

# ENLARGEMENT AND SUSTAINABILITY OF MUNICIPAL SOLID WASTE COMPOSTING IN MEGACITY - A CASE STUDY FOR SURABAYA CITY -

## To Initiate “SISTER VILLAGE CONCEPT (SVC)”

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## Abstract

The aim of this report is to initiate the Sister Village Concept (SVC) in megacity like Surabaya city, Indonesia. This concept is to address Municipal Solid Waste Management (MSWM) program to reduce the volume of waste load on final land fill disposal site and to promote composting both in each household level and in composting centers. The SISTER in term of SVC itself is stand for Sharing of Information, System, Technology and Economic Resources. In addition, it tries to bridge the relationship among villages and exchange any resources based on mutual respect, learning and cooperation. The principle of SVC is a sustainable cooperation between compost producer villages and compost user villages, within this cooperation, producer villages will supply the compost to user villages. Instead the compost user villages will supply the solid waste to the compost producer villages.

Keywords; Surabaya city, Sister Village Concept, Solid waste management, Compost

## 1. Introduction

Surabaya city is the second largest economic and industrial centre of Indonesia with current population of about 3 million. It is also the capital of East Java Province. The city is populated with density 8,043 people/km<sup>2</sup>. Every day 8,700 m<sup>3</sup> of waste is disposed from this megacity. The waste composition of Surabaya city are like 55.0% organic matter, 10.0% woods/bamboo, 13.0% street sweeping, 8.0% paper, 8.0% plastic and others 8.0% (KITA, 2007) which indicates organic waste shares more than half (as much as 70.0-80.0%) of total amount of waste. This situation prioritizes reduction of organic waste which promotes composting to Solid Waste Management (SWM) concept from this city. It is a good opportunity to revitalize the organic waste to more useful way, both economically and environmentally.

The main strategy to address the SWM concept was to reduce the volume of waste at the final land fill disposal site, and also to try promoting composting activity both in each household level and in composting centers. In 2007, there has been 18.6% reduction of waste transported to final disposal area compared to the years before the SWM was taken. The number of waste was reduced to 1,480 tons dramatically. In 2008, 350 ton/day waste was reduced (40 t/d from household composting, 40 t/d came from composting centers, and the remaining 270 t/d by reuse and recycling activity) which means approximately 1 ton of composting have reduced 2-3 ton of waste (Maeda, 2010). Furthermore, this SWM concept as a community based waste management program has increased the community awareness and cohesiveness.

The community based program has been believed will be successfully implemented when all stakeholders make a good collaboration. The SWM is successful in the early of 2008, but the overload of producing compost made some problems occurred in distribution process. Therefore, it is needed to distribute and to look for a good market to roll the product as an economic and environment benefits.

### 1.1. Problem Statement

Although Surabaya city has received international awards recognizing their achievements in improving the environment, i.e. EGA (Energy Globe Award), Austria 2005; Water and Environment Category Green Apple and Green Organization, London 2007; UNESCAP (United Nation Economic and Social Commission for Asia Pacific) Award 2007 for Urban Environment Improvement, current challenges arise of the city is to expand composting pilot activities to entire city. Several specific challenges arise from enlargement of composting in megacity including (1) thorough implementation of separate collection, (2) special allocation of composting facilities with optimal size, (3) ensuring markets of organic fertilizer, (4) sustainable of composting activity, etc. More specifically, in this research report we try to initiate the sustainability of the composting program as a part of Municipal Solid Waste Management (MSWM) concept.

In order to solve the problem in the future, the increasing population could be act as main driving force of waste problem. The other factor is market demand of compost for the sustainability of the program. There are also other issues like financing, participation, technology development, marketing strategies for compost, collection and transportation system, willingness of using compost, and etc that are needed to be looked forward. However, it is not easy to secure a market for compost and often demand fluctuates seasonally. In fact, PUSDAKOTA (*Pusat Pemberdayaan Komunitas Perkotaan* - Centre for Urban Community Empowerment) has stored a large stock of compost in a work space which could otherwise be used to increase production. Therefore, managing a composting centre is profitable providing there are buyers (Maeda, 2010). Another challenge for the NGOs like PUSDAKOTA and community groups are the capital cost to establish a composting centre.

The entire problems stated above start from the first step before installment of SWM programs (called as PRE stage). After the communities have increased their awareness, the institution model are tried to be introduced and to be built (PRO

stage). Then, the communities should try to find the market in order to distribute their product and to get income from it to roll the composting activity (POST stage). The details are described in Figure 1. Based on this PRE-PRO-POST stage, this report tries to introduce a concept that will solve those problems that possibly will be occur in the communities, called as the Sister Village Concept (SVC).

