

”Promoting Canadian Agrifood Exports”

Effective Microorganisms (EM) for Accelerating Composting

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The world is facing many problems, one of them being the treatment and disposal of solid waste. Many new technologies are being developed but they must follow strict environmental regulations (K. R. Gupta et al., 2007). According to the Government of Canada (2014), in Canada solid waste is sent to landfills to be disposed of and in some cases treated. A disadvantage of landfills includes the release of methane gas, a greenhouse gas, from decomposing organic waste (Government of Canada, 2014). The government of Canada (2014) states that methane emissions from landfills can be reduced by diverting organic material (food and yard waste) from landfills by composting or using anaerobic digestion. One of the many methods being used for the disposal of the organic material is the use of effective microorganisms (EM) for accelerating composting. This paper will focus on the potential exportation of effective microorganisms to Nepal.

Part I: Information about Effective Microorganisms

What are they?

EM is a natural and probiotic technology developed at the university of Ryukus, Ikinawa Japan by Dr. Higa during the 1970s (K. R. Gupta et al., 2007; Latin America EM Technology Portal, 2008). EM comes in liquid form and is made up of non-pathogenic and non-harmful coexisting aerobic and anaerobic microorganisms (Higa, [n.d]). According to the EM Research Organization (EMRO) (n.d.) these microorganisms are natural occurring, which means they are not genetically modified or chemically synthesized. The main species present in EM include lactic acid bacteria, photosynthetic bacteria, yeasts, acitinomycetes, and fermenting fungi (Sekeran, Balaji, & Bhagavathipushpa, 2005). These microorganisms have the ability to suppress harmful microorganisms and disease inducing microorganisms (Sekeran, Balaji, & Bhagavathipushpa, 2005).

Moreover, effective microorganisms are known to be useful in a wide variety of fields such as agriculture, animal husbandry, gardening and landscaping, composting, bioremediation, and even algal control (Higa, [n.d.]; Sekeran, Balaji, & Bhagavathipushpa, 2005). Several studies have been done to prove that effective microorganisms are beneficial in many fields. For instance, a study done to evaluate effective microorganisms in solid waste management revealed three things. Firstly, kitchen waste provided effective microorganisms an ideal environment to grow, which produced a higher quality of compost (Sekeran, Balaji, & Bhagavathipushpa, 2005). Secondly, organic matter improves soil management for sustainable cultivation of any crop and since effective microorganisms help produce higher quality compost, the crops used in the study had optimal growth (Sekeran, Balaji, & Bhagavathipushpa, 2005). Lastly, Sekeran, Balaji, and Bhagavathipushpa (2005) stated that “the adaptation of effective microorganisms (EM) leads to detoxification of... landfills, decontamination of [the] environment and promotes highly sustainable, closed-cycle agricultural and organic waste treatment.”

Types of EM Products

Also, there are different kinds of EM products. The original and most common EM solution is EM-1, which is used in over 120 countries (EMRO, [n.d.]). EM-1 is present in all applications of EM (agriculture, livestock, aquaculture, etc.), but it needs to be activated first (Latin America EM Technology Portal, 2008). The activation process of EM-1 involves a number of steps, but already activated EM-1 is usually sold by companies such as The Organic Gardener’s Pantry, Teraganix, or EMRO Japan. Other types of EM products include EM Bokashi, EM Mud balls, EM • X GOLD. EM Bokashi is fermented organic material made from activated EM-1, molasses, water, and organic material such as saw dust of dried leaves (EMRO, [n.d.]). It used in composting kitchen waste; it ferments and stops the food waste from rotting,

which eliminates bad odours released from food waste (EMRO, [n.d]). Next, EM Mud balls are simply made of dried mud into Bokashi or activated EM-1, and they are used to clean up bodies of water like rivers, lakes, and even oceans (EMRO, [n.d.]). Lastly, EM • X GOLD is a drink to balance individuals' health and its main ingredient is extract from culture of effective microorganisms, XCEM (EMRO, [n.d.]).

