# Tanah Sutera Development, an eco-city development project in Malaysia: two years on

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***Abstract*—Tanah Sutera Development Sdn Bhd has been developing an eco-city with harmonious coexistence of human, nature and microbiome. Our company base our practices on the principle of 5Rs (Rethink, Reduce, Reuse, Recycle and Responsible) and the concept of "Good habits are better than a carefree life". Since 2011, our company has incorporated Effective Microorganisms (EM) into our various activities, such as construction, landscaping, sanitation, waste treatment and outreach education programs. In 2014, we presented our project at Universal Village 2014, on the use of EM particularly in the fields of construction, landscaping and sanitation. It was in the early days of infrastructure building. Since then, we have shifted our focus and placed more emphasis on waste treatment (particularly food waste treatment), outreach programs and involvement with social enterprises. In this paper, we present these ongoing activities and discuss the challenges we faced and overcame.**

***Keywords*—Effective Microorganisms; eco-city; social enterprise; waste treatment; environment outreach***

## I. BACKGROUND

### *A. Tanah Sutera Development, an eco-city development project in Johor Bahru, Malaysia*

Johor Bahru resides at the southern tip of West Malaysia, closely linked to Singapore in the south by a Causeway and Tuas Second Link. In 2006, a 2,217 km$^2$ city development project "Iskandar Malaysia" was launched by the Government of Malaysia and the Executive Authorities of Johor State, and set to run for 20 years, from 2006 to 2025. The objective of this project was to attract a total cumulative investment of US$100 billion, to involve a population of 3 million, and to achieve per-capita GDP of US$ 31,100, in fields as diverse as finance, tourism, education, logistics, healthcare, to electricity-electronics, oil-petrochemicals, food-processing businesses [1]. Tanah Sutera Development (TSD) occupies over 1,000 acres of land in two regions in Iskandar Malaysia, namely Taman Sutera and Taman Sutera Utama, and the city is being developed to include housing, schools, religious, retail and commercial facilities (Fig. 1).

Because TSD is built as an integrated town, with residents, schools, parks and facilities for waste collection, we possess the capability to close the food loop (from farm to kitchen back to the farm). We envision to create a zero-waste and green living environment, and hope to build a model eco-town that promotes such sustainability. In addition, TSD is committed to the mission to cultivate good earth-friendly habits in our community through various green outreach events. Since 2010, we have been promoting the principles of 5Rs, namely, **R**educe, **R**euse, **R**ecycle, **R**ethink and **R**esponsible. "Reduce" means to reduce food wastes and to reduce the use of chemical fertilizers, pesticides, etc. "Reuse" means to reuse existing technologies and materials. "Recycle" means to recycle wastes into useful materials. "Rethink" means to rethink our consumption behaviours and old habits, whether by incorporating green features into our building design, or a complete overhaul of our existing mind-sets. "Responsible" means to be a responsible member of the community and to ensure the health and environment for us as well as for our children [2]. While the 5Rs form an essential backbone, Effective Microorganisms (EM) was the nerves and muscles that facilitated all our green activities

### *B. Eco-cities and Effective Microorganisms*

Since the conception of the "eco-city" in the mid-1970s, most eco-cities around the world have concentrated mainly on achieving carbon-neutral status, i.e. sustainable energy production [3] and/or resource conservation through waste management and recycling, such as the extensive Tianjin Eco-City in China [4]. As far as we know, Tanah Sutera Development is the only eco-city hitherto that incorporates the concept of microbiome [5]. Being part of the earth microbiome [6] that exerts its influence on all living things on the planet, including our very own human microbiome, Effective Microorganisms (EM) has the potential to harmonize the living conditions of our cities.

The mixed culture of EM comprises beneficial microorganisms such as lactic acid, photosynthetic bacteria and yeast. Originally isolated from nature and developed as a soil conditioner in the 1980s for use in agriculture to promote plant growth [7], in the succeeding decades its use has since then widened to fields that include animal husbandry, fishery, environmental conservation, construction, and farm/food waste and wastewater treatment [8].