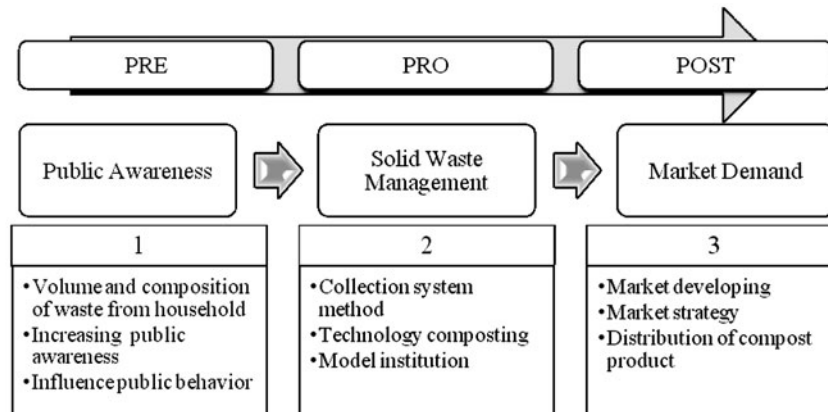


Figure 1: Framework of problem statements

## 1.2. The Aim of Report

The aim of this report is to initiate the Sister Village Concept (SVC) in term of sustainability for composting program in Municipal Solid Waste Management (MSWM). Furthermore, is trying to convince that the SVC is one of choices to solve waste problem in urban area, like Surabaya city.

## 2. The Sister Village Concept (SVC)

### 2.1. Definition of the SVC

The Sister Village Concept (SVC) is the alternatives proposed to provide a solution to solve existing occurred problems as stated above. The SVC describes relationship among villages and exchange based on mutual respect, learning, and cooperation (for details please visit [www.theschoolhouseatmutianyu.com](http://www.theschoolhouseatmutianyu.com)). Sister in term of sister village in this report has the meaning of **Sharing of Information, System, Technology and Economic Resources**. Related to the SWM, the SVC is relationship among villages on sharing of information, system, technology and economic resources in order to make a sustainable SWM. The SVC in principle is a sustainable cooperation between the compost producer villages and the compost user villages. Within this cooperation, the producer villages will supply the compost to user villages. Instead, the user villages will supply solid waste into the compost producer village.

As mentioned early, the PUSDAKOTA has a lot of programs that were trying to empower urban community. Based on the reports of solid waste composting program of Takakura Basket method which is a partnership between the PUSDAKOTA as environmental NGO and Kitakyushu International Techno-Cooperative Association (also called as KITA) could be known that:

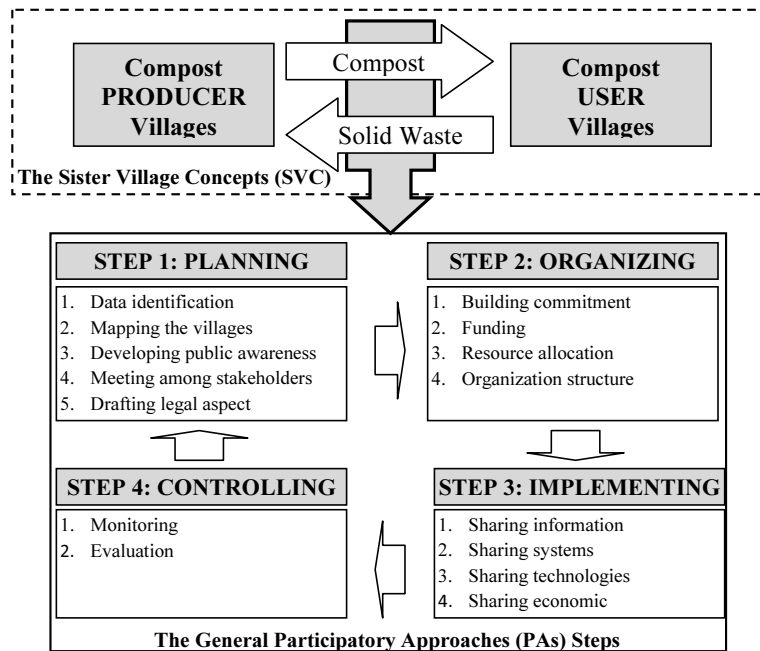
- The program has succeeded in building a composting at 14 points in Surabaya.
- The trend continues to increase compost production
- Projections of compost markets still unclear
- Sustainability of incomes in the production of compost is not yet clear

It has widely known that composting programs have some benefits that could be reaching by all citizens of the city. Currently, those programs are needed to be expanded. In addition, there are some fundamental problems that need to look forward in order to find some solutions during program expansion. One of them is how to develop marketing strategies of compost from processing product. In the end, the economic income for communities that gain from the SVC will be projecting more clear, measurable, and sustainable.