The main types of EM products sold and researched by the EM Research Organization of Japan:

EM Product	Application	Advantages
EM-1	<ul style="list-style-type: none"> • Agriculture (crops, livestock, composting) • Environment (water purification, construction, sewage treatment) • Household- used to make waste oil solid or liquid soap. • Household- used to make Bokashi. 	<ul style="list-style-type: none"> • Decomposes organic matter and improves fertilizer effects. • Recycles and increases availability of plant nutrients. • Increases nitrogen fixation • Suppresses soil-borne pathogens. • Produces polysaccharides and overall rich microflora to improve soil aggregation. • Enhances functionality of construction materials.
EM Bokashi	<ul style="list-style-type: none"> • Household- used to recycle or prickle food waste. 	<ul style="list-style-type: none"> • Ferments food waste, therefore bad odour is eliminated. • Helps create a valuable fertilizer.
EM Mud balls	<ul style="list-style-type: none"> • Environment (water purification) 	<ul style="list-style-type: none"> • Help reduce sludge and foul odours. • Help polluted waters revive.

EM • X GOLD	<ul style="list-style-type: none"> • Health 	<ul style="list-style-type: none"> • Enhances natural healing ability by balancing body functions
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Market Opportunity

EM products have a large market opportunity since they can be used in many fields. For instance, they can be used by an average family for their kitchen waste and for themselves to maintain good health. Also, farmers can use it to enrich the soil to produce better quality and healthier crops at a greater yield (Higa, [n.d.]). In agriculture, effective microorganisms can decrease pests, diseases, and the need for weeding or tilling (Higa, [n.d.]). Moreover, it can be used in industries such as construction; adding EM to cement gives it more strength (Higa, [n.d.]). EM products can be used by mostly any individual in many different fields, which gives it huge market opportunities.

How does exporting EM to Nepal benefit Canada?

The use of EM for composting in agriculture involves the recycling of solid waste into fertilizers in an environmentally friendly and efficient way (EMRO, [n.d.]). The fact that this method does not harm the environment and counteracts environmental pollution benefits the entire world, including Canada. Exporting activated EM to Nepal will benefit Canadians by providing jobs for the production of this technology. Individuals could potentially be hired to activate the EM-1, to prepare the different products that may be exported, and even to handle paperwork that may be needed. According to the Government of Canada (2013), Canada and Nepal have had long-lasting bilateral relations since 1965. From 2012 to 2013 Canada exported a total of \$7.1 million into Nepal and imported \$11.7 million from Nepal (Government of Canada,

2013). The major exports to Nepal fall under the areas of aerospace, machineries, paper and paper board, vegetables and optical instruments and appliances (Government of Canada, 2013). Exporting EM products to Nepal will bring more money into Canada and it will make Canada and Nepal relations even stronger.

Canadian Company

Currently, Canadians can only obtain EM products from “The Organic Gardener’s Pantry” located in Victoria, BC. This business is run by two individuals, Christina Nikolic and Phil Nauta, Christina being the only one in Canada. Their goal is to “... [find] real solutions to some of today’s pressing environmental issues, and to share these finds with others so that [they] can effect real change, one garden and one field at a time” (Christina, [date unknown]). At the moment they only provide individuals in the United States and Canada with EM products, they do not ship anywhere else in the world (C. Nikolic, Personal communication, November 4, 2014). Even though Canadians do not have many ways of obtaining the product themselves, if there is a bigger demand for it, more places will begin to produce it and sell it. This way, “The Organic Gardener’s Pantry” can potentially extend their company by shipping EM products to other parts of the world like Nepal. The export of EM to Nepal will not only bring money into “The Organic Gardener’s Pantry,” but will also create more jobs in Canada.

There are also other companies around the world that supply EM product. The biggest one is “EM Research Organization” in Japan, which supplies most countries in the world except for Canada and the United States. Another supplier of EM products is “Teraganix” and they are located in the United States (The Compost Gardener, [n.d.]).

Part II: Export Potential to Nepal

About Nepal

Nepal is a country located in south Asia between China and India. It has a population of about 29,339,000 people and its capital is Kathmandu (Maps of World, [n.d.]). Its currency is a Nepalese Rupee, which is equivalent to \$0.011 CAD (Raja Khanal, Personal communication, September 2014). It has 4 seasons: winter (December-February), spring (March-May), summer (June-August), and autumn (September-November). Nepal has a per capita income of \$300 USD, and also more than 30% of its gross domestic income comes from agriculture. The majority of Nepalese practice Hinduism. In Nepal, composting consists of fixed pits of solid waste, with no chemicals added. They are able to use this compost in their crops after one year (R. Khanal, Personal communication, September, 2014).