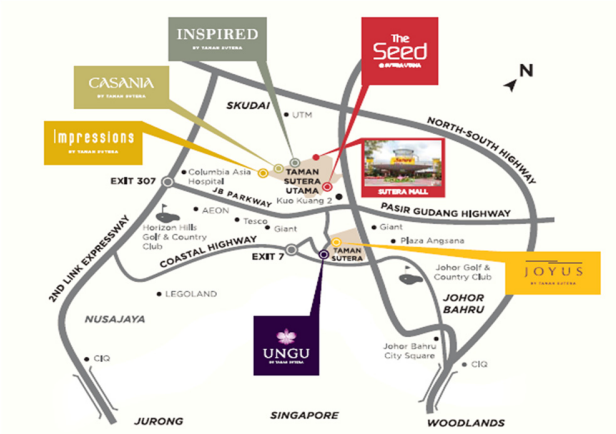


*Figure 1* Location of Tanah Sutera Development Sdn. Bhd.

The diverse applications of EM technology enable it to be integrated into a comprehensive project such as the Good Earth project by TSD. We have been using EM with good results since 2011, as was reported in a previous paper [5]. In parks and landscape precincts in TSD, EM is sprayed on the roadside trees and plants by our gardeners, to replace pesticides used previously, while promoting healthy growth of the plants. Instead of chemical fertilizers, food waste composts are used to fertilize soil. In ponds, liquid EM is added to the water to enhance the cleaning capability inherent in the ecosystem. Wastewater from two schools is also treated with liquid EM and occasionally EM mud balls in their oxidation ponds. The water is monitored monthly to ascertain their suitability to be discharged into the river. For construction, EM is added into concrete to enhance buildings' air quality and to reduce the Sick House Syndrome. The sites for construction are also sprayed with EM. One of our EM buildings, Matahari School, has been mold-free for 3 years despite not being painted on the exterior walls (Fig. 2). On the urban side, EM is applied as a cleaning agent for the toilets and floors of Sutera Mall, a shopping mall managed by TSD. To date, there has been a 90% reduction in the use of commercial chemical detergents and bleaching agents. The overall environment of TSD and its precincts have seen much improvement with the use of EM.

*Figure 2* The mold-free walls of Matahari School.

Since 2014, all our green projects have come under the same umbrella named "Good Earth Project", which was launched to spearhead the zero-waste living concept within our neighbourhood. In addition to installing the necessary eco-infrastructure and all the above mentioned activities, we feel there is a need to engage other institutions and educate the community, on the principles of 5Rs and the use of EM, which will be discussed in the following sections.

## II. ACTIVITIES OF GOOD EARTH PROJECT

### *A. Inception of Good Earth Center*

With effect from September 2015, under the Solid Waste and Public Cleansing Management Act 2007 of Malaysia, all households in Kuala Lumpur and Putrajaya as well as six states – Pahang, Johor, Malacca, Negeri Sembilan, Perlis and Kedah – have to separate their trash. Recyclable wastes such as paper and plastics are to be separated from food and organic wastes, collectively termed as "bulky/garden waste", and from "residual waste" which will be sent to landfills. Such a measure aims to prevent disposal of recyclable materials, reduce the amount of solid waste sent to landfills and reduce the country's allocation for solid waste disposal [9]. The benefits of recycling food waste into compost also include: conversion of food waste into a valuable resource (fertilizer); natural restoration of the biodiversity of soil; reduction in carbon footprint and greenhouse gas emissions, thus cutting down global warming; decrease in downstream pollution due to chemical fertilizers; and a possible source of revenue.

The new law tied in seamlessly with the principles of 5Rs promoted by TSD. With the objective of achieving a zero-waste township status, Sutera Mall has pioneered its first food waste composting centre for mall tenants in 2014. The main objectives are to minimize food waste generated by the malls' food and beverage outlets, and to convert said food waste into useful resources such as compost. With a tenant size of 325 (of which 65 are Food & Beverage businesses), 500 kg of food waste is generated daily. Due to the sheer volume of food waste and manpower constraint, we installed two units of food waste composting machines (Bio-mate) at the Good Earth Center (Fig. 3).


*Figure 3* (A) Two units of Bio-mate food waste composting machine at Sutera Mall's Good Earth Center. Capacity of each unit is 250 kg food waste/day. Steps for processing the food waste include: (B) sorting out inorganic waste, (C) pre-rinse with water, (D) loading into the machine, and (E) adding sawdust into the mix.