In general, compost producer village is act as supplier of compost. They have to produce compost intensively. They have to be managed by a good and strong leadership. They also have to be convinced that the SVC programs will give some benefits that will help them financially and also in the long term will positively give a good environment where they are living. As said by Wilson (1985) that the continuing provision of an efficient, reliable and cost-effective service for solid waste management requires the preparation of a sound long-range plan.

Compost user villages are mostly some villages that need compost to fertilize their agricultural or gardening land (green open areas). Therefore the compost user villages as the compost market should be managed optimally. As the case study, some compost producer village and compost user villages as a material for preparing the forecast simulation compost marketing strategy with the initiation PUSDAKOTA and KITA were selected.

Process development of the SVC is mainly start from the step of (1) planning, (2) organization, (3) implementation and (4) controlling (Figure 2). In each step, there are some objectives that should be appropriate with the participatory approaches (PAs) based on problems occurred during the SVC implementation in the communities. A further assistance is needed when they have to move on from step 4 to step 1, where they have to redevelop this concept again. At least seven PAs are provided to solve any situation that will detain all the processes.



**Figure 2:** The development process of the Sister Village Concept (SVC) through four general steps in Participatory Approaches (PAs)

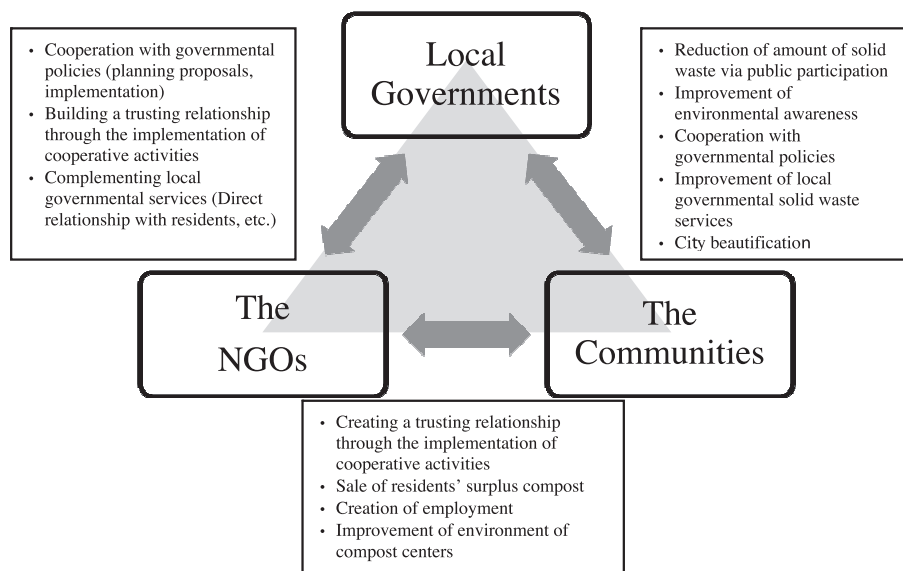
**Table 1:** The Sister Village Concept (SVC) in Details

| SISTER: Sharing of | Details Sharing  |
|--------------------|--|
| Information        | In order to initiate the SVC, the first step has to be done is to share the information about it. The three stakeholders (community-local governments-NGO) and also producer-user villages should be convinced that the SVC is one of solutions to solve solid waste problems. All information should be clear in the beginning, so that there will be no gaps or misunderstandings. Like sisters who will help each others, the villages should share anything to make sure every village is saved.   |
| System             | The meaning of system in this report not only system of information, but also any system that can help composting activity become much better than before. Any system like marketing system to recognize and develop market value and increase benefit, or like geographical information system (GIS) that will help spatially the distance, road condition among compost producer-user villages. Those systems are basically the comprehensive and powerful procedures that can minimize the human error, and at the same time will save the energy, time and budget.   |
| Technology         | The SVC needs a composting technology that could help communities more efficiently and effectively produce saleable compost to consumer. This technology should be friendly (easy to use), high durability, and the most important thing is it has acceptable price. In the case of Surabaya city, there are two technology methods have been introduced and implemented, i.e:<br>1. TAKAKURA HOME METHOD (THM) is a household composting basket. The composting could be conducted at home level.<br>2. TAKAKURA SUSUN METHOD (TSM) is a community composting centre. The community will collect their waste in a collecting site near their home. This is to solve for communities that have a home with a small space. Further details about these technologies are shown at <a href="http://www.kitakyushu.iges.or.jp">www.kitakyushu.iges.or.jp</a> . Those products are copyrighted. |
| Economic Resources | The analyses of cost-benefit, supply-demand, and climate change issue have to be share among villages that will become a big value economically. The SVC is believed will give those benefits, also will give additional income, and at the same time will help the environment to gain “high-environmental-value” because the beauty, hygienic, and convenience place to live.  |