Benefits to Nepal

Individuals living in Nepal can greatly benefit from the import of EM for accelerating composting in many ways. Firstly, bad odour released from composting is eliminated; when EM is applied to the solid waste, the rotting process is stopped by fermentation types of organisms such as lactic acid bacteria (Higa and Chinen, 1998). The lactic acid bacteria produce enzymes, organic acids and antioxidants, all these help in reducing bad odours with a buffer effect (Higa and Chinen, 1998). Secondly, the compost process speeds up, allowing individuals to have access to compost for their crops more quickly, rather than having to wait a whole year. Also, the nutrients are retained in Bokashi and are not lost in the atmosphere as greenhouse gases, which is beneficial for the plants since they will have a better nutrient source (Higa and Wididana, [n.d.]). It is also beneficial for the environment because it is reducing the release of greenhouse gases into the atmosphere. The fact that the crops will have better access to nutrients, allows for greater crop yield.

In conventional composting the heap must be frequently turned over in order to prevent it from becoming anaerobic (EMRO, [n.d.]). The danger about the compost becoming anaerobic is that it will putrefy; when this happens, foul odour gases like ammonia are released and harmful bacteria are produced. Turning the compost heap is very labour intensive, especially for women in Nepal, and also expensive. Using effective microorganisms for composting will ferment the waste anaerobically and the turning of the heap will no longer be necessary since no oxygen is needed. This will reduce labour and cost for Nepalese (EMRO, [n.d.]). The fact that this technology will reduce labour may also mean that jobs may be lost in that field, but those jobs can be replaced with jobs for distributing the product within Nepal.

Cost Analysis

“The Organic Gardener’s Pantry” sells one liter of their inactivated EM for \$20.00 CAD, which is about 2566.88 rupees, plus shipping charges. Since not every individual in Nepal may be able to afford this, the prices could potentially be brought down, or larger companies in Nepal could purchase it and provide individuals with it for a lower cost. Also, instead of purchasing the inactivated EM, they could purchase the already activated EM for a cheaper price. One liter of activated EM costs \$12.00 CAD, which is about 1074.80 rupees. Also, one liter of EM-1 can be made into 20 litres of activated EM-1 by dilution, and it will be just as efficient (EMRO, [n.d.]). In addition, 1 liter of activated EM-1 can be used to make about 200lb of Bokashi (The Compost Gardener, [n.d.]). This makes it more affordable for individuals in Nepal.

Storage

Activated EM-1 is typically ready to use, 4 to 7 days after preparing it, when its pH is at a range of 3 to 3.5 (EMRO, [n.d.]). The product should be kept at temperatures of about 30°C to

40°C (86°F to 104°F) in order for the temperature to be suitable for fermentation. Preferably, activated EM-1 should be used within a week after it is ready, because at this time the effective microorganisms are very active and powerful. It can be used for up to one month after it is ready, but the younger it is, the more efficient the effective microorganisms will be. Moreover, after the activated EM-1 is ready, it should be kept in an air-tight container to keep it anaerobic. It should also be kept at room temperatures of about 20°C to 30°C and not refrigerated (EMRO, [n.d.]).

Transportation

The exportation of EM to Nepal gives rise to the need for sources of transportation. According to the Embassy of Nepal (2014), most cargo and goods get into Nepal through carriers like Air Canada and British Airways, and it is all done by cargo agents in Nepal. “Tudor International Freight,” ships sea cargo to Kathmandu, Nepal, at a rate of \$4.51 CAD per kilogram if the total weight of the cargo is more than 100 kilograms.

Airfreight Pricing to Nepal with Tudor International Freight:

Destination	Under 100kg	Over 100kg	Minimum
Kathmandu	\$5.62 CAD	\$4.39 CAD	\$263.48 CAD

These prices only include the shipping up to when the product arrives at the airport. The product will then be picked up from the airport and transported to the buyers. There may be a possibility that a small place could be built where the EM products could be taken to and then picked up from there, or the products could be directly transported to the buyers, which may include average individuals, farmers, and even bigger industries.

