

## Challenges and Lessons Learnt from a Community-based Food Waste Composting Project in Johor

Nur Farzana Ahmad Sanadi<sup>a</sup>, Norfhairna Baharulrazi<sup>a</sup>, Nur Naha Abu Mansor<sup>b</sup>, Takeshi Fujiwara<sup>c</sup>, Chew Tin Lee<sup>a,\*</sup>

<sup>a</sup>Faculty of Chemical and Energy Engineering, Universiti Teknologi Malaysia, 81310 Johor Bahru, Johor, Malaysia.

<sup>b</sup>Faculty of Management, Universiti Teknologi Malaysia, 81310 Johor Bahru, Johor, Malaysia.

<sup>c</sup>Graduate School of Environmental and Life Science, Okayama University, 3-1-1, Tsushima-Naka, Kita-ku, Okayama, 700 8530 Japan.  
[ctlee@utm.my](mailto:ctlee@utm.my)

A series of Low-Carbon Society (LCS) Blueprint has been launched in Iskandar Malaysia (IM) region since 2012. The public must be equipped with fundamental knowledge and skills related to the LCS work conducted collectively through a structured network of like-minded individuals and receive technical support and monitoring from experts and practitioners. This paper presents the lessons learned from a community-based food-waste composting program, a low-carbon action outlined under the IM LCS Blueprint, at Layang-layang, Johor as a case study. Selected volunteers in SC Jaya Sepakat, with the support by Mini Rural Transformation Centre (MRTC) have been trained and were given home composting kits. A centralised composting site was set up where one volunteer has been identified as the key player to manage daily composting operation. Food waste bins were collected and converted into compost through a five-step process at the composting site. A technical advisor from Universiti Teknologi Malaysia transferred the knowledge and technology to the villagers in terms of hands-on training, overall operation, compost quality analysis and post-application study of compost on plants. This study aims to empower the community to implement the food waste composting practices in a sustainable manner that would fulfill the societal and economic needs. The challenges and lessons gained through the 8 months engagement are reported. Post-training and end of project surveys were conducted to assess the performance of the community engagement. The survey concluded that the volunteers require extrinsic motivation from external organisations to continue the LCS initiatives until a tangible economic impact is generated. Community's daily commitment and limited communication facilities in rural areas made continuous engagement a challenge. The project also drew a lesson of importance in collaboration with different stakeholders for greater impact and optimisation in resources that would require further study.

### 1. Introduction

Malaysia produced about 38 kt/d of MSW where 15 kt/d is food waste and about 3 kt/d of food waste was sent to landfills (Channel News Asia, 2017). It is estimated that a household with five people spends an average of MYR 900 on food monthly where 25 % of the food were wasted during preparation, production, and consumption. This translates into MYR 2,700 of food waste annually, which exceeds the mean monthly salary of an individual living in the urban area (Channel News Asia, 2017). Malaysian agencies such as Iskandar Region Development Malaysia launched the Low Carbon Society (LCS) Blueprint for Iskandar Malaysia 2025 (LCS IM, 2013) since 2013, to serve as a guide for government to develop LCS. Introducing practical actions could reduce the food waste in the household and lead the community to a sustainable lifestyle (Phang et al., 2016). Composting can reduce 50 to 80 % of municipal solid waste (MSW) in the developing countries (World Bank, 2017), however this potential has not been harnessed. Community composting through the concerted effort of experts, community and supported by the government or local authorities can be a viable model to implement food waste composting. Lack of feasible business model and clear policy for composting, skeptics

on the collection of segregated food waste, and quality of the final compost (Fan et al., 2016) are among the major concerns.

