



Assessment of Solid Waste Management in Ecovillages Case Study of Konohana Family in Japan

JOSE C. VEIZAGA

Graduate Program in Sustainability Science, School of Frontier Sciences, The University of Tokyo, Chiba, Japan

E-mail: jocrisvebe@hotmail.com

EIJI YAMAJI

Department of International Studies, The University of Tokyo, Chiba, Japan

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Abstract The inadequate management of solid waste causes environmental and social problems that can be minimized by realizing sustainable practices in communities. In Japan, some communities are taking active role in efforts to achieve sustainability on regional scale. In Shizuoka–Japan, Konohana Family, a community of 56 members, nowadays, known as an ecovillage is challenging to be a sustainable community. Ecovillages are considered the newest and most potent kind of sustainable community. Although ecovillage definitions do not indicate a specific way to manage solid wastes, Konohana community, is challenging its safe management by using sustainable practices. As solid waste management is closely linked not only technical but also social aspects, it should be studied based on an integral approach. Thus through a physical characterization of Konohana’s solid wastes, this research assesses parameters for a sustainable local management. Also, through 43 surveys to adults and 7 surveys to children, this study was complemented. It is identified that 77% of members believe that reducing wastes should be the major priority in their ecovillage; 14% argues reusing wastes; and 9% suggest recycling as main concern. Besides children’s opinions, support the necessity of preserving the common environment through eco–friendly actions like composting and recycling. This research also determines that 0.4 kg is daily generated per person, where almost 70% are organic wastes and completely recycled. The 17% is potentially recyclable, 5% is previously reused and 8% are others (mixed waste); indicating favourable conditions and the necessity of dialogue to reconsider some recyclable materials which may be recycled or reused in source, in order to reduce, even more, the amount of wastes given to local collection facilities. Finally to contextualize Konohana’s scenario, it is important to mention that the spiritual aspect (without any religion) plays an important role since spirituality is understood as the ability to communicate and cooperate with spiritual forces, belongs to the basic necessities of humankind.

Keywords solid waste management, ecovillage, assessment, Konohana Family, Japan

INTRODUCTION

Since societies are clustered in villages and cities, the generation of solid wastes becomes a concern for basic sanitation. Wastes cause nuisance and discomfort, and during long time, its management lied in throwing out to rivers, oceans, burning or buried. Currently, although methods are more sophisticated, the waste generation keeps increasing. Thirty years ago, in Asia, the amount of solid wastes was between 0.1 - 0.5 kg hab⁻¹ d⁻¹. Nowadays, Asian countries generate around 1 - 3 kg hab⁻¹ d⁻¹ of solid wastes (Agamuthu *et. al.*, 2009). This increment on the generation rate is caused by permanently population growth and industrialization process. In order to minimize environmental impacts, four basic methods of solid waste management were developed, and nowadays, are mainly combined by modern societies. These methods are: *recycling*, *composting*, *incineration* and final disposal in *sanitary landfills*. Recycling involves processing used materials into new products;

Composting is the biodegradation of organic matters into a rich soil; Incineration is the process of burning materials where only ashes remain; and Sanitary landfills are sites where wastes are isolated from the environment until it is safe. Although, these alternatives may be safe to manage solid wastes, many researchers coincide with people's behavior, as a key element to address sustainability in future generations (Devane, 2009 and Juarez *et al.*, 2009). Thus, sustainable practices, in small-scale communities regarding solid waste management might be considered a path towards sustainability. In Nalanda (India) a Tibetan community of 50 members has been conducting a project on agriculture soil improvement, incorporating sustainable composting practices, that were internationally recognized as an integral practice to success cropping (GEN, 2008). Also in Bangladesh, a village has demonstrated that using human waste, as organic fertilizer, is highly useful to enrich the soil (GEN, 2008). However, as solid wastes are not only organic matters, but also inorganic ones, a tendency in reusing some materials has been observed in small communities. For instance, in 1905, in Nevada (United States), a community house was built using 51 000 glass bottles combining with adobe, due to, community members did not have enough economic resources to use another materials and because other materials were hard to come by in that area (Peck, 2008). In this sense, it is important considering sustainable practices experienced as well as assessing ongoing experiences in order to take advantage of practical knowledge acquired, in a socially, culturally and economically diverse society.