## 2.2. Institutional Model of the SVC

There are three principle actors in the SVC. They are the local governments, the communities and the NGOs (Figure 3). The SVC is a highly interactive process between those three stakeholders. As the central actor, most municipalities are obligated by national laws within the Municipal Systems Act to *ensure* the provision of solid waste services to their jurisdiction. However, the municipality is not obligated to provide these services itself and may incorporate the private sector and community organizations into the process. Furthermore, a new institutional and legislation framework has to be structured with the objectives to establish a holistic, integrated, and cost-effective solid waste management system, with an emphasis on environmental protection and public health (Manaf et al., 2009).

Some factors influencing the quality of the service such as, lack of policies/strategies and financial support, low involvement of private sectors, inefficiency, and low community awareness led to the low Level of Service (LoS) of SWM. The problem occurred in all steps of SWM (storage, collection, transferring, transporting, and treatment) with the tendency to rise at the end point, landfill. Based on the study of waste management conducted by UNEP in 2004, it showed that only 33.0% of the indicators for LoS of SWM have been fulfilled by the government. It means that the level of service of waste management was still low (Meidiana et al., 2010).



**Figure 3:** Three key stakeholders and its roles (adopted from KITA (2007))

### (1) The Communities

The communities are linking the improvement of waste management composting activities in their own living and hygienic environments. The community participations in waste disposal can be a catalyst in community-development work, because it gives residents a feeling of self-esteem. It can lead to the possibility of income generation through the recycling system which will also reduce the quantities of material that have to be transported for disposal. The community's participations are essential in the selection of methods, also in the cooperation, in storage and in decisions about separation and recovery of resources. The communities members can participate in the SVC by showing proper sanitation behavior, by contributions in cash, by kind or labor, by participation in consultation and by participation in administration and management of solid waste services (Anschutz, 1996). Beside community's members, local leaders in urban communities also play important roles in the SVC. On a community organization basis in low-income housing areas, the separation of waste on a household level is very profitable, easily becomes an economically viable undertaking (Habitat, 1989).

Basically, the local leaders can be divided into traditional, formal and informal leaders. Traditional leaders derive their authority from hereditary rights and from their status in the local culture. Formal leaders are appointed by the government or elected as local representatives of the government. Informal leaders are influential members of a community on the basis of their personal status or of their activities in community-based organizations such as political parties, churches, youth and women's organizations, neighborhood committees, etc. All three types of local leaders may have different roles in the SVC programs. Usually, formal and informal leaders are more involved in the SVC than traditional leaders. Involvement in management of solid waste services includes participation in the management of solid waste services and keeping in contact both with the local governments and the communities.

The roles of communities are:

- a. Should convince resident/household that composting is best solution to reduce waste/pollution and as the alternative income,
- b. Should as fast as they can to improve and report if there is problem in their area,
- c. Promoting the sister village system to community and encouraging the resident to build and maintain this system, and
- d. Promoting the product and attracting people to use compost.

#### (2) The. NGOs

The NGOs have to develop trust with communities to educate the public who are directly engaged with waste issues. The NGOs make use of their specialized knowledge to identify techniques to solve the problem. The NGOs carry out educational and practical activities directly with community residents in the fields that make use of their own distinctive qualities, in which the local government is not experienced.

The roles of NGOs are:

- a. Since the NGOs will be the actors in composting, they should professionally manage this activity in order to make sure the SVC can be sustained in the long term. The composting activity is not only a profit-oriented project but is also included in the integrated waste management. A competent worker should be hired, so that the control for compost quality can be done carefully.
- b. Linking villages to share all information about compost.
- c. Providing system and information and transferring composting technology.

#### (3) Local Governments

In Indonesia, before the decentralization era (before 1998), the SWM was the responsibility of several departments and ministries such as Ministry of Public Works, Ministry of Home Affairs, Ministry of Health, Agency for Technology Assessment and Development, Board of Environmental Impact Management (BAPEDAL), and Sub Directorate for Solid Waste Management. After the decentralization, in 1999 there were changes in national and local waste institution where the central government plays a role as a regulator and the local governments are the prominent players. The local governments obtained more responsibilities in planning and implementing SWM and the SVC in their territory. Solutions to waste problems must be placed as an important local governmental policy and the strong leadership of the local government actions must be taken, while simultaneously presenting clear techniques and methods to all stakeholders.