Public awareness, on the urgent need of food waste recycling to safeguard the environment and economy, can be powerful to change the current scenario of low recycling rate. This study shares the case study of community composting conducted in Layang-layang, Johor, Malaysia. The case study has been initiated by the researchers from Universiti Teknologi Malaysia (UTM) with financial support from the Malaysian Government National Blue Ocean Strategy (NBOS, 2017), supported by Mini Rural Transformation Centre (MRTC) and the local communities in Layang-layang, Johor. This study aims to present the lessons learned on the community participation and the deliverables of the project. Project sustainability remained the key challenge to ensure the success transformation of the community on the waste to wealth quest. Ideally, the villagers could continue the effort on their own accord, moving towards the highest level of citizen participation under Arnstein (1969)'s ladder of full citizen control.

## 2. Methods

The methods for setting up the composting site and community engagement are summarised in Figure 1.

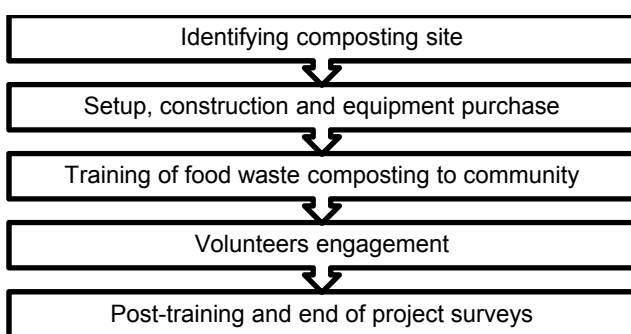


Figure 1: Project flowchart

### 2.1 Identifying composting site

Mini RTC (MRTC) Layang-Layang was chosen as the key stakeholder to drive the community project. MRTC recommended the composting site at Kampung SC Jaya Sepakat in Johor. The composting site was built in the palm oil plantation land (14,164 m<sup>2</sup>) belonging to Mr. Zambri Ab Hamid, a small holder of palm oil plantation and the key person responsible for the composting work. A memorandum of agreement was signed in May 2017 between MRTC Layang-Layang and UTM to bind the interest of both parties to sustain the community project.

### 2.2 Set up, site construction and equipment purchase

A budget (MYR 30,000) was allocated to MRTC Layang-Layang to construct the composting site (1,858 m<sup>2</sup>) with concrete floor for leachate collection, with a steel roof and a rainwater-harvesting tank. Equipment such as palm frond shredder (MYR 7,000), a final compost grinder (MYR 3,500), composting bins (MYR 1,000) and materials for composting (MYR 1,000), i.e. molasses, Effective Microorganisms (EMRO Private Limited, Johor, Malaysia) was purchased. A three-wheeled motorcycle (MYR 4,000) was purchased to facilitate the collection of composting bins from each household within the village.

### 2.3 Training of food waste composting to community

Workshops were organised in order to introduce the concept of sustainability and low-carbon lifestyle to the villagers and to encourage participants to be actively involved in food waste composting. There were 13 workshops organised throughout the project, involving a total of 1,618 participants, which exceeded the original participants targeted for the project eight-fold, i.e. 200 participants was targeted. A two-stage composting process was introduced. 20-L bins were distributed to the community (12 households) for food waste segregation at source, two to three times a week. The food waste collected was transferred to the 50-L bins (40 units at the composting site) with a pipe retrofitted near the bottom of the bin to drain and collect the bioliquid (or leachate). Food waste (about 5.1 – 10.2 m) was first layered with shredded palm oil fronds (about 400 g) placed at the bottom of the bin; 5 % microbial inoculant (EM) was added to the layers. The process continues until the bin was full and left for facultative fermentation of about 2 - 3 weeks. Bioliquid was drained after 2 - 3 weeks from the 50-L composting bins and used as foliar liquid fertiliser to nourish plant growth. The

partially degraded compost would be removed from the bins and laid on the concrete floor for the second-stage aerobic composting. Each compost pile (about 200 kg) was mixed manually using a spade for every 3 d; the temperature increased up to 60 °C within the first 3 d and decreased close to ambient temperature after 7 d. Compost was ground using a grinder and packed for sale (USD 1/kg).