Transportation of EM products within Nepal can also be achieved by using Nepal's public transportation. There are many buses and minibuses available for transportation to different locations in the valley (Welcome Nepal, [n.d.]). Also, there is a long distance bus service, which runs day and night. These buses travel from Kathmandu to all cities in Nepal (Welcome Nepal, [n.d.]). An agreement could be made with these bus services to deliver the product. This would allow individuals in every city to acquire EM products.

Import Licensing, Permits, and Pre Shipping Inspection

For imports, no licence is required unless the product is prohibited or quantitatively restricted (SME Toolkit Nepal, [n.d.]). An import permit is needed from the Plant Quarantine office when plants or plant products are imported into Nepal. In Nepal, the Department of Agriculture has its own Plant Quarantine sections, where they issue import permits and phytosanitary certificates (it certifies that the product is free from harmful pests). Also, the importer must fill out a Nepalese Customs Declaration Form for the calculation of applicable duty and tax. There is no set system for pre-shipping inspection, but certain commodities like pharmaceuticals and industrial chemicals may need a pre-shipment quality inspection certificate to maintain Nepalese standards (SME Toolkit Nepal, [n.d.]). But since EM products do not contain any industrial chemicals they do not need a pre-shipment quality inspection certificate.

Competition

EM-1 was introduced in Nepal in 1996 by the Community Welfare and Development society (CWDS) through a non-government organization (EMRO, [n.d.]). It is being imported into Nepal from Japan. The use of EM-1 has expanded under the NGO network, and is currently used for organic farming and to reduce bad odour at a processing factory in Kathmandu. The

employees at this factory have reported that EM-1 is effective at reducing bad odours. Also, an NGO called “Help and Care” is promoting EM technology to a group of farmers to improve production in agriculture in about twenty Nepalese districts. This group of farmers is using effective microorganisms for rice, vegetable and fruit cultivation, and livestock (EMRO, [n.d.]).

There was a study conducted in the hills of Nepal to observe the effect on the growth and yields of radish and cabbage, after the application of EM (EMRO, [n.d.]). It has been found that the effective microorganisms’ solution is very effective under field conditions in Nepal. The study concluded that although the soil organic matter in the test pots was very low, when EM spray was applied at specific concentrations and time intervals there was a significant increase in crop yields (EMRO, [n.d.]). This study shows how helpful EM technology can be and already is in Nepal because it helped to significantly increase crop yield for two major commercial vegetables.

Since EM-1 is already being imported into Nepal from Japan, Canadians can still export other types of EM products. For instance, the Bokashi can be prepared in Canada and then exported to Nepal. This way Nepalese can begin to use Bokashi for their kitchen waste. Even if Nepalese would continue to buy from Japan since it is closer to them, they could be introduced to new EM applications to improve their quality of life. To make new EM applications more affordable for Nepalese, they only need to purchase activated EM-1 and with this product they can be taught to make other EM products like Bokashi or EM Mud balls.

Recommendations

In order for Canadians to be able to start exporting EM products to other countries more individuals should start using them. If Canadians were to start using effective microorganisms in

a greater scale, there would be more suppliers. Also, since EM technology promotes sustainable agriculture, more people should be using them for their crops to increase crop yields in an environmentally friendly way. Moreover, since many EM products have not yet been introduced in Nepal studies should be done to prove to individuals the benefits that come along. For instance, a study could be done on how EM · X GOLD helps people maintain good health by maintaining balance within the body.

In conclusion, effective microorganisms have a wide variety of application which can all greatly benefit Nepal and its population. The use of effective microorganisms in agriculture can benefit Nepal the most since 30% of their GDP comes from agriculture and crop yields have been proven to increase with EM applications. Using the diluted form of activated EM-1 individuals can obtain this product for a fair price. Transportation arrangements can be made and storage of the product is very simple, easing the exportation process from Canada to Nepal. Lastly, the use of effective microorganisms is beneficial for the entire world since it does not harm the environment making it an ideal product to introduce to countries that do not know about it.

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