The roles of Local Governments are:

- a. In terms of institutional aspect, the strengthening of legal aspects such as local government regulation (*peraturan daerah*) that regulates commitment of villages to build composting and the responsibilities among stake holders to improve solid waste composting.
- b. In order to know about potentiality of villages, the local governments should mapping area/village based on the commodity. The conception of one village - one product will make the compost products are easier to sell, because the compost products (nutrition contain, labeling, etc) are based on characteristic of commodities from specific village.
- c. Providing public education (campaign and seminar programs) to inform the public on solid waste composting. When citizens become interested in the community's waste management program, they will frequently demand to be involved not only in the decision making process but also to contribute actively in the program.
- d. Financing is also an important factor in order to reach the goal of the project. Since composting can be classified as a clean development mechanism project and through carbon trade mechanisms, the local government can get economic benefits, this revenue can be used to subsidize compost price to attract farmers to replace chemical fertilizer and use compost instead.

### 2.3. Potential Conflicts within Three Stakeholders

#### (1) Local Governments - The NGOs

The good relationship between the Local Government and the NGO depends on understanding of:

- 1) Different potential of each of them.
- 2) Scope of role and responsibility.
- 3) Problem, mission and mission understanding.

If one or more of three points above are not happen, not only the trusting relationship between Local Government and NGOs could not be reached, but also cooperation with governmental policies and complementing local governmental service could not be happen too. Hence, win-win condition could be never reached. Contrary, there has been a good relationship within this network, and no conflict so far within the scavengers. The produced compost is not sold, but they utilized it for their plants

instead (USAID, 2006).

### (2) The NGOs - The Communities

The NGOs have to give some tangible benefits to the communities, such as sale of surplus compost, employment creation and environment improvement. Those benefits must be given by the NGOs through cooperating activity. This situation could increase trusting relationship of both.

There are several external factors that will support the success and sustainability of programs within the framework of enlargement the village of SVC solid composting waste in megacity like Surabaya city, i.e.:

- Investment

Creating an investment is needed to sustain the market share of compost that has been generated by the compost producer village. Investment funds are collected from various funding sources, especially from private companies. Sharing of the benefits given to all parties involved for investing and managing investments in solid waste composting program.

- Global Climate Change Issue

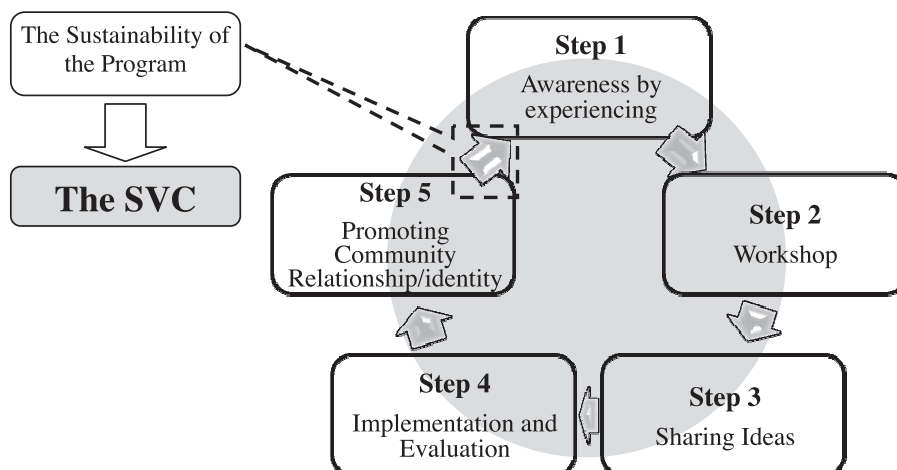
Lately, the issue of global climate change has been pushing the various parties to conduct mitigation activities such as focusing on tree planting activities on public lands, critical area, as well as citizen's yard. To support the success of greening activities, so it is needed to grow a media for plant that consisting of soil and compost. This condition is a good opportunity to increase the demand of compost.

### (3) The Communities - Local Governments

The untrusting situation between the communities and local governments is a symptom of conflict from both of them. The communities trust to local governments will makes participatory approaches to implement the government program easier to be conducted. In this case, solid waste reduction participation, environment improvement awareness, governmental policies cooperation, local governmental solid waste services improvement, and city beautification will not be implemented at all. Therefore the win-win solution between both of them has to be arranged properly.