#### **2.4 Volunteer engagements**

UTM voluntary team comprised of academic staffs and students visited the composting site every 1 - 2 week for the first 3 months (March - May 2017) to consistently motivate and encourage the community to pursue composting in their own capacity. MRTC and the head of the village coordinated the participation of villagers in the training and monitoring programs conducted by UTM team. UTM team monitors the on-going composting process in terms of temperature, waste and compost weight as recorded daily by the community about once per month since June 2017. UTM team also collected the compost and bioliquid sample for analyses i.e. nitrogen (N), phosphorus (P) and potassium (K) based on Horwitz (2017). The community was reassured that they can seek assistance from the research team beyond the duration of the project (6 months, December 2016 till May 2017).

#### **2.5 Post-training and end of project surveys**

Two surveys were conducted in order to gauge participants' feedback on the workshops. Post-training survey was conducted at the end of each session; end of project survey was conducted about 2 - 3 months after the workshops were conducted. The survey involved 142 participants from seven workshops sessions, mainly from schools or communities. The post-training survey comprised of seven items. Two of the survey items were open-ended questions that asked participants to state rationales in attending the workshop and their general feedback concerning the workshop. The remaining four aspects comprised of direct statements that described workshop content, content usefulness, and workshop duration and speaker delivery. Respondents were offered a choice of five pre-coded responses on a Likert scale, enabling them to express how much they agree or disagree with the statements. End of project survey comprised of an online survey form, on Google Forms that was emailed to 142 participants, who have responded to the post-training survey. The survey comprised of 13 items. All items comprised of direct statements with a choice of three pre-coded responses on a Likert scale. The participants were asked to state the location of the workshop attended, and the type of session (seminar / hands-on session / both) attended. They were prompted for responses based on the following four aspects; Satisfaction in content delivery, Importance of composting, Interest in initiating composting and the extrinsic motivation required to initiate composting at home.

### **3. Results and Discussion**

#### **3.1 Outcomes of community food-waste segregation and composting**

Challenges exist for the communication and interaction between academics and other agencies, the different languages spoken by these two spheres slows down the transformation and could result in misunderstanding (Muscio et al., 2013). Trainings were facilitated by the poster and video illustrating the Standard Operating Procedures (SOP) for the two-stage composting process (UTM Green DNA, 2017). UTM undergraduate students who have joined the UTM service-learning course entitled Science and Community prepared the poster and video. Since April 2017, 10 community volunteers signed up to segregate food waste at the source for collection by Mr. Zambri Ab Hamid. Incentive system was established to engage the interest of the community volunteers in which they could purchase the compost and bioliquid at a discounted rate of 50 %. About 100 kg/week of food waste has been consistently collected and composted.

#### **3.2 Post-training and end of project surveys**

Over 70 % of the participants indicated positive responses (agree and strongly agree) in terms of workshop content and duration, the usefulness of the program, and the quality of the speakers as shown in Table 1. Only 17.6 % or 25 out of 142 participants invited have responded to the survey. The response rate was higher than the response rate proposed by Fan and Yan (2010), i.e. 11 % for web surveys.

There were four rationales behind the low response rate. First, the population attending the workshop might be occupied with their daily commitments. Secondly, this population is predominantly living in semi-urban / rural areas, and they may not have access to good Internet connection. Thirdly, the survey is administrated within a short period of three weeks without repetitive reminders. Finally, some participants may not have a smart phone, and cannot access the survey on Google Forms. These factors should be deliberated in future iterations of surveys involving members of the community.