It should be noted that at the beginning of the project, in order to realize the ideal of an "EM eco-city", we used EM bokashi (rice bran fermented with EM) as a starter for the compost machines. However, we were not able to optimize the breakdown of food waste at higher temperatures, as the mainly mesophilic EM could not work efficiently at temperatures beyond 50°C. As a result, we experienced a couple of cases of infestation of houseflies in Sutera Mall, which had hatched from the piles of incomplete compost. After evaluation, we switched to thermophilic starters (Inozyme) provided by the machine manufacturer. Since then, the problem of flies subsided. In spite of the initial setback, the Good Earth Center reported a total production of about 22 tons and 35 tons of compost from food waste in the years 2014 and 2015 respectively, of which 14 tons were used in landscaping in the mall and surrounding neighbourhood and the rest were sold or distributed in outreach events.

In addition to processing food waste, residents and NGOs work together to collect various types of recyclable waste, including paper, aluminium, metals, plastics, clothes, etc. In 2015, a total of 33.5 tons recyclables were collected and sent for recycling at the Good Earth Center. (Fig. 4)

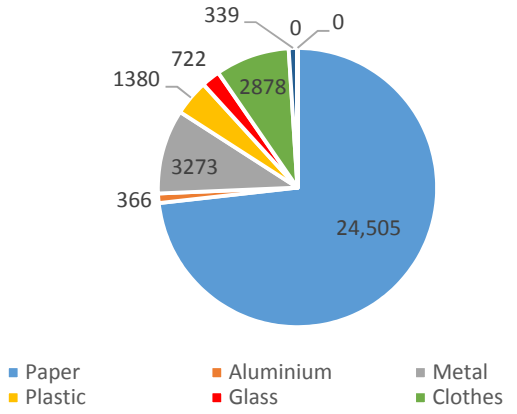


*Figure 4* Breakdown of the recyclables (in kg) collected in 2015 and sent to the Good Earth Center.

In view of the modest success we have achieved for the Good Earth Center at Sutera Mall, we are working with Fo Guang Shan Hsing Ma Si Malaysia, a Buddhist Education Centre which can accommodate thousands of devotees, to replicate the system at their center. In addition to recycling of food waste into compost, the center is open to visitors for the purpose of education. Towards the end of 2016, we will also replicate the same system at "The Seed", our new residential precinct of 1,250 households once fully completed, with a projected 7.5 (based on 1,250 households x 0.5 kg per household x 12 months) tons of food waste treated per annum. It will be a similar center for collecting, sorting and disseminating recyclable waste, as well as a processing center for household food waste. The compost thus produced will be channelled to landscaping and establishing home gardens for the center and residents.

### B. *Evaluation of Food Waste Compost Quality*

The treated food waste compost was sent in three separate batches for laboratory analyses (Table 1). In our composts, organic matter are high, constituting about 80% by weight of the compost. That translates to about Organic Carbon of 46.5%, using a conversion factor of 1.72 [10]. Taking the Nitrogen content to be 3%, the C:N ratio of our composts are 15.5. In a traditional aerobic compost, the ideal C:N ratio is 25-30. Compared to traditional composts, our compost is high on the nitrogen content, and ranks similarly to C:N ratios of manures. That is in agreement with the type of raw material (food waste) that goes into our compost. Our compost also tends to be mildly acidic at pH 6. However there is not much cause for concern as the normal range for compost is 6-8, with the ideal pH in compost at neutral 7. The NPK value in our compost is roughly 6:1:1. Hence our compost is more suited for the plants that have a higher nitrogen requirement, such as for shoot growth or foliage.