## 3. Alternatives Participatory Approaches (PAs) in Approaching the SVC

The relevance or applicability and goal of participatory approaches in the local content were analyzed in order to find out the best solution to implement the ideal PAs. There are two project could be think about, namely the projects that have been implemented and the projects that will be implemented. Projects that have been implemented need to be sustaining and initiated by the local communities themselves.



**Figure 4:** The initiative to promoting sustainability of SVC (adopted from Kubota, 2010). The crucial process is how to take the fifth step move forward to the first step as the beginning of the SVC program that could be re-run by communities themselves.

As shown in Figure 4, the problem in making sustainable of soling waste composting usually face the initiating of stage 5 to step 1. In order to initiate this critical step, we recommend some PAs toolkits which are called as interactive display, street stall, gaming, design workshop, models, ideas completion and electronic map (Table 2). Thus, the process of selection from each PAs is based on the objective during running the SVC project of planning, organization, implementation and controlling.

The dominant PAs tools is designed workshop, which is located in the informal level and resident interest (Kubota, 2010). Moreover, to promote communities relationship among citizen as the key factor of sustainability of the SVC programs, the controlling step has to consist of monitoring and evaluation. This final step is important in order to initiate the next PAs based on the problems occur in the community or in the relationship among the communities, local governments and the NGOs.

The seven PAs in Table 2 should be deployed based on real situation in the field. In deciding which PAs have to be deployed, we must take into account the following five elements:

- 1) **Objectives:** Reasons for involvement and expected outcomes
- 2) **Topic:** The nature and scope of the issue
- 3) **Participants:** Who is affected, interested or can contribute to solutions
- 4) **Time:** Amount of time available
- 5) **Budget:** Availability of resources

**Table 2:** The Participatory Approaches Tools

| Objective                      | The Participatory Approaches Tools |                   |             |                      |             |                        |                     |
|--------------------------------|------------------------------------|-------------------|-------------|----------------------|-------------|------------------------|---------------------|
|                                | 1<br>Interactive displays          | 2<br>Street stall | 3<br>Gaming | 4<br>Design workshop | 5<br>Models | 6<br>Ideas Competition | 7<br>Electronic map |
| <b>STEP 1. PLANNING</b>        |                                    |                   |             |                      |             |                        |                     |
| 1. Data identification         | V                                  |                   |             | V                    |             |                        |                     |
| 2. Mapping areas/villages      |                                    | V                 |             | V                    | V           |                        | V                   |
| 3. Developing Public awareness |                                    | V                 | V           | V                    |             | V                      |                     |
| 4. Meeting among stakeholder   |                                    |                   |             | V                    |             |                        | V                   |
| 5. Drafting legal aspect       |                                    |                   |             |                      | V           | V                      |                     |
| <b>STEP 2. ORGANIZING</b>      |                                    |                   |             |                      |             |                        |                     |
| 1. Building commitment         | V                                  |                   |             | V                    |             |                        |                     |
| 2. Funding                     | V                                  |                   | V           | V                    | V           |                        |                     |
| 3. Resource allocation         | V                                  |                   | V           |                      | V           |                        | V                   |
| 4. Organization structure      | V                                  |                   | V           | V                    |             |                        | V                   |
| <b>STEP 3. IMPLEMENTING</b>    |                                    |                   |             |                      |             |                        |                     |
| 1. Sharing information         | V                                  | V                 | V           |                      | V           |                        | V                   |
| 2. Sharing systems             | V                                  |                   |             | V                    | V           |                        | V                   |
| 3. Sharing technologies        | V                                  |                   |             | V                    | V           |                        |                     |
| 4. Sharing economic resources  | V                                  |                   | V           |                      | V           | V                      | V                   |
| <b>STEP 4. CONTROLLING</b>     |                                    |                   |             |                      |             |                        |                     |
| 1. Monitoring                  | V                                  |                   |             | V                    |             |                        |                     |
| 2. Evaluation                  | V                                  |                   |             | V                    |             |                        |                     |

#### 4. Proposed PAs in Implementing the SVC

Some participatory approaches (PAs) are needed in order to make the SVC more sustainable. The PAs are not only related to the role of the local government as an agency in charge with the SVC but also to the NGOs as the initiator, and the communities institution such as PKK (women's group), Karang Taruna (youth's group) as inter mediator, and also a private companies/mass media as supporter for the community to campaign and promote the products (compost).

Sustainability of the SVC programs can be continued by the local communities and could be established in the local area easily. The most important thing to maintain the sustainability is marketing. Without market, the program could be nothing, but in the opposite, if the market is good it will make compost as a valuable selling product (has profit). In addition, the communities will be interested to do composting and try to implement the SVC program. Again, the SVC is one of the solution to open compost's market which is among areas/villages can share information about production, market, technology, and others concerning related to composting activities. The seven PAs that recommended previously in Table 2 could be selected



appropriate to the problems occur in each sub-district level or villages.