Table 1: Positive responses (agree and strong agree) for the post-training survey

Date	Workshop location (Total respondents)	% of positive responses to four questions			
		The content of the workshop is accurate and easy to follow	The course is useful	The length of the workshop is sufficient	The speaker is a specialist and suitable for this workshop
24/07/2016	UTM (30)	90 %	100 %	86.67 %	100 %
07/08/2016	MRTC Layang-Layang (25)	88 %	88 %	76 %	80 %
02/09/2016	Kota Kulai Secondary School (25)	72 %	92 %	72 %	92 %
09/10/2016	MRTC Murnijaya (12)	75 %	91.67 %	66.66 %	66.67 %
30/10/2016	MRTC Parit Sapran (17)	76.47 %	82.35 %	70.59 %	82.35 %
06/11/2016	Hutan Bandar Putra Kulajaya (6)	83.33 %	83.33 %	83.33 %	83.34 %
27/02/2017	Kota Kulai Secondary School (42)	80.95 %	90.48 %	76.19 %	71.43 %

From Table 2, the participants are generally satisfied with the content delivery of the project. They are also aware of the importance of composting for environmental sustainability and agree that food composting is an easy process. They are unsure if they would start food composting at their homes or their workplace within the next 6 months. They need extrinsic motivation to initiate composting, as they would only start with guidance from instructors and research team (52 %), have a partner to support them (56 %), and attend follow-up programs from instructors and research team (56 %). The research team may be successful in knowledge transmission, but more effort is needed in terms of developing support structures that would ensure participants follow through with their workshop training after the end of the project.

Table 2: Summary of responses from end of project survey

Aspect	Survey	Response		
		Disagree	Not sure	Agree
Satisfaction in content delivery	The sessions I attended were satisfactory in terms of the delivery of knowledge	-	6 (24 %)	19 (76 %)
Importance of composting	I understand the importance of composting in reducing waste to landfill.	-	4 (16 %)	21 (84 %)
	By composting I can reduce waste to landfill	-	1 (4 %)	24 (96 %)
Interest in initiating composting	Composting supports the sustainability and preservation of the environment	-	-	25 (100 %)
	Composting process is easy	-	1 (4 %)	24 (96 %)
	I am interested in starting composting at home / workplace	2 (8 %)	12 (48 %)	11 (44 %)
Extrinsic motivation required to initiate composting	I plan to start composting in the next 6 months	4 (16 %)	13 (52 %)	8 (32 %)
	I will start composting at home / workplace if advised by the instructor / organiser	3 (12 %)	9 (36 %)	13 (52 %)
	I will start composting at home / workplace if I have a partner to help me	4 (16 %)	7 (28 %)	14 (56 %)
	I need a follow-up program from the instructor/organiser to assist in composting at home/workplace.	4 (16 %)	7 (28 %)	14 (56 %)

### 3.3 Project impact

The following subsections review the impact of this project from four perspectives, and the lessons learned during project implementation.

#### 3.3.1 Breaking the silo

A community-based composting site requires the involvement of different stakeholders to ensure functionality and sustainability in the long run. Activities related to the establishment of the composting site and daily operations may fall under the jurisdiction of several stakeholders. Limited resources and expertise may restrict initiatives that can be implemented on the composting site. These challenges can only be overcome through communication and collaboration with other stakeholders.

A series of meetings between the research team and different parties had clarified the governance structure and relevant legal requirements related to the project. The restrictions include lack of key performance (KPI) placed under the local authorities and some government agencies to reduce waste at source.

Throughout the public engagement, it was found that many stakeholders are interested in food composting on commercial basis across the country. Several food wastes composting initiatives have been implemented within Johor including FOLO Farms in Ulu Tiram (3 t/d, windrow composting) and Sutera Mall commercial outlet (1 t/week, 2 in-vessel composters). With many real-life cases, UTM team is able to draw lessons for implementation and seek collaboration from different stakeholders for greater impact and sustainability.

The setting up of the composting site at MRTC Layang-Layang also provides lessons to be learned in terms of resource optimisation. According to the stakeholders, there are several government agencies that could support the composting site by sourcing better equipment. As the project was funded by NBOS supported by the Ministry of Rural and Regional Development, there is a positive indication of continual funding to sustain the current initiatives up to the commercialisation stage. One of the government agencies, the Southeast Johor Development Authority (KEJORA, 2017), is likely to offer support in terms of product packaging and marketing. The Department of Agriculture, Johor may provide some equipment for process scale-up, provided that the community is able to show the evidence of project sustainability and revenue generation from the sale of compost. The small profit generated from the sale of compost is currently used to subsidise the cost of waste collection and man-power at the site. The profit to be gained upon process scale-up would be managed by MRTC as a mediator for the community project. Wong et al., 2017 conducted a case study on low carbon practices at schools in Iskandar Malaysia stated that engagement of school with government agencies is important as government provide support in terms of resource and financial.