In Japan, traditional communities have been involved in sustainable practices, mainly, related with agriculture. However, nowadays, Japan's food self-sufficiency ratio has dropped below 40% (TTF, 2008); therefore, this issue has become in a special concern for its local authorities who deal with re-establishing sustainable agriculture practices. One of the traditional practices, in Japan, has been organic farming that means the process of producing food naturally and without using synthetic chemical fertilizers to influence the growth of crops (FAO, 2009). In Fujinomiya city, Shizuoka Prefecture (Japan), a community called Konohana Family, is considered one of the successful cases in regard to sustainability (Furuhashi, 2009). The community was founded in 1993 by 20 interested in practicing organic farming; therefore, the basis of the economy is agriculture. Nowadays, this community is almost 100% self sustained, where 56 members live together, as a big family, who challenge creating lower environmental impact style and building a harmonious world. In addition, the community has been internationally identified and recognized as a sustainable community that immediately started to be called ecovillage by international visitors [Personal interview - Furuhashi, (2009)]. According Rosental (2000), an ecovillage is an intentional community that looks for a sustainable way of living, giving to the dwells harmony between people and nature. However, in the case of Konohana, it has occurred even before members realized the existence of the ecovillage word itself. Since then, Konohana community decided to learn more about the ecovillage approach through the *Ecovillage Design Education Program* promoted by Global Ecovillage Network, and also following ecovillage principles was decided by Konohana community. This program deals with sustainability by integrating four core aspects, such as: social, economic, ecological and world view. To integrate these four aspects, evaluating current conditions, are essentially required as well as considering focal themes interlinked with these four aspects mentioned before. In this sense, this research has chosen a transversal topic such as solid waste management in an ecovillage context. It due to, solid waste generation is fundamentally interlinked with population growth and people's behaviours. Although Konohana members have been conducting sustainable practices regard to solid wastes, this issue has not been yet assessed. Therefore, this paper discusses whether Konohana Family achieves a sustainable solid waste management by following ecovillage principles.

MATERIALS AND METHODS

To assess solid waste management in ecovillages, this research was divided into literature review and field work. The information reviewed was oriented to sustainable communities and ecovillage approach in a national and international context. On the other hand, the field work was focused on a characterization method for solid wastes that consists, basically, in collecting wastes during seven days in order to measure three parameters, such as: Per Capita Production (PCP), Volumetric Weight

(VW) and the selection and quantification of sub products. Following are detailed the equations that were employed (EPA, 2007):

$$PCP = \frac{\sum Xi}{\sum Yi} \tag{1}$$

where PCP = Per Capita Production, kg/person·da, Xi = weight of solid wastes, kg, and Yi = population.

$$VW = \frac{W}{V} \tag{2}$$

where VW = Volumetric Weight, kg/m³, W = Weight, kg, and V = Volume of cylinder, m³.

$$\% = \frac{WF}{TW} \times 100 \tag{3}$$

where % = percentage of each fraction, WF= Weight of each fraction, kg and TW = total weight, kg.

In addition, to evaluate the perception of Konohana members regarding to its solid waste management, questioners were conducted. Aoki (2006) suggests considering –dimensions like: shelter, access and tenure; and attributes like: environmental, human, social, economic, symbolic and spiritual– to assess sustainable communities. Thus, in order to assess people’s perception these aspects mentioned were considered at moment of elaborating questionnaires.

RESULTS AND DISCUSSIONS

Konohana Family was founded in 1993 by 20 members interested in practicing organic farming; hence, the basis of its economy is agriculture. Currently, the community has 56 members, where 42 are adults and 14 are kids. Children (<6 years) go to the primary school. Two teenagers go to the Junior high school. The oldest one (19 years) attends to a National University, and the 2nd oldest one studies hair dressing in Tokyo. Figure 1 shows the age groups at Konohana ecovillage. Currently, in Konohana 22 are males and 34 females.