#### 4.1. Cost Analysis of Economic Potential Marketing

Some calculations have been done related to environmental improvement and social benefit in term of Sharing Economic Resource. Since the leaders from communities have to convince their people, so they have to proof that the SVC will give some benefits, particularly give some incomes. Below are the calculations for cost-benefit analysis, and then continue by two scenarios to show the potential resources that will occur when the SVC is implemented.

- The amount of waste disposed from each household (HH) in Surabaya City is assumed to be 500 gram/household/day (g/HH/day) (KITA, 2007), the amounts of waste production are calculated as follow:

$$500 \text{ g/HH/day} \times 365 \text{ day} = 182,500 \text{ g/HH/yr equal to } 180 \text{ kg/HH/yr}$$

This calculation could be also said as the annual reduction in organic waste, because this composting activity will help the communities to reduce solid waste disposal.

- When the composting rate from organic waste is assumed to be 20% the amount of compost produced per year (including 30% water rate), the annual amount of produced compost calculated as follow:

$$180 \text{ kg/HH/yr} \times 20\% = 36 \text{ kg/HH/yr}$$

- The population of Surabaya City is 709,991 HH (BPS, 2009), which is assumed all households are participating in the SVC program, the potential income that can derived from compost product is calculated as follow:

Price of compost : IDR 1,000/kg

Production : 36 kg/HH/yr x 709.991 HH = 25,559,676 kg/yr

Total sales : IDR 25,559,676,000 / yr ~ IDR 25.6 billion /yr

According above calculation, the potential total income that could be derived from compost activities is IDR 25.6 billion/yr. Which 1 HH in one year could be receiving income about IDR 180,000.

#### 4.2. Supply and Demand Analyses

Supply and demand analyses also were calculated with the needs for compost is assumed have two scenarios, i.e. (1) 1,000.0 kg/ha/yr, and (2) 1,500.0 kg/ha/yr. Another assumption is that the agricultural land area in Surabaya city is around 18,813.5 ha (BPS, 2009). We do not include another potential market from green opened space areas that cover 160.19 ha, because those areas probably in extensive management (low fertilizing input) condition. The calculations below are to show the surplus or deficit from amount of supply product deducted from demand product. The details are shown in Table 3 and 4.

**Table 3:** The number of household and potential market for compost product

| Sub-district     | Number of Household (HH) | Percent of total (%) | Green Opened Space Area (ha) | Percent of total (%) | Agriculture Land (ha) | Percent of total (%) |
|------------------|--------------------------|----------------------|------------------------------|----------------------|-----------------------|----------------------|
| Central Surabaya | 84,585                   | 11.91                | 33.32                        | 20.80                | 0                     | 0.00                 |
| North Surabaya   | 127,095                  | 17.90                | 17.81                        | 11.11                | 950.18                | 5.05                 |
| East Surabaya    | 211,961                  | 29.85                | 45.14                        | 28.18                | 5,663.00              | 30.10                |
| South Surabaya   | 184,004                  | 25.92                | 32.45                        | 20.26                | 4,034.31              | 21.44                |
| West Surabaya    | 102,346                  | 14.42                | 31.49                        | 19.66                | 8,166.01              | 43.41                |
| Total            | 709,991                  | 100.00               | 160.19                       | 100.00               | 18,813.50             | 100.00               |

(Source: BPS 2009)

**Table 4:** The calculation for two scenarios in different compost needs

| Analyzed Factor                            | Calculation | Scenario 1      | Scenario 2      |
|--|-------------|-----------------|-----------------|
| Amount of compost needed (kg/ha/yr)        | (1)         | <b>1,000.00</b> | <b>1,500.00</b> |
| Total area that have to be fertilized (ha) | (2)         | 18,813.50       | 18,813.50       |
| Total compost production per year (kg/yr)  | (1) x (2)   | 18,813,500.00   | 28,460,542.00   |
| Compost demand per year (kg/yr)            | (3)         | 25,559,676.00   | 25,559,676.00   |
| Compost surplus per year (kg/yr)           | (3) - (2)   | 6,585,982.00    | -2,900,866.00   |

- Scenario 1

Amount of compost needed is **1,000.00** kg/ha/yr of green open space/agriculture land. There is surplus amount 6,585,982.00 kg/yr which is needed to find out the potential market outside. So, if the SVC has been implemented and gives a good result the compost products still remain, then will be marketed to compost user villages.