TABLE 1. Analytical results of food waste compost quality from The Good Earth Center at Sutera Mall.

| **Parameter** | **Average ± standard deviation** |
|---|---|
| Total Nitrogen as N, % | 3.06 ± 0.16 |
| Phosphorus as P, % | 0.74 ± 0.23 |
| Potassium as K, % | 0.65 ± 0.13 |
| Organic Matter, % | 78.31 ± 0.81 |
| pH | 5.97 ± 0.25 |
| Magnesium as Mg, % | 0.36 ± 0.14 |
| Calcium as Ca, % | 2.78 ± 0.75 |

One of the concerns of using food waste as the raw material for manufacturing organic composts was the possibility of pesticide contamination. The food waste were obtained from multiple and sometimes non-identifiable sources, and as these food waste may not be organic to begin with, pesticides may enter into our chain of production, and further contaminate downstream soils. When tested for a group of 20 organo-chlorine pesticides and another group of 40 organo-phosphorus pesticides, all traces of pesticides were below the detectable range (results not shown). In addition, pathogens like *E. coli*, *Salmonella* sp. and *Staphylococcus aureus* are tested to have no growth or absent in our food waste compost (results not shown). Hence it may be concluded that the compost produced at the Good Earth Centre is pathogen- and pesticide-free, and safe for use to grow food crops.

### C. *Partnering with Social Enterprises*

Because TSD strives to build an eco-city, we need to enlist the cooperation of other institutions and entities to make it a vibrant and sustainable project. We have the honor to partner, amongst others, Kiwanis Careheart Center, Pusat Kebajikan Kalvari Johor (PKK) and Nature Concept TCM Healthcare Sdn Bhd in our Good Earth Project to promote environmental awareness within our community.

*1) Kiwanis Careheart Center*

Kiwanis Careheart Center (KCHC) was established in 2000 to provide a comprehensive range of programs and services for young adults with intellectual disability. Its mission is to equip persons with special needs through best practices in education, training and support services, for open employment and life-long learning, in partnership with our stakeholders and community [11]. Through the partnership that began from 2012, with TSD and EM Research Organization and the use of EM, KCHC set up a chemical-free vegetable farm and a mushroom farm in its premises (Fig. 5). The farm provides training opportunities and employment not only for the center's trainees, but to the larger community keen to learn about organic farming practices with EM and sustainability. Because KCHC runs on private funds and is not supported by the Malaysian government as yet, the produce from the farm are sold in Sutera Mall, to raise funds for the maintenance of KCHC as well as to provide a ready supply of safe, pesticide-free food for the community.

*Figure 5* Bountiful harvest at vegetable and mushroom farms at Kiwanis Careheart Center.

*2) Pusat Kebajikan Kalvari Johor (PKK)*

A charity organization, Pusat Kebajikan Kalvari (PKK) builds homes and rehabilitation centers that provide places of refuge for the helpless, abused, abandoned and disadvantaged. A 13.6 acre plot of land in Pasir Gudang, Johor is being developed into a Calvary Care Village for men recovering from substance abuse and who are psychologically challenged. Animal husbandry (chickens and goats) and agriculture (oil palm, vegetables and fruits) will be practised at the village, which also reintroduces these men back into society and full-time employment, in addition to raising funds for the operation of the village [12]. TSD and EM Research Organization are involved in providing advice and monitoring on EM use, and the supply of EM for their farming and cleaning purposes.

*3) Nature Concept TCM Healthcare Sdn Bhd (Nature Concept)*

Traditional Chinese medicine requires brewing of medicinal herbs and tends to generate a lot of non-digestible food waste. In an effort to reduce such medicinal waste that would otherwise end up in landfills, TSD partners with *Nature Concept* to process their food waste. The compost that result is in turn used by *Nature Concept* to be applied to their farm for the cultivation of medicinal herbs. The owners of the business are Chinese physicians and lecturers who also participate in TSD's outreach programs, to educate and impart their knowledge on medicinal herbs to the general public.

*D. Community and Outreach/Educational Programs*

With the infrastructure, systems and collaborations in place, the third pillar in our environmental endeavor rests on the education of the community. It is imperative to raise the awareness of the general public, without which, our activities will not be sustained for long. To this end, we set up learning stations such as the Good Earth Center and My Library Green Corner and organized exhibitions on EM and the Good Earth Project, designed a series of EM and 5Rs workshops and activities and sponsored food waste recycling programs in schools.

*1) Learning Stations and Exhibitions*

Since the launch of the Good Earth Project, there had been a steady flow of requests by interested parties locally and internationally, to visit our Good Earth Center. We have since hosted government officials, developers, polytechnic and university staff and students, and EM users from Japan, Thailand, Philippines, and other countries (Fig. 6). In addition, users of My Library at Sutera Mall are also able to browse through educational materials related to EM and environmental conservation that are permanently on exhibit at the Green Corner (Fig. 7).