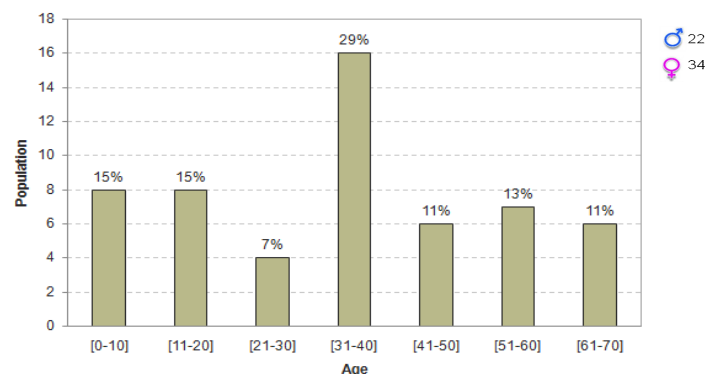


Fig.1 Age group at Konohana ecovillage (Jan, 2010)

On the other hand, it is important to point out that Konohana has implemented a natural remedy program as well as practical organic farming program which are offered to the general public. Also those simple guests who want to observe the daily life at Konohana are accepted as well. In this regard, as the number of people is not continuously constant, to conduct the experiment this variation was considered into the experiment. In order to present results, the quantitative survey will be presented before and afterwards the qualitative part.

Quantitative survey

The characterization method for solid waste generation at Konohana ecovillage was conducted from January 21 to 27, 2010. Through this method three parameters were obtained, such as: ①Per Capita

Production (PCP); ② Volumetric Weight (VW); and ③ percentage of each fraction contained into waste samples.

① The PCP at Konohana community is $0.40 \text{ kg} \cdot \text{hab}^{-1} \text{ d}^{-1}$, and also the average of generation is 27.64 kg per day. Table 1 shows the generation in each day considering the number of people per each day.

Table 1 The per capita production (PCP) at Konohana ecovillage

Date 2010	Days	Population	Generation $\text{kg} \cdot \text{d}^{-1}$	PPC $\text{kg} \cdot \text{hab}^{-1} \text{ d}^{-1}$
Jan 21	1	67	25.00	0.37
Jan 22	2	67	58.70	0.88
Jan 23	3	78	19.30	0.25
Jan 24	4	79	29.95	0.38
Jan 25	5	65	17.30	0.27
Jan 26	6	67	27.40	0.41
Jan 27	7	67	15.80	0.24
Average			27.64	0.40

During the seven days the population has been increased due to some visitors and some long term guest (3 month), therefore, it was considered into the experiment. However, in the second day the amount of wastes was high, due to, some metals were founded. In order to figure out its precedence, it was asked to members, and they explained that this amount comes from some woods that contain small part of metals. So they decided to keep these woods (obtained from its last house refurbishment around 10 months before). That is way, in the second day the PPC has had a variation.

② In order to obtain the volume, a plastic cylinder of 65 Lt was employed. Thus, just its conversion to cubic meters was done. Thus the average of VW is 70.33 Kg m^{-3} . This parameter indicates the weight of wastes contained into a certain volume; therefore, it is helpful to determine total capacity of bins, but also to realize that whether more sustainable practices are implemented into Konohana, even this volume could be less. Especially to estimate the volume of wastes that are given directly to the local collection system, without any option of recovery because this amount is locally incinerated.

③ The selection and quantification of sub-products shows that 69.20% are organic wastes. Konohana members classify organic wastes basically into three groups. First one is for feeding chickens (without eggs shells and corn scraps). Second one goes to the field to make compost (reminder of organic wastes). And third, some organic scraps like fruits skins, tofu scraps, lives, etc., are the basis of *Konohana Kin* that they drink as well as it as a key ingredient for pastry-making, and also it is essential to prepare an organic fertilizer called *bocashi* for agricultural propose.

Table 2 The volumetric weight at Konohana ecovillage

Date 2010	Days	Net weight kg	Volume	VW kg m^{-3}
Jan 21	1	3.80	0.0065	57.69
Jan 22	2	4.50	0.0065	68.46
Jan 23	3	3.20	0.0065	49.23
Jan 24	4	3.60	0.0065	55.38
Jan 25	5	4.10	0.0065	63.08
Jan 26	6	6.70	0.0065	103.08
Jan 27	7	6.20	0.0065	95.38
Average				70.33

On the other hand, inorganic wastes are not only classified to be given to local recycling facility, but also Konohana ecovillage has assumed the decision of helping to reduce waste generated by their neighbours. Thus, some disused wastes like paper, cardboard, PET bottles, cloths, toys, and so on; are given to community for free by neighbours. In this way, at the moment of selecting and quantifying wastes, it was so curious, because materials such as cans or PET bottles were not founded. Following is presented the physical characterization of wastes.