The mediated discussion with MRTC and the community also pointed to the need for clear expectation setting across all parties working on the project. Some of the stakeholders, the Johor Chief Minister's office and the Ministry of Rural and Regional Development, expected the research team to commercialise the compost and bioliquid produced to increase the income of the villagers and reduce the cost of fertiliser for their plantations. Currently, project witnesses the shortcomings to address the need for product commercialisation at a faster rate to keep the motivation on-going. In the future, the research team should engage experts from different fields, notably for product commercialisation and marketing, in order to close the gap for project sustainability.

A case study of composting project conducted under Clean Development Mechanism (CDM) in Uganda focused on knowledge transfer between stakeholders and farmers (Lederer et al., 2017). In this case study, the focus is on knowledge transfer, collaboration with different stakeholders and resource optimisation will be considered in the future study.

### 3.3.2 Low-cost high impact

NBOS emphasised on low cost and rapid execution of high impact outreach programs. The composting site should require minimum resources to function, yet being able to generate great returns to all involved. The project received MYR 110,000 for the 18-month project. About 45 % of the budget was spent on-site construction and the purchase of small-scaled equipment for the composting site; while the rest was used for human resource (site manager) for community training and project monitoring, sample analyses, travel cost and reporting.

The project successfully engaged a large number of participants (> 1,000) that has exceeded the expected target of 200 participants. Several schools have participated in the training, e.g. Pulai Chinese Primary School, Kota Kulai Secondary School, have been empowered to begin the composting program at their schools. Retrofit the recycled bins into compost bins has saved the compost bins cost by six-fold. Recruiting UTM student volunteers supported by UTM Centre for General Courses and Co-Curriculum has reduced the man-power cost while inculcating good personal attributes in the students.

### 3.3.3 Rapid execution and sustainability

The design and layout of the composting site were set at a minimum in order to accelerate the construction works. The food composting method is easy and can be implemented immediately. The SOP developed by UTM students have facilitated the process of food composting in households and served as an illustrated guide for the public at the composting site. Community project often incurs a delay in achieving the milestone as planned. All key stakeholders would be occupied by their routine work, coordination of the meeting time to suit all can be a challenge. The procurement procedure using public funding is subjected to various limitations for approval and caused some unexpected delay in the site construction and equipment purchase.

The most difficult challenge is to identify the community that is committed to pursuing the food waste composting work. In this study, it has taken 12-months to identify the right community. This was learnt from another case study in a composting project in Johor (Bong et al., 2017) that has not been sustained. The volunteer engagement comprised of the local community only and lack of a local program mediator to resolve the conflict of interest. A supportive mediator, who is able to source further funding and provide marketing

support, is crucial for program sustainability. Future teams wishing to carry out community engagement projects should be realistic on the timeline required for the introduction of concept, consensus building and program implementation.

#### 4. Conclusion

It shows that there is a high public interest in the LCS concept to reduce waste at source through composting. There are still gaps for the community to carry on the LCS initiatives to move towards the highest level of citizen participation under Arnstein (1969)'s ladder of public participation, that is, full citizen control. Continuous engagement is needed to manage a change of behavior such as food waste segregation and home composting. The project implemented at Layang-layang, Johor has proven the concept of a community-based food waste composting effort set to turn waste into valuable products with potential for commercialisation. The project has proven the concepts breaking the silo, low cost, high impact and rapid execution. Additional support is required to implement the sustainable business model, product commercialisation, and marketing. Future strategies would aim to increase the number of participants and volunteers to facilitate process scale-up.

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