- Scenario 2

Amount of compost needed is **1,500.00** kg/ha/yr of green open space/agriculture land. There is deficit of supply amount - 2,900,866.00 kg/yr. The compost product is needed to be more to be produced, in other hand the households should more productive. However, the utilization of compost product could be replaced at least 20% by chemical fertilizer in some particular case.

Two scenarios mentioned above describe the supply and demand condition with two different compost needs for agricultural land fertilizing. Both of them, even though give a surplus and deficit conditions still have a potential marketing depend on kind of solving approaches. When surplus, the producer villages should find market as a user village. When deficit, the producer villages should increase the compost productivity.

## 5. Discussion in Implementing the SVC by Seven PAs

Some external factors which will occur in implemented of the SVC by seven PAs in previous discussion are mainly caused by three pillar of relationship, namely local communities, local government and some NGOs. The SWM which have initiated in Surabaya city since 2001 is still running well until present day. Some little stagnancy project could be found in some village areas, but it was analyzed that the SVC program can promote this composting to more extend.

Two scenarios have derived from calculations that have been done related to environmental improvement and social benefit. First scenario, if all household have participated by the SVC program, there is some surplus of compost product. In this case, we should find the market outside Surabaya city. Second scenario, if the compost utilization has increased by the SVC program, there is some deficit of compost product. The SVC should apply simultaneous the PAs that should trigger the communities to be more productive.

Adapted from Kubota (2010) to promote the sustainability relationship among communities as their own identity, it needs more participation involved that could solve by the SVC program. On the early step, the SVC will try to make people believe gradually, ended by convince them to make the SVC as their own project. Convince them that this is a good way to conduct these activities as an additional income, save the environment and protect the future of their children. Table 5 shows the benefits for three stakeholders (the communities-local governments-the NGOs) when they implement the SVC.

**Table 5:** The benefits for three key stakeholders when implement the SVC

| The Communities  | Local Government  | The NGOs   |
|--|---|--|
| <ul style="list-style-type: none"> <li>● Living in hygienic environments</li> <li>● Additional income to households</li> <li>● Improvement of living and hygiene environments</li> <li>● Improvement of community unity</li> </ul> | <ul style="list-style-type: none"> <li>● Effectiveness for achievement of local government objectives</li> <li>● Reducing solid waste disposal costs</li> <li>● Improvement in efficiency and revenue from compost centers</li> <li>● Network and knowledge expansion to other cities (domestic and international)</li> </ul> | <ul style="list-style-type: none"> <li>● Effectiveness for achievement of missions</li> <li>● Increasing composting process of consulting requests</li> <li>● Improvement of efficiency and income from composting centers</li> <li>● Expansion of knowledge and network to other cities (domestic and international)</li> </ul> |

The SVC is one of the solution to open the access of marketing compost which is among areas/villages can share any information about production, market, technology, and others concerning related to composting activities. Those villages can help each to figure out the best solution from each problem and try to implement the selected PAs to solve their own problems. The SVC idea is so clear, the implementation could be real and the result should be deal with any problems occurred.

## 6. Conclusion

The SVC is the one of proposes to provide an alternative solution to solve existing SWM occurred problems. Again, related to the SWM, the SVC is the relationship among villages for sharing of information, system, technology and economic

resources in order to obtain sustainability in solid waste composting. The SVC in principle is a sustainable cooperation between the compost producer villages and the compost user villages. Within this cooperation, producer villages (mainly in urban areas) which have high population will supply the compost to user villages (mainly in rural areas) which have a lot of agriculture land that have to be fertilized. Instead the user villages will supply the solid waste to the producer villages.

This report has figured out that the SVC could be one of the solutions to open the access of compost marketing among villages, particularly in Surabaya city by sharing any information about production, market, technology, and others related activities to composting process. The SVC, in fact has described relation producer-user villages, role and play of three key stakeholders, the supply-demand condition, and also two potential scenarios in the near future.

The deep evaluation and study from composting technology as part of the SVC, like THM and TSM, came out with some conclusions and summarize which are:

- The Sister Village Concept (SVC) can promote the solid waste composting to more extend.
- The SVC is a robust concept to sharing any information of producer-user village, system of marketing, friendly and easy technology for composting, and knowledge to gain economic resources benefit from those activities.
- Solid waste composting in Surabaya City is running well through technology that have been introduced by PUSDAKOTA and KITA.
- Our scenario 1 shows that when the SVC will be implemented, there is a surplus of compost product. Therefore, finding the market is a must.
- Three key stakeholders should build a sustain collaboration, and more participation should be needed for sustainability of the SVC program.
- The SVC program idea is so clear, the implementation has been real and the result should be able to deal with any problems occurred during the realization.

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