and water pollution. As a result, agriculture and agro-industry, and their accompanying human activities, are major contributors to the global environmental health crisis which we are now experiencing.*

*At EARTH University, we are working to foster a new paradigm, based upon the philosophy of sustainable development. We promote the concept that agricultural systems are complex and they cannot be treated as isolated entities; they cannot be considered industries separate from the environment and people which form such as integral part of their systems.*

*EARTH University's facilities have an agro-industrial, commercial, residential and academic infrastructure. These facilities generate, on average, 0.65 kg per person per day, of solid domestic wastes. More than 60% of these wastes are characterized as biodegradable. EARTH faces an important challenge; to develop and operate an integrated waste management system capable of providing a solid domestic waste collection and treatment service that is efficient, economically feasible, in agreement with the institution's mission, principles and values, and appropriate for neighbouring communities. The use of EM (effective microorganisms) as a tool in the integrated waste management program has helped EARTH to meet this challenge.*

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## **Introduction**

Traditional rural growth models have created serious problems of soil, air and water pollution. As a result, agriculture and agro-industry, and their accompanying human activities, are major contributors to the environmental health crisis we are now experiencing in Costa Rica. During the last three decades of the twentieth century, Costa Rica has adopted the economic growth paradigm commonly referred to as the "Green Revolution". As such, there has been an emphasis on short-term economic results and productivity over the integrity of the ecosystem and rational, efficient resource use. The wants and needs of the market prevailed, with natural resources being considered inexhaustible, and their exploitation unrestricted. Furthermore, the distribution of the benefits generated by the use of natural resources has not always been fair, and the quality of life for some sectors of society has not been measurably improved. No provisions have been made to guarantee that future generations will continue to enjoy today's quality of life.

Because of the fragile ecosystem of the humid tropics and their rainforests, the need for change is even more critical. The deterioration of the environment in this region is

brought about by poverty, accelerated population growth, limited opportunities and insufficient knowledge and means for sustainable exploitation of the humid tropical ecosystem (Lieth and Werner, 1989). Harwood *et al.* (1993) suggest the need to take on a new attitude towards administration and sustainable development in order to preserve our resources and maintain their productivity, and to generate positive changes in growth policies that revert current pattern of environmental deterioration.

At EARTH University we espouse the philosophy of sustainability. We encourage eco-efficiency, which sees production and environmental protection as synergetic complements. We emphasize agriculture and natural resources, but recognize the intimate relationship between the community, the individual and the environment that brings them together into a single system. We feel that development requires an improvement in the quality of life for today's generations and future generations.

We are dedicated to generating and extending practical knowledge applicable to the humid tropics. We endeavor to establish a bridge for the two-way flow of information. We learn from communities, then conceptualize and synthesize this knowledge into appropriate technology which we transmit through active participation of our neighbours in the University's programs. At EARTH University we believe, and share the opinion, that only through practice can appropriate technology for the sustainable development of our region be proven. Only by example do we have the moral authority to propagate our knowledge.

### **Earth University**

EARTH University is a private, non-profit international institution dedicated to education in agricultural science and natural resources that contributes to sustainable development in the humid tropical region. Its mission is:

- To be a leading university, committed to the formation of vanguard professionals with ethical and human values, a social and environmental conscience, a business mentality and a commitment to serving others.
- To generate knowledge in the spirit of innovative, analytical service for fostering the welfare of the inhabitants and community development in humid tropical regions.
- To promote exchange, analysis, synthesis and dissemination of information about agriculture, natural resources and the environment in humid tropical regions.

EARTH University is located in the Caribbean basin of Costa Rica, in the county of Guacimo, the province of Limon. Its academic campus is on a 3300 ha property which contains a 600 ha forest reserve, a teaching farm and a commercial farm. The commercial farm is operated on a profit basis, with its profits used to financially maintain the institution. On this farm, bananas, plantains, heart of palm, and cattle are raised, and 400 ha of forest are being developed.

Before classes began in 1990, an environmental impact study of the university's operations was carried out. This study acknowledged that EARTH University would generate various types of solid and liquid wastes, both agro-industrial and domestic (ordinary, special and hazardous), and that these wastes needed to be handled in a way that was congruent with the principles of sustainable development. In response to this need,

EARTH University proposed the implementation of an Integrated Waste Management Program (IWM). The goal of this program was to look for an innovative solution to the waste management problem that was economically feasible, sustainable and applicable and adaptable to small urban centres in the humid tropical region. This paper limits itself to presenting the Integrated Waste Management Program for only the solid domestic wastes, including management of ordinary, special and hazardous wastes. In this program, we have extensively used EM (effective microorganisms) as a tool in waste management.

### **Description of the Problem**

EARTH University's facilities have agro-industrial, commercial, medical, residential and academic infrastructures. All these facilities which provide logistic support, make up a small urban community with an accelerated pace of human activity and a moderate production of ordinary, special, and hazardous solid domestic wastes.

Within the EARTH University complex, approximately 1125 people generate solid domestic wastes; these are the users and beneficiaries of the corresponding management system. Of all the users, 621 are permanent residents on the campus. The rest are employed at the University but maintain their residence in the surrounding communities. When the student population is included, 88% of the users are Costa Rican and the rest are citizens of 22 other nations from five continents.