*Figure 6* Staff of TSD and EM Research Organization giving a demonstration of food waste composting process to visitors from


*Figure 7* Green Corner at My Library, Sutera Mall

Every two years, TSD would hold an environmental exhibition in Sutera Mall, to reach out to the general public ("EM & ME" in 2012, "The Good Earth Exhibition" in 2014 and "The Good Earth Carnival" in 2016). Programs include talks, workshops, contests, performances and signing of environmental pledges. Retailers are invited to sell their environmental-friendly wares. To date, we have attracted over 50,000 visitors to our exhibitions.

*2) Talks and Workshops*

To promote environmental awareness more actively, TSD has developed a series of talks cum workshops. From the initial EM workshops that inculcate the cultivation of EM (EM Activated Solution, Food Waste Fermentation and Soil Treatment, EM Mud Balls), we have expanded to workshops on using EM to make DIY facial masks and handmade soaps. Future workshops such as EM for household cleaning and pest control are in the pipeline. With the materials at hand, our team proceed to schools, private societies and residential neighborhood to hold talks and workshops. Since the commencement of this project, more than 25,000 people from over 40 institutions have benefitted from these events.

At Pei Chun High School, we are sponsoring the EM food waste project for the students to recycle canteen waste into fertilizers, to be applied into their school gardening plots. We hope that in the process, the students understand the importance of the closing of the food loop. In the near future, our newly constructed condominium The Seed will also see a slew of activities, from talks and workshops to organization of residential garden plots in the compound.

## III. CONCLUSIONS

The use of EM in Tanah Sutera Development's Good Earth Project forms an integral part of our Go Green activities. Through the years, we have found that in addition to building the hardware, such as infrastructure, systems and collaboration network, we need more to invest more time and energy in the software of promoting environmental awareness. While the hardware is being built up steadily by degrees, we need to adopt the long term view with the software approach, because it involves changing the current mind-set and habits of people.

## REFERENCES


[1] Iskandar Malaysia Web Site: http://www.iskandarmalaysia.com.my/

[2] Tanah Sutera Web Site: http://www.tanahsutera.com/home-1.aspx/.

[3] Joss, S. "Eco-cities: a global survey 2009" *The Sustainable City VI: Urban Regeneration and Sustainability:* 239-250. 2010.

[4] Caprotti, F. "Critical research on eco-cities? A walk through the Sino-Singapore Tianjin Eco-City, China" *Cities*:36, 10-17. 2014.

[5] Shintani, M.; Hia, H.C.; Fukugauchi, Y.; Miyagi, M.; Higa, T.; Shum, S. "An eco-city development project with special consideration for harmonious coexistence of human, nature and microbiome, in Malaysia" *The 2nd International Conference on Universal Village (UV2014)*, Boston, USA, 16-17 June, 2014.

[6] Alivisatos, A.P.; M. J. Blaser, M.J.; Brodie, E. L.; Chun, M.; Dangl, J.L.; Donohue, T.J.; Dorrestein, P.C.; Gilbert, J.A.; Green, J.L.; Jansson, K.; Knight, R.; Maxon, M.E.; McFall-Ngai, M.J.; Miller, J.F.; Pollard, K.S.; Ruby, E.G.; Taha, S.A.; Unified Microbiome Initiative Consortium. "A unified initiative to harness Earth's microbiomes" *Science*: 350 (6260), 507-508. 2015.

[7] Olle, M., Williams, I. H. "Effective microorganisms and their influence on vegetable production" *Journal of Horticultural Science & Biotechnology*: 88, 380-386.2013.

[8] Higa, T. "Our Future Reborn: EM Technology Changes The World" English edition: Sunmark Publishing, 2006.

[9] Ministry of Urban Wellbeing, Housing and Local Government, Malaysia Web Site: http://www.kpkt.gov.my/separationatsource/en/

[10] The soil quality fact sheet .http://www.soilquality.org.au/factsheets/organic-carbon.

[11] Kiwanis Careheart Center. http://www.kiwaniscareheartcentre.com/

[12] Pusat Kebajikan Kalvari. http://pkk.com.my/