Table 3 The selection and quantification of sub-products

Material	Weight kg	Composition %
Kitchen scraps	19.10	69.20
Paper	1.20	4.24
Cardboard	1.80	6.68
Textiles	1.40	5.04
Rigid plastic	1.60	5.84
Ruber	0.10	0.36
Plastic bags	0.10	0.36
Metals	0.10	0.29
Others	2.20	7.99
Global		100

Recyclable materials according its management are mainly paper, cardboard, rigid plastic and metals. Thus these materials are appropriately divided and storage to give directly to recycling companies. However in the case of 5% of textiles is different, because these materials were previously reused, cut, and used for cleaning dishes as sustainable practice. Another practice related, it that when the stock of clots is huge and it can not be managed, this amount is sold to a local recycling shop. So these are some of the sustainable practices which are being experienced by Konohana members. Finally, the 8% are others (hygienic paper, paper mixed, dust, small pieces of plastics); the 0.1% of plastic bags and the 0.1% of rubbers; are given to the local service as burnable waste. However, these fractions as future challenge could be even minimized.

Qualitative information

In order to find out the perception about whether Konohana Family is a sustainable community or if it is an ecovillage according personal opinion from adult members the following the Fig.2 shows their opinions. The 5% argues that the word itself is not important, as long as, people move towards sustainable future society. The 21% argues that both ecovillage and sustainable communities have the same orientation and although Konohana started as a sustainable community then through its positives actions people just started to call Konohana ecovillage; and both ways are welcomed.

However, 32% of people think that both are different concepts, it due to, ecovillage word is more oriented to the environment, but sustainable community is mainly focused in people; and although Konohana is known as an ecovillage, they feel more like a sustainable community. In addition, the 33% is still confused and although both terminologies sound attractive, they just prefer Konohana Family. Finally, the 9% did not express any opinion.



Fig.2 Perception about whether Konohana is sustainable community or an ecovillage

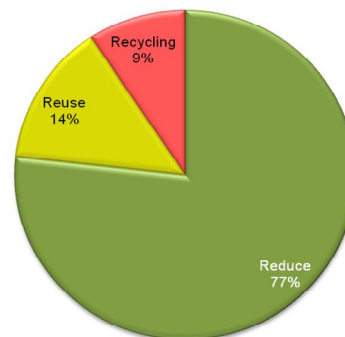


Fig.3 Priority regarding solid waste management at Konohana ecovillage

Regarding the main priority that Konohana community has for the future, the 77% assures that reducing the amount of wastes should be a priority. The 14% argues that reusing wastes should be the main priority, and the 9% thinks that Konohana should focus its management on recycling.

Base on the people's perception it is possible to identify the Konohana's way to addressing a sustainable wastes management. However, the way how to achieve and improve it will be analyzed once results of this research are officially presented in Konohana. Finally, it is important to mention that children perception is mainly oriented to contribute in improving environmental conditions through positive actions, and they would like learn more about recycling and hand paper making.

CONCLUSION

This paper sets a pathway to assess solid waste management in ecovillages. So far, almost without exception, other ecovillages may consider views addressed here and evaluating current achievement in order to accentuate sustainable practices. Following conclusions are presented;

- The spirituality aspect adopted by Konohana members in its essence provides a framework for organization, due to, spirituality is the ability to communicate and cooperate with spiritual forces, which is daily, practiced through collective meetings, where consensus building is addressed.
- Konohana ecovillage achieves a sustainable solid waste management, due to, current conditions of generation and composition allows to continue a sustainable management, or even, to make it better, as long as practices such as waste reduction is considered as priority.
- Almost 70% of solid wastes are organic which supports the natural life style followed by Konohana members.
- The 30% of wastes may be discussed among members in order to make a positive intervention oriented to activities like: promoting recycling in source, or improving the reuse of some materials like plastic bags.

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