In view of the studies conducted in the first quarter of 2001, we can infer that EARTH University generates an average of 0.65 kilograms of waste per day per person. Earth University's rate of waste generation is similar to that of San José, Costa Rica's capital city, but higher than that of the rural urban areas which have a rate of around 0.30 kilograms per day per person. The average weight of ordinary solid wastes generated at EARTH University is about 730 kilograms per day. More than 60% of the wastes generated at EARTH University are biodegradable, a typical description of the waste flow in developing countries. EARTH University was faced with an important challenge - to reduce a problem to an opportunity. We needed to develop and operate a technological package capable of providing for a solid domestic waste collection and treatment service that would be efficient, economically feasible, in agreement with the institution's mission, principles and values and appropriate for neighbouring communities.

### **Materials and Methods**

EARTH University's system for treating ordinary solid wastes is based on the "4 Rs" - REDUCE, REUSE, RECYCLE, and RETAIN (sanitary landfill).

Incineration is not excluded, but only used as a last resort in the management of hazardous wastes. The system consists, first, of applying techniques to reduce wastes at their point of origin. Waste materials are reused, whenever the material permits it. Other waste materials are recycled to create useful new products. Finally, when all other techniques have been applied and there is no other recourse, trash is disposed of in a technically designed and operated sanitary landfill.

The following describes each of the six main activities of the Integrated Waste Management System at EARTH University.

- **Classification at the Source, Collection, and Pick-up** - Each user is required to separate the clean paper, and plastic, glass and aluminium containers they use and

deposit them in appropriate receptacles. Three colour-coded receptacles are used for this classification with organic materials being specially separated for fermentation. In the residential area, there is a collection centre for every three houses. A contractor is hired to pick up the materials and take them to the recycling centre. The recollection is done on a daily basis as fresh organic material is necessary for Bokashi production (fermentation). The use of EM to produce Bokashi has significantly lowered the quantities of organic material that go to the landfill. Furthermore, the Bokashi that is produced is being used as fertilizer and organic amendments for horticultural crop production.

- **Recycling of Materials** - All wastes are taken to the material-recycling centre. Here the containers are separated according to the type of material (plastic, glass or aluminium). In addition, glass containers are separated according to colour. The recovered containers are given to a contractor who sells them to the reprocessing plants.

Clean paper is taken to the paper mill run by the university, to use as a complement in the manufacturing of banana paper. Plastic bags used for collection of wastes are washed and reused. Non-reusable bags are delivered to the plastic supplier for recycling.

The organic materials collected are fermented using a Bokashi system of EM technology.

Unrecoverable ordinary materials are taken to the sanitary landfill. Special and hazardous materials are classified at the source and handled separately.

- **Sanitary Landfill** - EARTH has a sanitary landfill that complies with the minimum technical and operational conditions appropriate for this type of facility. It is manually operated to serve as a model for small communities in the humid tropics that don't have the financial resources for buying equipment. Ordinary materials are deposited in the trench and covered with soil every day. At the bottom of the trench, a system has been installed to collect leachates, which then pass through a sand filter and subsequently into a wetland for purification.

Hazardous materials, especially those from medical facilities and laboratories, are deposited in a special concrete pit. Other hazardous materials, especially wastes from sanitary facilities, are incinerated.

- **Waste Water** - All installations at EARTH University handle waste water from their sanitary facilities in septic tanks. A program has been initiated to use EM in the septic tanks to increase the rate of decomposition of the organic material and to reduce unpleasant odors. The pilot project for this program, which began six months ago in the septic tank at the cafeteria, has been very successful. The odors emanating from the tank have been reduced significantly. As well, the problem of clogging of the filters going into the tank has been eliminated.

- **Training** - In order for the IWM Program to function efficiently, it has been necessary to implement a very aggressive and innovative training program for employees,

residents and students. The program has a laboratory for users to actively participate in the classification of wastes and where they learn to appreciate the magnitude and importance of the problem.

- ***Control and Monitoring*** - At least once a week the receptacles are inspected and the program's efficiency is measured. Every month a report is issued to inform users of the results of these inspections. These reports help to motivate the users to cooperate with the University in this Program. In addition, this information helps to identify and give recognition to those who participate in the Program.

## **Results and Conclusions**

The IWM Program was transformed from a project into a routine operation of the University starting in 1991 and up to now, has been providing efficient, satisfactory service. It has often been used to show visitors and donors a successful example of how simple, feasible, appropriate technology can be used to solve problems in the region. In addition, the IWM Program has demonstrated to neighbouring communities that technologies requiring expensive imported equipment and large quantities of raw materials are not essential for solving the problem of ordinary solid wastes.

Since the problem of solid wastes is a current reality, the IWM Program has attracted considerable publicity for the institution. CNN and all of the national television channels have aired documentaries on the project, and several articles about the project have been published in national newspapers. Many communities have visited and observed the project in operation. As a result of this positive exposure in the mass media, EARTH has benefited and has been projected as a substantial force behind sustainable development in the region.

Finally, the IWM Program has positively influenced the students. There is a considerable number of graduates that are currently working with waste management programs.

The analysis of the IWM Program shows that the project was well designed technically, is economically feasible and has an efficient operational organization. However, it often faces problems of acceptance and cooperation on the part of users and requires a campaign of constant training and promotion. There have also been some technical problems that have been solved through trial and error.

We have tried to take advantage of the opportunity presented by the fact that many university workers live in the neighbouring communities. If the program works well at EARTH University, the workers will hopefully take the idea home to their communities and push to establish a similar system there. There is still no example, however, of a neighbouring community that manages its wastes appropriately.

In conclusion, waste management is not exclusively an administrative, technical or financial problem. It entails a strong cultural element that can only advance through a slow but constant process of education. EARTH University's mission fits into this process perfectly and offers the opportunity to act as a tool for substantial change in the welfare of the region's communities.

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